

LIBRARY

LIGHT-SCATTERING;
A TECHNIQUE FOR STUDYING SOOT IN FLAMES

S-11

by

Wayne D. Erickson

X
1962

Department of Chemical Engineering
Massachusetts Institute of Technology

December, 1961

Department of Chemical Engineering
Massachusetts Institute of Technology
Cambridge 39, Massachusetts
December 8, 1961

Professor Phillip Franklin
Secretary of the Faculty
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

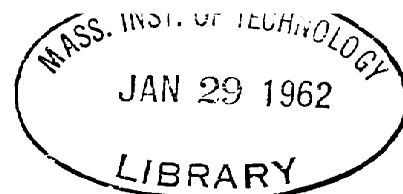
Dear Professor Franklin:

I herewith submit, in partial fulfillment of the requirements for the Degree of Doctor of Science in Chemical Engineering, a thesis entitled, "Light-Scattering; A Technique for Studying Soot in Flames".

Respectfully submitted,

Wayne D. ERICKSON

LIGHT-SCATTERING;
A TECHNIQUE FOR STUDYING SOOT IN FLAMES



by

Wayne D. Erickson

B.S., Michigan State College
(1954)

M.S., Michigan State University
(1955)

S.M., Massachusetts Institute of Technology
(1958)

Submitted in Partial Fulfillment of the Requirements for

the Degree of

Doctor of Science

at the

Massachusetts Institute of Technology

December, 1961

Signature of Author

Wayne D. Erickson
Department of Chemical Engineering

Certified by

Hoyt C. Hottel, Thesis Supervisor

Glenn C. Williams, Thesis Supervisor

Accepted by

Glenn C. Williams
Chairman, Departmental Committee on
Graduate Students

ACKNOWLEDGEMENTS

The author wishes to thank Professors Hoyt C. Hottel and Glenn C. Williams for their guidance and encouragement throughout all phases of this thesis. The many pleasant and informative discussions with Professor Hans Mueller were extremely helpful. Special thanks is extended to W. Paul Jensen, Research Associate at the MIT Fuels Research Laboratory during the course of this work, for his administrative support of this study.

Appreciation is due to the National Aeronautics and Space Administration for support during graduate study leave from the Langley Research Center. Association with the personnel of the MIT Fuels Research Laboratory has been very helpful and enjoyable. A portion of this research was supported by the United States Army Research Office. The major portion of the machine calculations were carried out at the MIT Computation Center. The electron micrographs were taken by the Godfrey L. Cabot, Inc. Research Laboratories.

Finally, the devotion and encouragement of my wife Alice has helped to bring this thesis to completion.

TABLE OF CONTENTS

	PAGE
I. SUMMARY	1
II. INTRODUCTION	6
III. LIGHT-SCATTERING THEORY	12
IV. CALCULATION OF LIGHT-SCATTERING FUNCTIONS	24
V. NUMERICAL RESULTS OF LIGHT-SCATTERING CALCULATIONS	29
VI. APPLICATION OF THE CALCULATED LIGHT-SCATTERING RESULTS	40
VII. EFFECT OF A DISTRIBUTION OF PARTICLE SIZES ON LIGHT-SCATTERING MEASUREMENTS	47
VIII. EXPERIMENTAL APPARATUS	51
IX. EXPERIMENTAL TECHNIQUE	60
X. EXPERIMENTAL RESULTS	70
XI. DISCUSSION	107
XII. CONCLUDING REMARKS AND RECOMMENDATIONS	114
APPENDIX A- Light-Scattering Relations for Spheres of Arbitrary Size	118
APPENDIX B- The Relation Between the Absorption Constant and the Absorption Coefficient	120
APPENDIX C- Development of a System of Equations for Evaluating the Light-Scattering Functions and a Listing of the Fortran Program	122
APPENDIX D- Tabulation of the Calculated Light-Scattering Functions and Coefficients for Spheres of Arbitrary Size	137
APPENDIX E- Calculation of Light-Scattering Functions for a Normal Distribution of Sizes	222

	PAGE
APPENDIX F- Further Description of the Light-Scattering Apparatus	229
APPENDIX G- Procedure for Alining Optical System	244
APPENDIX H- Tabulation of Test Conditions for Light-Scattering Measurements and Experimental Data	261
APPENDIX I- A Sample Calculation Showing the Effect that a Large Number of Small Particles Mixed with a Relatively Small Number of Large Particles has on the Light-Scattering Patterns for Two Different Wavelengths	267
REFERENCES	274
BIOGRAPHICAL NOTE	278

LIST OF FIGURES

FIGURE	TITLE	PAGE
3.1	Relation between incident light, plane of observation, and plane in which charges oscillate	13
3.2	Geometric relation between the component of the oscillating vector in the plane of observation and amplitude of its component which is perpendicular to the direction of observation of the scattered light	16
3.3	Scattered-light intensity distribution for $d \ll \lambda$.	17
5.1	Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 0.05$	30
5.2	Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 0.50$	31
5.3	Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 1.00$	32
5.4	Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 1.50$	33
5.5	Dissymmetry, $i_1(0^\circ)/i_1(180^\circ)$ and $i_2(0^\circ)/i_2(180^\circ)$ plotted against x for $m = 1.71 - 0.76 i$	36
5.6	Dissymmetry, $i_1(30^\circ)/i_1(150^\circ)$ and $i_2(30^\circ)/i_2(150^\circ)$ plotted against x for $m = 1.71 - 0.76 i$	37
5.7	Dissymmetry, $i_1(45^\circ)/i_1(135^\circ)$ and $i_2(45^\circ)/i_2(135^\circ)$ plotted against x for $m = 1.71 - 0.76 i$	38
5.8	Dissymmetry, $i_1(60^\circ)/i_1(120^\circ)$ and $i_2(60^\circ)/i_2(120^\circ)$ plotted against x for $m = 1.71 - 0.76 i$	39
8.1	Schematic drawing of light-scattering apparatus for measuring the light-scattering intensity at various angular positions	55
8.2	Schematic drawing of light-scattering apparatus for measuring the reflected incident light intensity .	56
9.1	Mirror arrangement for measuring the reflected incident light	65

FIGURE	TITLE	PAGE
9.2	Equivalent optical system for measuring the incident light intensity	66
10.1	Electron micrograph of soot particles from a premixed laminar benzene-air flame burning with a fuel-air ratio of 2.45 times stoichiometric	71
10.2	Electron micrograph of soot particles from an amyl acetate diffusion flame burning on a Hefner candle	73
10.3	Comparison of the scattering diagrams for various values of x for a given value of m where $m = 1.71 - 0.76 i$	75
10.4	Comparison of the scattering diagrams for various values of m where $n = 1.60$ and $n' = 0.60, 0.80,$ and 1.00 for a given value of x where $x = 1.00$	77
10.5	Comparison of the scattering diagrams for various values of m where $n = 2.00$ and $n' = 0.60, 0.80,$ and 1.00 for a given value of x where $x = 1.00$	78
10.6	Comparison of the scattering diagrams for various values of m where $n' = 0.80$ and $n = 1.60, 1.80,$ and 2.00 for a given value of x where $x = 1.00$	80
10.7	Experimental light-scattering data for Run 1 compared to theory for $m = 1.71 - 0.76 i$ and $x = 1.05$	81
10.8	Experimental light-scattering data for Run 1 compared to theory for various values of m and x	85
10.9	Experimental light-scattering data for Run 1 compared to theory for $m = 1.40 - 1.00 i$ and $x = 1.10$	87
10.10	Experimental light-scattering data for Run 2 compared to theory for various values of m and x	88
10.11	Experimental light-scattering data for Run 3 compared to theory for various values of m and x	89
10.12	Experimental light-scattering data for Run 4 compared to theory for various values of m and x	90
10.13	Experimental light-scattering data for Run 5 compared to theory for various values of m and x	93

FIGURE	TITLE	PAGE
10.14	Experimental light-scattering data for Run 6 compared to theory for various values of m and x	95
10.15	Experimental light-scattering data for Run 7 compared to theory for various values of m and x	99
10.16	Experimental light-scattering data for Run 8 compared to theory for various values of m and x	100
10.17	Experimental light-scattering data for Run 9 compared to theory for various values of m and x	101
10.18	Experimental light-scattering data for Run 10 compared to theory for various values of m and x	104
E.1	Density function, $f(x)$, for a normal distribution plotted against x for $\mu = 0.8$ at various values of the standard deviation	223
E.2	Light-scattering functions, \bar{i}_1 and \bar{i}_2 , normalized with respect to $\bar{i}_1(90^\circ)$ for $\mu = 0.8$ and various values of the standard deviation for $m = 1.71 - 0.76 i$	228
F.1	Average spectral distribution from a GE B-H6 mercury arc lamp	231
F.2	Spectral sensitivity characteristic of an RCA 931-A multiplier phototube for equal values of radiant flux at all wavelengths	232
F.3	Schematic drawing of square aperture system	235
F.4	Schematic drawing of observed scattering volume at an arbitrary angle, θ	235
F.5	Arrangement of electronic equipment for light-scattering apparatus	238
F.6	Measured filtration characteristics of the sound analyzer tuned to 120 cps	239
F.7	Benzene-air mixing system	241
G.1	Alinement of circular aperture with axis of mercury arc lamp	245

FIGURE	TITLE	PAGE
G.2	Arrangement of alinement jigs for alining lens tube for incident beam	246
G.3	Burner tube fixture mounted on spindle of rotating arm system	249
G.4	Detail view of burner tube fixture	250
G.5	Slotted alinement jig for alining the lens systems .	252
G.6	Alinement of the three-mirror system	254
G.7	Mirror support system	255
I.1	Comparison of the calculated light-scattering pattern for a supposed discontinuous particle distribution system , which contains a large fraction of small particles mixed with a small fraction of large particles, to the theoretical scattering pattern for a uniform particle size system where $\lambda = 4358\text{\AA}$ and $m = 1.71 - 0.76 i$	271
I.2	Comparison of the calculated light-scattering pattern for the same supposed discontinuous particle distribution as used for Figure I.1 to the theoretical scattering pattern for a uniform particle size system where $\lambda = 5461\text{\AA}$ and $m = 1.79 - 0.79 i$	272

LIST OF TABLES

TABLE	TITLE	PAGE
4.1	Index of Refraction of Amorphous Carbon from Senftleben and Benedict (17)	25
4.2	Index of Refraction of Amorphous Carbon Calculated from Equation by Stull and Plass (18)	26
10.1	Size and Concentration of Soot at Successive Elevations in a Fuel-Rich Benzene-Air Flame for Run 1 through Run 4	91
10.2	Apparent Value of x and Concentration of Soot at Successive Elevations in a Fuel-Rich Benzene- Air Flame for Run 7 through Run 9	102
(APPENDIX D)	Tabulation of the Calculated Light-Scattering Functions and Coefficients for Spheres of Arbitrary Size	138-221
H.1	Test Conditions for Light-Scattering Measurements	262
H.2	Experimental Light-Scattering Data	263-266

NOTATION

a_n	light-scattering coefficient, defined by eq. A.3
b_n	light-scattering coefficient, defined by eq. A.4
d	particle diameter
$e(\theta)$	measured voltage at angle θ
i_1	light-scattering function for perpendicular polarization, defined by eq. A.1
i_2	light-scattering function for parallel polarization, defined by eq. A.2
k	wave number, defined as $2\pi/\lambda$
l	optical path through the cloud of scattering particles
m	index of refraction of soot particles, $m = n - n'i$
n	real part of index of refraction
n'	imaginary part of index of refraction
r	distance from the scattering particles to the point of measurement of the scattered-light intensity
s	sensitivity of the multiplier phototube system
x	size parameter, defined as $\pi d/\lambda$
y	product of x and m
α	attenuation factor for the three-mirror system
β	number fraction of agglomerates in soot particle system which contains agglomerates and ultimate particles
γ	absorption coefficient
θ	angle at which the scattered-light intensity is measured referred to the forward direction of the incident light
λ	wavelength of light used

- μ mean particle size for a normal distribution
 σ standard deviation

Subscripts

- 0 refers to incident light
1 refers to the polarized component whose electric field vector is perpendicular to the plane of observation
2 refers to the polarized component whose electric field vector is parallel to the plane of observation

LIGHT-SCATTERING;
A TECHNIQUE FOR STUDYING SOOT IN FLAMES

by

Wayne D. Erickson

Submitted to the Department of Chemical Engineering on December 8, 1961 in partial fulfillment of the requirements for the Degree of Doctor of Science.

ABSTRACT

An investigation has been undertaken to develop a light-scattering technique for measuring the size and concentration of soot particles in flames. To this end, the theoretical light-scattering functions for arbitrary size spherical particles have been calculated for a range of parameters which correspond to those expected for soot particles. The numerical results were obtained with the help of an IBM 709 Computer. These light-scattering functions and associated coefficients are presented for the size parameter, $\pi d/\lambda$, ranging from 0.05 up to 2.00 in increments of 0.05 for angles from the incident light, θ , ranging from 0° to 180° in increments of 5° , and 14 values of the index of refraction which cover the expected range and includes the most likely value of $m = 1.71 - 0.76i$ for $\lambda = 4358\text{\AA}$.

A light-scattering apparatus has been constructed and used to obtain experimental data from a premixed laminar benzene-air flame. Data were also obtained from an amyl acetate diffusion flame and a Cambridge City Gas flame. The experimental light-scattering data indicate that the apparent soot particle size in the premixed benzene-air flame ranges from 1250\AA to 1800\AA in diameter, the larger sizes corresponding to larger elevations above the burner tip. Electron micrographs of soot particles collected on a cool metallic probe, however, show that the ultimate soot particles are only about 250\AA . This difference is believed to be due to the presence of agglomerated units of the ultimate soot particles. Additional experiments coupled with calculations, strongly indicate that the soot particle system within the flame consists of a very large number fraction of ultimate soot particles mixed with a very small fraction of agglomerates.

Further development of this technique is necessary before its full potential as a research tool for studying combustion problems can be realized. Recommendations for additional work are offered.

Thesis Supervisor
Title:

Hoyt C. Hottel
Professor of Fuel Engineering

Thesis Supervisor
Title:

Glenn C. Williams
Professor of Chemical Engineering

I. SUMMARY

The object of this investigation was to develop a technique for determining the size and concentration of soot particles at various positions in laminar flames of hydrocarbons in air. This entailed the design and construction of an apparatus for measuring the polar diagram of the intensity of the light scattered by a flame illuminated by a strong incident light, the calculation of the theoretical light-scattering intensities which were applied to the experimental results to deduce soot particle size and concentration, and an evaluation of the results.

A schematic drawing of the light-scattering apparatus which was used for measuring the scattered-light intensities at various positions in a flame is shown in Figure 8.1. The scattered-light intensity was measured at 10° intervals between 30° and 150° from the direction of the incident light beam and in both planes of polarization at various elevations above the burner tip. The majority of the data were obtained from a fuel-rich premixed benzene-air flame. Additional data were also obtained from an amyl acetate diffusion flame and a Cambridge City Gas diffusion flame.

A machine program for calculating the desired theoretical light-scattering functions was developed using the Fortran coding system. The calculated light-scattering functions for the perpendicular and parallel components and the corresponding light-scattering coefficients are presented in tabular form for practical ranges in the size

parameter and index of refraction which correspond to those expected for soot particles in flames. These calculated results are presented for angles from the incident light direction ranging from 0° to 180° in increments of 5° . The size parameter, $x(= \pi d/\lambda)$, ranges from 0.05 to 2.00 in increments of 0.05, while the range in the index of refraction covered the expected values for soot particles based on a study of the literature. Calculations were made for 14 values of the index of refraction and the above combinations of the range of the size parameters and angles. These calculations are for homogeneous, monodisperse spherical particles.

The procedure for calculating the light-scattering functions for a distribution of sizes of spheres is presented and a Fortran program for obtaining numerical results. A few results for a normal distribution of sizes are also presented but no attempt to use these results in the analysis was made.

The experimental light-scattering data were compared to the theoretical scattering patterns for a uniform particle system for various values of the size parameter and indices of refraction. A rather good fit of the theoretical scattering pattern to the experimental data was always possible for the perpendicular component with an appropriate value of the size parameter for a given value of the index of refraction. The comparison between the theoretical scattering pattern for a uniform size particle system for the parallel component and the corresponding experimental data is quite poor when the value

of the index of refraction is kept reasonably close to the expected value. A good fit of the theory to experiment was found for both the perpendicular and parallel components when the index of refraction was taken to be considerably different from the expected value.

Figure 10.8 shows the results for a typical run where the experimental light-scattering data are compared to theory for various values of the index of refraction m and the size parameter x for a premixed benzene-air flame burning with a fuel-air ratio of 2.39 times stoichiometric. The flame height is approximately 3.15 inches and the elevation above the burner tip at which the data were obtained is 1.25 inches. In this experiment the wavelength was 4358 \AA . Figure 10.9 shows these same data compared to theory for a uniform size particle system for a value of the index of refraction of $1.40 - 1.00 i$, which is considerably different from the expected value of $1.71 - 0.76 i$.

The experimental light-scattering data indicate that the soot particles in the premixed benzene-air flame range from about 1250 \AA to 1800 \AA in diameter, depending on the elevation above the burner tip at which the data were obtained. In general, larger apparent particle sizes were obtained at progressively higher elevations in the flame.

Electron micrographs of soot particles collected on cool metallic probes, passed through the same flame and at the same elevation for which the light-scattering measurements were obtained, show that the ultimate soot particles from the premixed benzene-air flame are only

about 250 Å. It is expected that this difference between the apparent size deduced from the light-scattering measurements and that observed from the electron micrographs is due to agglomeration of the ultimate soot particles within the flame. The apparent increase in particle size with increasing elevation above the tip of the burner is consistent with the thought of agglomerated particles within the flame, since the agglomerated soot particles could be expected to become larger at progressively higher elevations due to additional agglomeration.

A pair of runs on a flame which had essentially the same test conditions but different incident light wavelengths for each run, show that the ratio of the values of the apparent size parameters for the two runs is quite different from the inverse ratio of the respective wavelengths, as would be expected for a uniform size particle system. Instead of the value of 1.25, which is the inverse ratio of the respective wavelengths used, a ratio of 1.11 was found. In one attempt to explain this result, calculations were made for an assumed soot particle system which was made up of a small number of large particles (representing the agglomerated soot particles) mixed with a very large number of small particles (representing the small ultimate soot particles). The light-scattering patterns were calculated for the same two wavelengths as were used in the experiment and based on this supposed particle system. These were then compared to the theoretical scattering patterns for various uniform size particle systems

to find the best fit for the two cases. The results of these calculations show that the ratio of the apparent size parameters for the two different wavelengths could be as found by experiment for the proper choice of the number ratio of large-to-small particles and the respective absolute sizes.

The experimental results obtained herein from an amyl acetate diffusion flame are consistent with the results of Senftleben and Benedict. Here again, there is a strong indication that the soot particles exist in the flame as agglomerates mixed with a rather large fraction of small ultimate spherical soot particles.

The results of the concentration measurements are in question because the nature of the soot particle distribution is not known. The apparent number concentrations of the soot particles deduced from experiments are about 10^8 particles per cc but are likely orders of magnitude greater.

Additional development of the light-scattering technique is necessary before its full potential as a research tool for studying practical combustion problems can be realized. It should be pointed out that this technique has potential application to several other problems involving study of growth and decay rates of liquid and solid particles in reacting systems in addition to the soot formation process in flames.

II. INTRODUCTION

The formation of soot particles in flames is important in many combustion applications. The commercial production of carbon black is one example. Carbon black produced by incomplete combustion of hydrocarbons is used extensively in rubber compounding, as a pigment in inks and paints, and has many other uses. A problem in the operation of a turbojet combustion chamber is the formation of free soot with the subsequent fouling of the fuel nozzles and blocking of the air ports. Still another example is the formation and subsequent combustion of soot particles in a luminous flame such as is required for the high heat transfer in industrial furnaces. The governing physical and chemical processes involved for the various conditions in which soot is formed are not well understood.

A great deal of effort has been directed toward the understanding of the soot formation process over the years as evidenced by the appearance of more than a hundred publications dealing with this problem directly. While working with a miner's safety lamp, Davy, in 1816, concluded that the luminosity of flames is caused by the production and ignition of solid matter in flames (1). At the present time it is generally agreed that the luminosity of hydrocarbon flames is due to the presence of soot particles. It is well known that a sample of soot can be collected by passing a cold probe through a luminous but nonsmoking flame.

Coward and Woodhead (2) measured the luminosities of flames of a rather large variety of chemical compounds to determine the effect of chemical structure of the fuel on the luminosity. The results show that chemical structure of the fuel has a very marked effect on the luminosity of a flame. Hunt (5) has also examined a large number of compounds in order to determine the effect of molecular structure on soot formation. In his work the smoke points of the various fuels were determined. (The smoke point is defined as the height in millimeters of the highest flame produced without smoking when the fuel in question is burned in a standard burner.) In addition to making a systematic study of the smoking tendency of many different hydrocarbon fuel types, Schalla, Clark, and McDonald (4) also studied the effect of pressure, oxygen supply, degree of preheat, and fuel-flow rate in premixed flames.

Fenimore, Jones, and Moore (5) studied soot formation in quenched flat flames of propane and butane. They found that the yellow carbon luminescence of a fuel-rich flat flame fades abruptly as the pressure is lowered to a critical pressure at a fixed mass flow and fuel-air ratio. This critical pressure was higher for lower fuel-air ratios or for greater mass flows per unit area of the burner.

Arthur and Napier (6) examined the physical properties of soot collected from various hydrocarbon flames. They find marked changes in the nature of the collected soot by suitable modification of the combustion conditions.

Stehling, Frazee, and Anderson (7) find from electron microscope observations of collected acetylene soot that the small particles are grouped into aggregates to form chain-like structures. These small particles ranged from 800 to 2000 Å in diameter. Parker and Wolfhard (8) measured, under an electron microscope, the size of soot particles collected from an amyl acetate diffusion flame. They found that the soot particles from a nonsmoky flame were nearly all the same size and approximately 100 Å in diameter. These particles were found to be built together into filaments or chains. They also report that the particles collected near the top of the flame were similar in size to those near the base. Their study of a smoky amyl acetate flame, however, showed some particles with diameters of about 500 Å. Gaydon and Wolfhard (9) indicate that the size of soot particles in flames range from 100 to 2000 Å in diameter.

Several mechanisms have been proposed for the soot formation process, but a firm understanding of this subject is certainly lacking. The question of a soot formation mechanism has recently been reviewed by Gaydon and Wolfhard (9).

One method for determining the size of soot particles in flames involves removing a sample of soot from the flame and examining it under an electron microscope. This type of study has been made by Tesner, Robinovitch, and Rafalkes (10) wherein two methods were used to remove soot particles from different parts of a methane diffusion flame with and without addition of other compounds. One method

entailed the collection of soot on a cold surface introduced into the flame at various heights above the burner. The other method involved collecting the soot particles in a bag filter which was preceded by a quenching lattice made of water-cooled metallic capillaries. The mean diameters of the particles removed from different parts of the flame were in the range of 200 to 400 Å.

The method of determination of soot particle sizes by physically probing a flame with subsequent examination under an electron microscope has the obvious undesirable feature of probe interference. It would be desirable to have a method for determining soot particle sizes in an undisturbed flame.

In 1919, Senftleben and Benedict (11) measured the scattered-light intensity generated by focusing light from a carbon-arc source in the luminous zone of a Hefner lamp burning amyl acetate. The scattered-light intensity was measured at various angles from the incident light beam. From a comparison of the measured scattered-light intensities with the light-scattering theory for arbitrary size spheres due to Mie (12), Senftleben and Benedict deduced a soot particle size of 1750 Å in their experiment. The scattering volume in the flame was comparable with the total flame volume so that their results represent some sort of average size weighted over a large portion of the flame. A method for determining the soot particle size based on light-scattering results avoids the complication and uncertainty caused by probe disturbances.

It was the object of the present study to develop a light-scattering technique for determining the soot particle size and concentration in flames. This entailed the design and construction of an apparatus for measuring the scattered-light intensity from a laminar flame illuminated by a strong incident light, the calculation of the theoretical light-scattering intensities which, when applied to the experimentally determined intensities, permit deduction of soot particle size and concentration, and finally an evaluation of this technique for studying the soot formation process.

The scope of this work includes a presentation of the light-scattering theory for the expected size range of soot particles. This is followed by a discussion of the application of light-scattering theory to experiment for determining the soot particle size and concentration. Also, a discussion of the design considerations and description of an apparatus for measuring the light-scattering intensity from a luminous flame are given. The experimental results are presented, followed by a discussion and evaluation of these results. Finally, the conclusions drawn from this study and some recommendations for future work on this problem are presented.

While this work has the objective of developing a light-scattering technique for determining the soot particle size and concentration in flames, there are certainly several other practical systems to which this type of study could be applied. For example, the application of the light-scattering technique to a study of the growth

and decay of particles within rocket exhausts looks promising. Durbin (13) has presented a method for measuring the size and concentration of particles in a supercooled hypersonic stream. Quite recently, Kaskan (14) has reported some preliminary light-scattering measurements on particles of liquid boron oxide condensing in a trimethyl borate-air flame. The scattering measurements presented in reference 14 were made entirely by determining the extinction as a function of wavelength.

III. LIGHT-SCATTERING THEORY

Light can be represented as an electromagnetic wave and thus has a transverse oscillating electric field associated with it. When a beam of light passes through a particle, this oscillating electric field, which is perpendicular to the direction of the incident light, causes the electric charges contained within this particle to be set into forced oscillation with a frequency equal to that of the incident light. These oscillating electric charges, in turn, are each sources of electromagnetic radiation, scattered light.

Physical Description of a Simple Scattering Process

Consider the simple case shown in Figure 3.1 where a beam of parallel light is incident on a single scattering particle which is very much smaller than the wavelength of the incident light. Unpolarized parallel light enters from the left along the z-axis and is partially scattered by the very small particle at point p. Since the oscillating electric field of the incident light is always perpendicular to the direction of the incident light, the oscillating charges move only in a plane which is perpendicular to the z-axis and passes through point p. This plane is defined in Figure 3.1. A reference plane containing the z-axis is also shown and is arbitrarily chosen to correspond to the plane of the page. This second plane is denoted as the plane of observation. (This designation will become apparent later.)

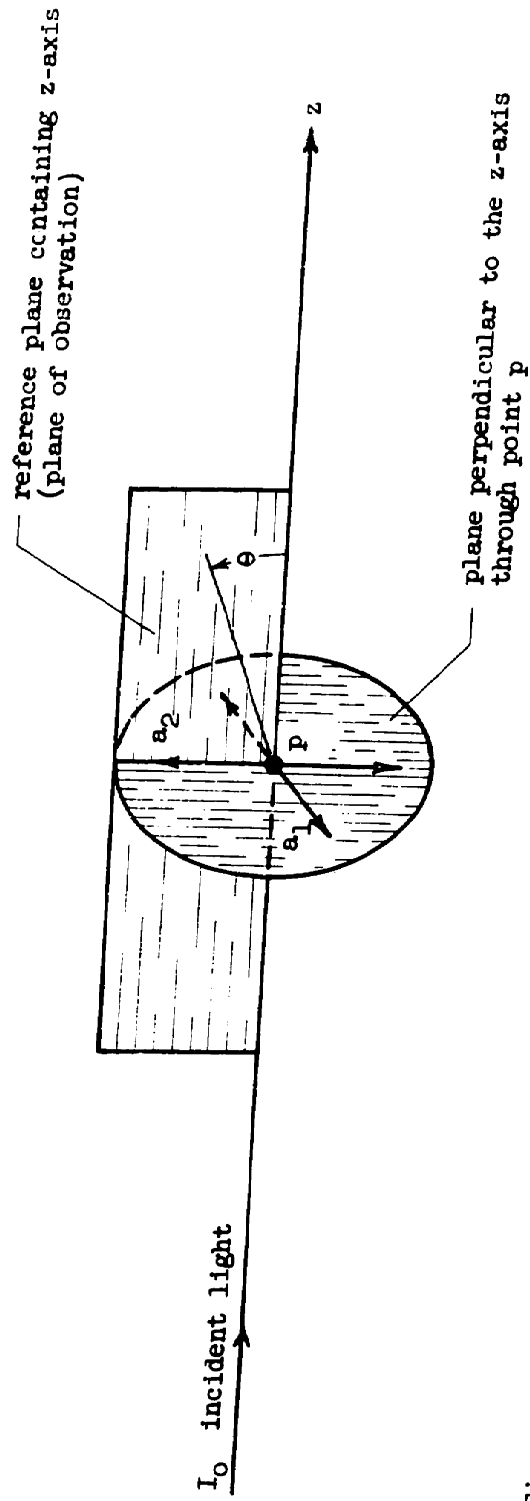


Figure 3.1.- Relation between incident light, plane of observation, and plane in which charges oscillate.

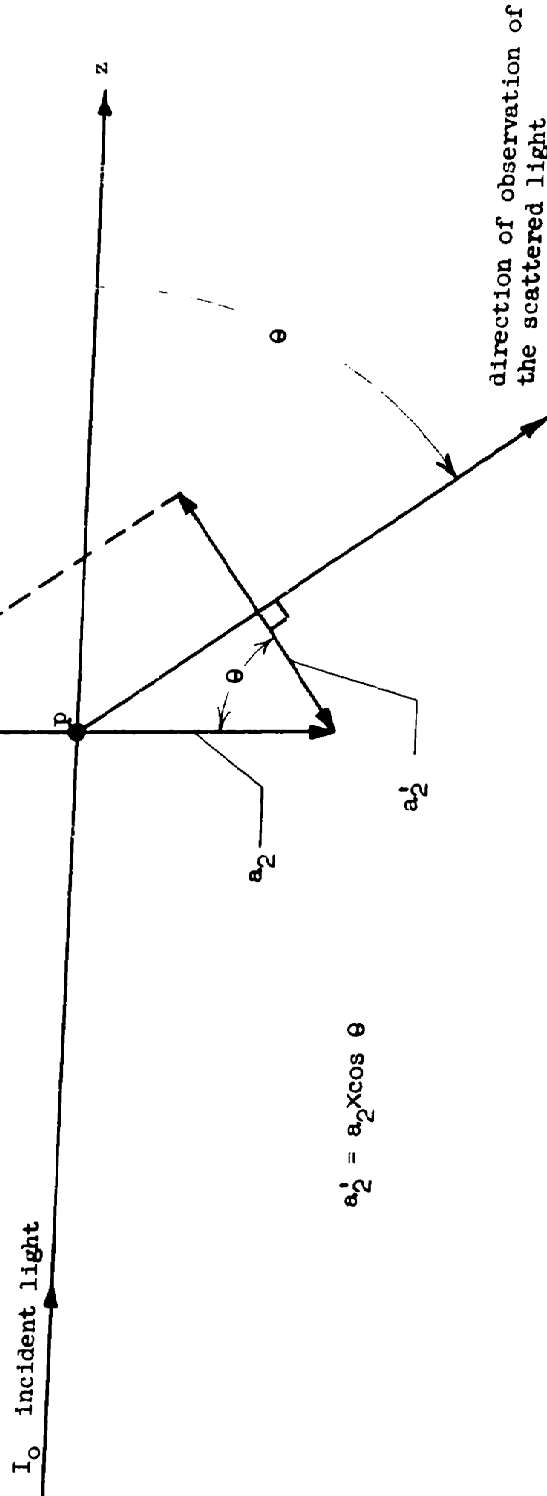
The components a_1 and a_2 of the vector which defines the direction and amplitude of the periodic motion of the oscillating charges are indicated in Figure 3.1 and lie in the plane perpendicular to the z-axis through point p. The direction of a_1 is perpendicular to the plane of observation and a_2 is parallel to the plane of observation.

If the incident light is unpolarized, the amplitude of a_1 will equal a_2 . On the other hand, if the incident light is plane polarized with its electric vector perpendicular or parallel to the plane of observation, the amplitude a_2 or a_1 will be respectively zero.

The amplitude and direction of the two components of the electric field vector associated with the scattered light, E_1 and E_2 , which are generated by the oscillating charges, are proportional to the projected amplitudes of a_1 and a_2 which lie perpendicular to the direction at which the scattered light is observed. Referring again to Figure 3.1, it is seen that the amplitude a_1 , which is perpendicular to the plane of observation, does not vary with the angle θ measured from the forward direction of the incident light. Since the intensity of light is proportional to the square of the amplitude of the associated electric field, the plane polarized scattered-light intensity I_1 whose electric field vector is perpendicular to the plane of observation, is independent of the angle of observation θ .

The plane polarized scattered-light intensity, I_2 , whose electric field vector is parallel to the plane of observation, however, does depend on θ because of the variation with θ of the projected amplitude of a_2 , that is a_2' , which lies perpendicular to the direction of observation as shown in Figure 3.2. It is clear from Figure 3.2 that the projected amplitude of a_2 , that is a_2' , which lies perpendicular to the direction of observation of the scattered light, is proportional to $\cos \theta$. Since E_2 is proportional to a_2' , and the intensity I_2 is proportional to the square of E_2 , the scattered-light intensity I_2 , whose electric field vector is parallel to the plane of observation, is proportional to $\cos^2 \theta$. If one simultaneously observes the total scattered-light intensity, $I_1 + I_2$, the angular dependence is $1 + \cos^2 \theta$.

Figure 3.3 shows the polar distribution of the scattered-light intensity for the two plane polarized components, I_1 and I_2 , and for the total scattered light $I_1 + I_2$ as a function of θ when the scattering particle is very much smaller than the wavelength of the incident light. The perpendicular component I_1 is independent of θ , but the parallel component I_2 is a maximum and equal to I_1 at $\theta = 0^\circ$, decreases to zero at $\theta = 90^\circ$, and increases again to a maximum at $\theta = 180^\circ$. The variation in the total light-scattering intensity is the average of the separate component intensities I_1 and I_2 .



$$a_2' = a_2 \times \cos \theta$$

Figure 3.2.- Geometric relation between the component of the oscillating vector in the plane of observation and the amplitude of its component which is perpendicular to the direction of observation of the scattered light.

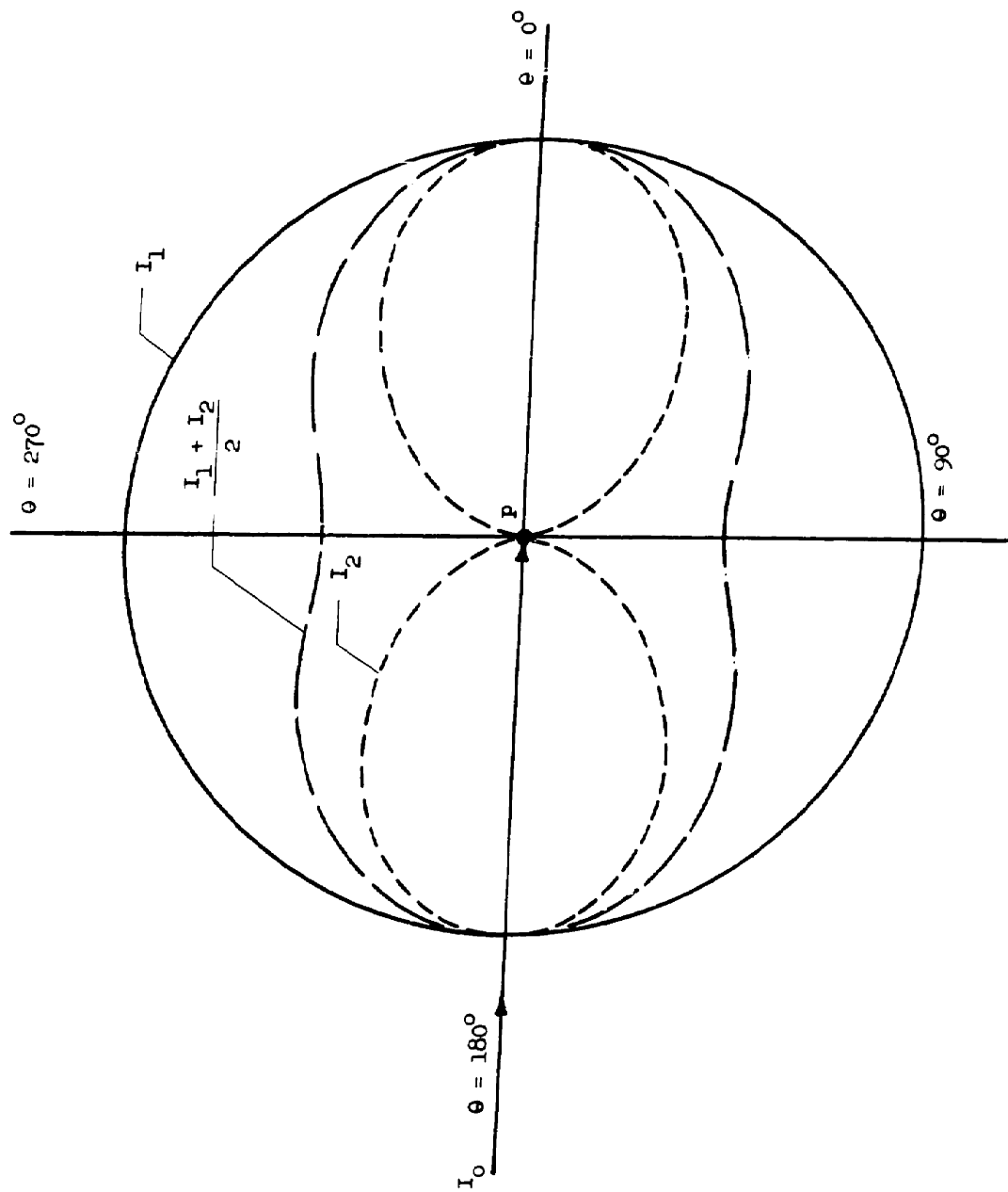


Figure 3.3.- Scattered-light intensity distribution for $d \ll \lambda$.

Rayleigh Scattering Equations

The analytical expressions for the intensity of scattered light from particles much smaller than the wavelength of the incident light were given by Lord Rayleigh in 1899. The equations for the two plane polarized components of the scattered-light intensity for particles much smaller than the wavelength of the incident light are, according to Sinclair and LaMer (15)

$$I_1 = \frac{9\pi^2}{r^2} \left| \frac{m^2 - 1}{m^2 + 2} \right|^2 \frac{V^2}{\lambda^4} I_{O,1} \quad 3.1$$

for the perpendicular component, and

$$I_2 = \frac{9\pi^2}{r^2} \left| \frac{m^2 - 1}{m^2 + 2} \right|^2 \frac{V^2}{\lambda^4} \cos^2\theta I_{O,2} \quad 3.2$$

for the parallel component. In these equations, I_1 and I_2 are the plane polarized scattered-light intensities measured at a distance r from the scattering particle, whose electric field vectors are perpendicular and parallel to the plane of observation, respectively. The corresponding plane polarized incident light intensities are denoted by $I_{O,1}$ and $I_{O,2}$. The distance from the scattering particle to the point of observation of the scattered-light intensity is r . The index of refraction of the scattering particle relative to the surrounding medium is m , the volume of the scattering particle is V , and the wavelength of the incident light is denoted by λ .

The total intensity of the scattered light when the incident light is unpolarized is

$$I = \frac{9\pi^2}{2r^2} \left(\frac{m^2 - 1}{m^2 + 2} \right)^2 \frac{V^2}{\lambda^4} (1 + \cos^2\theta) I_0 \quad 3.3$$

where I is the total scattered-light intensity and I_0 is the incident-light intensity. It is seen that the angular dependence of the scattered-light intensity as given by the above equations is the same as that already deduced by physical argument.

In the foregoing equations and in the light-scattering equations to follow, the intensity I is understood to be the energy flux per unit area. In c.g.s. units the intensity is in ergs per cm^2 per sec. It should be pointed out that this definition of intensity, which has been used in light-scattering work in the past and which will be used herein, is called illuminance in optics.

The consequence of the limitation of the scattering particle size to much less than the wavelength of the incident light is the absence of interference due to phase differences between the scattered light generated by oscillating charges located at various positions in the particle. There will be interference between the scattered light generated by the various oscillating charges contained in a scattering particle which can no longer be treated as very small compared to the wavelength. In addition to this effect, the applied electric field from the incident light, which causes the charges within the particle

to oscillate, will be distorted by a scattering particle which is not very much less than the wavelength. As particles of larger size are considered, the effects of interference and distortion become more important and change the angular distribution of the scattered-light intensity.

Mie Scattering Theory

The rigorous scattering theory for spheres of arbitrary size was developed by Mie (12) in 1908. A brief derivation of the Mie theory is presented by Van de Hulst (16). The scattered-light intensity for the two plane polarized components and the total scattered light are given by the following equations. For perpendicular polarization

$$I_1 = \frac{i_1}{k^2 r^2} I_{0,1} \quad 3.4$$

for parallel polarization

$$I_2 = \frac{i_2}{k^2 r^2} I_{0,2} \quad 3.5$$

and for the total scattered light when the incident light is unpolarized

$$I = \frac{i_1 + i_2}{2k^2 r^2} I_0 \quad 3.6$$

where $k(= 2\pi/\lambda)$ is the wave number, i_1 and i_2 are light-scattering functions which are discussed below, and the other variables have the same meaning as before.

The scattering functions i_1 and i_2 which are directly proportional to the scattered-light intensity, are rather involved functions of x , y , and θ . Formally,

$$i_1 = f_1(x, y, \theta) \quad 3.7$$

$$i_2 = f_2(x, y, \theta) \quad 3.8$$

where x is the size parameter defined as the ratio of the circumference of a particle divided by the wavelength of light, y is the product of x and the index of refraction of the scattering particle relative to the surrounding medium, and θ is the angle at which the scattered-light intensity is measured relative to the forward direction of the incident light. The rather involved functional relationships for i_1 and i_2 are given in appendix A.

It is seen from equations 3.4 through 3.8 that the angular distribution of the scattered-light intensity, normalized with respect to the incident light intensity, is a function only of x , y , and the state of polarization if λ and r are fixed. This in turn means that the shape of the scattering diagram (I_1 , I_2 , or I plotted as a function of θ) is determined by the values of the particle

diameter d and the particle index of refraction m . If the value of m is known, the particle diameter alone determines the shape of the scattering diagram.

Scattering by a Cloud of Particles

Thus far only the scattering by a single particle has been considered. Since this present work is concerned with measuring the scattered-light intensity from a small volume of soot particles within a flame, it is necessary to know the relationship between the scattering from a many particle system and the single particle case. Provided the concentration of the scattering particles and the distances through which the incident and scattered light must travel are not too large, the intensity of light scattered by a cloud of particles is directly proportional to the number of scattering particles. In other words, the proportionality between the scattered-light intensity and the number of particles holds only if the light incident on each particle is essentially the light of the original incident beam.

As the concentration of the particles increases or the distance through which the incident and scattered light travel increases, more and more of the incident light undergoes extinction by the other particles and the more each particle will be exposed to the scattered light from the other particles. When these effects become important, the proportionality between the scattered-light intensity and the number of particles is no longer a valid assumption. This type of scattering is known as multiple scattering.

If the extinction of the incident light is negligible in passing through a cloud of particles, it may be assumed that multiple scattering effects are unimportant. In order to determine whether or not the effects of multiple scattering are important in this work, the extinction was calculated for a given flame size and for the expected range of soot particle size and concentration. The results indicate that multiple scattering effects may be neglected.

The next section will be concerned with the actual calculation of the light-scattering functions.

IV. CALCULATION OF LIGHT-SCATTERING FUNCTIONS

One of the first steps in a light-scattering investigation of this kind is to calculate the scattering functions over the expected ranges of x and y for various values of θ . As before, $x = \frac{\pi d}{\lambda}$ and $y = mx$. The expected diameter d of soot particles, according to Gaydon and Wolfhard (9), ranges from 100 to 2000 Å. A combination of a light source and an interference filter was chosen, for reasons given in a later section, to give approximately monochromatic light of 4358 Å. The range of the size parameter x for this combination of d and λ is about 0.07 to 1.44. The values of x over which the scattering functions are calculated range from $x = 0.05$ to $x = 2.00$ in increments of 0.05.

The second parameter required, y , depends directly on the index of refraction, m , of the scattering particle. There appear to be no data available on the index of refraction of soot particles in a flame specifically, however, there is a limited amount of data for carbon. In this work it is assumed that the index for carbon closely approximates that of soot. Carbon particles are somewhat opaque and therefore absorb a portion of the incident light as well as scattering it. This absorption must be accounted for in the calculation of the light-scattering functions. This is done by representing the index of refraction m as a complex number.

$$m = n - in'$$

4.1

The real part n has to do only with the velocity of light in the particle and is equivalent to the usual index of refraction for transparent materials, that is, the ratio of the velocity of light in a reference medium, usually vacuum, to that in the material in question. The imaginary part n' has only to do with the absorption of light by the particle and is known as the absorption constant. The absorption constant n' is related to the usual absorption coefficient γ by the relation

$$\gamma = \frac{4\pi n'}{\lambda} \quad 4.2$$

as shown in appendix B.

Senftleben and Benedict (17) measured the index of refraction of what they call amorphous carbon at room temperature for various wavelengths. Table 4.1 lists the values of m reported and indicates that m is only a weak function of λ .

TABLE 4.1.- INDEX OF REFRACTION OF AMORPHOUS CARBON
FROM SENFTLEBEN AND BENEDICT (17).

λ	m
4360 Å	1.90 - 0.68 i
4920	1.94 - 0.66 i
5460	1.96 - 0.66 i
5780	1.97 - 0.65 i
6230	2.00 - 0.66 i

In order to take into account the effect of temperature on m , Stull and Plass (18) have derived a dispersion equation, based in part on the room temperature data of Senftleben and Benedict, from which the index of refraction at 2250° K can be calculated. Values of m calculated from the dispersion equation given by Stull and Plass for two wavelengths are shown in Table 4.2.

TABLE 4.2.- INDEX OF REFRACTION OF AMORPHOUS CARBON
CALCULATED FROM EQUATION BY STULL AND PLASS (18)

λ	m
5348 Å	1.71 - 0.76 i
5461	1.79 - 0.79 i

In addition to the above data, Wartenberg (19) has measured the index of refraction at room temperature of a freshly cut surface of graphite. He reports an index of refraction of $m = 2.98 - 1.74 i$ for a wavelength of $\lambda = 5790 \text{ Å}$.

The values of the index of refraction m for carbon which were determined in both (17) and (19) are based on a reflection method which measures the state of polarization of light reflected from a surface of the sample carbon as a function of the angle of incidence. A general description of the method for determining the values of n and n' from reflection measurements is given in reference 20. Tool (21) points out that the condition of the surface effects the values of n and n' . In addition to the question of surface effects,

there is uncertainty concerning the similarity of the structure of soot particles compared to the actual carbon samples examined.

Warren (22) has made X-ray diffraction studies of carbon black. He indicates that carbon black or soot is not a truly amorphous form of carbon. Carbon black does have a graphitic form but differs from graphite in that the successive layers are not parallel but are oriented with respect to each other in a random manner. The extent of the crystalline or amorphous character of soot depends on the fuel and conditions under which the soot is formed.

Without actually measuring the index of refraction of soot particles in a flame, the correct value of m can only be estimated from the above data. The most recent work of Stull and Plass (18) was assumed best to represent the optical properties of soot. The particular values of m , on which the light-scattering calculations are based, were taken to include a broad possible range. The 14 values of m are listed later along with the calculational procedure.

The last independent parameter in the scattering expressions, θ , is varied from 0° to 180° in 5° increments for each combination of x and m (or y).

Gucker and Cohn (23) have developed a general scheme for calculating the desired scattering functions by starting with the expressions already given in appendix A. The scheme is shown in appendix C.

Based on the general scheme of Gucker and Cohn, a detailed system of equations was developed for the numerical evaluation of the

desired scattering functions and coefficients. A machine program, using the Fortran programming system, was then developed which applied this system of equations for the chosen values of x , m , and θ . The detailed system of equations and the Fortran program are also presented in appendix C. The calculations were carried out at the MIT Computation Center on an IBM 709 computer.

V. NUMERICAL RESULTS OF LIGHT-SCATTERING CALCULATIONS

The light-scattering functions i_1 and i_2 for spherical particles have been calculated with the help of an IBM 709 computer for values of the size parameter x ranging from $x = 0.05$ to $x = 2.00$ in increments of 0.05 for values of θ ranging from $\theta = 0^\circ$ to $\theta = 180^\circ$ in increments of 5° and for the following values of m :

1.60 - 0.60 i	1.80 - 1.00 i
1.60 - 0.80 i	1.90 - 0.68 i
1.60 - 1.00 i	1.96 - 0.66 i
1.71 - 0.76 i	2.00 - 0.60 i
1.79 - 0.79 i	2.00 - 0.80 i
1.80 - 0.60 i	2.00 - 1.00 i
1.80 - 1.00 i	2.98 - 1.74 i (graphite)

In addition to the functions i_1 and i_2 , the scattering coefficients a_n and b_n which are intermediate parameters in the program for calculating i_1 and i_2 , were also printed as output results from the machine computations. The numerical results for the above mentioned combinations of x , m , and θ are presented in tabular form in appendix D. A tabulation of a_n and b_n for the corresponding values of x and m for n up to 6 are also given in appendix D.

Based on these results, polar scattering diagrams of i_1 and i_2 plotted against θ for $m = 1.71 - 0.76 i$ and various selected values of x are presented in Figures 5.1 through 5.4.

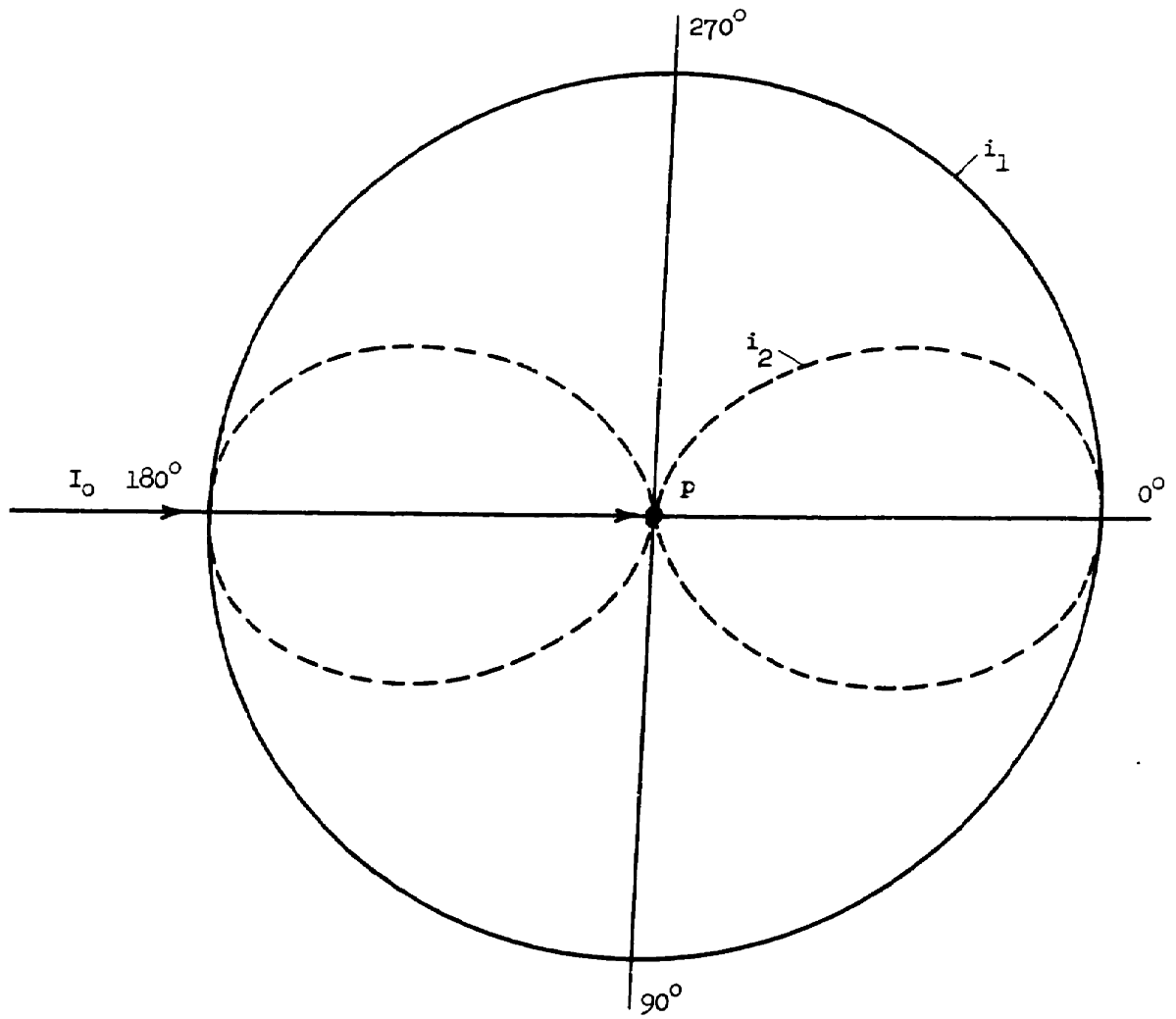


Figure 5.1.- Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 0.05$.

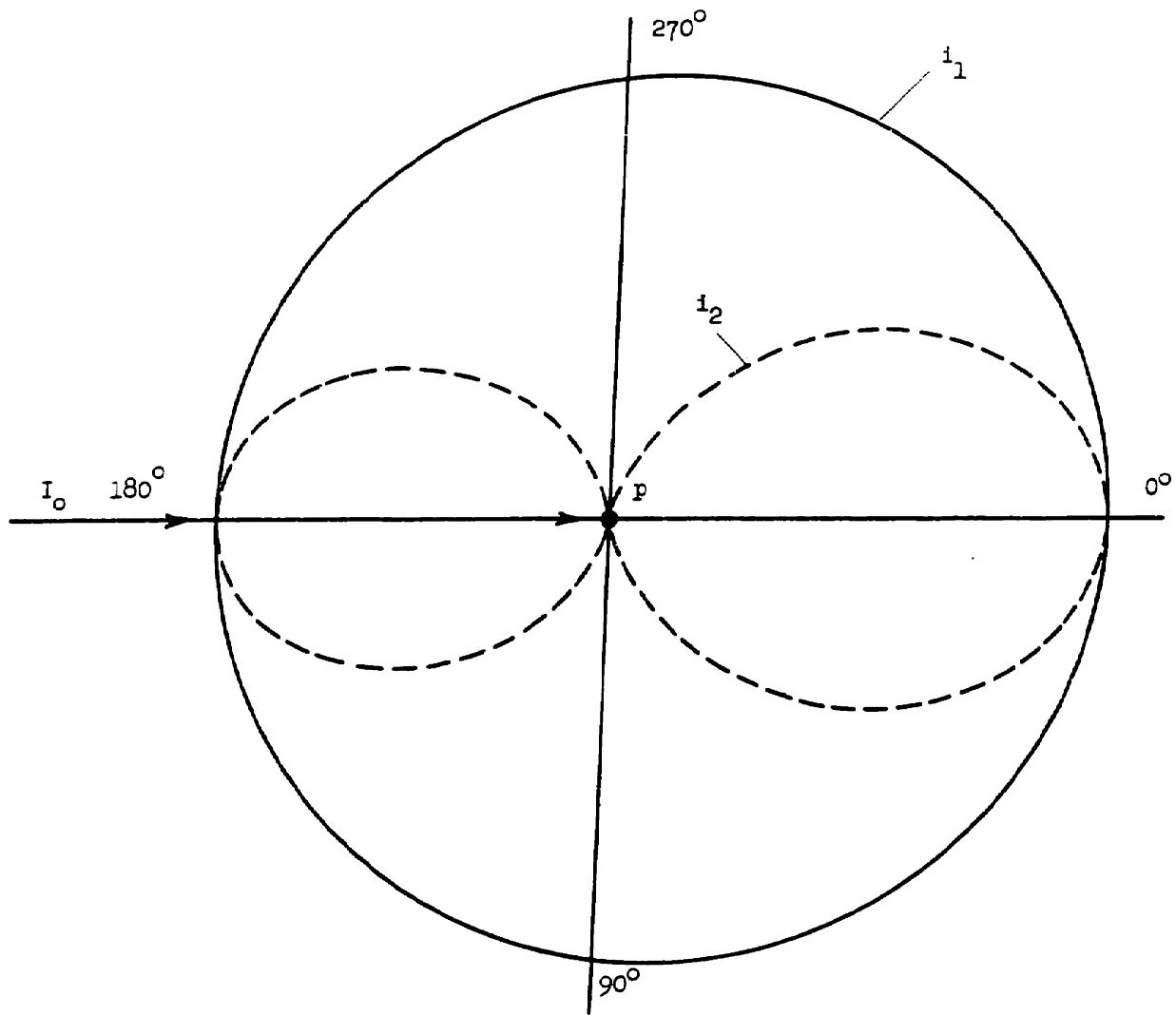


Figure 5.2.- Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 0.50$.

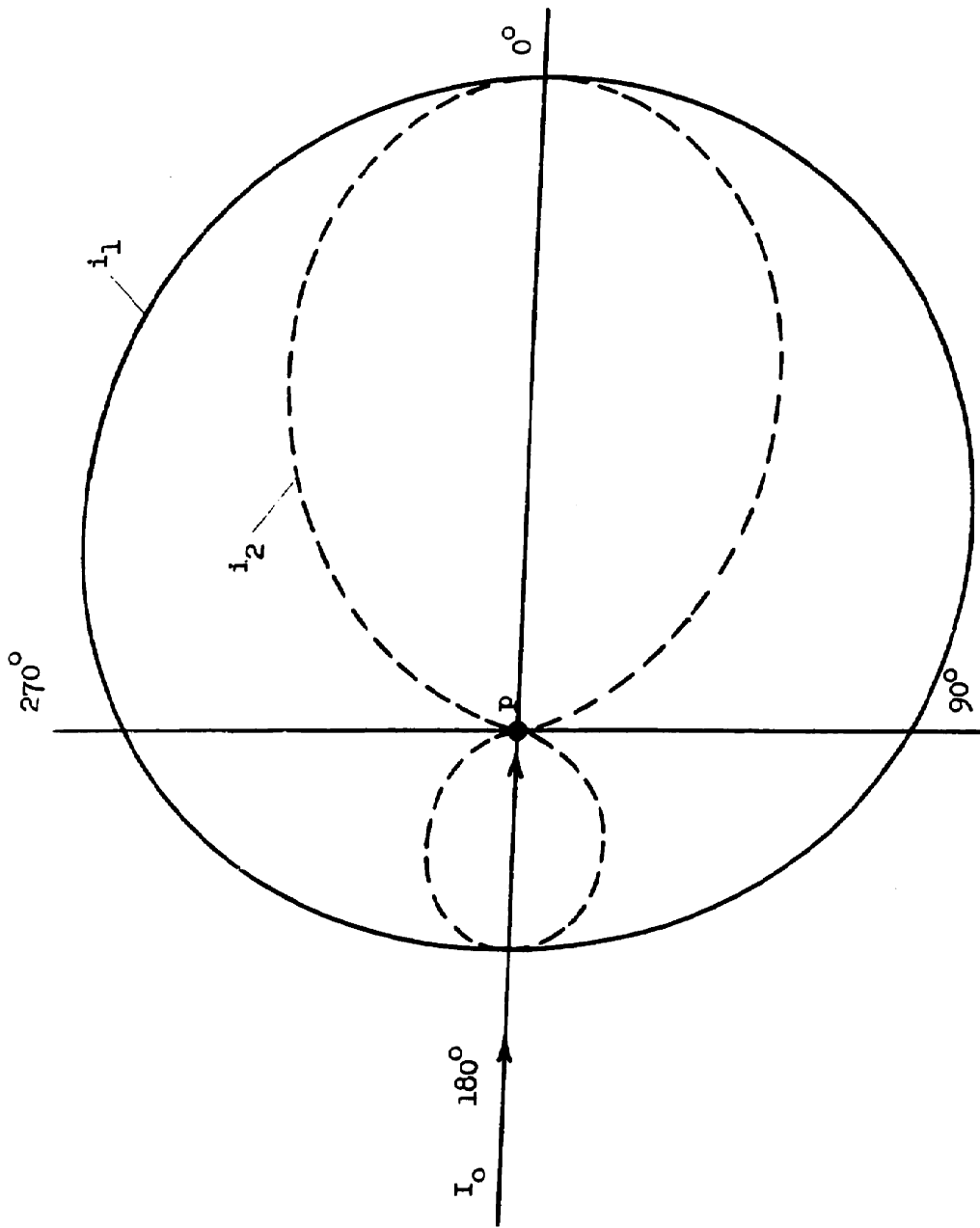


Figure 5.3.- Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 1.00$.

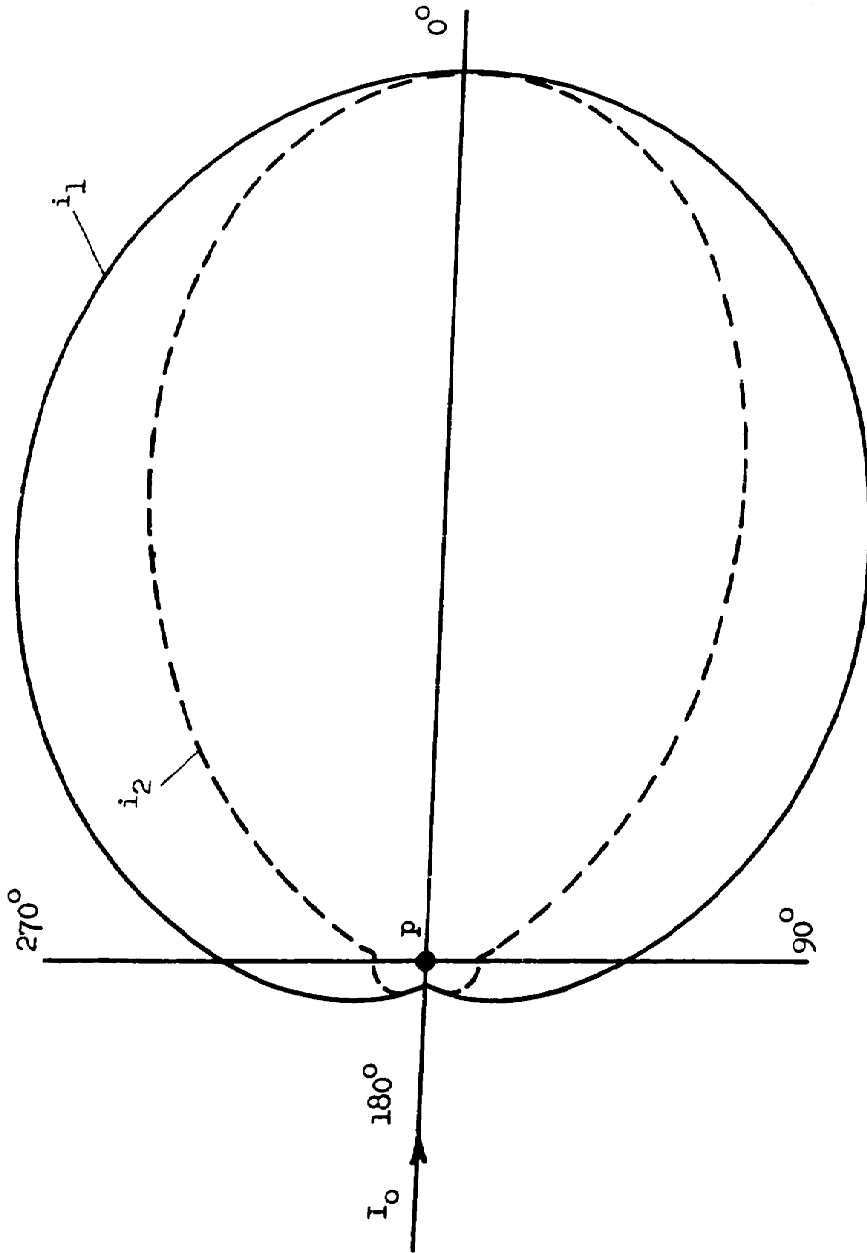


Figure 5.4.- Polar light-scattering diagram for $m = 1.71 - 0.76 i$ and $x = 1.50$.

Figure 5.1 is based on $x = 0.05$ which represents a case where the particle size is much less than the wavelength of the light used. If the wavelength λ is 4358 \AA , the particle diameter is only about 70 \AA when $x = 0.05$. This plot shows that the scattered-light intensity for this value of x is symmetrical about the 90° to 270° axis as it is for the case for all small particles which satisfy the condition $d \ll \lambda$. The shape of the light-scattering diagram of i_1 and i_2 against θ for this case ($x = 0.05$) is the same as that given in Figure 3.3 for any very small particle for which $d \ll \lambda$. It is also of interest to compare the numerical values of i_1 and i_2 obtained by machine calculation with the values that would be found by using the simple scattering equations based on $d \ll \lambda$.

Equate the right-hand side of equation 3.1 to that of equation 3.4.

This gives

$$i_1 = \left| \frac{m^2 - 1}{m^2 + 2} \right|^2 x^6 \quad 5.1$$

where V in equation 3.1 has been replaced by $\frac{\pi d^3}{6}$ and $\frac{\pi d}{\lambda}$ has been replaced by x . This is the equation for i_1 only if $d \ll \lambda$.

The corresponding equation for i_2 is

$$i_2 = \left| \frac{m^2 - 1}{m^2 + 2} \right|^2 x^6 \cos^2 \theta \quad 5.2$$

The value of i_1 as calculated from equation 5.1 for $x = 0.05$ and

$m = 1.71 - 0.76 i$ is approximately 0.5220×10^{-8} and is independent of θ . In the way of comparison, the more exact value of i_1 determined by the machine computation shows a very slight dependence on θ and ranges from $i_1 = 0.5232 \times 10^{-8}$ at $\theta = 0^\circ$ down to $i_1 = 0.5219 \times 10^{-8}$ at $\theta = 180^\circ$ as shown in appendix D. The results are essentially the same and agree within 0.23 percent.

A similar comparison for i_2 can be made at a given value of θ , say 60° . It follows from equation 5.2 that $i_2 = 0.1305 \times 10^{-8}$. The machine computation result for $\theta = 60^\circ$ is $i_2 = 0.1307 \times 10^{-8}$. This is likewise good agreement.

Figure 5.2 is a scattering diagram for the same index of refraction but $x = 0.50$. It can be seen that the light-scattering intensity in the forward direction ($\theta < 90^\circ$) is somewhat greater than that in the backward direction ($\theta > 90^\circ$). As the size parameter x is increased further to $x = 1.00$ for Figure 5.3 and to $x = 1.50$ for Figure 5.4, the dissymmetry of the scattering diagram increases, that is, the forward scattered-light intensity increases relative to the backward intensity with increasing x .

The effect that the size parameter x has on this dissymmetry is quite clearly shown by plotting the ratio of the forward scattered-light intensity at a given angle θ divided by the backward scattered-light intensity corresponding to the angle $(180^\circ - \theta)$. Dissymmetry plots for $m = 1.71 - 0.76 i$ are presented in Figures 5.5 through 5.8 which show the ratios $i_1(\theta)/i_1(180 - \theta)$ and $i_2(\theta)/i_2(180 - \theta)$ plotted against x for four values of θ .

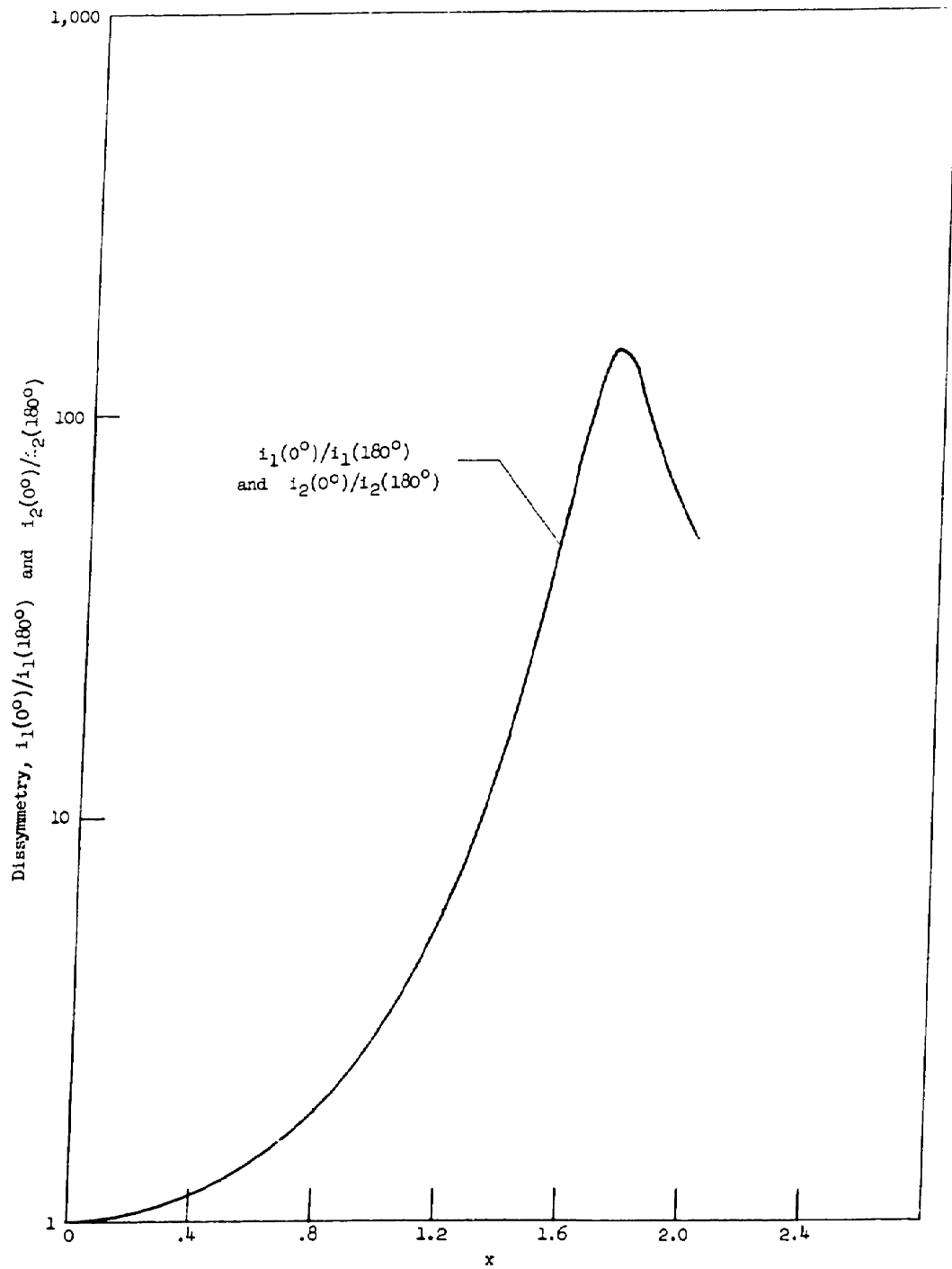


Figure 5.5.- Dissymmetry, $i_1(0^\circ)/i_1(180^\circ)$ and $i_2(0^\circ)/i_2(180^\circ)$ plotted against x and for $m = 1.71 - 0.76 i$.

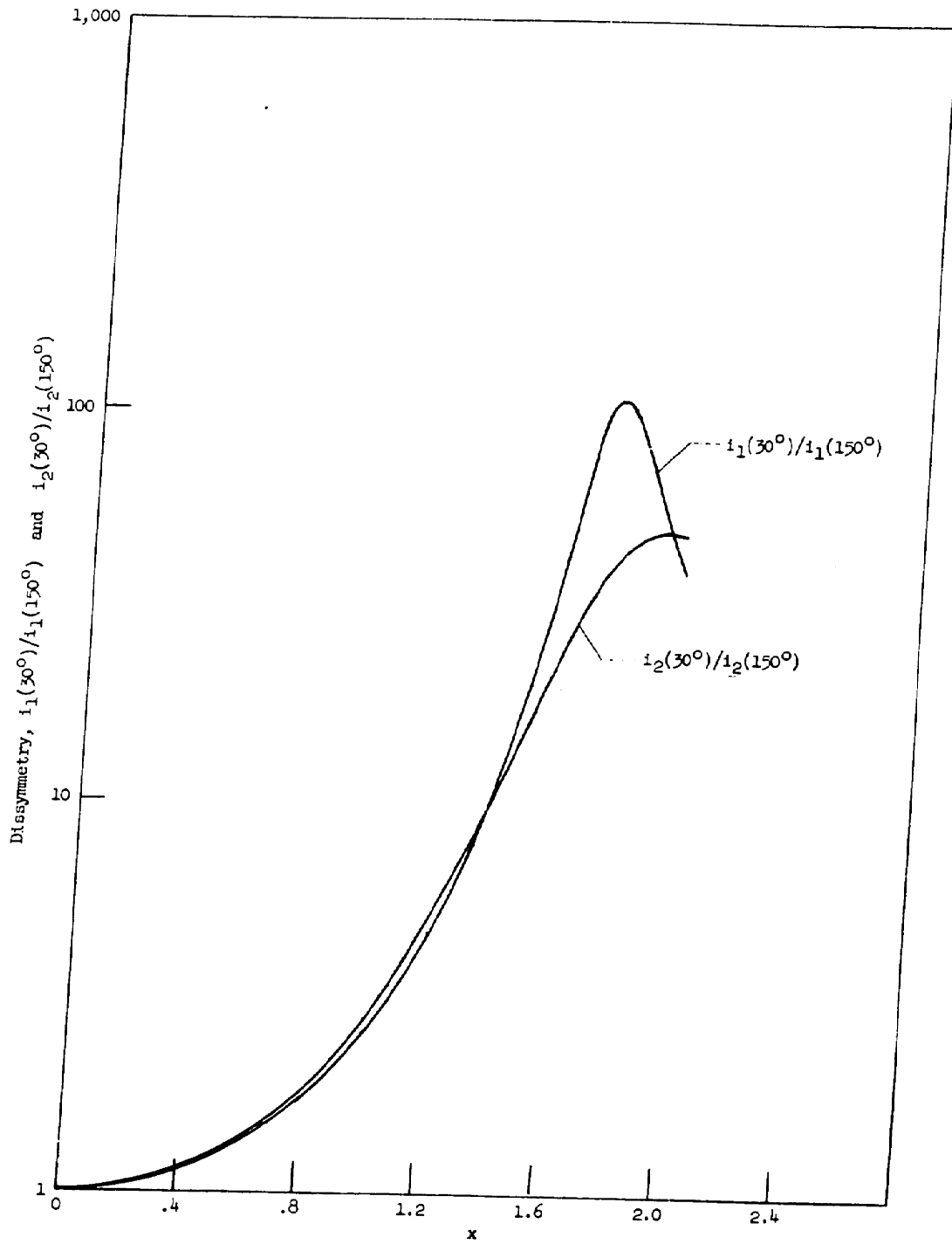


Figure 5.6.- Dissymmetry, $i_1(30^\circ)/i_1(150^\circ)$ and $i_2(30^\circ)/i_2(150^\circ)$ plotted against x for $m = 1.71 - 0.76 i$.

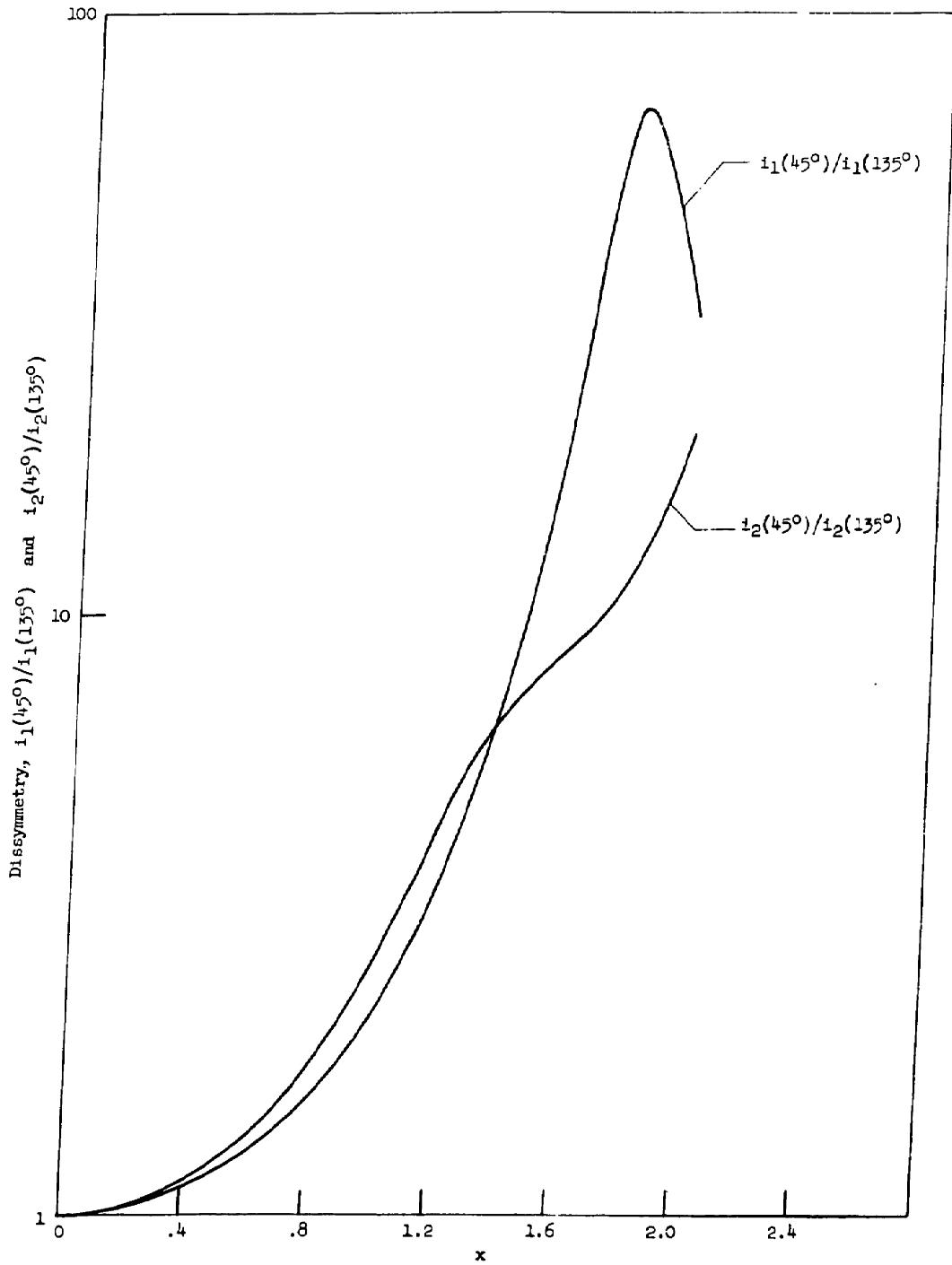


Figure 5.7.- Dissymmetry, $i_1(45^\circ)/i_1(135^\circ)$ and $i_2(45^\circ)/i_2(135^\circ)$ plotted against x for $m = 1.71 = 0.76 i$.

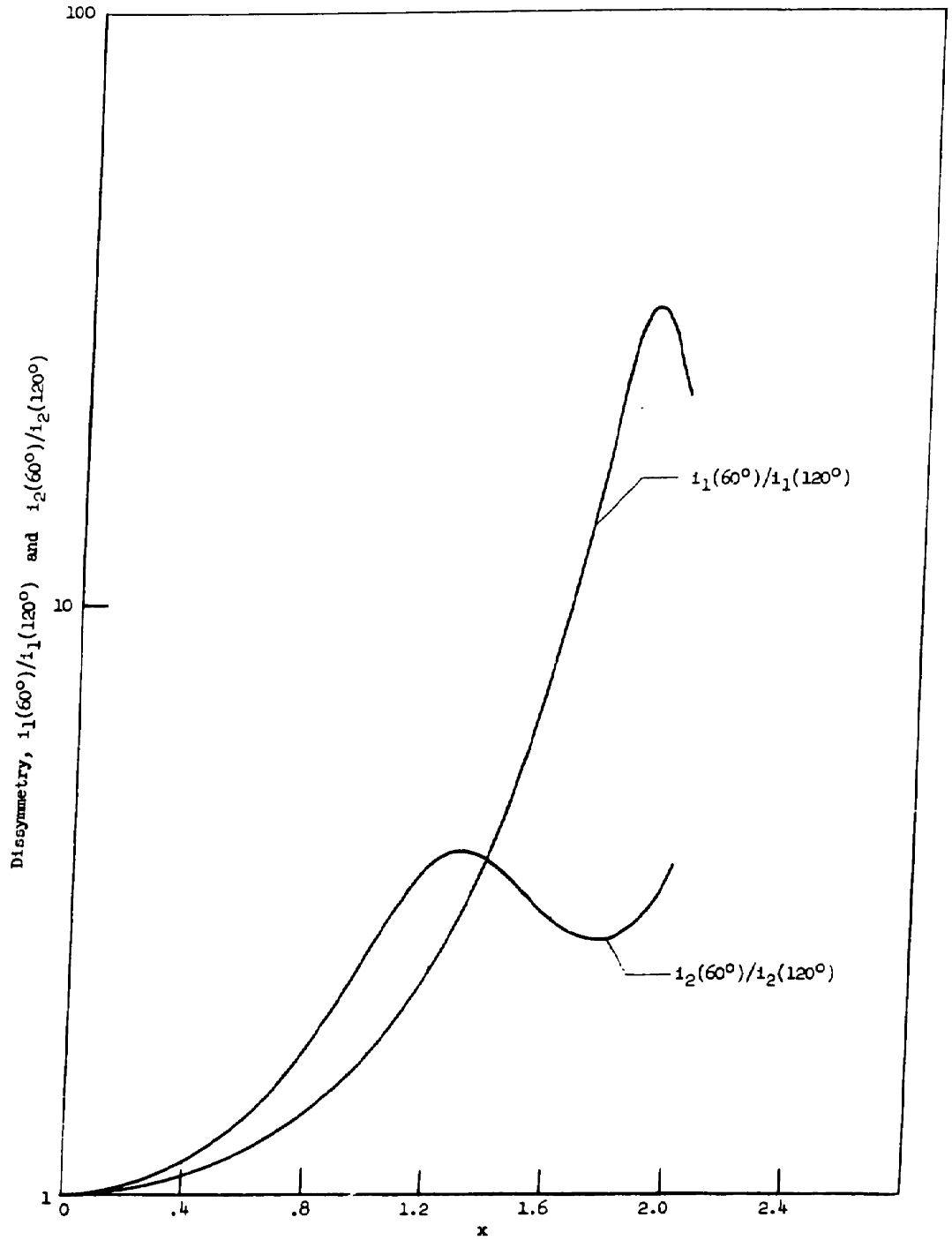


Figure 5.8.- Dissymmetry, $i_1(60^\circ)/i_1(120^\circ)$ and $i_2(60^\circ)/i_2(120^\circ)$ plotted against x for $m = 1.71 - 0.76 i$.

VI. APPLICATION OF THE CALCULATED LIGHT-SCATTERING RESULTS

In the previous section, the theoretical light-scattering functions were determined and tabulated for the range of soot particle sizes expected in flames. It is the purpose of this section to show how these theoretical results can be applied to light-scattering measurements for determining the size and concentration of soot particles in flames. Before discussing various possible approaches, it should be remembered that, while the primary objective of this work was to develop a technique for measuring soot particle size and concentration in flames, it was done with the hope of eventually being able to follow the growth and decay of soot particles within a flame. Here it is important to keep the size of the observed scattering volume as small as possible in order to reduce size averaging effects due to the presence of different particle sizes at different locations in the flame.

It is assumed that the soot particles are spherical and monodisperse so that the theoretical results of the previous section can be applied directly.

Particle Size Determination

There are several different light-scattering measurements, which, when combined with the theoretical scattering results, can be made to determine particle size, if the particle diameter falls in a given range.

It can be observed from Figures 5.1 through 5.4 that the shape of the light-scattering diagram is strongly dependent on the particle diameter so long as x is not too small. Stacey (24) suggests that the approximate practical lower limit of x for which dissymmetry can be measured corresponds to a particle which has one dimension greater than $1/20$ of the wavelength of the incident light, that is, x of about 0.16 for a sphere.

For soot particles which are large enough to produce a measurable unsymmetrical scattering pattern, the size parameter x can be determined by measuring the light-scattering as a function of θ and comparing the resulting pattern with the theoretical scattering diagrams corresponding to different values of x . The value of x which corresponds to the theoretical pattern which best fits the experimental data is then the correct value of x . This method of course assumes a knowledge of the correct values of m .

This is the method used in this work for determining the soot particle size. The two plane polarized scattered-light intensities I_1 and I_2 were measured with the aid of a polarization filter and a relatively narrow band pass optical interference filter. For a cloud of N scattering particles which are monodispersed and not too concentrated, the two plane polarized light-scattering intensities I_1 and I_2 follow from equations 3.4 and 3.5.

$$I_1 = N \frac{1_1}{k_T^2} I_{0,1} \quad 6.1$$

and

$$I_2 = N \frac{i_2}{k^2 r^2} I_{0,2} \quad 6.2$$

In a given experiment, k is fixed and known from the narrow band pass optical interference filter, the state of polarization is fixed and known from the setting of the polarization filter, N is fixed, r is fixed and known, $I_{0,1}$ and $I_{0,2}$ are fixed, and I_1 and I_2 are measured. Then, if m is known, the shape of the scattering patterns of I_1 against θ and I_2 against θ will be determined by d only, since i_1 and i_2 are functions only of x , m , and θ . A comparison of the measured scattered-light intensity distribution with the various calculated distributions of i_1 and i_2 for a given value of m but various values of x then gives the particle diameter d since λ is known.

An alternative method for determining the value of x is to measure the ratio of the scattered-light intensities at two angles symmetric about $\theta = 90^\circ$, that is, at $\theta < 90^\circ$ and also at an angle of $(180^\circ - \theta)$. It is noted by referring back to Figures 5.5 through 5.8, that the dissymmetry, $i(\theta)/i(180^\circ - \theta)$ for either perpendicular or parallel polarization is a smooth function of x . The experimental determination of the dissymmetry for the two plane polarized components followed by a comparison with the theoretical dissymmetry yields the particle size. This method in which the dissymmetry is measured is just a special case of the previous method.

Still another method of size determination involves measuring the transmittance of a beam of light through the flame at several different wavelengths. The transmittance of light passing through a cloud of particles is the ratio of the intensity of the transmitted light intensity I to the incident intensity I_0 and is given by the equation

$$\frac{I}{I_0} = \exp(-\gamma l) \quad 6.3$$

where l is the optical path through the scattering cloud and γ is the extinction or absorption coefficient which is defined as

$$\gamma = \left(\frac{N}{V}\right) C_{\text{ext}} \quad 6.4$$

In this expression, $\left(\frac{N}{V}\right)$ is the number of particles per unit volume in the optical path and C_{ext} is the extinction cross section per particle which in turn is a function of x and λ . It should be remarked that the transmittance is independent of the state of polarization.

The extinction cross section is defined as

$$C_{\text{ext}} = \frac{2\pi}{k^2} \sum_{n=1}^m (2n + 1) \text{Re}(a_n + b_n) \quad 6.5$$

where $\text{Re}(a_n + b_n)$ denotes the real part of $a_n + b_n$. The scattering coefficients a_n and b_n are given in appendix D for various values of x and m for values of n up to six. The extinction

coefficient C_{ext} can therefore be calculated from equation 6.3 for various values of x at different wavelengths for a known value of m . The quantities I , I_0 , and l can be measured at several different wavelengths so that γ can be determined at these wavelengths from equation 6.3. A plot of the logarithm of the measured value of γ against the various values λ used is then compared to the calculated curve of C_{ext} against λ for various values of d to find the best fit without regard to the absolute magnitude of the γ or C_{ext} since $\left(\frac{N}{V}\right)$ in equation 6.4 is constant for a given experiment. The value of d which corresponds to the theoretical curve which best fits the experimental curve is the correct value.

This method, which involves measurement of the extinction coefficient, was not used in this work because the optical path, l , would correspond to the whole width of the flame. This would give some average size, weighted in an unknown manner over a rather large distance in the flame. As already mentioned, it is desired to have as small a scattering volume as possible in order to reduce any size averaging effects due to particle size variation with position in the flame.

None of the mentioned particle size determination methods which are based on light-scattering measurements alone can be applied when the particle size is so small that essentially Rayleigh scattering occurs. This can be seen by rewriting equation 3.1 for N scattering particles which satisfies the condition of $d \ll \lambda$.

$$\frac{I_1}{I_{0,1}} = \frac{9\pi^2}{r^2\lambda^4} \left(\frac{m^2 - 1}{m^2 + 2} \right)^2 (N \times V^2) \quad 6.6$$

It is seen from this equation which applies when $d \ll \lambda$, that the number of scattering particles N always appears in a product with the square of the volume of the scattering particle V^2 . Since N and V are both unknowns in the experiment and always appear as the product $N \times V^2$ when $d \ll \lambda$, the measurement of an additional quantity, which depends only on N or V or any combination of N and V which is different from $N \times V^2$, is necessary to find either N and/or V . This second measurement could be the refractive index of the composite medium of soot particles and flame gases which depends on the product $N \times V$.

Concentration Determination

The most common way to measure particle concentrations by light scattering after the particle size has been determined is to measure the extinction coefficient at a given wavelength. With a known particle size, wavelength, and value of m , C_{ext} can be calculated from equation 6.5 after which N/V is found directly from equation 6.4. As already indicated, extinction measurements were not used in this work.

The method which was used herein for evaluating the soot particle concentration involved the measurement of the ratio $I_2/I_{0,2}$ at a given angle θ . (The particular choice of using the parallel plane

polarized component is discussed later.) After the size parameter x has been determined by comparing the shape of the experimental and theoretical scattering patterns, the scattering function i_2 is known. Equation 6.2 gives the parallel plane polarized light-scattering intensity for a monodispersed system of N scattering particles. For a given measurement in which θ is fixed, the value of i_2 is known from the previous determination of particle size, the values of k and r are also known, and the ratio $I_2/I_{0,2}$ is measured. Substitution of these values into equation 6.2 gives the number of particles N in the scattering volume. The scattering volume V can be fixed and measured so that the soot particle concentration N/V can be found.

VII. EFFECT OF A DISTRIBUTION OF PARTICLE SIZES
ON LIGHT-SCATTERING MEASUREMENTS

Up to this point, the soot particles within a given small volume of a flame have been assumed to be of uniform size so that the scattered-light intensity can be represented by equations 6.1 and 6.2 for N identical scattering particles. It is possible, but difficult, to determine the distribution of sizes from very accurate light-scattering measurements by comparing these measured results with the calculated results made for various assumed size distributions. This was not done in this thesis. This discussion is limited to showing the effect that a distribution of particle sizes may have on light-scattering measurements.

For simplicity, a normal distribution of sizes is used to show this effect. The general procedure is the same for other distributions. The density function as given by Frazer (25) for the normal distribution is

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left[-1/2\left(\frac{x - \mu}{\sigma}\right)^2\right] \quad 7.1$$

where x is the random variable, μ is the mean about which x is distributed, and σ is the standard deviation. The random variable x in equation 7.1 is taken to be identical to the size parameter x which in turn is equal to $\frac{\pi d}{\lambda}$. It is clear that the density function $f(x)$, defined in this way is dependent on λ as well as on d , so

that a distribution of λ will have an effect which is similar to a distribution of sizes.

The two plane polarized scattered-light intensities for a cloud of particles having a distribution in the size parameter x are given by equations 6.1 and 6.2 if the scattering functions i_1 and i_2 for a single particle are replaced by appropriately averaged scattering functions \bar{i}_1 and \bar{i}_2 , respectively. These weighted scattering functions will depend on μ , σ , m , and θ , whereas the corresponding functions for a single particle or a monodispersed system depend on x , m , and θ . The weighted scattering functions for the two components are defined as

$$\bar{i}_1 = \frac{\int_0^{\infty} i_1 f(x) dx}{\int_0^{\infty} f(x) dx} \quad 7.2$$

$$\bar{i}_2 = \frac{\int_0^{\infty} i_2 f(x) dx}{\int_0^{\infty} f(x) dx} \quad 7.3$$

The denominator $\int_0^{\infty} f(x) dx$ is simply the normalization factor which is constant for a given set of μ and σ and is essentially unity when μ is not very near zero. The exact value of the integral can be found from tables such as given by Pearson and Hartly (26).

The evaluation of the integrals $\int_0^{\infty} i_1 f(x) dx$ and $\int_0^{\infty} i_2 f(x) dx$ for various combinations of μ and σ as a function of θ at given values of m was carried out by modifying the Fortram program previously used to calculate i_1 and i_2 . Further discussion of these calculations are presented in appendix E along with a listing of the modified Fortram program and some numerical results for different combinations of μ , σ , and θ .

For all cases considered, the shape of the scattered-light intensity pattern for a given mean size parameter μ and deviation σ corresponds best to a monodispersed scattering pattern for which x is larger than μ . As the standard deviation σ is increased, the difference between x and μ becomes larger. This is so because a given beam of light is scattered more by larger particles as long as the size parameter is not greater than a critical value. Beyond this critical value of x , the intensity oscillates with increasing x . For very small particles such that equations 3.1 and 3.2 apply, it is seen that the scattered-light intensity increases with particle size as d^6 . It follows that the effect of a large number of very small scattering particles is dominated by the effect of a small number of larger particles. Consider a cloud of particles in the size range such that $d \ll \lambda$ in which 10 percent have a diameter d and 90 percent have a diameter of $d/4$. The light-scattering intensity from the 10 percent which have a diameter d is $\frac{(4)^6}{9}$ or 455 times that scattered from the 90 percent which have a diameter $d/4$. For

larger particles which are not small compared to λ , the scattered-light intensity does not increase as rapidly with particle size.

VIII. EXPERIMENTAL APPARATUS

Light-scattering apparatus have been constructed for the purpose of determining the size and concentration of suspended particles in a large variety of systems. The basic components of a light-scattering apparatus include a light source, a collimating system for the incident light beam, the particle system to be studied, a collection system for the scattered light, a light transport system, and an electronic system for measuring the scattered light intensity. The discussion here will be limited to the design of a light-scattering apparatus which is to be used for determining the concentration of soot particles in a laminar flame.

Design Considerations

The intensity of the scattered light from a cloud of particles is many orders of magnitude less than the incident light intensity. Therefore, in order to develop scattered light of measurable intensity it is necessary to use a light source and associated collimating system which produces an intense beam of incident light. It should be remembered that the light-scattering theory, which is based on the assumption of a parallel beam of incident light, requires the design of a collimating system for the incident light. The design should take into account by making the angle of convergence of the incident light small so that the error due to a nonparallel incident beam is not too serious. A small collection angle for the scattered

desirable so that the measured scattered-light intensity at a given angular setting is that from only a small angle increment. On the other hand, the angle of convergence of the incident beam and the collection angle of the scattered light must still be large enough to give a measurable signal.

The background light due to the hot soot particles in the flame, whose spectrum is mainly continuous, must also be considered. Since the determination of soot particle size depends on measuring the shape of the scattering diagram or the ratio of the scattered-light intensity at two angles, the signal associated with the background flame light intensity must be essentially eliminated or by some means subtracted from the total signal due to the sum of the scattered light and the background.

As mentioned earlier, a distribution in the wavelength of the incident light will have an effect on the scattered-light intensity which is similar to the effect of a particle size distribution. It is therefore necessary to use a narrow wavelength band in order to be able to interpret the light-scattering measurements.

Since the broad objective of this work is to develop a technique for following the rate of growth and decay of soot particles within a flame, it is desirable to keep the observed scattering volume or the examined flame volume as small as possible. The undesirable size distribution effect due to the variation in particle size with location in the flame will be reduced as the scattering volume is made smaller.

In general, the shorter the wavelength of light used, the greater the scattered-light intensity and the greater the size parameter x for a given particle size. The determination of the size of very small particles which produce nearly a Rayleigh-type scattering pattern at a given wavelength may be made possible by decreasing the wavelength and thereby shifting to a size parameter x to a larger value which has measurable dissymmetry. On the other hand, for ease of alignment of the optical system and checking on equipment operation, it is desirable to keep the light in the visible range. It should be pointed out that, while the use of much shorter wavelengths does increase the value of x , the detection systems required for measuring the scattered-light intensity in this range are limited. The amount of atmospheric absorption for the shorter wavelengths will also be an important factor to consider.

Since the response of the detection system for measuring the scattered-light intensity (i.e., a multiplier phototube for visible illumination) depends on the wavelength, this also must be considered. For illumination with extremely short wavelengths, counting devices would be required.

It follows that the design of the light-scattering apparatus involves a certain degree of optimization, so an effort was made to keep the design flexible enough to permit easy changes after making initial experiments.

Figures 8.1 and 8.2 show schematically the light-scattering apparatus with the various components and associated electronic equipment. Figure 8.1 shows the arrangement for the particle size determination measurements and Figure 8.2 shows the arrangement for measuring the incident light intensity relative to the scattered-light intensity at a given angle which is needed for the concentration measurements. Referring first to Figure 8.1, a portion of the light generated by the light source passes through a small circular aperture which is placed almost on the surface of the source. This light then passes through a series of stops which defines the usable solid angle from the source and eliminates small angle reflections. This system of stops is followed by a short focal length achromatic lens which is located at a distance from the light source equal to its focal length so that it collects the light passing the system of stops and renders it nearly parallel. The light then passes through a stop, the function of which is not to define the light beam but only to reduce reflection from the walls of the tube which contains the lenses and stops. A relatively long focal length lens receives this light which in turn produces a slightly convergent beam which serves as the incident light beam. This lens is located at a distance from the center of the flame which is equal to its focal length. The angle of convergence of the incident light is determined by the light stop located at the long focal length lens.

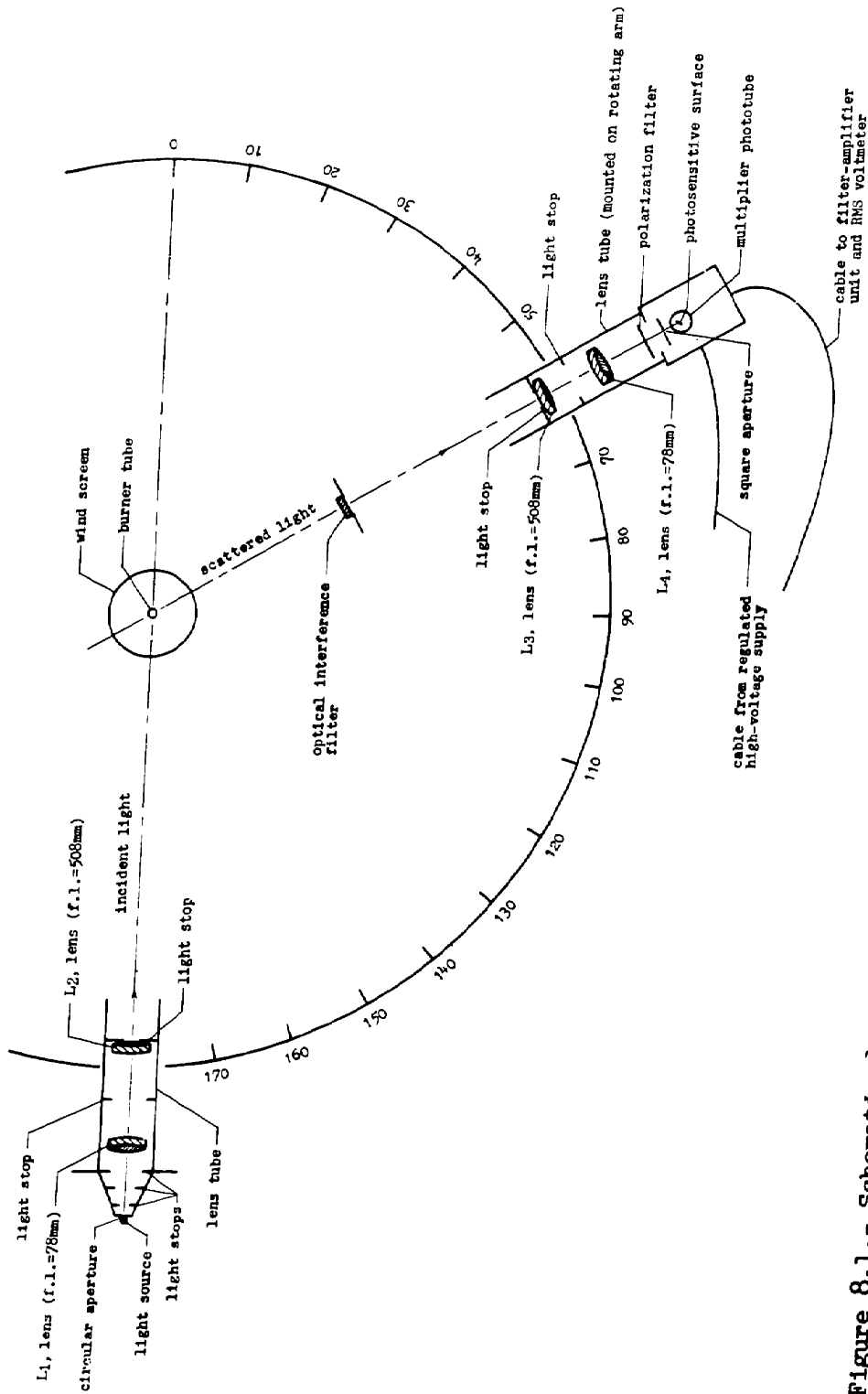


Figure 8.1.- Schematic drawing of light-scattering apparatus for measuring the light-scattering intensity at various angular positions.

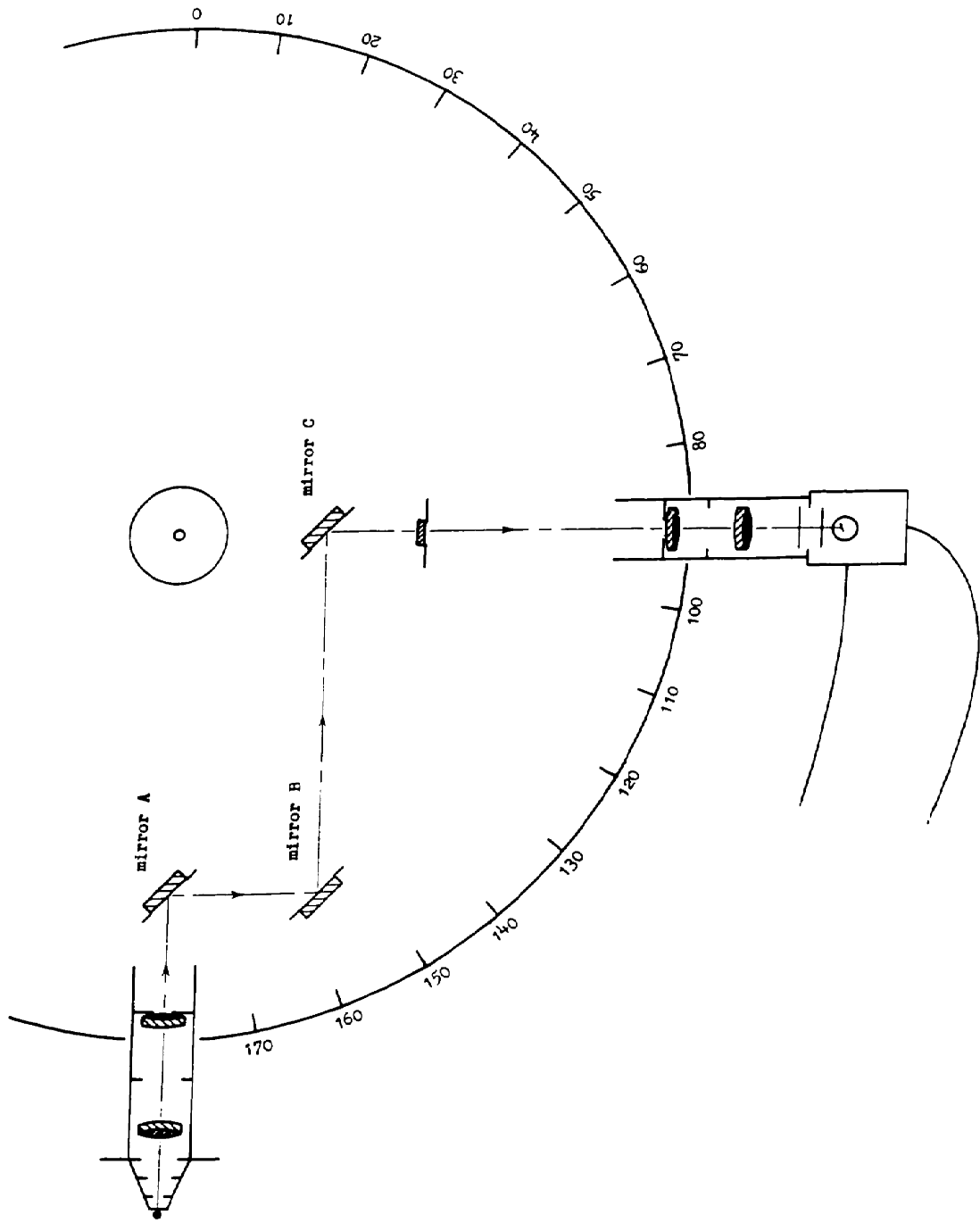


Figure 8.2.- Schematic drawing of light-scattering apparatus for measuring the reflected incident light intensity.

The incident light passes through an opening in a wind screen placed about the flame and generates an approximately cylindrical scattering volume in the flame due to the interaction of this incident light with the soot particles. All of the components, mentioned thus far, of this optical system, are centered on a single axis which intersects and is perpendicular to the axis of the burner tube.

A desired portion of the scattered light is collected by a similar optical system, the components of which are centered on an axis which passes through the intersection of the axes of the burner tube and the optical system for the incident light. Scattered light is generated of course in all directions from the scattering volume, but it is desired to measure the scattered-light intensity at various angles for a small collection angle. The optical system for collecting the scattered light is mounted on an arm which can be rotated about the axis of the burner tube. The angle of observation θ is determined with the help of the graduated circle. With the optical system for collecting the scattered light located at a given angle θ from the direction of the incident light, a portion of the scattered light passes through an optical interference filter which defines the wavelength of the light. The divergence angle or collection angle of this filtered light is determined by the scattering volume and the light stop located at the lens which serves to collect the scattered light. This lens has a relatively long focal length and is located at a distance from the axis of the burner which is equal to its focal length.

This lens produces approximately parallel light which then passes through a light stop to reduce small angle reflections from the walls of the containing tube. This light is focused by a short focal length lens on the plane of a small square aperture. The function of this square aperture is to define the observed scattering volume and eliminate as much of the flame light as possible. An adjustable polarization filter is located between this aperture and short focal length lens so that the intensity of either component of the scattered light can be measured.

A multiplier phototube is located a short distance behind the square aperture and is aligned with the optical system in such manner that a spot of light strikes the photosensitive surface of the multiplier phototube. The multiplier phototube in turn generates a signal which is proportional to the intensity of the spot. This signal is passed through a filter-amplifier unit (a General Radio 760-B sound analyzer) which is turned to the frequency of the modulated light source. This electronic arrangement essentially eliminates the steady background signal due to the flame light. The filtered and amplified signal, which is proportional to the intensity of the scattered light, is measured with an RMS voltmeter.

The apparatus for measuring the incident light intensity relative to the scattered-light intensity, which is required for the determination of particle concentration, is shown in Figure 8.2. The apparatus and adjustment of the various components is identical to that used for

the soot particle size determination with a single exception. Instead of the incident light beam passing through the flame, its path is diverted by a series of three black-glass mirrors, after which it is collected by the same optical system, positioned at $\theta = 90^\circ$, which was used to measure the scattered-light intensity. The incident light is turned 90° by the first mirror, turned back parallel to its original direction by the second mirror, and turned 90° again by the third mirror so that the attenuated beam is collected and measured by the same optical and electronic systems used to measure the scattered-light intensity. It should be noted that the distance through which the light passes is the same in Figure 8.1 as in Figure 8.2.

A more detailed description of the various apparatus components is presented in appendix F along with the bases used for selecting the various dimensions and locations of the components.

IX. EXPERIMENTAL TECHNIQUE

The method used herein for determining the size of soot particles in various laminar flames entailed measuring the two plane polarized components of the scattered-light intensity for a series of angles in increments of 10° between 30° and 150° from the incident light direction. In order to determine the number concentration of soot particles, the incident light intensity relative to the scattered-light intensity at a given angle for parallel polarization was measured. The first step toward gathering this experimental data is the alinement of the optical system. The alinement procedure is quite tedious but essentially fixes the axis of the incident light beam and the axis of the collection system for the observed scattered-light beam in the same plane and further, in such a way that the two intersect at the desired location in the flame and at the center of rotation of the rotating arm on which the collection system is mounted. The procedure for alining the optical system is given in appendix G.

After the apparatus has been optically alined, the mercury arc lamp is started and allowed to operate for a time sufficient to reach steady conditions. At the same time, the test flame is lighted and the desired fuel and airflow rates are adjusted and recorded. Operation of the electronic system, including the high voltage supply to the multiplier phototube, the sound analyzer, and vacuum tube voltmeter, is also begun at this time to insure steady operation during a test.

In all tests, at least 1 hour was allowed for this phase before collecting data.

In order to operate the RCA 931-A multiplier phototube with maximum stability, the anode current should not exceed 10 microamperes (27). It has already been mentioned that a 20 K Ω load resistor is used across the multiplier phototube output so that it follows from the above current limitation that the voltage across this 20 K Ω load resistor should not exceed 200 millivolts. Since the scattered-light intensity is the largest at angles nearest to $\theta = 0^\circ$ and for perpendicular polarization, the rotating arm was positioned at $\theta = 30^\circ$ and the polarization filter was set for measuring the perpendicular plane polarized scattered-light intensity while the voltage to the multiplier phototube from the high voltage supply was adjusted in a manner such that the unamplified and unfiltered signal from the multiplier phototube did not exceed 200 millivolts. The voltage setting at the high voltage supply is determined by the combination of the scattered-light intensity and the steady flame light intensity, each of which in turn depends on the size and concentration of soot in the observed volume of the flame. This voltage setting varied from 750 volts to 1250 volts, depending on the flame, but was held constant during any given run.

Following this adjustment, the amplifier of the sound analyzer was set and remained constant during each run. The adjustment and alinement of the entire light-scattering apparatus was unchanged over

the course of a run. Only the angular position of the rotating arm θ and the setting of the polarization filter were changed during a run. The filtered and amplified signal which is directly proportional to the scattered-light intensity was measured with the RMS voltmeter for various values of θ for the two plane-polarized components. This was done by setting the polarization filter to measure the vertical component and measuring the voltage at successive angles beginning at $\theta = 30^\circ$ up to $\theta = 150^\circ$. Sufficient time at each angular position was allowed for the instruments to reach steady operation. Each reading was checked by repeating this procedure. The parallel plane polarized component of the scattered light was likewise measured at the same angular positions.

The intensity of the incident light relative to the scattered-light intensity at a given angle θ was measured with the same apparatus and alinement directly after completing the scattering measurements at the various angles. A plan view of the apparatus is shown in Figure 8.2. Mirrors A and C are moved to their proper positions as shown in Figure 8.2 which were determined by a previous alinement technique which is discussed in appendix G. The polarization filter is set to observe the parallel plane polarized component after which the rotating arm on which the collection system for the scattered light is mounted is set at $\theta = 90^\circ$ so that the incident light is deflected into the collection system by the three parallel mirrors. The same procedure as mentioned already is used to limit

the signal generated by the multiplier phototube to insure its stability. It was often necessary to operate the multiplier phototube at a lower voltage for the incident light measurement than had been used for the corresponding scattering measurements, so it was necessary to measure the scattered-light intensity at one angle for the same supply voltage, amplifier setting, and the same setting of the polarization filter as was used to measure the incident light in order that the two measurements be on the same basis. A scattering angle of $\theta = 60^\circ$ was used for this additional measurement.

In order to obtain the actual incident light intensity relative to the scattered light at $\theta = 60^\circ$ for parallel polarization $I_{0,2}/I_2(60^\circ)$, it is necessary to multiply the ratio of the measured reflected incident light to the measured scattered light at $\theta = 60^\circ$ by the reciprocal of the total attenuation factor for the three black-glass mirrors and also take into account the geometry of the collection system. The incident light intensity, $I_{0,2}$, is the intensity of light striking the soot particles and has the dimensions of joules/cm². The reflected incident light, however, was measured at the same distance from the scattering soot particles as was the scattered-light intensity. It is therefore necessary to multiply the measured ratio by an additional factor which increases this measured ratio by an amount which would be equivalent to measuring the incident light with this system at the point where the incident light strikes the scattering soot particles. This is more clearly shown with the aid

of Figures 9.1 and 9.2. Figure 9.1 shows the optical arrangement for measuring the intensity of the incident light after it has been attenuated by reflection through the series of three mirrors. The circular cross-sectional area of the focused incident beam striking the scattering particles is denoted by A_0 , the circular cross-section of the light at the plane of the stop S_3 is denoted by A_3' , and the circular cross-sectional area of the stop S_3 is denoted by A_3 . It should be noted that A_3' is slightly greater than A_3 and was made so in order to be able to visually align this stop with the incident light.

The distance from the center of rotation of the revolving arm to the lens, L_3 , of the collection system is r . The distance r is also equal to $x_1 + x_2$ which is the distance from the focal plane of the incident light where the circular cross section of the beam is A_0 to lens L_3 . For the sake of discussion, an optically equivalent system for Figure 9.1 is given in Figure 9.2. Assume that the sensitivity of the collection system is s volts/joule of radiation passing through stop S_3 and let $e_{0,2}'$ be the measured voltage when the incident light is attenuated by the three mirrors and $e_2'(60^\circ)$ be the measured voltage related to the scattered light received at $\theta = 60^\circ$.

It is clear from Figure 9.2 that all of the energy which passes through A_0 also strikes the area A_3' so that the ratio of the intensity of the focused incident beam $I_{0,2}$ at p to the light

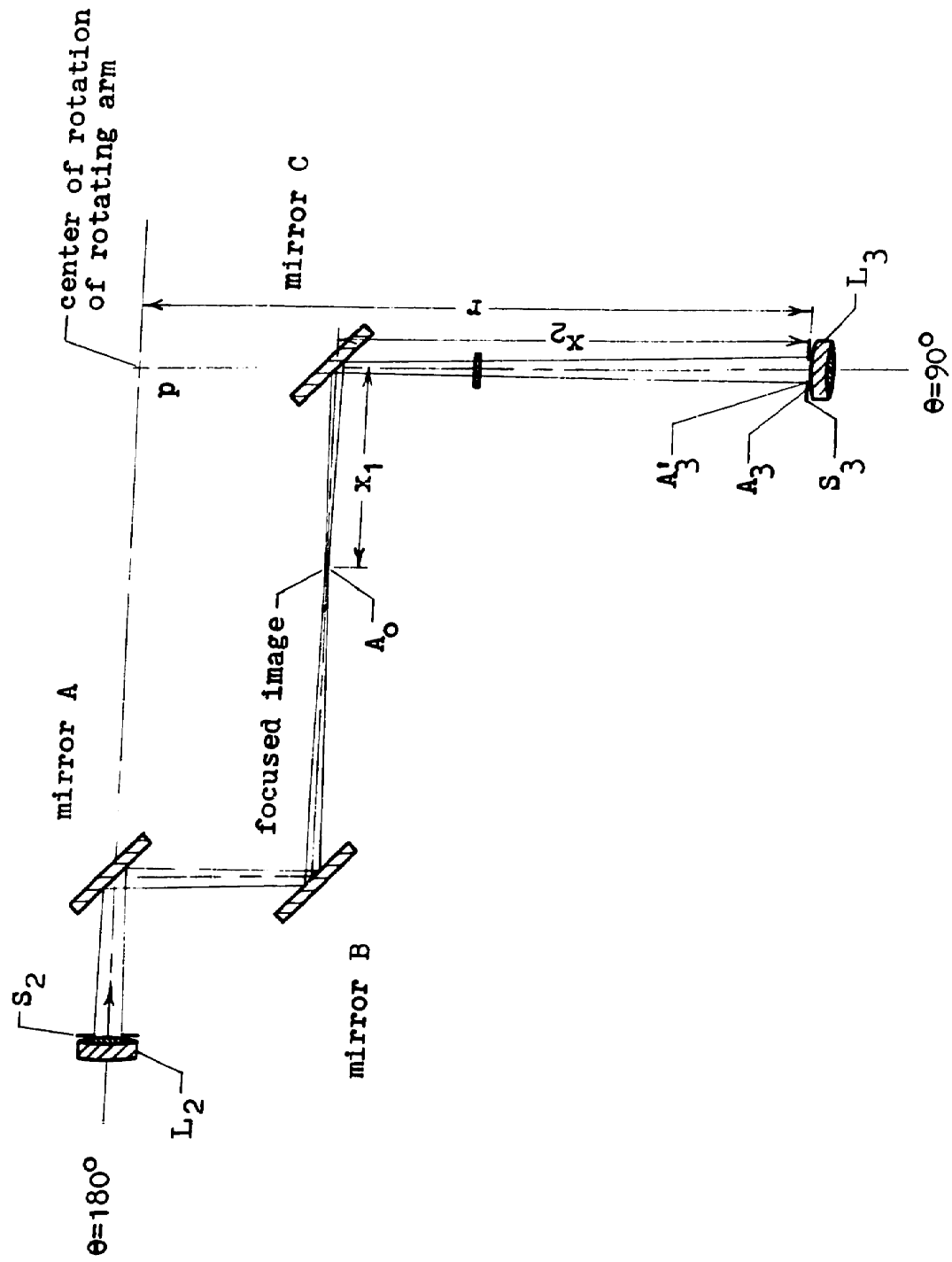


Figure 9.1.1.- Mirror arrangement for measuring the reflected incident light.

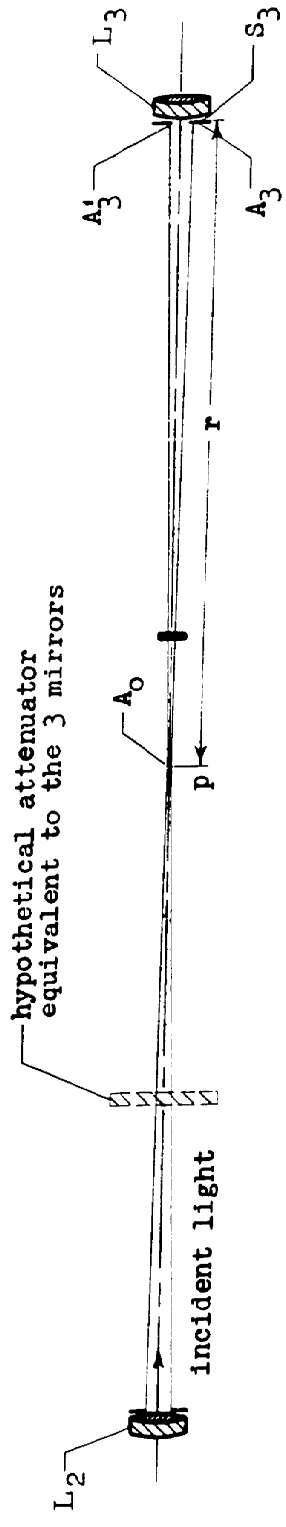


Figure 9.2.- Equivalent optical system for measuring the incident light intensity.

intensity I_3^i at the stop S_3 is

$$I_{0,2}/I_3^i = A_3^i/A_0 \quad 9.1$$

The energy which strikes an imaginary plane placed at S_3 would of course be $I_3^i A_3^i$, but the energy actually received by the collection system is reduced in the ratio, A_3/A_3^i , since A_3 is smaller than A_3^i . If we denote the product of the reflectivities of the series of three mirrors as α , the measured voltage for the reflected incident light is

$$e'_{0,2} = \alpha s I_3^i A_3^i \left(\frac{A_3}{A_3^i} \right) \quad 9.2$$

By combining this expression with equation 9.1, the desired incident light intensity is

$$I_{0,2} = \frac{1}{s} \frac{A_3^i}{\alpha A_0 A_3} e'_{0,2} \quad 9.3$$

On the other hand, the measured voltage for the scattered light at $\theta = 60$ is

$$e'_2(60^\circ) = s I_2(60) A_3 \quad 9.4$$

Since the light spot on the photocathode surface of the multiplier phototube is very nearly the same size and is at the same location for the measurement of $e'_{0,2}$ and $e'_2(60^\circ)$, the sensitivity of the

collection system s is the same in equation 9.4 as in equation 9.2. The ratio $I_{0,2}/I_2(60^\circ)$ needed for the concentration measurement is

$$I_{0,2}/I_2(60^\circ) = \frac{A_3'}{\alpha A_0} \frac{e'_{0,2}}{e'_2(60^\circ)} \quad 9.5$$

The diameter of the circular cross section corresponding to A_3' was 0.875 in., the diameter of the focused incident light corresponding to A_0 was 0.078 in., and the attenuation factor α was 2.57×10^{-6} so that $A_3'/\alpha A_0 = 4.9 \times 10^7$.

Simple rearrangement of equation 6.2 gives the expression for the number of particles N in the observed scattering volume V as

$$N = \frac{I_2(60^\circ)}{I_{0,2}} \frac{k^2 r^2}{i_2(60^\circ)} \quad 9.6$$

where the light-scattering function $i_2(60^\circ)$ is known from the particle size determination. (Once the correct value of x has been found from the measured shape of the light-scattering pattern, the value of $i_2(60^\circ)$ for a single particle can be obtained from the tables in appendix D.) The distance from the scattering particles to the point of measurement of the scattered-light intensity r was 508 mm for all runs. Substitution of the value of $k (= \frac{2\pi}{\lambda})$ for $\lambda = 4358 \text{ \AA}$, the value for r , and equation 9.5 with the numerical value of $A_3'/\alpha A_0$ into equation 9.6 yields

$$N = 1.10 \times 10^6 \frac{e'_2(60^\circ)}{e'_{0,2} i_2(60^\circ)} \quad 9.7$$

The observed scattering volume for the system of apertures used and already discussed in the previous section is

$$\frac{\pi}{4}(0.078)^2(0.094) = 4.49 \times 10^{-4} \text{ cubic inches or } 2.74 \times 10^{-3} \text{ cc}$$

for $\theta = 90^\circ$. For $\theta = 60^\circ$, the volume is increased to

$$2.74 \times 10^{-3}/0.866 = 3.16 \times 10^{-3} \text{ cc, so that the number concentration of soot particles in particles/cc is}$$

$$(N/V) = 3.48 \times 10^8 \frac{e'_2(60^\circ)}{e'_{o,2}(60^\circ)} \quad 9.8$$

The essential measurement for determining the number concentration of soot particles N/V after finding the size, is therefore

$$e'_2(60^\circ)/e'_{o,2}$$

Various elevations in the flame above the tip of the burner tube were examined by moving the burner tube up or down while the rest of the apparatus remained fixed.

X. EXPERIMENTAL RESULTS

Preliminary light-scattering tests were made using a rich premixed laminar benzene-air flame by measuring the ratio of the scattered-light intensity at several pairs of symmetric angles about $\theta = 90^\circ$ for both the perpendicular and parallel components. An optical interference filter with a peak transmittance at 4358 \AA was used. These measured ratios were then compared to the theoretical dissymmetry plots which were previously given in Figures 5.6 through 5.8. The results of this comparison indicated that the size parameter, x , ranged from about 0.9 up to about 1.3, depending on the elevation above the burner tip at which the data were obtained. In general, the greater the elevation, the greater was the value of x . Since λ is approximately 4358 \AA , the indicated particle diameter is about 1250 \AA to 1800 \AA . It should be realized that the correct value of x would be obtained by this method only if the examined soot particle system is essentially monodisperse.

In order to check the values of the soot particle diameters deduced from these preliminary light-scattering measurements, a sample of soot was collected on a probe placed in a benzene-air flame burning under nearly identical conditions and at the same elevation at which a light-scattering measurement indicated a particle diameter of about 1400 \AA . This collected sample of soot was then examined under an electron microscope. An electron micrograph of this collected soot is shown in Figure 10.1 where the magnification is $50,000 \times$ so that

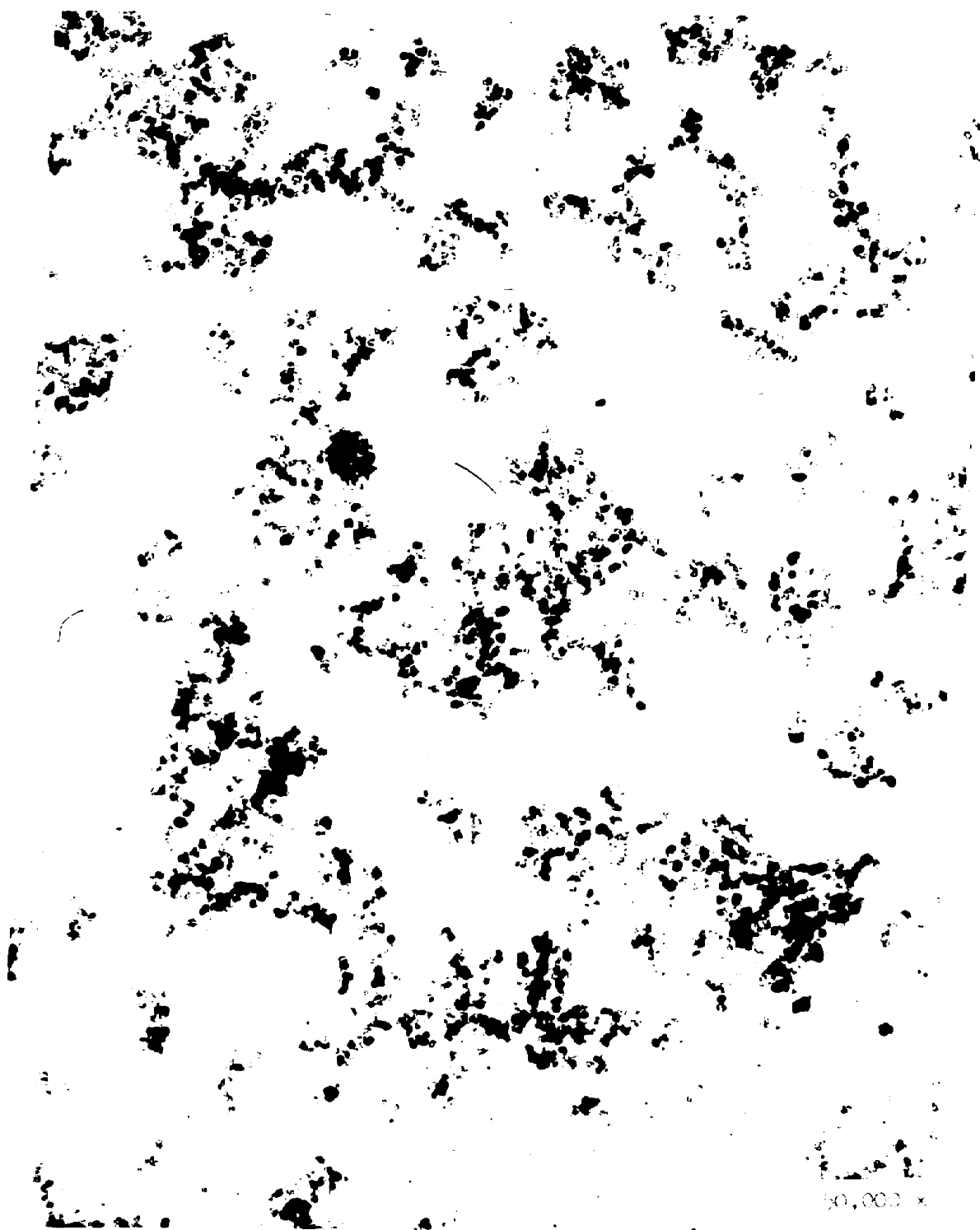


Figure 10.1.- Electron micrograph of soot particles from a premixed laminar benzene-air flame burning with a fuel-air ratio of 2.45 times stoichiometric.

the ultimate soot particle diameter is approximately 250 \AA . This figure also shows considerable agglomeration of the ultimate soot particles, but it is not possible to determine how much of this agglomeration took place on the cool probe.

The combination of these preliminary light-scattering measurements and the evidence from the electron micrograph of the collected soot particles indicate that some agglomerates exist in the flame which cause the apparent soot particle size obtained from light-scattering measurements to be greater than the ultimate particle size.

Senftleben and Benedict (11) reported a soot particle diameter of 1750 \AA based on light-scattering measurements on an amyl acetate flame burning in a Hefner candle. In order to check their soot particle size determination, a sample of soot was collected on a probe placed in an amyl acetate flame burning in a Hefner candle. An electron micrograph of this soot sample is shown in Figure 10.2 where the magnification is again $50,000 \times$ so that the ultimate particle diameter is approximately 400 \AA . As in the previous case, there is considerable agglomeration. Here again it appears that the existence in the flame of agglomerates of the ultimate particles causes the apparent particle size from light-scattering measurements to be much larger than the ultimate size observed in the electron micrograph.

The variation of the intensity of both the perpendicular and parallel plane polarized components of the scattered light with angle from the incident light beam were experimentally determined for



Figure 10.2.- Electron micrograph of soot particles from an amyl acetate diffusion flame burning on a Hefner candle.

several flame conditions. The intensity of the incident light relative to the intensity of the parallel component of the scattered light for $\theta = 60^\circ$ was also measured in order to estimate the number concentration of soot particles. The majority of the experimental data were obtained from a laminar premixed benzene-air flame. Some data were also obtained from an amyl acetate diffusion flame and a Cambridge City Gas diffusion flame. These data, along with the test conditions under which they were obtained, are tabulated in appendix H.

Before presenting these light-scattering measurements and their comparison with the theory to determine soot particle size and concentration, it is worthwhile to discuss the effect of the values of x and m on the light-scattering diagram. Figure 10.3 shows the comparison of the scattering diagrams for various values of x for a fixed value of m which is equal to $1.71 - 0.76 i$. The general trends shown in this figure for which $m = 1.71 - 0.76 i$ is the same for other values of m . In this figure, the scattered-light intensity for both components have been normalized with respect to the perpendicular component at $\theta = 90^\circ$, $i_1(90)$. For very small values of x (which are not shown in this figure) the normalized perpendicular component, $i_1(\theta)/i_1(90)$, would be unity for all angles. For $x = 0.80$ the normalized values of the perpendicular component are greater than unity for $\theta < 90^\circ$ and are less than unity for $\theta > 90^\circ$. As the value of x increases, the normalized perpendicular component shows an even greater preponderance of the value of $i_1(\theta)/i_1(90)$ for $\theta < 90^\circ$

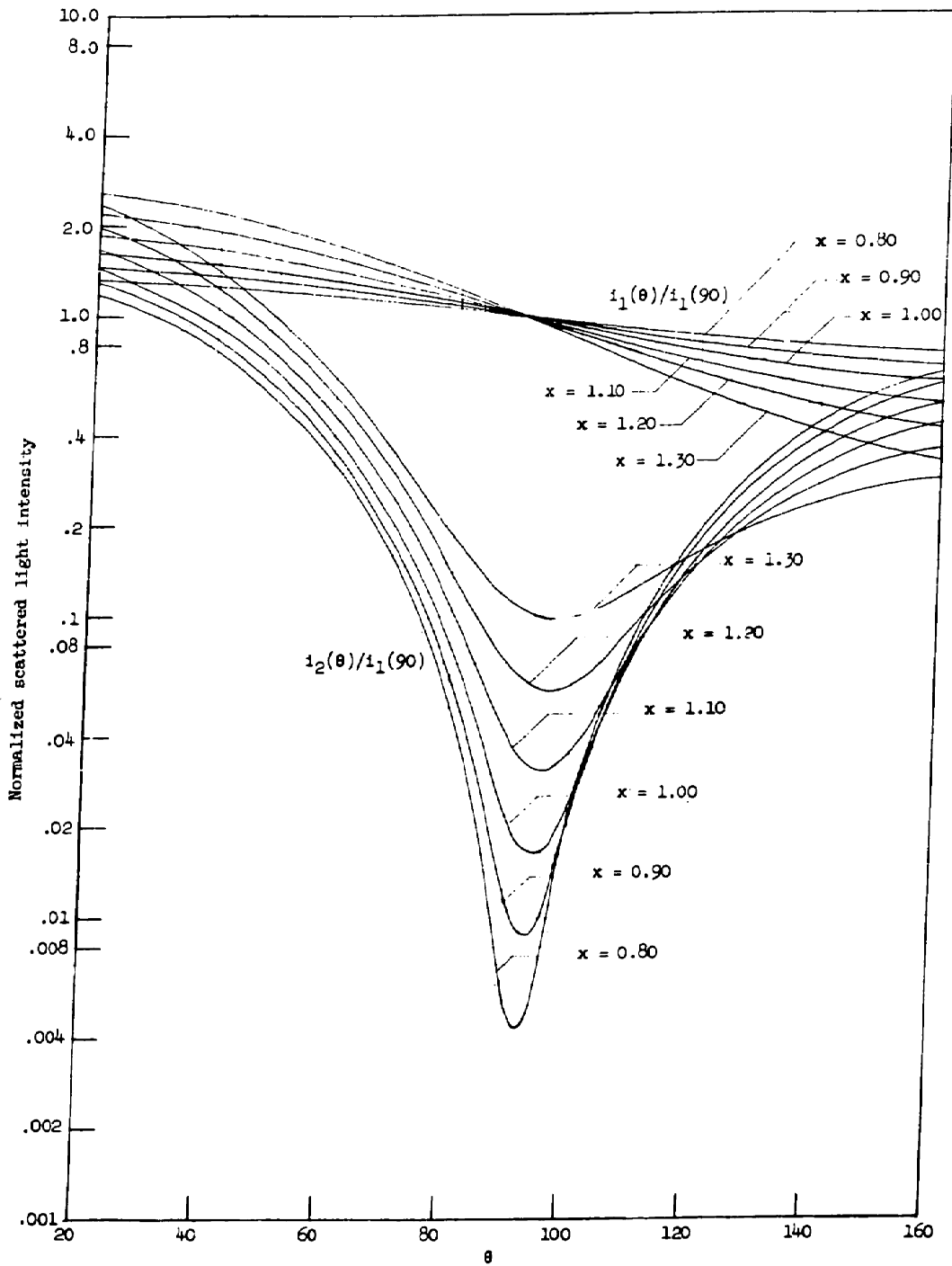


Figure 10.3.- Comparison of the scattering diagrams for various values of x for a given value of m where $m = 1.71 - 0.76 i$.

compared to values for $\theta > 90^\circ$. The trend of the normalized parallel component, $i_2(\theta)/i_1(90)$, with increasing values of x is also shown. Figure 10.3 shows that the larger the value of x , the shallower is the scattering pattern for the parallel component. In addition, the larger values of x produce a shift in the angular position of the minimum value of $i_2(\theta)/i_1(90)$ to larger values of θ .

The effect which the index of refraction has on the light-scattering pattern is somewhat more difficult to show in that both the real and the imaginary parts of m each have an effect. Figure 10.4 shows the comparison of the scattering diagrams for various values of m where the real part, n , is equal to 1.60 and the imaginary part, n' , is taken as 0.60, 0.80, and 1.00 for a fixed value of $x = 1.00$. The patterns of the perpendicular component for these various values of m differ only slightly and for this work they may be considered essentially the same. The effect on the parallel component is more pronounced, as shown in Figure 10.4, where an increase in the value of the imaginary part shows a shallowing of the scattering pattern with a simultaneous shift of the minimum value of $i_2(\theta)/i_1(90)$ toward $\theta = 90^\circ$. It should also be noticed that the parallel component of the forward scattered light is essentially unaffected by this variation of m , whereas there is a noticeable effect on those values where $\theta > 90^\circ$. Figure 10.5 is a similar plot in which the real part is equal to 2.00. The trends established in Figure 10.4 are also indicated in this figure.

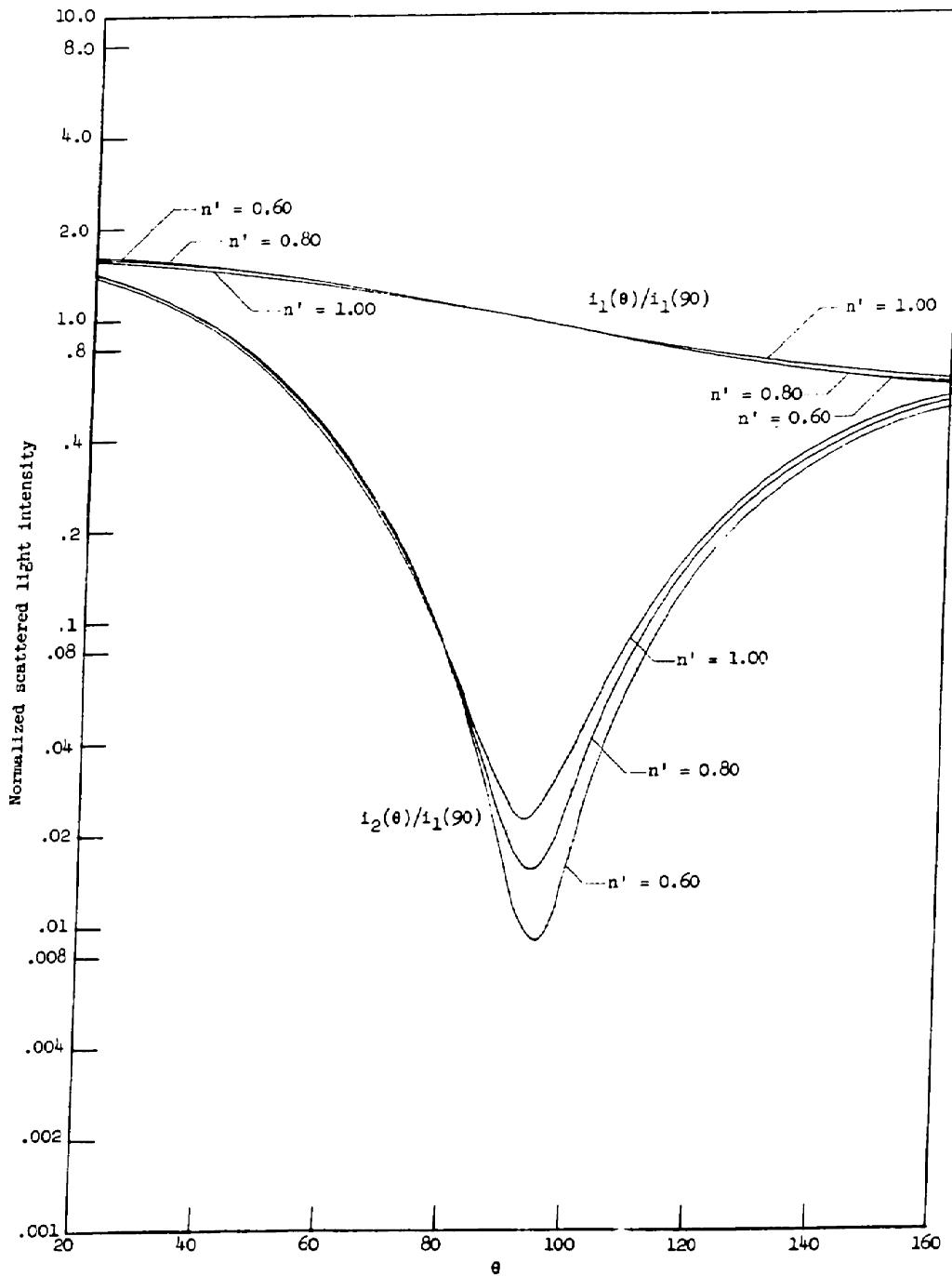


Figure 10.4.- Comparison of the scattering diagrams for various values of m where $n = 1.60$ and $n' = 0.60, 0.80, \text{ and } 1.00$ for a given value of x where $x = 1.00$.

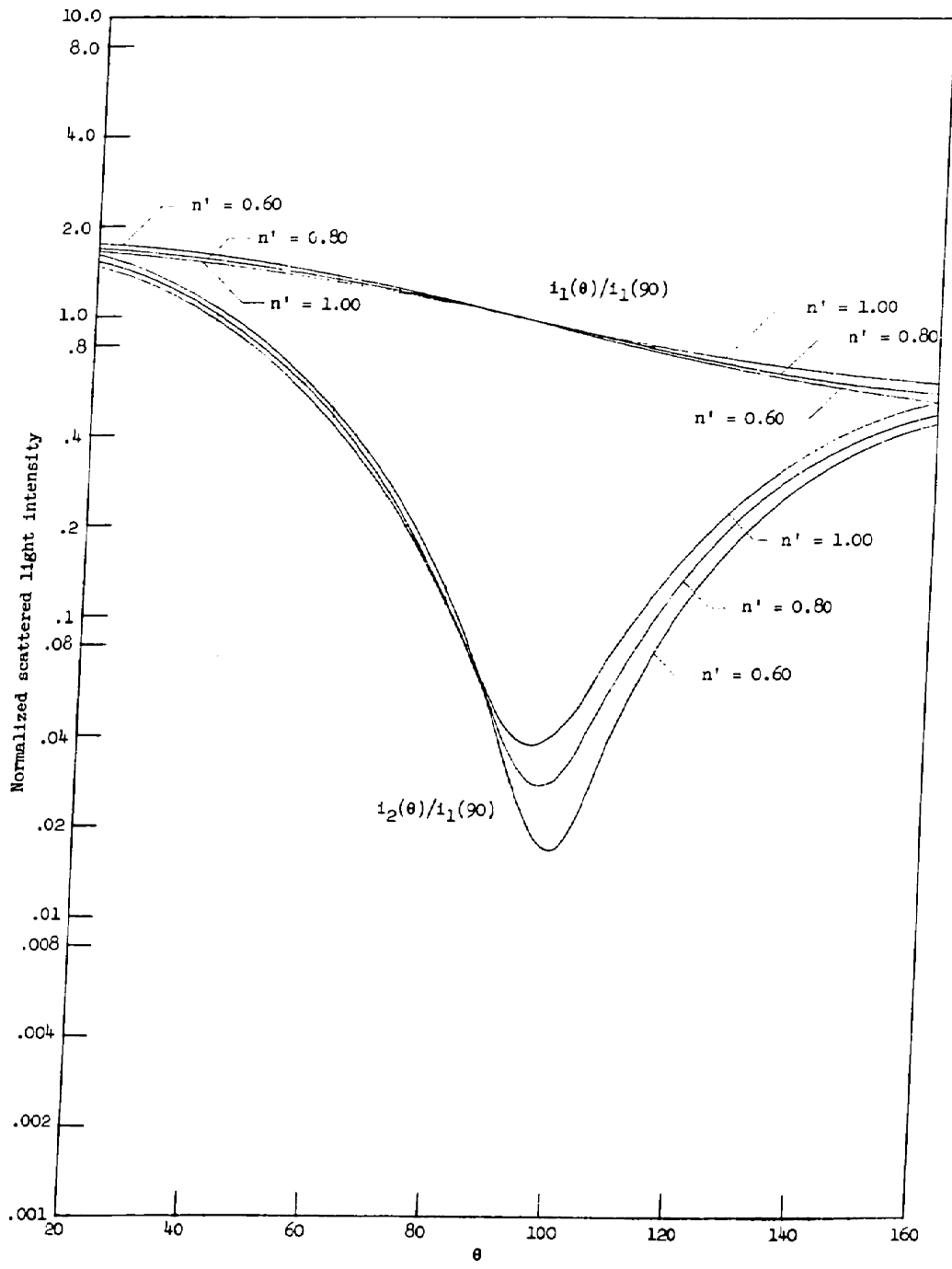


Figure 10.5.- Comparison of the scattering diagrams for various values of m where $n = 2.00$ and $n' = 0.60, 0.80, \text{ and } 1.00$ for a given value of x where $x = 1.00$.

The effect of varying the real part of m while the imaginary part is held constant at a fixed value of x is shown in Figure 10.6, where the $n = 1.60, 1.80, \text{ and } 2.00$ for $n' = 0.80$ and $x = 1.00$. Here again the perpendicular component pattern is essentially unaffected. However, the pattern of the parallel component is affected by increasing the value of n in a similar manner in which an increasing value of x affects the parallel component scattering pattern for fixed m .

The values of the real and imaginary parts of m used in the above comparisons cover the range which includes the expected value of m , while the range in x presented in Figure 10.3 corresponds to that in which the experimental data appear to lie.

A series of four runs were carried out experimentally to determine the light-scattering diagram for both the perpendicular and parallel components as a function of elevation above the tip of the burner for a fuel-rich benzene-air flame. The fuel-air ratio, f/a , was held at 2.35 ± 2 percent times stoichiometric for each of the four runs. Run 1 was made at an elevation of 1.25 inches from the tip of the burner on the axis of the flame. The elevation of 1.25 inches corresponds to a position in the flame which is just above the apex of the intercone. (Light-scattering measurements within the intercone and on the axis of the flame indicate the absence of soot in that region of the flame.) Figure 10.7 shows the experimental light-scattering data for run 1. (Refer to table H.1 for the particular test conditions for each run.) The total normalized light-scattering

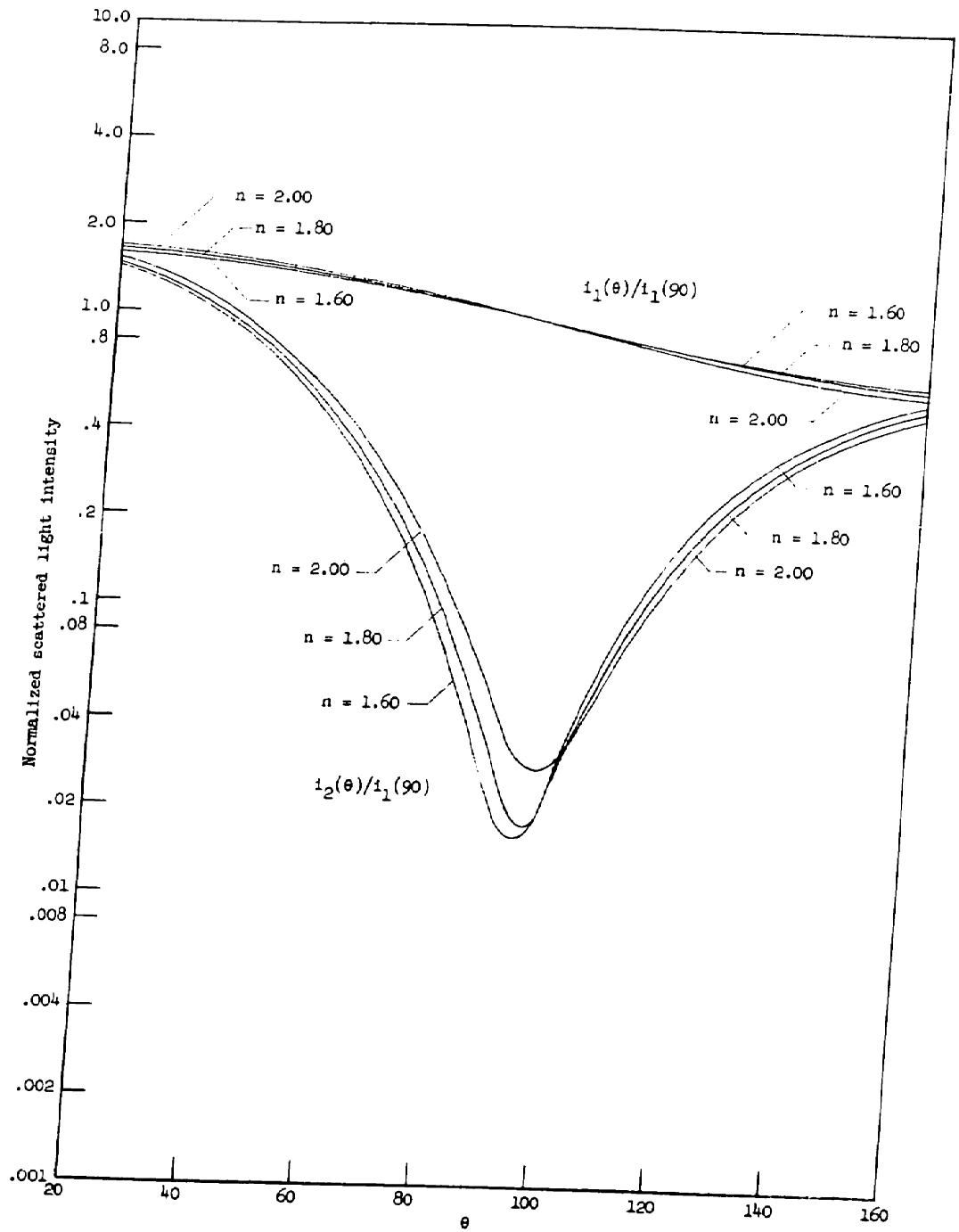


Figure 10.6.- Comparison of the scattering diagrams for various values of m where $n' = 0.80$ and $n = 1.60, 1.80, \text{ and } 2.00$ for a given value of x where $x = 1.00$.

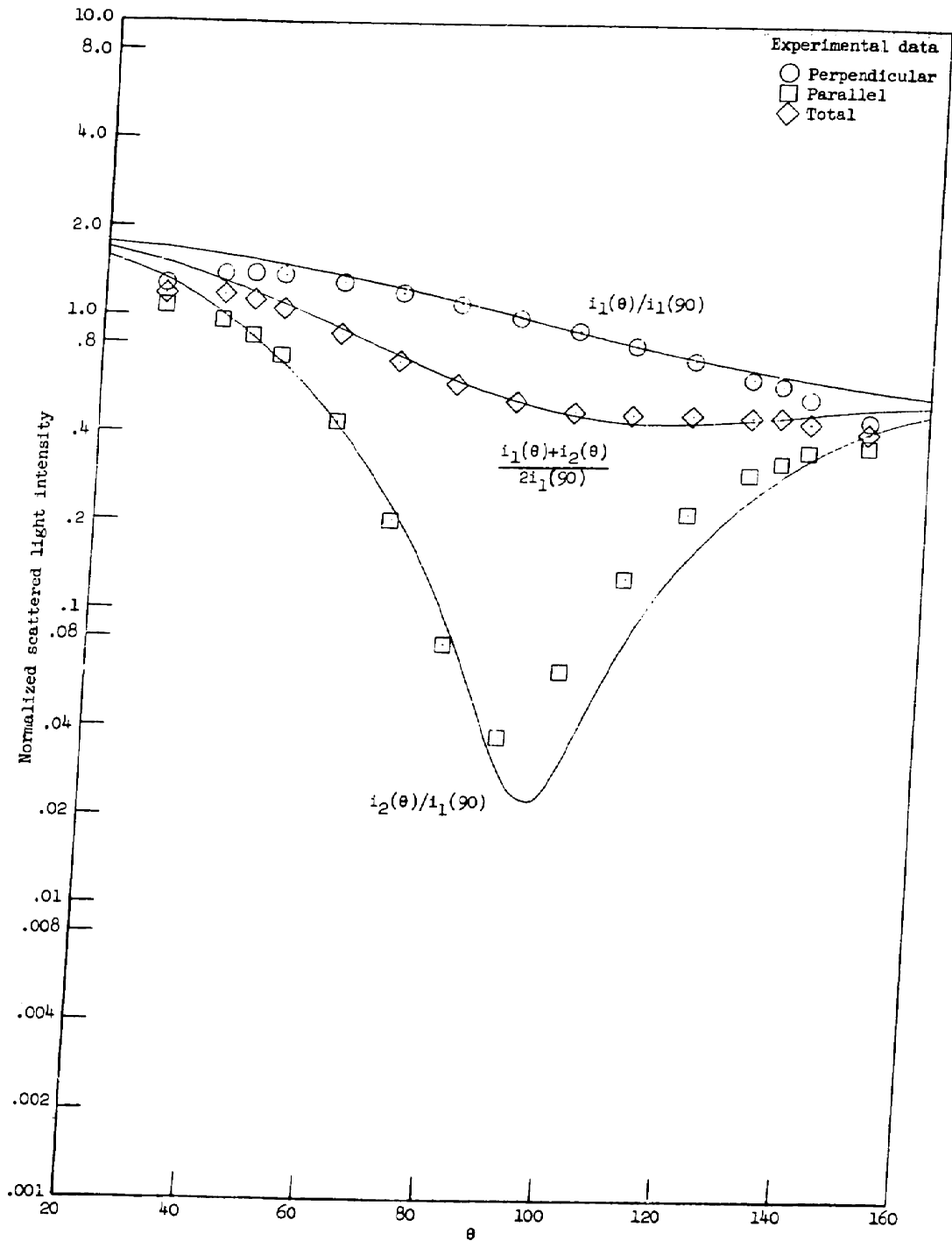


Figure 10.7.- Experimental light-scattering data for run 1 compared to theory for $m = 1.71 - 0.76 i$ and $x = 1.05$.

pattern, which is simply the arithmetic average of the perpendicular and the parallel components, $\frac{i_1(\theta) + i_2(\theta)}{2i_1(90)}$, is shown along with the other two components.

The data presented in Figure 10.7 for this run and in the remaining figures for all succeeding runs, excluding run 10, have been corrected by multiplying the observed intensities by the sine of the corresponding angle, θ , in order to account for the increase in the observed scattering volume with increasing departure from $\theta = 90^\circ$. The greater departure of the data from the theoretical scattering pattern at values of θ near 30° and near 150° is believed to be due to a decrease in soot particle size and/or concentration at the larger distances from the center of the flame. Since the observed scattering volume extends to these larger distances from the center of the flame at the angles in question, there is a decrease in the average intensity for these larger volumes. It should be noted that this explanation requires that the departure at each of a pair of symmetric angles about $\theta = 90^\circ$ should be of the same magnitude. This is the case as shown in Figure 10.7. Compare this departure of the data from theory at $\theta = 30^\circ$ and at $\theta = 150^\circ$.

These data were compared to the normalized theoretical light-scattering pattern for $m = 1.71 - 0.76i$ and various values of x in order to establish the best fit between experiment and theory for the perpendicular component. For this run, the best fit for the $i_1(\theta)/i_1(90)$ against θ pattern was obtained by setting $x = 1.05$.

It should be remembered that the theoretical scattering patterns were only obtained for values of x in intervals of 0.05 so that a somewhat better fit may have been found with a slightly different value of x . It is felt that the interval in x of 0.05 is fine enough for this work. After the value of x has been established by a comparison with theory for the perpendicular component, which is $x = 1.05$ for this run, the corresponding theoretical scattering pattern for the parallel component for $x = 1.05$ is also superimposed on the plot. The relative position of the theory and the experimental data for the parallel component is fixed once the value of x is established by the perpendicular fit. A rather good agreement between experiment and theory is found for the parallel component where $\theta < 90^\circ$, but the comparison is poor for angles of $\theta > 90^\circ$. This difference between experiment and theory is much too large to be explained simply as being due to experimental error.

The agreement between experiment and theory for the total light-scattering pattern is about as good as that for the perpendicular component. However, it must be remembered that the total scattering is simply the arithmetic average of $i_1(\theta)$ and $i_2(\theta)$ and that $i_1(\theta)$ is considerably larger than $i_2(\theta)$ in the region of θ where the agreement between experiment and theory is the poorest for the parallel component, so that quite large relative differences for the parallel component would have only slight influence on the total scattering pattern. For this reason, the total scattering pattern is omitted on the remaining plots.

In Figure 10.7 the index of refraction, $m = 1.71 - 0.76 i$, which corresponds to that given by Stull and Plass for $\lambda = 4358 \text{ \AA}$, was used for the comparison. While this value of m for soot is still the most likely value, in view of the lack of the true value of m for soot at the flame conditions for which the scattering measurements were made, several other values of m were also used to see if better agreement between experiment and theory could be obtained. Figure 10.8 shows the same experimental light-scattering data for run 1 compared to theory for various values of m and values of x which correspond to the best fit between experiment and theory for the perpendicular scattering diagram. The four indices used in Figure 10.8, excluding $m = 1.71 - 0.76 i$, represent a reasonable range in which the true value of m of soot should lie. The limits on the real part of m are 1.6 and 2.0, while the limits on the imaginary part are 0.6 and 1.0. For the values of m considered in Figure 10.8, the best comparison between experiment and theory is obtained for $m = 1.60 - 1.00 i$ with $x = 1.05$. This shows fair agreement but the difference between experiment and theory is still larger than can be attributed to experimental error.

It is seen by referring back to Figure 10.6, that the parallel light-scattering pattern is shifted toward the left as the real part, n , of m is decreased for a fixed value of the imaginary part, n' . This is the direction in which the theoretical pattern for the parallel component must be shifted in order to produce a better agreement

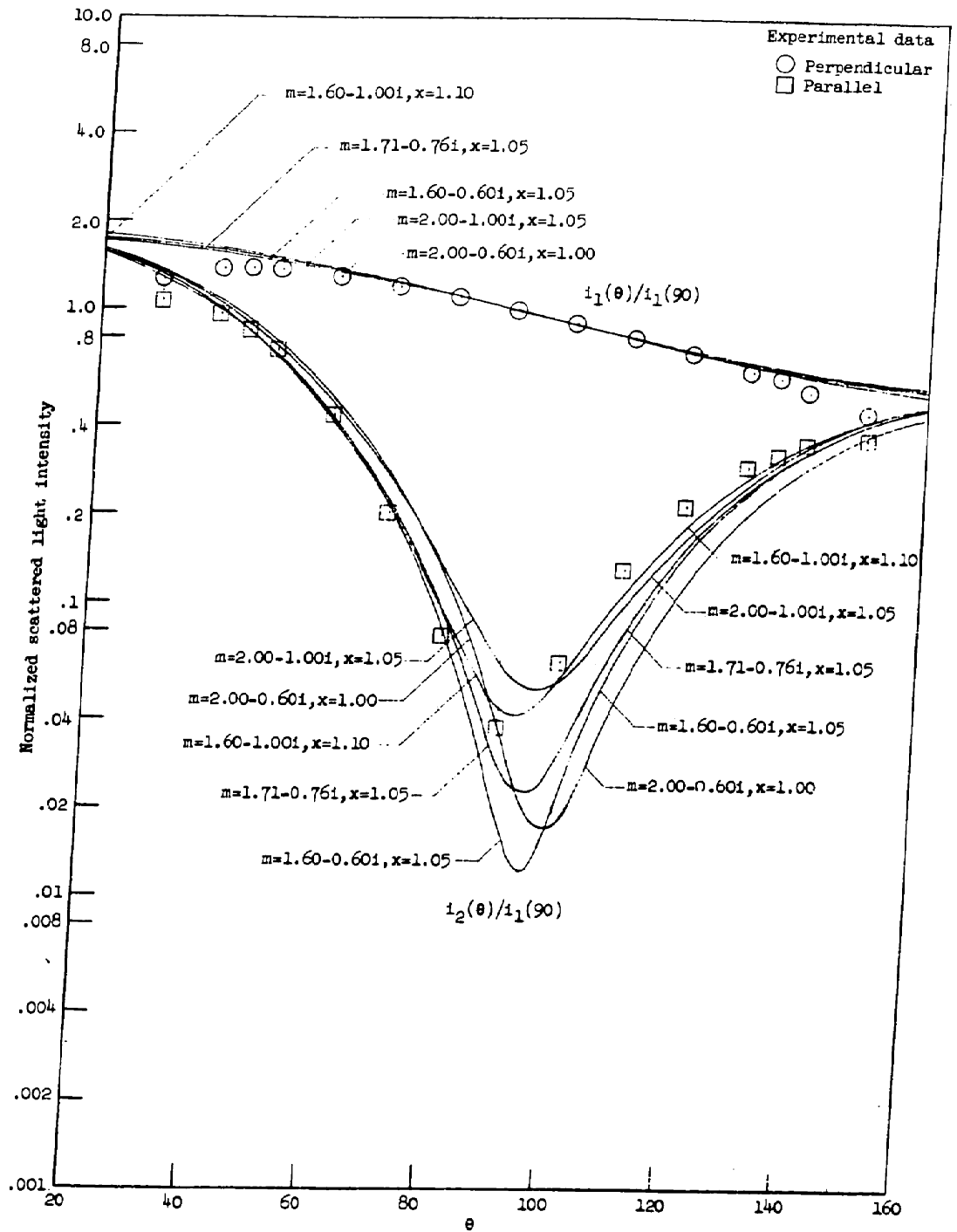


Figure 10.8.- Experimental light-scattering data for run 1 compared to theory for various values of m and x .

between experiment and theory for run 1. In order to see if there is a combination of m and x which gives a theoretical scattering pattern that shows good agreement with this data of run 1, a value of $m = 1.40 - 1.00$ was used, based on the trend given in Figure 10.6. Figure 10.9 only shows that it is possible to find good agreement between theory and experiment by allowing m to be a variable and is not intended to show that these are the correct values of m and x .

Three other runs were also made in this series at elevations of 1.50, 1.75, and 2.00 inches above the burner tip. Figures 10.10, 10.11, and 10.12 show the experimental light-scattering data for run 2, run 3, and run 4, respectively. As was the case for run 1, the data for the parallel component do not agree well with theory for the expected range of m . There is, however, an increase in the apparent value of x as the observed elevation is increased, which indicates increasing agglomeration with increasing elevation.

Before the number concentration of soot particles can be determined by the method given earlier, the correct value of x must have been found. For the sake of showing the procedure for determining the number concentration, it is assumed that the value of m is $1.71 - 0.76$ and that only the perpendicular component is to be used to find x . Further, only the experimental and theoretical ratios of $i_1(60)/i_1(120)$ will be used to find x for run 1 through run 4 in order that a number concentration of soot can be calculated. Table 10.1 lists the values of x and corresponding values of an apparent soot

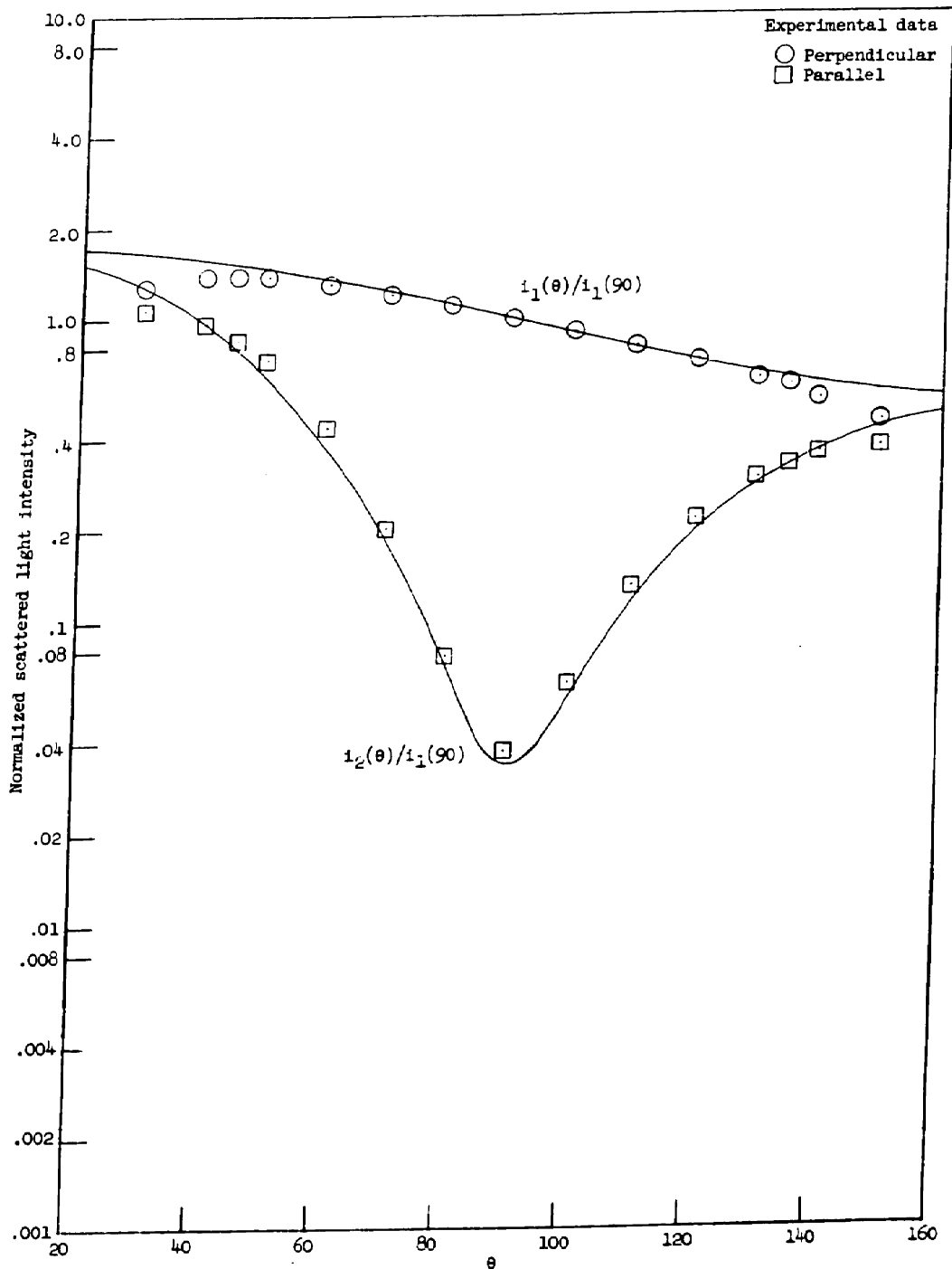


Figure 10.9.- Experimental light-scattering data for run 1 compared to theory for $m = 1.40 - 1.00 i$ and $x = 1.10$.

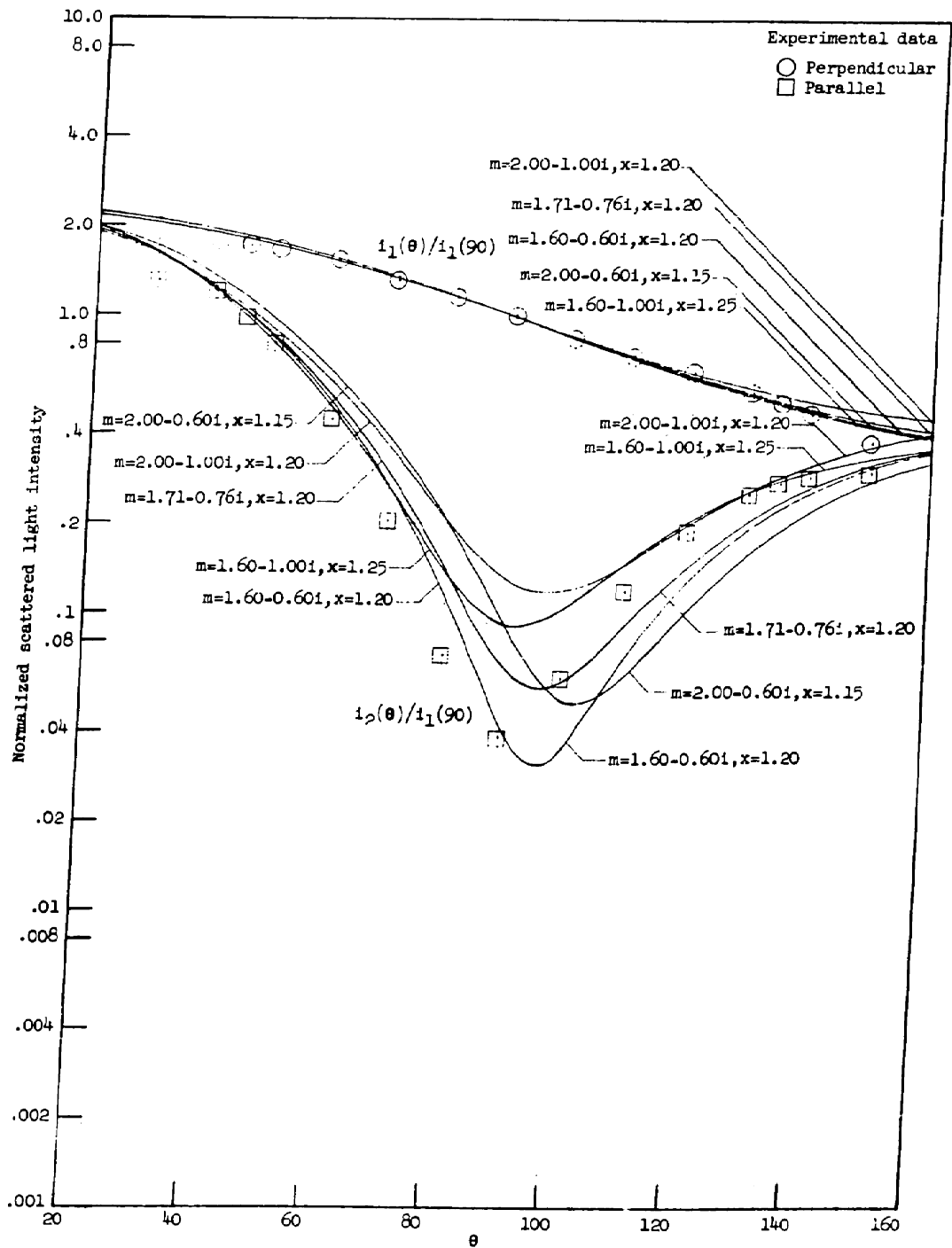


Figure 10.10.- Experimental light-scattering data for run 2 compared to theory for various values of m and x .

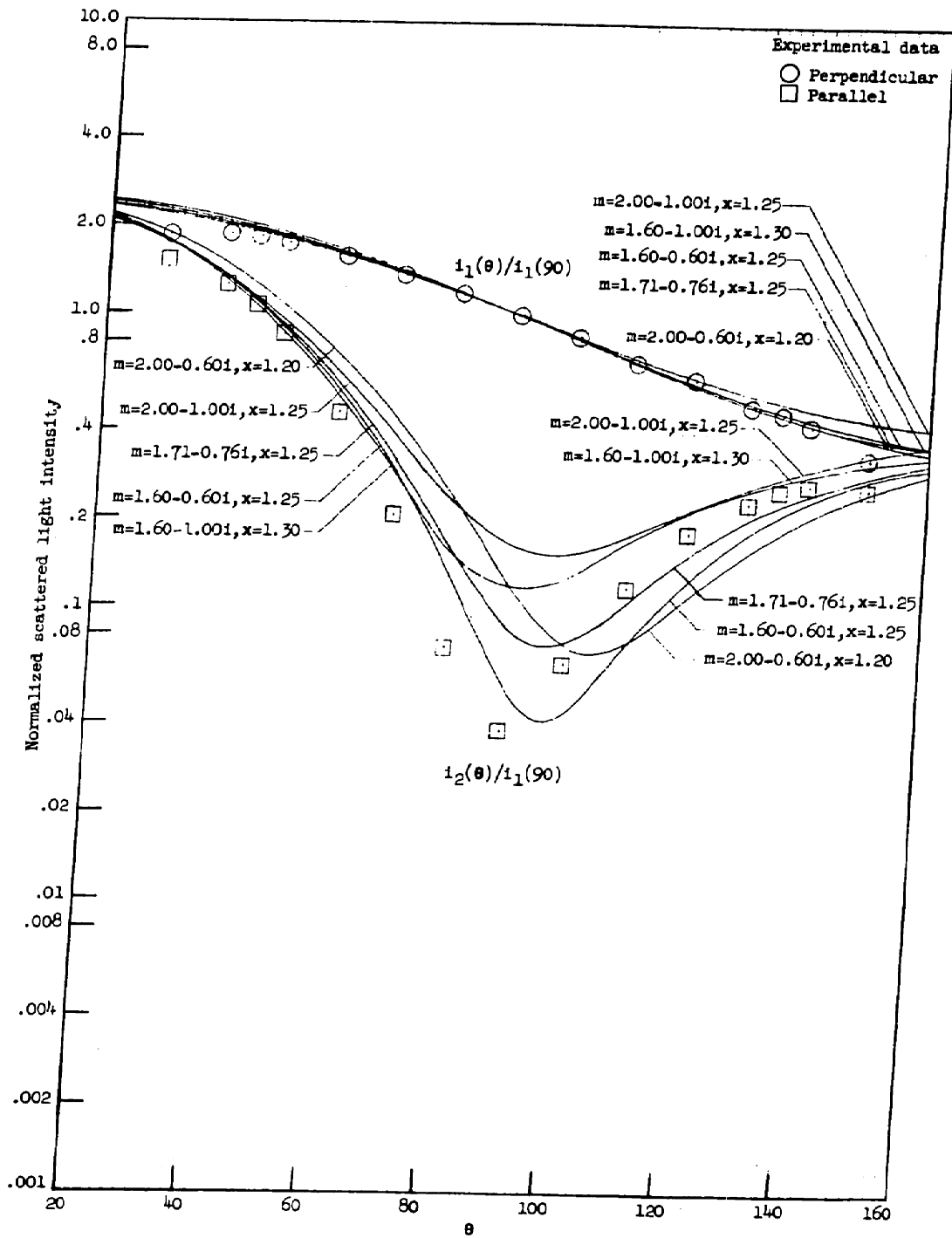


Figure 10.11.- Experimental light-scattering data for run 3 compared to theory for various values of m and x .

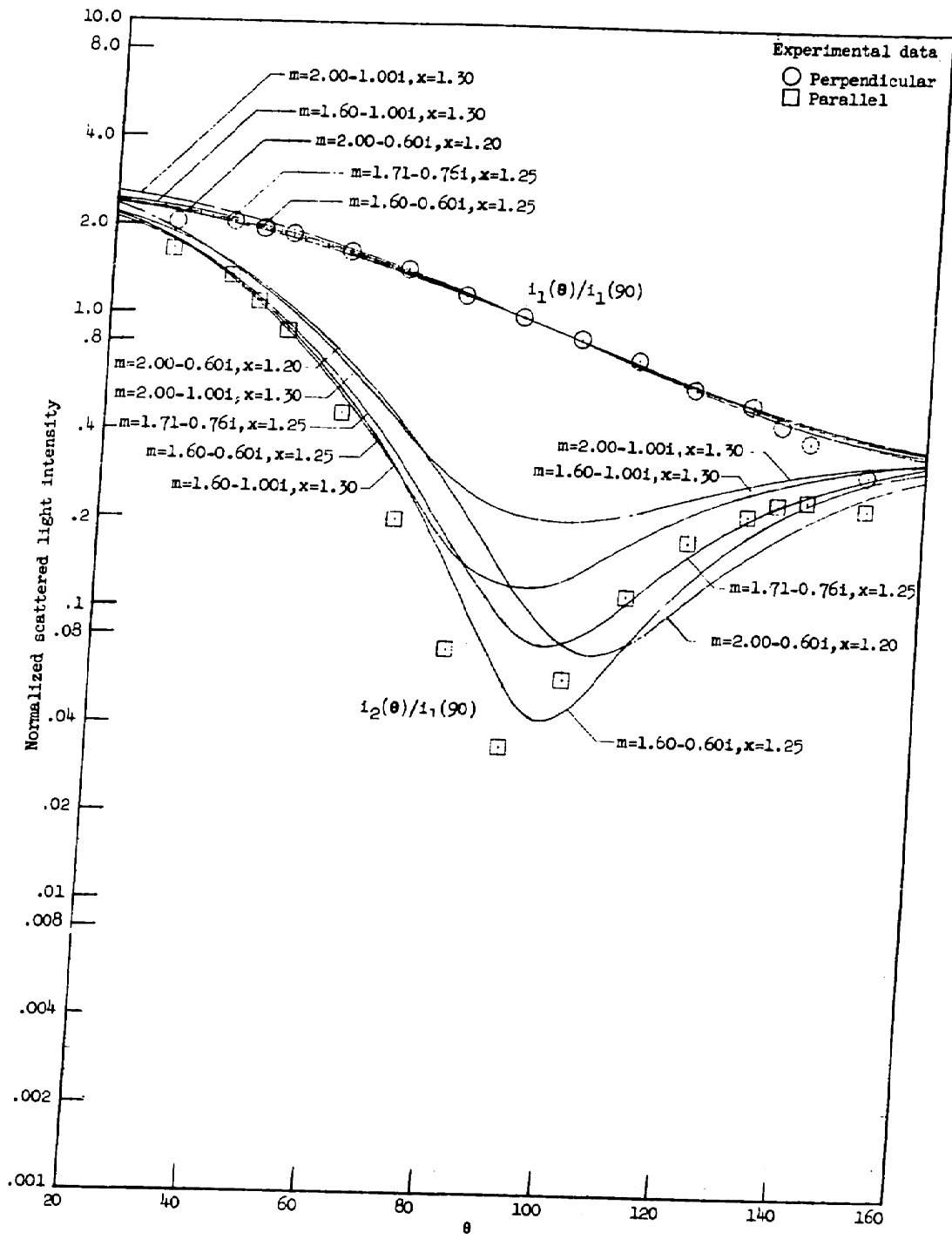


Figure 10.12.- Experimental light-scattering data for run 4 compared to theory for various values of m and x .

particle diameter deduced by comparing the experimental ratio of $e_1(60)/e_1(120)$ to the theoretical dissymmetry plot of $i_1(60)/i_1(120)$ against x , given in Figure 5.8, for run 1 through run 4. Also shown in Table 10.1 is the number concentration for each run based on these apparent values of x and assuming uniform size spherical particles. The number concentration of soot particles was calculated from equation 9.8, in which the value of $i_2(60)$ was found by interpolation from the light-scattering functions given in appendix D.

Table 10.1.- Size and concentration of soot at successive elevations in a fuel-rich benzene-air flame for run 1 through run 4*.

Run	Elevation (in.)	$e_1(60)/e_1(120)$	Apparent x	Apparent diameter, d (Å)	Concentration, N/V (particles/cc)
1	1.25	1.80	1.40	1440	2.75×10^8
2	1.50	2.36	1.19	1650	2.14×10^8
3	1.75	2.54	1.23	1700	1.92×10^8
4	2.00	2.83	1.28	1770	1.42×10^8

*These results are based on the assumption that $m = 1.71 - 0.76 i$, that the soot particles are uniform in size and are homogeneous spheres, and that only dissymmetry between $\theta = 60^\circ$ and $\theta = 120^\circ$ is needed for particle size determination.

The results presented in Table 10.1 indicate that the apparent soot particle diameter increases and the number concentration decreases with increasing elevation in the flame. The values of x given in

Table 10.1 are in good agreement with the values of x determined by the curve-fitting technique for each run. The absolute values of d and of N/V are of course in question due to reasons previously given.

The size parameter, x , for spherical particles is defined as the ratio of the circumference of the particle to the wavelength of light used in the scattering experiment or $\pi d/\lambda$. It is clear from this definition that the value of x which is determined from light-scattering measurements for a given particle is simply inversely proportional to λ . It follows that two light-scattering experiments in which all test conditions are made identical and only the wavelength λ is changed, would give two different values of x which are in a ratio which is equal to the inverse ratio of the respective values of λ . Two runs with nearly identical test conditions were made with two different wavelengths. A value of $\lambda = 4358 \text{ \AA}$ was used for run 5 and a value of $\lambda = 5461 \text{ \AA}$ was used for run 6 with both runs having nearly identical test conditions. As before, a premixed benzene-air flame was used with a fuel-air ratio of about 2.45 times stoichiometric at an elevation of 1.25 inches above the tip of the burner.

Figure 10.13 shows the experimental light-scattering data for run 5, in which $\lambda = 4358 \text{ \AA}$, compared to theory for various values of m and x . The value of x obtained by comparing the data with theory for different values of m are given on the figure. For $m = 1.71 - 0.76 i$, the value of x is approximately 1.00.

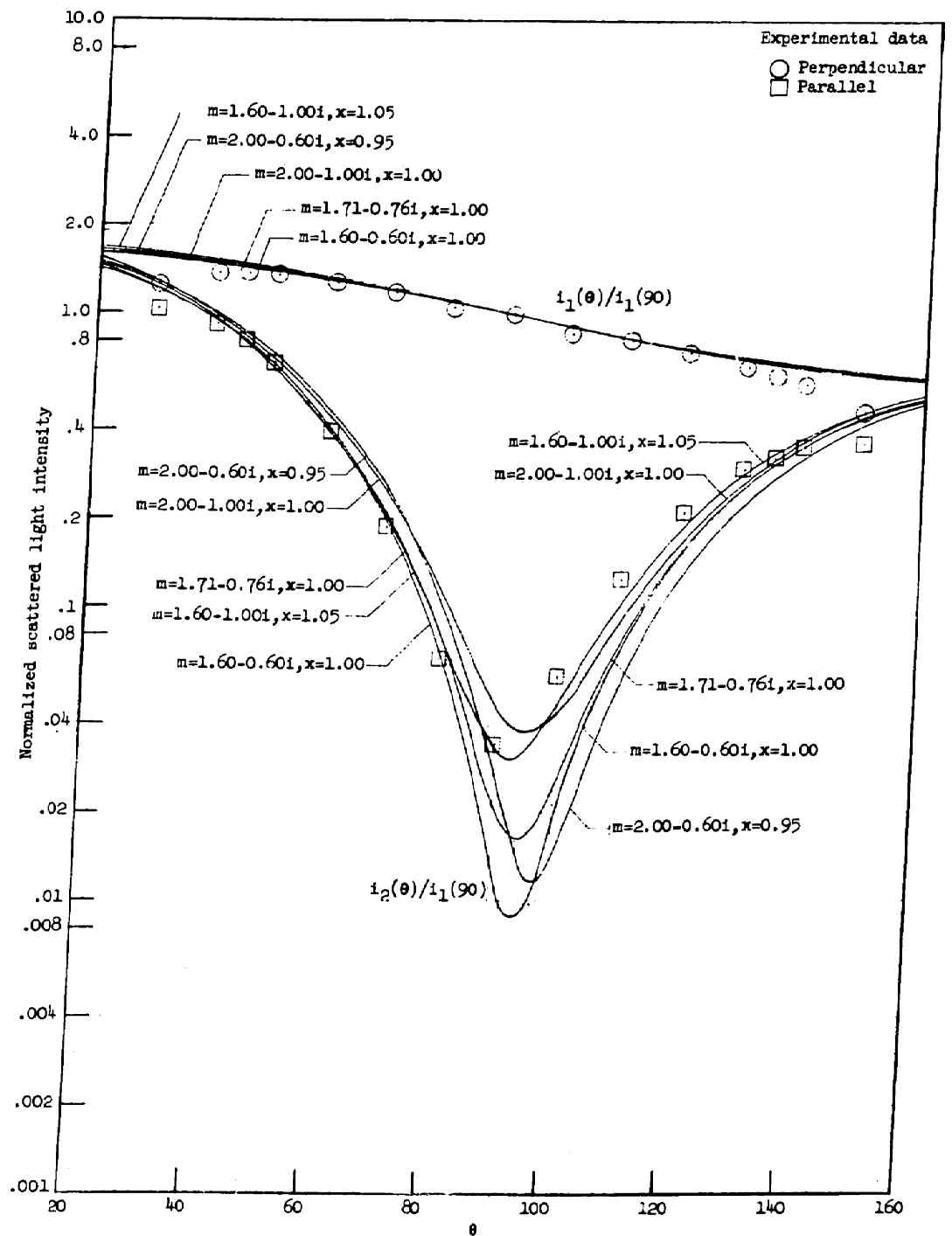


Figure 10.13.- Experimental light-scattering data for run 5 compared to theory for various values of m and x .

Figure 10.14 shows the experimental data for run 6, where $\lambda = 5461 \text{ \AA}$, compared to theory for the various values of m . The values of x obtained from the different values of m are nearly the same. The value of x for this run is 0.90 when $m = 1.79 - 0.79 i$, the most likely value of the index of refraction for soot when $\lambda = 5461 \text{ \AA}$.

A comparison of these last two runs, which were carried out for the same flame conditions and elevation, shows that the ratio of the values of x for the run where $\lambda = 4358 \text{ \AA}$ to that for the run where $\lambda = 5461 \text{ \AA}$ is $1.00/0.90 = 1.11$ rather than the expected value of $5461/4358 = 1.25$. The experimental value of this ratio 1.11 shows the correct trend, in that it is greater than unity, but further explanation is necessary.

It should be remembered at this point that the electron micrograph of the benzene soot shown in Figure 10.1 shows an ultimate particle size of only 250 \AA , while the light-scattering results give an apparent size many times larger. It is of interest to assume that the soot within the flame actually is a mixture of small soot particles which have this diameter of 250 \AA and much larger particles or elements which are agglomerates of the ultimate particles. It is further assumed for the sake of argument that the light-scattering behavior of the agglomerates can be assigned an equivalent sphere size. The respective values of x for the ultimate soot particles which have a diameter of 250 \AA are 0.180 and 0.144 when $\lambda = 4358 \text{ \AA}$ and $\lambda = 5461 \text{ \AA}$. The

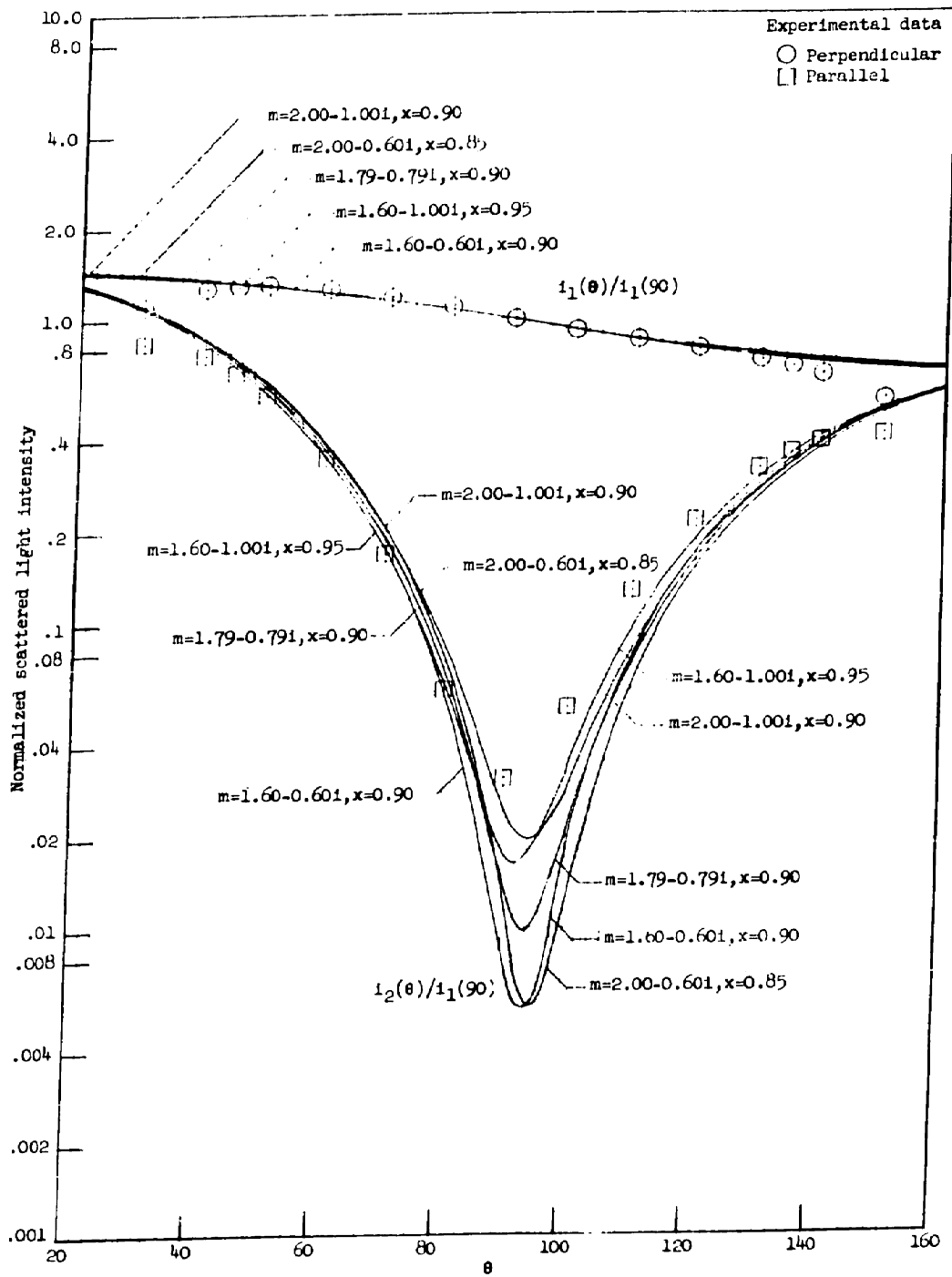


Figure 10.14.- Experimental light-scattering data for run 6 compared to theory for various values of m and x .

closest values of x to these numbers for which the light-scattering functions have been calculated are $x = 0.20$ and $x = 0.15$, respectively, and these were used in the following calculation. The effect which these small particles will have on the entire scattering pattern will be such as to reduce the apparent value of x below that which would be obtained from the agglomerates alone. In view of the data obtained from run 5 and run 6, a value of $x = 1.25$ was assumed for the agglomerates when $\lambda = 4358 \text{ \AA}$. This is equivalent to assuming that the agglomerates are spheres with an effective diameter of 1730 \AA , so that the value of x is 1.00 when $\lambda = 5461 \text{ \AA}$. The choice of the effective agglomerate size is arbitrary of course and was selected to simplify calculations, while at the same time supposing a realistic situation based on the data from run 5 and run 6. A value of $m = 1.71 - 0.76 i$ was also assumed.

The method of calculation and the results for this hypothetical system which includes a mixture of ultimate particles with a diameter of 250 \AA and agglomerates with an effective diameter of 1730 \AA are given in appendix I. In these calculations, the number fraction of agglomerates in the total number of particles was taken as 5×10^{-5} . In other words, it is assumed that there are 2×10^4 individual soot particles with a diameter of 250 \AA for each agglomerate with a diameter of 1730 \AA . This number fraction was, in part, based on a comparison of the scattered-light intensity from a single particle for the two sizes. Assuming the agglomerates to be of close-packed spheres,

this would correspond to a mass fraction of agglomerates of about 5×10^{-3} . Much smaller values of this number fraction would tend to produce scattering diagrams for each wavelength which would be essentially Rayleigh patterns, but this is not in accord with the data for run 5 and run 6. On the other hand, much larger values of this number fraction of agglomerates would result in a scattering pattern which corresponds to $x = 1.25$ for $\lambda = 4358 \text{ \AA}$ and to $x = 1.00$ for $\lambda = 5461 \text{ \AA}$, which is again contrary to the experimental data.

For the assumed conditions, a different scattering diagram was predicted for each wavelength. The size parameter, x , was determined for each of the two diagrams by finding the best fit for the perpendicular component using the theoretical scattering patterns for uniform sizes and $m = 1.71 - 0.76 i$. In short, the ratio of the resulting values of the apparent values of x for the case where $\lambda = 4358 \text{ \AA}$ to the case where $\lambda = 5461 \text{ \AA}$ for the hypothetical system of soot particles is approximately 1.1. The above bi-disperse system of soot particles therefore offers a possible explanation for the seemingly peculiar behavior of the experimental light-scattering data exposed by comparing run 5 and run 6. (See appendix I for the details of these calculations and resulting plots.)

The light-scattering data presented up to this point have been obtained from premixed benzene-air flames burning at high fuel-air ratios just short of expelling free soot above the flame. Since the rather large values of x obtained from the foregoing experiments,

relative to the value of x that is expected from the electron micrographs, were tentatively explained as being due to agglomeration, and effort was made to see if a more nearly Rayleigh-type scattering pattern would be obtained from a flame with a lower fuel-air ratio. It is supposed that a smaller amount of soot would result from a lower fuel-air ratio, which in turn may reduce the degree of agglomeration. Run 7 through run 9 were made to this end.

Figure 10.15 through Figure 10.17 present the experimental data compared to theory for various values of m and x for run 7 through run 9, respectively. These runs were made under the same test conditions with a fuel-air ratio of 2.16 times stoichiometric at closer elevation intervals than were used for run 1 through run 4. The values of x for these three runs are slightly less than the values deduced from run 1 through run 4, but it should be pointed out that the flame is shorter in this second series of runs than it was for the previous series. (See Table H.1 for the detail test conditions for these runs.)

As in the previous cases, the experimental data are compared to theory for different values of m with the result that x is about the same for all values of m which were used. The values of m used, and the corresponding values of x resulting from the comparison, are given on each figure. The values of x at successive elevations in the flame for the case of $m = 1.71 - 0.76$ are listed in table 10.2. The resulting number concentrations are also presented in table 10.2.

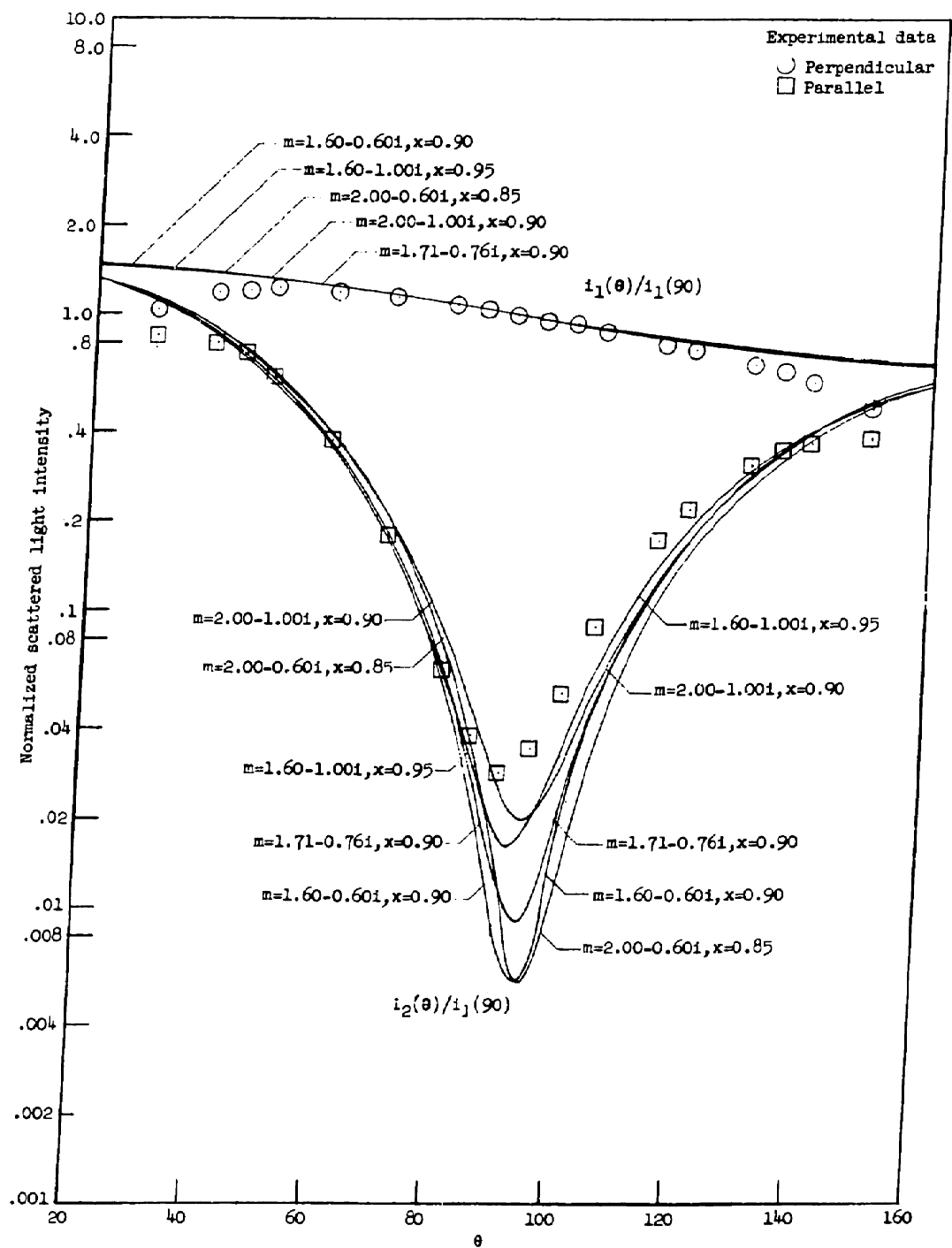


Figure 10.15.- Experimental light-scattering data for run 7 compared to theory for various values of m and x .

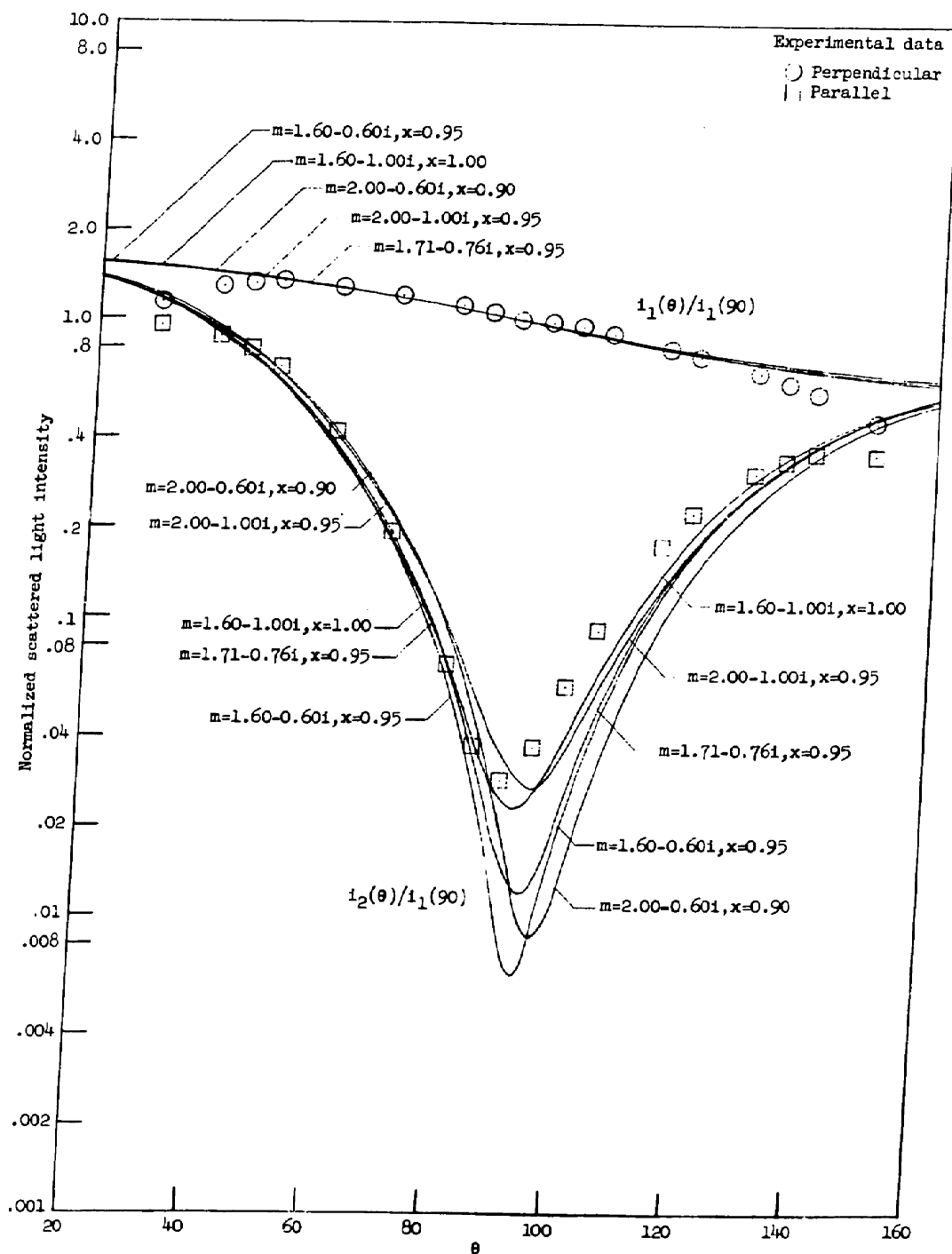


Figure 10.16.- Experimental light-scattering data for run 8 compared to theory for various values of m and x .

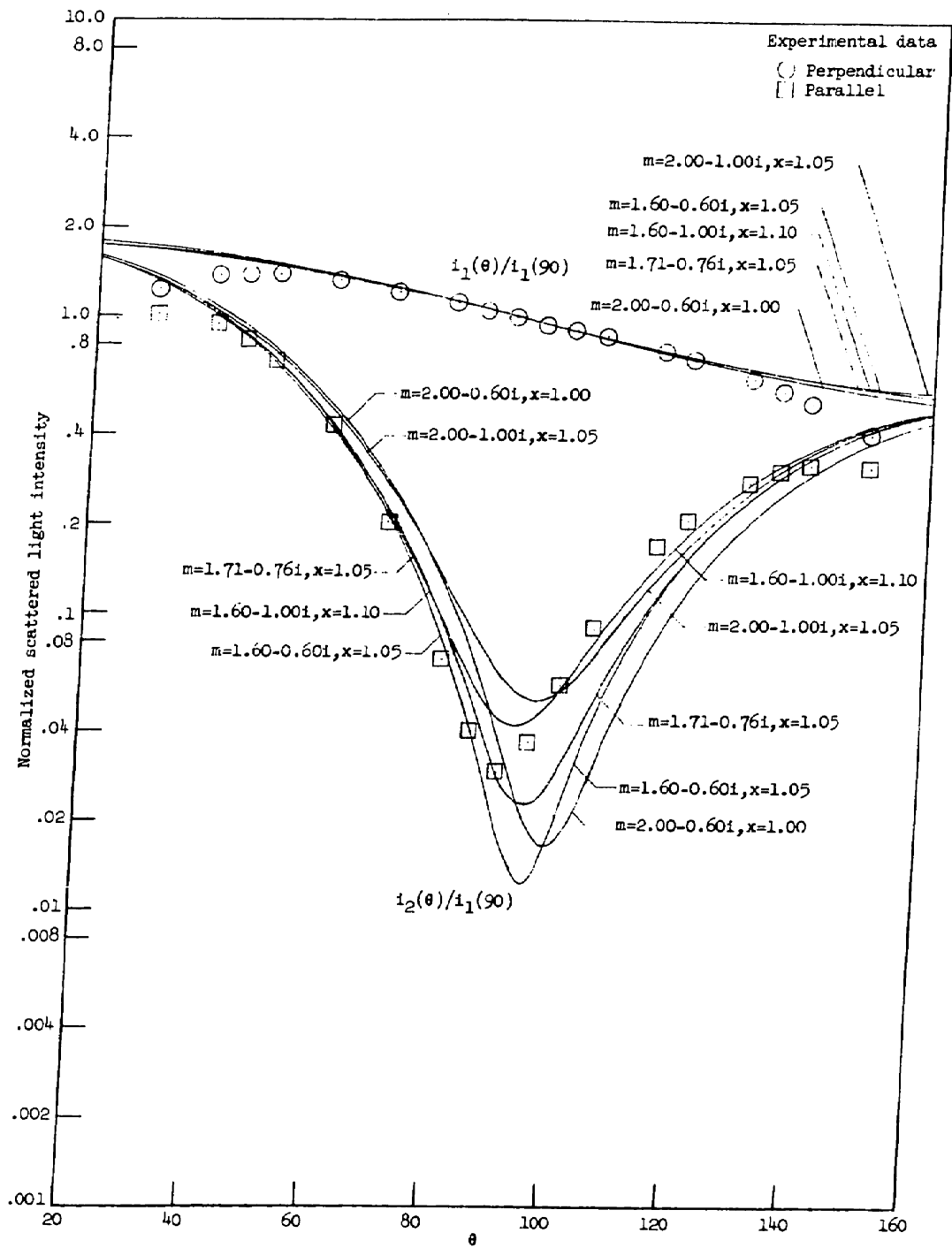


Figure 10.17.- Experimental light-scattering data for run 9 compared to theory for various values of m and x .

Table 10.2.- Apparent value of x and concentration of soot at successive elevations in a fuel-rich flame for run 7 through run 9.

Run	Elevation (in.)	Apparent x	Concentration, N/V particles/cc
7	1.03	0.90	5.04×10^8
8	1.10	0.95	4.90×10^8
9	1.23	1.05	3.48×10^8

The absolute elevations for this series of runs are less than those for run 1 through run 4, but the relative elevation in the flame based on the height of the respective flames are quite comparable. The relative elevation for run 2 is 47.7 percent of the flame height, while the relative elevation for run 8 is 47.8 percent. The apparent values of x for this somewhat leaner, but still very fuel-rich flame, are lower than the values of x found for the more fuel-rich flame at comparable relative elevations. As shown in table 10.2, the number concentration is about twice as large for the leaner flame when compared to the concentrations listed in table 10.1 for the more fuel-rich flame. This may be due to less agglomeration which would allow more separate and smaller soot particles. An attempt to obtain data for an even leaner, but still luminous flame, resulted in a shorter and narrower flame which could not easily be examined with the present apparatus.

Light-scattering measurements were also made on an amyl acetate diffusion flame burning on a Hefner candle with three objectives in mind. The first objective was to gather light-scattering data which could be compared to the data presented by Senftleben and Benedict (11). Secondly, the electron micrograph of amyl acetate soot showed an ultimate particle size of about 400 \AA whereas the electron micrograph of benzene soot showed an ultimate particle size of about 250 \AA , therefore, it is of interest to see what effect this difference may have on the experimental light-scattering results. Finally, it was desired to see what effect there would be on the experimental data for values of θ near 30° and near 150° (which showed rather definite and systematic departure from theory for the previous runs when corrected by the volume factor, $\sin \theta$) when the observed scattering volume remains constant for all values of θ . The observed scattering volume was made invariant with θ by using a larger aperture in front of the light source which in turn produced an incident light beam with a circular cross section at the flame that was larger than the width of the flame. With this arrangement, the observed scattering volume is defined solely by the width of the flame at the elevation in question and the cross-sectional area of the square aperture in front of the multiplier phototube. Both of these are invariant with the angle θ .

The experimental light-scattering data for run 10 compared to theory for various values of m and x are presented in Figure 10.18. The value of x obtained by comparing the data with theory is

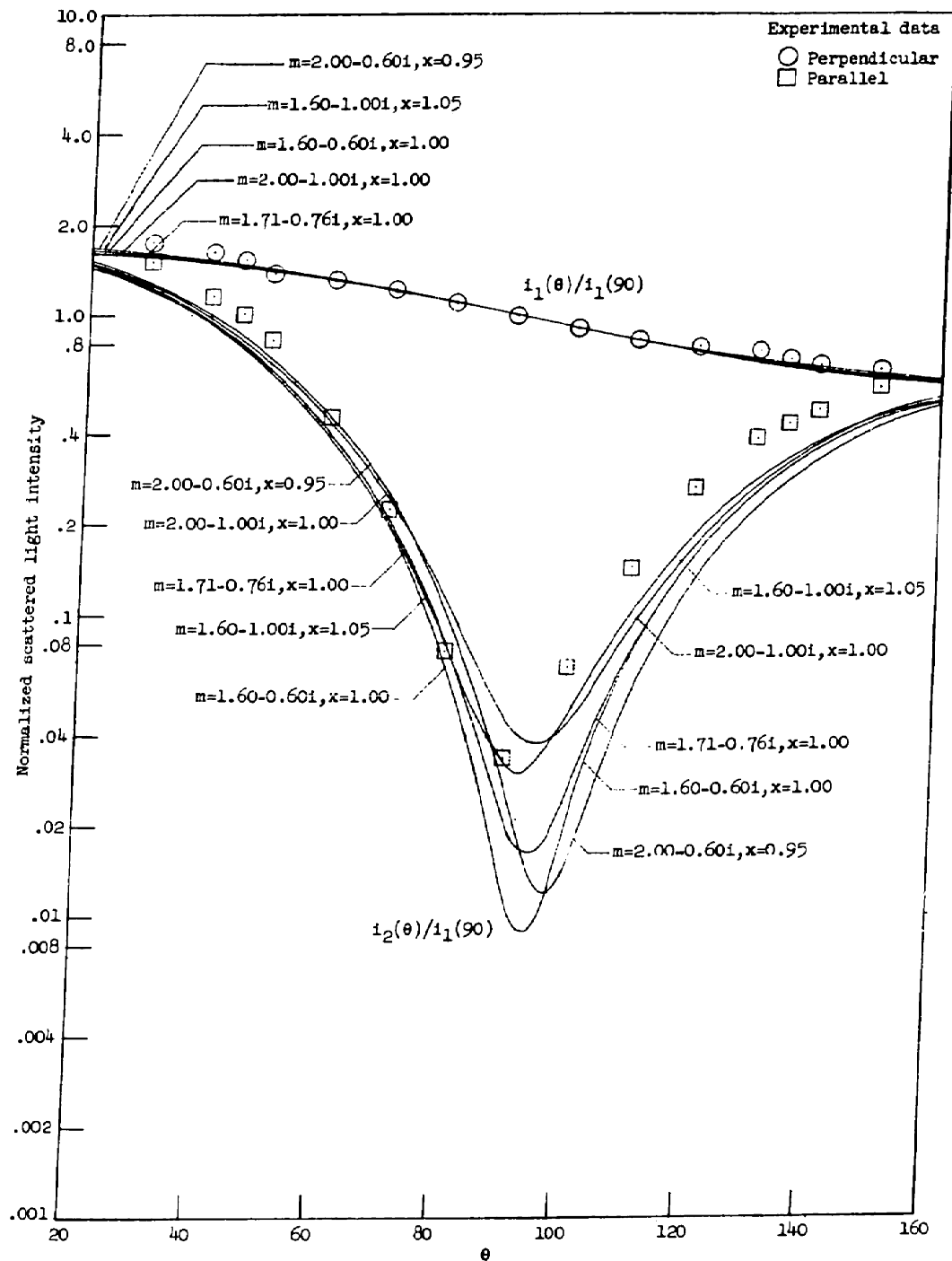


Figure 10.18.- Experimental light-scattering data for run 10 compared to theory for various values of m and x .

approximately 1.00, so that the apparent soot particle diameter is about 1400 \AA since $\lambda = 4358 \text{ \AA}$ for this run. Senftleben and Benedict reported an apparent soot particle diameter of 1750 \AA based on their light-scattering data for which $\lambda = 4910 \text{ \AA}$, that is, their apparent value of x was 1.12. This difference may be due to a possible difference in adjustment of the Hefner candle for the two separate experiments.

The apparent soot particle size deduced from this run is not sufficiently different from those in which benzene was used to be able to indicate an effect of the size of the ultimate particles on the experimental scattering patterns.

As shown in Figure 10.18, the departure of experimental data from theory at angles of θ near 30° and near 150° is absent in this run in which the observed scattering volume was made independent of the angle θ .

One more run was made on a Cambridge City Gas diffusion flame which contains about 94 percent methane. Due to the relatively small amount of soot in this flame, as evidenced by its rather feeble luminosity, it was necessary to operate the multiplier phototube with the maximum allowable supply voltage of 1250v. At this condition, the output voltage dropped quite rapidly with time at a given angular position, due to fatigue of the multiplier phototube, so that a reasonably good experimental scattering pattern was not obtained. The rough data from this run, however, did indicate much smaller dissymmetry than was

produced by the benzene-air and amyl acetate flames. This could be the result of smaller agglomerate sizes in this flame for this run.

XI. DISCUSSION

The experimental light-scattering data indicate that the soot particles in the premixed benzene-air flame range from 1250 Å to 1800 Å in diameter, depending on the elevation above the burner tip at which the data were obtained and the operating conditions of the flame. In general, larger soot particles were found at progressively larger elevations. These particle sizes were deduced by comparing the experimental light-scattering patterns with the theoretical patterns which were calculated for homogeneous carbon spheres of uniform diameter. A rather good fit of the experimental scattering patterns to the theoretical scattering patterns for uniform particle size for the perpendicular component was possible for all runs. The comparison between experiment and theory for the parallel component, however, was rather poor. By proper selection of a value for the index of refraction, a fairly good comparison between experiment and the theory for uniform particle size was found for a given run. The value of the index of refraction which gave this good fit was considerably different from the expected value of the index of refraction found in the literature. There is, of course, some doubt as to the correct value of the index of refraction of the hot soot particles within the flame, but in view of the results shown by the electron micrographs of the collected soot particles, it does not appear correct to assume that the soot particles are monodispersed and allow the index to vary a great deal from the expected value in order to find a fit of experiment to theory.

Electron micrographs of soot particles collected on cool metallic probes, passed through the same flame from which the light-scattering data were obtained, show that the ultimate soot particles from the premixed benzene-air flame are only about 250 \AA . A possible explanation for this difference may be that the soot within the flame is in an agglomerated state so that the experimental light-scattering data correspond to the relatively large agglomerates of the small ultimate soot particles. The apparent increase in soot particle size with increasing elevation above the burner tip is consistent with the idea of agglomerated soot particles within the flame in that the agglomerated soot particles could be expected to increase in size due to additional agglomeration at progressively higher elevations. Indeed, the electron micrographs show a rather high degree of agglomeration but it is hardly possible to distinguish between the fraction of agglomeration which took place on the cool probe due to its presence in the flame and that fraction which would naturally occur in an undisturbed flame.

The experimental results from a pair of runs on a flame, which had essentially the same test conditions but different wavelengths for each run, show that the ratio of the values of the size parameters for the two runs is not equal to the inverse ratio of the respective wavelengths as would be expected for a monodispersed system. Instead of the value of 1.25, which is the inverse ratio of the two wavelengths used, a ratio of 1.11 was found. In connection with this result,

calculations were made for a supposed soot particle system which was made up of a small number of large particles (corresponding to the agglomerated soot particles) and a very large number of small particles (corresponding to the small ultimate particles). The light-scattering patterns were calculated for the same two wavelengths as used in the experiments based on this supposed particle system. These were then compared to the theoretical scattering patterns for various monodispersed systems to find the best fit for the two cases. The results of these calculations show that the ratio of the apparent size parameters for the two different wavelengths is about 1.06 rather than 1.25 for the particular assumed fraction of large to small particles and their respective absolute sizes. A proper choice of the absolute sizes of the large and small particles and the relative amounts of each would yield a ratio for the apparent size parameters for the two different wavelengths which corresponds to the experimental ratio of 1.11. The point is that the ratio of the values of the size parameters obtained from the same particle system but for two different wavelengths does not necessarily equal the inverse ratio of the respective wavelengths for a particle system which is not monodispersed.

The technique for calculating the light-scattering diagrams for a smooth distribution of particle sizes was presented. A particle system with a normal distribution of sizes was taken and a fixed mean particle size was assumed with several different values for the standard deviation. The results of these calculations show that the

apparent particle size increases as the standard deviation increases even though the mean particle size remains fixed. The reason for the increase in the apparent particle size with an increasing value of the standard deviation is that larger particles scatter more light than smaller particles.

For all runs it was seen that the apparent value of the size parameter deduced from a given set of data is only weakly dependent on the particular value of the index of refraction used when the comparison between experiment and theory is made for the perpendicular component of the scattered light. The theoretical scattering diagram for the parallel component is more strongly dependent on the value of the index of refraction.

For all calculations herein, the soot particles have been assumed to be homogeneous spheres. Other particle shapes have not been considered in the analysis and would give different theoretical scattering patterns than presented in this work. This question, however, does not change the rather strong indication that the soot particles, within the flames studied, are agglomerates of smaller spherical units which continue to grow in size by further agglomeration as they travel up through the flame.

The number concentrations of the soot particles which are presented herein are based on the assumption that the observed light-scattering volume is made up of soot particles of uniform size. If the actual soot particle system in the flame contains a very large

fraction of small particles mixed with a rather small fraction of relatively large particles, such as supposed for the example presented in appendix I, the total number concentration of soot particles would be several orders of magnitude greater than indicated and would consist almost completely of the small ultimate particles, even though a sizeable portion of the scattered-light intensity is due to a very small number of larger particles, that is, agglomerates.

If the soot particles in the flame had not been in an agglomerated state, but instead existed in the flame only as ultimate particles of the size shown in the electron micrographs, the experimental light-scattering diagrams would have been more nearly of the Rayleigh-type showing very little dissymmetry.

In conjunction with this, light-scattering measurements were made on a diffusion flame of Cambridge City Gas (94 percent methane) with the expectation of less agglomeration of the ultimate soot particles, which in turn would give a more nearly Rayleigh-type scattering pattern. The data of this run, using Cambridge City Gas, show much less dissymmetry than given by the benzene-air or amyl acetate flames, but is of a rather poor quality due to apparatus limitations. The quantity and/or condition of the soot within this flame was such that the scattered-light intensity was too low to permit the collection of good data.

An additional quantity which should have been measured, but was not in this work, is the total weight of soot contained in the observed

light-scattering volume of the flame. This would involve collecting a quantity of soot for a known period of time during steady flame conditions. The mass of soot particles contained in the observed light-scattering volume as calculated from the size and concentration of soot particles deduced from light-scattering measurements should agree with the mass of soot determined by directly collecting and weighing it.

Another additional measurement which may help to determine the state of the soot particles in the flame is that of radiant emission from the luminous soot particles in the flame.

The experimental results obtained herein from an amyl acetate diffusion flame burning on a Hefner candle are consistent with the results of Senftleben and Benedict in that good agreement between theory for a uniform particle system and experiment is found for the perpendicular component of the scattered light and the parallel component for $\theta < 90^\circ$, but a rather poor comparison exists for the parallel component for $\theta > 90^\circ$.

Further development of this technique is of course necessary before its full potential as a research tool can be realized. Recommendations for additional work on this problem are presented in the next section.

It should be pointed out that this light-scattering technique, when developed more fully, has practical application to several other problems in addition to the soot formation problem. For example, the

rate of growth of TiO_2 particles, which are used for pigments, might be studied by this technique. As already mentioned, the rate of growth and decay of rocket exhaust particles may also be studied by this light-scattering technique.

XII. CONCLUDING REMARKS AND RECOMMENDATIONS

Concluding Remarks

The main object of this investigation was to develop a light-scattering technique for determining the size and concentration of soot particles in laminar flames. This work is incomplete in that further development of this technique is necessary before its full potential as a research tool can be realized. Based on the results of the present investigation, the following conclusions are drawn:

1. The experimental light-scattering results, when analyzed in the light of the electron micrographs of the collected soot particles, indicate that the soot particles within the flames studied are in an agglomerated state. These agglomerated units, which are responsible for the rather large dissymmetry of the experimental light-scattering patterns, are believed to be made up of smaller ultimate spherical particles. The ultimate particle size for benzene soot was about 250 \AA , whereas amyl acetate soot was about 400 \AA , based on the electron micrographs.

2. There is a strong indication that the soot particle system within the examined flames consists mainly of the smaller ultimate soot particles mixed with only a very small fraction of agglomerated units. Based on a comparison between the light-scattering data obtained from the same flame for two different wavelengths and on a comparison of calculated results for a supposed particle system using two different wavelengths, the number fraction of agglomerated units is

several orders of magnitude less than the number fraction of small ultimate soot particles.

3. The results indicate that the agglomerated units continue to grow by agglomeration or increase in number as they move up through the flame.

4. The value of the apparent size parameters deduced herein are only weakly affected by the value of the index of refraction when the perpendicular component of the scattered-light intensity is used for the analysis. The parallel component, however, is strongly dependent on the value of the index of refraction.

5. A light-scattering apparatus has been constructed and used to demonstrate that soot in a flame can be studied by application of the light-scattering technique. Within limits, the supporting analytical work has been developed.

6. With additional effort, the light-scattering technique could be applied to several other practical combustion problems.

Recommendations

The following recommendations for future work on this problem are offered:

1. An experiment in which the flame conditions are held constant but in which light-scattering measurements are made at many different wavelengths should be revealing. In conjunction with this, various soot particle systems would be supposed and the resulting calculated light-scattering patterns, based on the same wavelengths for which the

experimental data were taken, would be compared. Electron micrographs might also be taken to establish the size of the ultimate soot particles in this experiment.

2. The apparatus should be improved to permit data to be obtained from flames containing smaller amounts of soot than the flames presently investigated. Flames which contain smaller amounts of soot may have less agglomeration of the soot particles or none at all. This would simplify the interpretation of the light-scattering results.

3. An attempt should be made to develop a flame that has a more suitable shape for light-scattering measurements than was used herein.

4. An investigation in which the weight of soot contained in the observed scattering volume is measured by actually collecting and weighing it, in addition to the light-scattering measurements of size and number concentration, should be undertaken. This would establish a comparison between the soot particle weight in the flame as determined by the apparent size and concentration of soot from the light-scattering measurements and the independent method of collecting and weighing a portion of the soot.

5. A theoretical investigation into the effect that particle shape has on the light-scattering patterns is needed. Chains of spherical particles or groups of spherical particles with various packing densities may be realistic cases to consider. The size of these basic spherical particles which make up the bigger units might fruitfully be chosen to be equal to the size of the ultimate particles shown by the electron micrographs.

6. A study with the objective of determining the actual value of the index of refraction of hot soot particles might also be undertaken in support of this work.

APPENDIX A

Light-Scattering Relations for Spheres of Arbitrary Size

The functional relationships for the light-scattering functions, i_1 and i_2 , used in equations 3.4 to 3.6 for a sphere of arbitrary size are

$$i_1 = \left[\sum_{n=1}^{\infty} \frac{2n+1}{n(n+1)} \left\{ a_n \pi_n(\cos \theta) + b_n \tau_n(\cos \theta) \right\} \right]^2 \quad \text{A.1}$$

and

$$i_2 = \left[\sum_{n=1}^{\infty} \frac{2n+1}{n(n+1)} \left\{ b_n \pi_n(\cos \theta) + a_n \tau_n(\cos \theta) \right\} \right]^2 \quad \text{A.2}$$

In these equations, a_n and b_n are scattering coefficients which are functions of x and y only and are defined as

$$a_n = \frac{S'_n(y)S_n(x) - mS'_n(x)S_n(y)}{S'_n(y)\phi_n(x) - m\phi'_n(x)S_n(y)} \quad \text{A.3}$$

and

$$b_n = \frac{mS'_n(y)S_n(x) - S'_n(x)S_n(y)}{mS'_n(y)\phi_n(x) - \phi'_n(x)S_n(y)} \quad \text{A.4}$$

where

$$S_n(z) = \sqrt{(\pi z/2)} J_{n+1/2}(z) \quad \text{A.5}$$

$$C_n(z) = (-1)^n \sqrt{(\pi z/2)} J_{-(n+1/2)}(z) \quad \text{A.6}$$

and

$$\Phi_n(z) = S_n(z) + iC_n(z) \quad \text{A.7}$$

In these last three equations, the dummy argument z takes on either x or y . The primes denote the partial derivative with respect to the argument, $i \equiv \sqrt{-1}$, and J is the ordinary Bessel function. The angular functions $\pi_n(\cos \theta)$ and $\tau_n(\cos \theta)$ are given as

$$\pi_n(\cos \theta) = \frac{1}{\sin \theta} P_n^1(\cos \theta) \quad \text{A.8}$$

and

$$\tau_n(\cos \theta) = \frac{d}{d\theta} P_n^1(\cos \theta) \quad \text{A.9}$$

where $P_n^1(\cos \theta)$ is an associated Legendre polynomial.

With this system of equations, it is possible to calculate the necessary light-scattering functions i_1 and i_2 which are required for theoretically determining the scattered-light intensity as a function of x , y , and θ .

APPENDIX B

The Relation Between the Absorption Constant and the Absorption Coefficient

The amplitude of the electric field vector E associated with light traveling through a medium with an index of refraction m in the z direction is

$$E = E_0 \exp[i(\omega t - mkz)] \quad \text{B.1}$$

where z is the distance in the direction of propagation away from the point where $E = E_0$ at a given time t . The wave number $k = 2\pi/\lambda = \omega c$, where c is the velocity of light in the medium, ω is the angular frequency, and λ is the wavelength in the space surrounding the medium.

Substituting equation 4.1 for m into equation B.1 gives

$$E = E_0 \exp[i(\omega t - nkz) - n'kz] \quad \text{B.2}$$

and since the light intensity I is proportional to the square of the amplitude E

$$I = I_0 \exp 2[i(\omega t - nkz) - n'kz] \quad \text{B.3}$$

where I_0 is the light intensity at the point where $E = E_0$.

On the other hand, the usual absorption coefficient γ is defined by the expression

$$I = I_0 \exp(-\gamma z) \quad \text{B.4}$$

By comparing the real part of the exponent of equation B.3 with that of equation B.4, it is seen that

$$\gamma = 2n'k = \frac{4\pi n'}{\lambda} \quad \text{B.5}$$

APPENDIX C

Development of a System of Equations for Evaluating the Light-Scattering Functions and a Listing of the Fortran Program

The light-scattering functions i_1 and i_2 , which are defined by equations A.1 and A.2, are required for the theoretical determination of the scattered-light intensity. Gucker and Cohn (23) have developed a general scheme for evaluating these functions. They start with equations A.3 and A.4 and replace $\Phi_n(x)$ according to equation A.7. This substitution with a little rearrangement yields

$$a_n = \left[1 + i \frac{S'_n(y)C_n(x) - mC'_n(x)S_n(y)}{S'_n(y)S_n(x) - mS'_n(x)S_n(y)} \right]^{-1} = \left[1 + iG_n(x,y) \right]^{-1} \quad \text{C.1}$$

$$b_n = \left[1 + i \frac{mS'_n(y)C_n(x) - C'_n(x)S_n(y)}{mS'_n(y)S_n(x) - S'_n(x)S_n(y)} \right]^{-1} = \left[1 + iH_n(x,y) \right]^{-1} \quad \text{C.2}$$

The derivatives of the Bessel functions $S'_n(z)$ and $C'_n(z)$ are eliminated by means of the relation between the derivatives and the functions themselves

$$\frac{S'_n(z)}{S_n(z)} = \frac{S_{n-1}(z)}{S_n(z)} - \frac{n}{z} \quad \text{C.3}$$

and

$$\frac{C'_n(z)}{C_n(z)} = \frac{C_{n-1}(z)}{C_n(z)} - \frac{n}{z} \quad \text{C.4}$$

where z represents either the argument x or y . Substitution of these relations into equation C.2 to eliminate $S'_n(z)$ and $C'_n(z)$ yields

$$H_n(x,y) = \frac{mR_n(y)C_n(x) - C_{n-1}(x)}{mR_n(y)S_n(x) - S_{n-1}(x)} \quad \text{C.5}$$

where

$$R_n(y) \equiv \frac{S_{n-1}(y)}{S_n(y)} \quad \text{C.6}$$

For the particular case of concern here, where m and therefore y is complex, Gucker and Cohn indicate that the simplest way to evaluate $R_n(y)$ is by the recurrence relation for Bessel functions of three successive orders

$$R_n(y) = \left[\frac{2n-1}{y} - R_{n-1}(y) \right] \quad \text{C.7}$$

For the case $n = 0$

$$R_0(y) = \cot y \quad \text{C.8}$$

In a similar manner, the expression for $G_n(x,y)$ in equation C.1 reduces to

$$G_n(x,y) = \frac{W_n(y)C_n(x) - C_{n-1}(x)}{W_n(y)S_n(x) - S_{n-1}(x)} \quad \text{C.9}$$

where

$$W_n(y) = \frac{1}{m} R_n(y) + \frac{n}{x} \left(1 - \frac{1}{m^2}\right) \quad \text{C.10}$$

A detailed development of a system of equations for calculating the required scattering functions based on these expressions follows.

The first step, after choosing values for x , y , and θ is to find $R_0(y)$ according to equation C.8. Since y is a complex number, tables of $\cot y$ are generally not available so it is more convenient to express $\cot y$ in exponential form as

$$\cot y = \frac{i(\exp iy + \exp -iy)}{\exp iy - \exp -iy} \quad \text{C.11}$$

It can be shown by replacing y with $x(N - iN')^*$, that

$$\cot y = \frac{\sin 2xN + i \sinh 2xN'}{\cosh 2xN' - \cos 2xN} \quad \text{C.12}$$

The real and imaginary parts of $R_0(y)$ defined by the following equation

$$R_0(y) = R_0^r + iR_0^i \quad \text{C.13}$$

are therefore,

$$R_0^r = \frac{\sin 2xN}{\cosh 2xN' - \cos 2xN} \quad \text{C.14}$$

*In this section, the real and imaginary parts of the index of refraction are denoted respectively as N and N' rather than n and n' to avoid confusion with the order n .

and

$$R_0^i = \frac{\sinh 2xN'}{\cosh 2xN' - \cos 2xN} \quad \text{C.15}$$

In these equations and in those to follow, the superscripts r and i denote the real and imaginary parts, respectively.

Before writing equation C.7 in its component parts, it should be noted that

$$1/m = \frac{N + iN'}{N^2 + (N')^2} \quad \text{C.16}$$

so that

$$(1/m)^r = \frac{N}{N^2 + (N')^2} \quad \text{C.17}$$

and

$$(1/m)^i = \frac{N'}{N^2 + (N')^2} \quad \text{C.18}$$

From equation C.7 then

$$1/R_n(y) = \frac{2n-1}{x} [(1/m)^r + i(1/m)^i] (R_{n-1}^r + iR_{n-1}^i) \quad \text{C.19}$$

so that

$$(1/R_n)^r = \frac{2n-1}{x} (1/m)^r - R_{n-1}^r \quad \text{C.20}$$

and

$$(1/R_n)^i = \frac{2n-1}{x}(1/m)^i - R_{n-1}^i \quad \text{C.21}$$

Since

$$R_n(y) = R_n^r + iR_n^i \quad \text{C.22}$$

it follows that

$$R_n^r = \frac{(1/R_n)^r}{[(1/R_n)^r]^2 + [(1/R_n)^i]^2} \quad \text{C.23}$$

and

$$R_n^i = -\frac{(1/R_n)^i}{[(1/R_n)^r]^2 + [(1/R_n)^i]^2} \quad \text{C.24}$$

Also,

$$mR_n(y) = (N - iN')(R_n^r + iR_n^i) \quad \text{C.25}$$

so that

$$(mR_n)^r = NR_n^r + N'R_n^i \quad \text{C.26}$$

and

$$(mR_n)^i = NR_n^i - N'R_n^r \quad \text{C.27}$$

Now from equation C.5, let

$$mR_n(y)C_n(x) - C_{n-1}(x) = D_n = D_n^r + iD_n^i \quad \text{C.28}$$

so that

$$(mR_n)^r C_n(x) - C_{n-1}(x) = D_n^r \quad \text{C.29}$$

and

$$(\mathfrak{mR}_n)^i C_n(x) = D_n^i \quad \text{C.30}$$

Likewise, let

$$\mathfrak{mR}_n(y)S_n(x) - S_{n-1}(x) = E_n = E_n^r + iE_n^i \quad \text{C.31}$$

so that

$$(\mathfrak{mR}_n)^r S_n(x) - S_{n-1}(x) = E_n^r \quad \text{C.32}$$

and

$$(\mathfrak{mR}_n)^i S_n(x) = E_n^i \quad \text{C.33}$$

It follows from equations C.5 and C.28 through C.33 that

$$H_n(x,y) = H_n^r + iH_n^i = \frac{D_n^r + iD_n^i}{E_n^r + iE_n^i} \quad \text{C.34}$$

so that

$$H_n^r = \frac{D_n^r E_n^r + D_n^i E_n^i}{(E_n^r)^2 + (E_n^i)^2} \quad \text{C.35}$$

and

$$H_n^i = \frac{D_n^i E_n^r - D_n^r E_n^i}{(E_n^r)^2 + (E_n^i)^2} \quad \text{C.36}$$

From equation C.2

$$1/b_n = 1 + iH_n(x,y) = (1 - H_n^i) + H_n^r \quad C.37$$

or

$$b_n = \frac{(1 - H_n^i) - iH_n^r}{(1 - H_n^i)^2 + (H_n^r)^2} \quad C.38$$

Since

$$b_n = b_n^r + ib_n^i \quad C.39$$

it follows from equation C.38 that

$$b_n^r = \frac{(1 - H_n^i)}{(1 - H_n^i)^2 + (H_n^r)^2} \quad C.40$$

and

$$b_n^i = - \frac{H_n^r}{(1 - H_n^i)^2 + (H_n^r)^2} \quad C.41$$

The scattering coefficient b_n can be evaluated numerically for various values of n by this system of equations for a given set of x , N , and N' if $C_n(x)$ and $S_n(x)$ are known for the appropriate values of n . It should be noted that the terms containing Bessel functions with complex arguments have been eliminated. The numerical values of $C_n(x)$ and $S_n(x)$ as defined by equations A.5 and A.6 can be obtained from tables given in reference 28 with only slight modification for various values of x over a sufficiently large range of n .

A similar expression for a_n is found by beginning with

$$R_n(y)/m = (R_n/m)^r + i(R_n/m)^i = \left[(1/m)^r + i(1/m)^i \right] (R_n^r + iR_n^i) \quad \text{C.42}$$

from which it follows that

$$(1/m)^r R_n^r - (1/m)^i R_n^i = (R_n/m)^r \quad \text{C.43}$$

and

$$(1/m)^i R_n^r + (1/m)^r R_n^i = (R_n/m)^i \quad \text{C.44}$$

Also, since

$$1/m^2 = \left[(1/m)^r + i(1/m)^i \right]^2 \quad \text{C.45}$$

it follows that

$$1/m^2 = \left[(1/m)^r \right]^2 - \left[(1/m)^i \right]^2 + i \left[2(1/m)^r (1/m)^i \right] \quad \text{C.46}$$

Now let

$$(n/x)(1 - 1/m^2) = F_n = F_n^r + iF_n^i \quad \text{C.47}$$

Substituting equation C.46 into C.47 yields

$$F_n^r = \frac{n}{x} \left\{ 1 - \left[(1/m)^r \right]^2 + \left[(1/m)^i \right]^2 \right\} \quad \text{C.48}$$

and

$$F_n^i = -\frac{2n}{x} (1/m)^r (1/m)^i \quad \text{C.49}$$

By combining equations C.10, C.42 through C.44, and C.47 through C.49, the relation for $W_n(y)$ is

$$W_n(y) = W_n^r + iW_n^i = (R_n/m)^r + F_n^r + i[(R_n/m)^i + F_n^i] \quad C.50$$

so that

$$W_n^r = (R_n/m)^r + F_n^r \quad C.51$$

and

$$W_n^i = (R_n/m)^i + F_n^i \quad C.52$$

Now let

$$W_n(y)C_n(x) - C_{n-1}(x) = K_n = K_n^r + iK_n^i \quad C.53$$

so that

$$K_n^r = W_n^r C_n(x) - C_{n-1}(x) \quad C.54$$

and

$$K_n^i = W_n^i C_n(x) \quad C.55$$

Likewise, let

$$W_n(y)S_n(x) - S_{n-1}(x) = L_n = L_n^r + iL_n^i \quad C.56$$

so that

$$W_n^r S_n(x) - S_{n-1}(x) = L_n^r \quad C.57$$

and

$$W_n^i S_n(x) = L_n^i \quad C.58$$

Now combine equations C.53 through C.58 with equation C.9 to obtain

$$G_n(x,y) = G_n^r + iG_n^i = \frac{K_n^r + iK_n^i}{L_n^r + iL_n^i} \quad \text{C.59}$$

so that

$$\frac{K_n^r L_n^r + K_n^i L_n^i}{(L_n^r)^2 + (L_n^i)^2} = G_n^r \quad \text{C.60}$$

and

$$\frac{K_n^i L_n^r - K_n^r L_n^i}{(L_n^r)^2 + (L_n^i)^2} = G_n^i \quad \text{C.61}$$

From equation C.1

$$1/a_n = 1 + i(G_n^r + iG_n^i) \quad \text{C.62}$$

It follows from

$$a_n = a_n^r + ia_n^i \quad \text{C.63}$$

and from equation C.62, that

$$a_n^r = \frac{(1 - G_n^i)}{(1 - G_n^i)^2 + (G_n^r)^2} \quad \text{C.64}$$

and

$$a_n^i = - \frac{G_n^r}{(1 - G_n^i)^2 + (G_n^r)^2} \quad \text{C.65}$$

The scattering coefficient a_n , like b_n , can be evaluated numerically for various values of n for a given set of x , N , and N' if $C_n(x)$ and $S_n(x)$ are known for the appropriate values of n .

The numerical values listed in reference 28 for various values of the real argument x over a large range of n , are the spherical Bessel functions, $\sqrt{\pi/2x} J_{n+1/2}(x)$ and $\sqrt{\pi/2x} J_{-(n+1/2)}(x)$. A comparison of this definition of the tabulated values with equations A.5 and A.6 shows that $S_n(x)$ is obtained by multiplying $\sqrt{\pi/2x} J_{n+1/2}(x)$ by x and that $C_n(x)$ is obtained by multiplying $\sqrt{\pi/2x} J_{-(n+1/2)}(x)$ by x and the term $(-1)^n$. It can be noted in the foregoing system of equations that the term $\sqrt{\pi/2x}$ which appears in the definitions of $S_n(x)$ and $C_n(x)$ appears in equations C.34 and C.59 in both the numerator and denominator in such a way to exactly cancel each other, so that the final result for a_n and b_n is the same whether or not the tabulated spherical Bessel functions are multiplied by x . However, the term $(-1)^n$ in the equation for $C_n(x)$ must be taken into account and has the effect of changing only the sign of the tabulated values for odd values of n . The tabulated values given in reference 28 were therefore used directly as $S_n(x)$ and $C_n(x)$ with the sign of $C_n(x)$ changed for the odd values of n .

The angular scattering functions, $\pi_n(\cos \theta)$ and $\tau_n(\cos \theta)$, which are also needed to evaluate equations A.1 and A.2 for i_1 and i_2 , respectively, are tabulated by Gucker and Cohn (23) for values of $\theta = 0^\circ(2.5^\circ) 180^\circ$ for $n = 1(1)32$. For the present calculations,

θ takes on all values from 0° to 180° in increments of 5° for each combination of x and m .

It would have been possible to calculate both the Bessel functions $S_n(x)$ and $C_n(x)$ and the angular scattering functions $\pi_n(\cos \theta)$ and $\tau_n(\cos \theta)$ in the course of the following machine program, but it is more efficient from the standpoint of machine time to introduce these quantities as input data to the program.

A machine program to be executed on an IBM 709 computer was developed using the Fortran programming system. This system is discussed in reference 29 and only a listing of the working program will be given here.

For the purpose of writing the Fortran program, the following symbols used in the above equations were redefined by alphabetic groups.

N by U	b_n^r by $BREAL(N)$
N' by V	B_n^i by $BIMAG(N)$
$\sinh 2xN'$ by $SINH$	$(R_n/m)^r$ by $TREAL$
$\cosh 2xN'$ by $COSH$	$(R_n/m)^i$ by $TIMAG$
R_0^r by $GREAL(1)$	F_n^r by $UREAL$
R_0^i by $GIMAG(1)$	F_n^i by $UIMAG$
$(1/m)^r$ by $DREAL$	W_n^r by $VREAL$
$(1/m)^i$ by $DIMAG$	W_n^i by $VIMAG$
$(1/R_n)^r$ by $EREAL$	K_n^r by $WREAL$
$(1/R_n)^i$ by $EIMAG$	K_n^i by $WIMAG$

R_n^r by GREAL (N)	L_n^r by XREAL
R_n^i by GIMAG (N)	L_n^i by XIMAG
$(mR_n)^r$ by HREAL	G_n^r by YREAL
$(mR_n)^i$ by HIMAG	G_n^i by YIMAG
D_n^r by QREAL	a_n^r by AREAL (N)
D_n^i by QIMAG	a_n^i by AIMAG (N)
E_n^r by RREAL	$\pi_n(\cos \theta)$ by PI (N,M)
E_n^i by RIMAG	$T_n(\cos \theta)$ by TAU (N,M)
H_n^r by SREAL	x by ALPHA
H_n^i by SIMAG	θ by ANGLE

A listing of the Fortran program which is based on the above system of equations follows:

```

      DIMENSION PI(10,75), TAU(10,75), C(10), S(10), GREAL(10), GIMAG(10),
      L(10), P(10), AREAL(10), AIMAG(10), BREAL(10), BIMAG(10),
      ANGLE(75), PRI(75), PLI(75), TLI(75), Z(10)
10  FORMAT (2I6, F.2)
20  FORMAT (6E12.5)
30  FORMAT (5E14.8)
40  FORMAT (2F10.3)
50  FORMAT (I1)
      READ10, NFINAL, MFINAL, ANGSIZ
      READ20, ((PI(N,M), N=2, NFINAL), M=1, MFINAL), ((TAU(N,M), N=2,
      NFINAL), M=1, MFINAL)
      GOTO 900
60  READ30, ALPHA, (C(N), N=1, NFINAL), (S(N), N=1, NFINAL)
      GOTO (70, 80, 70, 1000), IND
70  READ40, U, V
80  DCONS=U**2+V**2
      DREAL=U/DCONS
      DIMAG=V/DCONS
      SINH=(EXPF(2.*ALPHA*V)-EXPF(-2.*ALPHA*V))/2.
      COSH=(EXPF(2.*ALPHA*V)+EXPF(-2.*ALPHA*V))/2.
      GCONS=COSH-COSF(2.*ALPHA*U)
      GREAL(1)=SINF(2.*ALPHA*U)/GCONS

```

```

GIMAG(1)=SINH/GCONS
DO90N=2,NFINAL
P(N)=N-1
L(N)=N-1
EREAL=(2.*P(N)-1.)*DREAL/ALPHA-GREAL(N-1)
EIMAG=(2.*P(N)-1.)*DIMAG/ALPHA-GIMAG(N-1)
GCONS=EREAL**2+EIMAG**2
GREAL(N)=EREAL/GCONS
GIMAG(N)=-EIMAG/GCONS
HREAL=U*GREAL(N)+V*GIMAG(N)
HIMAG=U*GIMAG(N)-V*GREAL(N)
QREAL=HREAL*C(N)-C(N-1)
QIMAG=HIMAG*C(N)
RREAL=HREAL*S(N)-S(N-1)
RIMAG=HIMAG*S(N)
SCONS=RREAL**2+RIMAG**2
SREAL=(QREAL*RREAL-QIMAG*RIMAG)/SCONS
SIMAG=(QIMAG*RREAL-QREAL*RIMAG)/SCONS
BCONS=(1.-SIMAG)**2+SREAL**2
BREAL(N)=(1.-SIMAG)/BCONS
BIMAG(N)=-SREAL/BCONS
TREAL=DREAL*GREAL(N)-DIMAG*GIMAG(N)
TIMAG=DIMAG*GREAL(N)+DREAL*GIMAG(N)
UREAL=P(N)*(1.-DREAL**2+DIMAG**2)/ALPHA
UIMAG=-2.*P(N)*DREAL*DIMAG/ALPHA
VREAL=TREAL+UREAL
VIMAG=TIMAG+UIMAG
WREAL=VREAL*C(N)-C(N-1)
WIMAG=VIMAG*C(N)
XREAL=VREAL*S(N)-S(N-1)
XIMAG=VIMAG*S(N)
YCONS=XREAL**2+XIMAG**2
YREAL=(WREAL*XREAL+WIMAG*XIMAG)/YCONS
YIMAG=(WIMAG*XREAL-WREAL*XIMAG)/YCONS
ACONS=(1.-YIMAG)**2+YREAL**2
AREAL(N)=(1.-YIMAG)/ACONS
AIMAG(N)=-YREAL/ACONS
90 CONTINUE
100 FORMAT(10H1      ALPHA=F5.3,6H      U=F5.3,6H      V=F5.3)
110 FORMAT(72H0      N      A(REAL)      A(IMAG)      B(REAL)
           B(IMAG))
120 FORMAT(1H0I3,4E17.5)
PRINT100,ALPHA,U,V
PRINT110
PRINT 120,(L(N), AREAL(N), AIMAG(N), BREAL(N), BIMAG(N), N=2,
           NFINAL)
D0140M=1,MFINAL
G=M-1

```

```

    ANGLE(M)=ANGSIZ*G
    SARP=0.0
    SART=0.0
    SBRP=0.0
    SBRT=0.0
    SAIP=0.0
    SAIT=0.0
    SBIP=0.0
    SBIT=0.0
    DOL3ON=2,NFINAL
    P(N)=N-1
    Z(N)=(2.*P(N)+1.)/(P(N)*(P(N)+1.))
    ARP=AREAL(N)*Z(N)*PI(N,M)
    SARP=SARP+ARP
    ART=AREAL(N)*Z(N)*TAU(N,M)
    SART=SART+ART
    BRP=BREAL(N)*Z(N)*PI(N,M)
    SBRP=SBRP+BRP
    BRT=BREAL(N)*Z(N)*TAU(N,M)
    SBRT=SBRT+BRT
    AIP=AIMAG(N)*Z(N)*PI(N,M)
    SAIP=SAIP+AIP
    AIT=AIMAG(N)*Z(N)*TAU(N,M)
    SAIT=SAIT+AIT
    BIP=BIMAG(N)*Z(N)*PI(N,M)
    SBIP=SBIP+BIP
    BIT=BIMAG(N)*Z(N)*TAU(N,M)
    SBIT=SBI+BIT
130 CONTINUE
    PRI(M)=(SARP+SBRT)**2.+(SAIP+SBIT)**2.
    PLI(M)=(SART+SBRP)**2.+(SAIT+SBIP)**2.
    TLI(M)=(PRI(M)+PLI(M))/2.
140 CONTINUE
150 FORMAT(72HO      ANGLE          PERPENDICULAR          PARALLEL
           TOTAL)
160 FORMAT(1HOF8.1,3E21.5)
    PRINT150
    PRINT160,(ANGLE(M), PRI(M), PLI(M), TLI(M), M=1, MFINAL)
900 READ50,IND
    GOTO(60,60,70,1000),IND
1000 CALL EXIT
    END

```

APPENDIX D

Tabulation of the Calculated Light-Scattering Functions and Coefficients for Spheres of Arbitrary Size

Two sets of tables are presented. The first set lists the calculated light-scattering functions i_1 and i_2 for the size parameter x ranging from 0.05 in increments of 0.05 up to 2.00 for θ ranging from 0° to 180° in increments of 5° for 14 values of the index of refraction m . Following this set of tables, the light-scattering coefficients a_n and b_n are listed for values of n up to 6 for the same range of x and m . All values of i_1 , i_2 , a_n , and b_n are presented to five significant figures. The exponent associated with these tabulated values is denoted by E , the value of which is determined by the sign and two digits following it. For example, the number followed by $E-08$ is to be multiplied by 10^{-8} .

m = 1.60-0.00 1

θ	$x = 1.55$	$x = 1.60$	$x = 1.65$	$x = 1.70$	$x = 1.75$
0	0.22718E 01	0.24273E 01	0.25241E 01	0.25485E 01	0.25495E 01
5	0.22602E 01	0.24157E 01	0.24995E 01	0.25241E 01	0.25485E 01
10	0.22495E 01	0.24050E 01	0.24838E 01	0.25087E 01	0.25333E 01
15	0.22398E 01	0.23942E 01	0.24730E 01	0.24934E 01	0.25180E 01
20	0.22310E 01	0.23834E 01	0.24622E 01	0.24826E 01	0.25072E 01
25	0.22230E 01	0.23726E 01	0.24514E 01	0.24718E 01	0.24964E 01
30	0.22158E 01	0.23618E 01	0.24406E 01	0.24610E 01	0.24856E 01
35	0.22094E 01	0.23510E 01	0.24298E 01	0.24502E 01	0.24748E 01
40	0.22038E 01	0.23402E 01	0.24190E 01	0.24394E 01	0.24640E 01
45	0.21989E 01	0.23294E 01	0.24082E 01	0.24286E 01	0.24532E 01
50	0.21947E 01	0.23186E 01	0.23974E 01	0.24178E 01	0.24424E 01
55	0.21911E 01	0.23078E 01	0.23866E 01	0.24070E 01	0.24316E 01
60	0.21881E 01	0.22970E 01	0.23758E 01	0.23962E 01	0.24208E 01
65	0.21857E 01	0.22862E 01	0.23650E 01	0.23854E 01	0.24100E 01
70	0.21839E 01	0.22754E 01	0.23542E 01	0.23746E 01	0.23992E 01
75	0.21826E 01	0.22646E 01	0.23434E 01	0.23638E 01	0.23884E 01
80	0.21818E 01	0.22538E 01	0.23326E 01	0.23530E 01	0.23776E 01
85	0.21815E 01	0.22430E 01	0.23218E 01	0.23422E 01	0.23668E 01
90	0.21817E 01	0.22322E 01	0.23110E 01	0.23314E 01	0.23560E 01
95	0.21824E 01	0.22214E 01	0.23002E 01	0.23206E 01	0.23452E 01
100	0.21836E 01	0.22106E 01	0.22894E 01	0.23098E 01	0.23344E 01
105	0.21853E 01	0.22000E 01	0.22786E 01	0.22990E 01	0.23236E 01
110	0.21875E 01	0.21894E 01	0.22678E 01	0.22882E 01	0.23128E 01
115	0.21902E 01	0.21788E 01	0.22570E 01	0.22774E 01	0.23020E 01
120	0.21934E 01	0.21682E 01	0.22462E 01	0.22666E 01	0.22912E 01
125	0.21971E 01	0.21576E 01	0.22354E 01	0.22558E 01	0.22804E 01
130	0.22013E 01	0.21470E 01	0.22246E 01	0.22450E 01	0.22696E 01
135	0.22060E 01	0.21364E 01	0.22138E 01	0.22342E 01	0.22588E 01
140	0.22112E 01	0.21258E 01	0.22030E 01	0.22234E 01	0.22480E 01
145	0.22169E 01	0.21152E 01	0.21922E 01	0.22126E 01	0.22372E 01
150	0.22231E 01	0.21046E 01	0.21814E 01	0.22018E 01	0.22264E 01
155	0.22298E 01	0.20940E 01	0.21706E 01	0.21910E 01	0.22156E 01
160	0.22370E 01	0.20834E 01	0.21598E 01	0.21802E 01	0.22048E 01
165	0.22447E 01	0.20728E 01	0.21490E 01	0.21694E 01	0.21940E 01
170	0.22529E 01	0.20622E 01	0.21382E 01	0.21586E 01	0.21832E 01
175	0.22616E 01	0.20516E 01	0.21274E 01	0.21478E 01	0.21724E 01
180	0.22708E 01	0.20410E 01	0.21166E 01	0.21370E 01	0.21616E 01

θ	$x = 1.05$	$x = 1.10$	$x = 1.15$	$x = 1.20$	$x = 1.25$
0.0	0.01099E-00	0.02330E-00	0.04493E-00	0.79120E-00	0.92946E-00
10.0	0.01692E-00	0.52279E-00	0.64487E-00	0.79120E-00	0.93148E-00
15.0	0.01938E-00	0.52279E-00	0.64487E-00	0.79120E-00	0.93148E-00
20.0	0.02130E-00	0.50532E-00	0.64487E-00	0.79120E-00	0.93148E-00
25.0	0.02258E-00	0.48332E-00	0.64487E-00	0.79120E-00	0.93148E-00
30.0	0.02311E-00	0.45720E-00	0.64487E-00	0.79120E-00	0.93148E-00
35.0	0.02333E-00	0.42714E-00	0.64487E-00	0.79120E-00	0.93148E-00
40.0	0.02311E-00	0.39345E-00	0.64487E-00	0.79120E-00	0.93148E-00
45.0	0.02258E-00	0.35682E-00	0.64487E-00	0.79120E-00	0.93148E-00
50.0	0.02130E-00	0.31767E-00	0.64487E-00	0.79120E-00	0.93148E-00
55.0	0.01938E-00	0.27649E-00	0.64487E-00	0.79120E-00	0.93148E-00
60.0	0.01692E-00	0.23390E-00	0.64487E-00	0.79120E-00	0.93148E-00
65.0	0.01398E-00	0.18955E-00	0.64487E-00	0.79120E-00	0.93148E-00
70.0	0.01099E-00	0.14400E-00	0.64487E-00	0.79120E-00	0.93148E-00
75.0	0.00805E-00	0.09777E-00	0.64487E-00	0.79120E-00	0.93148E-00
80.0	0.00516E-00	0.05148E-00	0.64487E-00	0.79120E-00	0.93148E-00
85.0	0.00233E-00	0.00554E-00	0.64487E-00	0.79120E-00	0.93148E-00
90.0	0.00000E-00	0.00000E-00	0.64487E-00	0.79120E-00	0.93148E-00
95.0	0.00000E-00	0.00000E-00	0.64487E-00	0.79120E-00	0.93148E-00
100.0	0.00000E-00	0.00000E-00	0.64487E-00	0.79120E-00	0.93148E-00

θ	$x = 1.30$	$x = 1.35$	$x = 1.40$	$x = 1.45$	$x = 1.50$
0.0	0.11396E-01	0.13486E-01	0.15950E-01	0.18909E-01	0.21497E-01
10.0	0.11397E-01	0.13490E-01	0.15951E-01	0.18910E-01	0.21498E-01
15.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
20.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
25.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
30.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
35.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
40.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
45.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
50.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
55.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
60.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
65.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
70.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
75.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
80.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
85.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
90.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
95.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01
100.0	0.11397E-01	0.13491E-01	0.15951E-01	0.18910E-01	0.21498E-01

m = 1.60-0.80 1

θ	$x = 1.55$	$x = 1.60$	$x = 1.65$	$x = 1.70$	$x = 1.75$
0	0.24830E 01	0.24830E 01	0.24830E 01	0.24830E 01	0.24830E 01
5	0.24722E 01	0.24722E 01	0.24722E 01	0.24722E 01	0.24722E 01
10	0.24614E 01	0.24614E 01	0.24614E 01	0.24614E 01	0.24614E 01
15	0.24506E 01	0.24506E 01	0.24506E 01	0.24506E 01	0.24506E 01
20	0.24398E 01	0.24398E 01	0.24398E 01	0.24398E 01	0.24398E 01
25	0.24290E 01	0.24290E 01	0.24290E 01	0.24290E 01	0.24290E 01
30	0.24182E 01	0.24182E 01	0.24182E 01	0.24182E 01	0.24182E 01
35	0.24074E 01	0.24074E 01	0.24074E 01	0.24074E 01	0.24074E 01
40	0.23966E 01	0.23966E 01	0.23966E 01	0.23966E 01	0.23966E 01
45	0.23858E 01	0.23858E 01	0.23858E 01	0.23858E 01	0.23858E 01
50	0.23750E 01	0.23750E 01	0.23750E 01	0.23750E 01	0.23750E 01
55	0.23642E 01	0.23642E 01	0.23642E 01	0.23642E 01	0.23642E 01
60	0.23534E 01	0.23534E 01	0.23534E 01	0.23534E 01	0.23534E 01
65	0.23426E 01	0.23426E 01	0.23426E 01	0.23426E 01	0.23426E 01
70	0.23318E 01	0.23318E 01	0.23318E 01	0.23318E 01	0.23318E 01
75	0.23210E 01	0.23210E 01	0.23210E 01	0.23210E 01	0.23210E 01
80	0.23102E 01	0.23102E 01	0.23102E 01	0.23102E 01	0.23102E 01
85	0.22994E 01	0.22994E 01	0.22994E 01	0.22994E 01	0.22994E 01
90	0.22886E 01	0.22886E 01	0.22886E 01	0.22886E 01	0.22886E 01
95	0.22778E 01	0.22778E 01	0.22778E 01	0.22778E 01	0.22778E 01
100	0.22670E 01	0.22670E 01	0.22670E 01	0.22670E 01	0.22670E 01
105	0.22562E 01	0.22562E 01	0.22562E 01	0.22562E 01	0.22562E 01
110	0.22454E 01	0.22454E 01	0.22454E 01	0.22454E 01	0.22454E 01
115	0.22346E 01	0.22346E 01	0.22346E 01	0.22346E 01	0.22346E 01
120	0.22238E 01	0.22238E 01	0.22238E 01	0.22238E 01	0.22238E 01
125	0.22130E 01	0.22130E 01	0.22130E 01	0.22130E 01	0.22130E 01
130	0.22022E 01	0.22022E 01	0.22022E 01	0.22022E 01	0.22022E 01
135	0.21914E 01	0.21914E 01	0.21914E 01	0.21914E 01	0.21914E 01
140	0.21806E 01	0.21806E 01	0.21806E 01	0.21806E 01	0.21806E 01
145	0.21698E 01	0.21698E 01	0.21698E 01	0.21698E 01	0.21698E 01
150	0.21590E 01	0.21590E 01	0.21590E 01	0.21590E 01	0.21590E 01
155	0.21482E 01	0.21482E 01	0.21482E 01	0.21482E 01	0.21482E 01
160	0.21374E 01	0.21374E 01	0.21374E 01	0.21374E 01	0.21374E 01
165	0.21266E 01	0.21266E 01	0.21266E 01	0.21266E 01	0.21266E 01
170	0.21158E 01	0.21158E 01	0.21158E 01	0.21158E 01	0.21158E 01
175	0.21050E 01	0.21050E 01	0.21050E 01	0.21050E 01	0.21050E 01
180	0.20942E 01	0.20942E 01	0.20942E 01	0.20942E 01	0.20942E 01

θ	$x = 1.80$	$x = 1.85$	$x = 1.90$	$x = 1.95$	$x = 2.00$
0	0.46080E 01	0.46080E 01	0.46080E 01	0.46080E 01	0.46080E 01
5	0.45972E 01	0.45972E 01	0.45972E 01	0.45972E 01	0.45972E 01
10	0.45864E 01	0.45864E 01	0.45864E 01	0.45864E 01	0.45864E 01
15	0.45756E 01	0.45756E 01	0.45756E 01	0.45756E 01	0.45756E 01
20	0.45648E 01	0.45648E 01	0.45648E 01	0.45648E 01	0.45648E 01
25	0.45540E 01	0.45540E 01	0.45540E 01	0.45540E 01	0.45540E 01
30	0.45432E 01	0.45432E 01	0.45432E 01	0.45432E 01	0.45432E 01
35	0.45324E 01	0.45324E 01	0.45324E 01	0.45324E 01	0.45324E 01
40	0.45216E 01	0.45216E 01	0.45216E 01	0.45216E 01	0.45216E 01
45	0.45108E 01	0.45108E 01	0.45108E 01	0.45108E 01	0.45108E 01
50	0.45000E 01	0.45000E 01	0.45000E 01	0.45000E 01	0.45000E 01
55	0.44892E 01	0.44892E 01	0.44892E 01	0.44892E 01	0.44892E 01
60	0.44784E 01	0.44784E 01	0.44784E 01	0.44784E 01	0.44784E 01
65	0.44676E 01	0.44676E 01	0.44676E 01	0.44676E 01	0.44676E 01
70	0.44568E 01	0.44568E 01	0.44568E 01	0.44568E 01	0.44568E 01
75	0.44460E 01	0.44460E 01	0.44460E 01	0.44460E 01	0.44460E 01
80	0.44352E 01	0.44352E 01	0.44352E 01	0.44352E 01	0.44352E 01
85	0.44244E 01	0.44244E 01	0.44244E 01	0.44244E 01	0.44244E 01
90	0.44136E 01	0.44136E 01	0.44136E 01	0.44136E 01	0.44136E 01
95	0.44028E 01	0.44028E 01	0.44028E 01	0.44028E 01	0.44028E 01
100	0.43920E 01	0.43920E 01	0.43920E 01	0.43920E 01	0.43920E 01
105	0.43812E 01	0.43812E 01	0.43812E 01	0.43812E 01	0.43812E 01
110	0.43704E 01	0.43704E 01	0.43704E 01	0.43704E 01	0.43704E 01
115	0.43596E 01	0.43596E 01	0.43596E 01	0.43596E 01	0.43596E 01
120	0.43488E 01	0.43488E 01	0.43488E 01	0.43488E 01	0.43488E 01
125	0.43380E 01	0.43380E 01	0.43380E 01	0.43380E 01	0.43380E 01
130	0.43272E 01	0.43272E 01	0.43272E 01	0.43272E 01	0.43272E 01
135	0.43164E 01	0.43164E 01	0.43164E 01	0.43164E 01	0.43164E 01
140	0.43056E 01	0.43056E 01	0.43056E 01	0.43056E 01	0.43056E 01
145	0.42948E 01	0.42948E 01	0.42948E 01	0.42948E 01	0.42948E 01
150	0.42840E 01	0.42840E 01	0.42840E 01	0.42840E 01	0.42840E 01
155	0.42732E 01	0.42732E 01	0.42732E 01	0.42732E 01	0.42732E 01
160	0.42624E 01	0.42624E 01	0.42624E 01	0.42624E 01	0.42624E 01
165	0.42516E 01	0.42516E 01	0.42516E 01	0.42516E 01	0.42516E 01
170	0.42408E 01	0.42408E 01	0.42408E 01	0.42408E 01	0.42408E 01
175	0.42300E 01	0.42300E 01	0.42300E 01	0.42300E 01	0.42300E 01
180	0.42192E 01	0.42192E 01	0.42192E 01	0.42192E 01	0.42192E 01

m = 1.00-1.00 1

θ	$x = 1.05$	$x = 1.10$	$x = 1.15$	$x = 1.20$	$x = 1.25$	$x = 1.30$	$x = 1.35$	$x = 1.40$	$x = 1.45$	$x = 1.50$
0	0.49730E 00	0.46278E 00	0.42782E 00	0.39336E 00	0.35940E 00	0.32594E 00	0.29298E 00	0.26052E 00	0.22856E 00	0.19710E 00
5	0.50270E 00	0.46774E 00	0.43278E 00	0.39832E 00	0.36436E 00	0.33090E 00	0.29794E 00	0.26548E 00	0.23352E 00	0.20206E 00
10	0.50810E 00	0.47314E 00	0.43818E 00	0.40372E 00	0.36976E 00	0.33630E 00	0.30334E 00	0.27088E 00	0.23892E 00	0.20746E 00
15	0.51350E 00	0.47854E 00	0.44358E 00	0.40912E 00	0.37516E 00	0.34170E 00	0.30874E 00	0.27628E 00	0.24432E 00	0.21286E 00
20	0.51890E 00	0.48394E 00	0.44898E 00	0.41452E 00	0.38056E 00	0.34710E 00	0.31414E 00	0.28168E 00	0.24972E 00	0.21826E 00
25	0.52430E 00	0.48934E 00	0.45438E 00	0.41992E 00	0.38596E 00	0.35250E 00	0.31954E 00	0.28708E 00	0.25512E 00	0.22366E 00
30	0.52970E 00	0.49474E 00	0.45978E 00	0.42532E 00	0.39136E 00	0.35790E 00	0.32494E 00	0.29248E 00	0.26052E 00	0.22910E 00
35	0.53510E 00	0.50014E 00	0.46518E 00	0.43072E 00	0.39676E 00	0.36330E 00	0.33034E 00	0.29792E 00	0.26596E 00	0.23454E 00
40	0.54050E 00	0.50554E 00	0.47058E 00	0.43612E 00	0.40216E 00	0.36870E 00	0.33574E 00	0.30336E 00	0.27140E 00	0.24000E 00
45	0.54590E 00	0.51094E 00	0.47598E 00	0.44152E 00	0.40756E 00	0.37410E 00	0.34114E 00	0.30878E 00	0.27684E 00	0.24544E 00
50	0.55130E 00	0.51634E 00	0.48138E 00	0.44692E 00	0.41296E 00	0.37950E 00	0.34654E 00	0.31420E 00	0.28228E 00	0.25088E 00
55	0.55670E 00	0.52174E 00	0.48678E 00	0.45232E 00	0.41836E 00	0.38490E 00	0.35194E 00	0.31964E 00	0.28772E 00	0.25632E 00
60	0.56210E 00	0.52714E 00	0.49218E 00	0.45772E 00	0.42376E 00	0.39030E 00	0.35734E 00	0.32508E 00	0.29316E 00	0.26176E 00
65	0.56750E 00	0.53254E 00	0.49758E 00	0.46312E 00	0.42916E 00	0.39570E 00	0.36274E 00	0.33052E 00	0.29860E 00	0.26720E 00
70	0.57290E 00	0.53794E 00	0.50298E 00	0.46852E 00	0.43456E 00	0.40110E 00	0.36814E 00	0.33596E 00	0.30404E 00	0.27264E 00
75	0.57830E 00	0.54334E 00	0.50838E 00	0.47392E 00	0.43996E 00	0.40650E 00	0.37354E 00	0.34140E 00	0.30948E 00	0.27808E 00
80	0.58370E 00	0.54874E 00	0.51378E 00	0.47932E 00	0.44536E 00	0.41190E 00	0.37894E 00	0.34684E 00	0.31492E 00	0.28352E 00
85	0.58910E 00	0.55414E 00	0.51918E 00	0.48472E 00	0.45076E 00	0.41730E 00	0.38434E 00	0.35228E 00	0.32036E 00	0.28896E 00
90	0.59450E 00	0.55954E 00	0.52458E 00	0.49012E 00	0.45616E 00	0.42270E 00	0.38974E 00	0.35772E 00	0.32580E 00	0.29440E 00
95	0.60000E 00	0.56500E 00	0.53000E 00	0.49552E 00	0.46156E 00	0.42810E 00	0.39514E 00	0.36316E 00	0.33124E 00	0.29984E 00
100	0.60550E 00	0.57050E 00	0.53550E 00	0.50092E 00	0.46696E 00	0.43350E 00	0.40054E 00	0.36860E 00	0.33668E 00	0.30528E 00
105	0.61100E 00	0.57600E 00	0.54100E 00	0.50632E 00	0.47236E 00	0.43890E 00	0.40594E 00	0.37404E 00	0.34212E 00	0.31072E 00
110	0.61650E 00	0.58150E 00	0.54650E 00	0.51172E 00	0.47776E 00	0.44430E 00	0.41134E 00	0.37948E 00	0.34756E 00	0.31616E 00
115	0.62200E 00	0.58700E 00	0.55200E 00	0.51712E 00	0.48316E 00	0.44970E 00	0.41674E 00	0.38492E 00	0.35300E 00	0.32160E 00
120	0.62750E 00	0.59250E 00	0.55750E 00	0.52252E 00	0.48856E 00	0.45510E 00	0.42214E 00	0.39036E 00	0.35844E 00	0.32704E 00
125	0.63300E 00	0.59800E 00	0.56300E 00	0.52792E 00	0.49396E 00	0.46050E 00	0.42754E 00	0.39580E 00	0.36388E 00	0.33248E 00
130	0.63850E 00	0.60350E 00	0.56850E 00	0.53332E 00	0.49936E 00	0.46590E 00	0.43294E 00	0.40124E 00	0.36932E 00	0.33792E 00
135	0.64400E 00	0.60900E 00	0.57400E 00	0.53872E 00	0.50476E 00	0.47130E 00	0.43834E 00	0.40668E 00	0.37476E 00	0.34336E 00
140	0.64950E 00	0.61450E 00	0.57950E 00	0.54412E 00	0.51016E 00	0.47670E 00	0.44374E 00	0.41212E 00	0.38020E 00	0.34880E 00
145	0.65500E 00	0.62000E 00	0.58500E 00	0.54952E 00	0.51556E 00	0.48210E 00	0.44914E 00	0.41756E 00	0.38564E 00	0.35424E 00
150	0.66050E 00	0.62550E 00	0.59050E 00	0.55492E 00	0.52096E 00	0.48750E 00	0.45454E 00	0.42300E 00	0.39108E 00	0.35968E 00
155	0.66600E 00	0.63100E 00	0.59600E 00	0.56032E 00	0.52636E 00	0.49290E 00	0.45994E 00	0.42844E 00	0.39652E 00	0.36512E 00
160	0.67150E 00	0.63650E 00	0.60150E 00	0.56572E 00	0.53176E 00	0.49830E 00	0.46534E 00	0.43388E 00	0.40196E 00	0.37056E 00
165	0.67700E 00	0.64200E 00	0.60700E 00	0.57112E 00	0.53716E 00	0.50370E 00	0.47074E 00	0.43932E 00	0.40740E 00	0.37600E 00
170	0.68250E 00	0.64750E 00	0.61250E 00	0.57652E 00	0.54256E 00	0.50910E 00	0.47614E 00	0.44476E 00	0.41284E 00	0.38144E 00
175	0.68800E 00	0.65300E 00	0.61800E 00	0.58192E 00	0.54796E 00	0.51450E 00	0.48154E 00	0.45020E 00	0.41828E 00	0.38688E 00
180	0.69350E 00	0.65850E 00	0.62350E 00	0.58732E 00	0.55336E 00	0.51990E 00	0.48694E 00	0.45564E 00	0.42372E 00	0.39232E 00

x = 1.55

Table with columns labeled i1, i2, and i3, and rows labeled with values from 0 to 1000. The table contains numerical data for x = 1.55, x = 1.60, x = 1.65, x = 1.70, x = 1.75, and x = 2.00.

m = 1.71-0.76 1

θ	$x = 1.05$	$x = 1.10$	$x = 1.15$	$x = 1.20$	$x = 1.25$
0.0	0.43700E+00	0.57615E+00	0.71418E+00	0.85214E+00	0.10013E+01
5.0	0.43002E+00	0.57134E+00	0.70784E+00	0.84644E+00	0.10013E+01
10.0	0.42304E+00	0.56653E+00	0.70134E+00	0.84094E+00	0.10013E+01
15.0	0.41606E+00	0.56172E+00	0.69484E+00	0.83544E+00	0.10013E+01
20.0	0.40908E+00	0.55691E+00	0.68834E+00	0.82994E+00	0.10013E+01
25.0	0.40210E+00	0.55210E+00	0.68184E+00	0.82444E+00	0.10013E+01
30.0	0.39512E+00	0.54729E+00	0.67534E+00	0.81894E+00	0.10013E+01
35.0	0.38814E+00	0.54248E+00	0.66884E+00	0.81344E+00	0.10013E+01
40.0	0.38116E+00	0.53767E+00	0.66234E+00	0.80794E+00	0.10013E+01
45.0	0.37418E+00	0.53286E+00	0.65584E+00	0.80244E+00	0.10013E+01
50.0	0.36720E+00	0.52805E+00	0.64934E+00	0.79694E+00	0.10013E+01
55.0	0.36022E+00	0.52324E+00	0.64284E+00	0.79144E+00	0.10013E+01
60.0	0.35324E+00	0.51843E+00	0.63634E+00	0.78594E+00	0.10013E+01
65.0	0.34626E+00	0.51362E+00	0.62984E+00	0.78044E+00	0.10013E+01
70.0	0.33928E+00	0.50881E+00	0.62334E+00	0.77494E+00	0.10013E+01
75.0	0.33230E+00	0.50400E+00	0.61684E+00	0.76944E+00	0.10013E+01
80.0	0.32532E+00	0.49919E+00	0.61034E+00	0.76394E+00	0.10013E+01
85.0	0.31834E+00	0.49438E+00	0.60384E+00	0.75844E+00	0.10013E+01
90.0	0.31136E+00	0.48957E+00	0.59734E+00	0.75294E+00	0.10013E+01
95.0	0.30438E+00	0.48476E+00	0.59084E+00	0.74744E+00	0.10013E+01
100.0	0.29740E+00	0.47995E+00	0.58434E+00	0.74194E+00	0.10013E+01
105.0	0.29042E+00	0.47514E+00	0.57784E+00	0.73644E+00	0.10013E+01
110.0	0.28344E+00	0.47033E+00	0.57134E+00	0.73094E+00	0.10013E+01
115.0	0.27646E+00	0.46552E+00	0.56484E+00	0.72544E+00	0.10013E+01
120.0	0.26948E+00	0.46071E+00	0.55834E+00	0.71994E+00	0.10013E+01
125.0	0.26250E+00	0.45590E+00	0.55184E+00	0.71444E+00	0.10013E+01
130.0	0.25552E+00	0.45109E+00	0.54534E+00	0.70894E+00	0.10013E+01
135.0	0.24854E+00	0.44628E+00	0.53884E+00	0.70344E+00	0.10013E+01
140.0	0.24156E+00	0.44147E+00	0.53234E+00	0.69794E+00	0.10013E+01
145.0	0.23458E+00	0.43666E+00	0.52584E+00	0.69244E+00	0.10013E+01
150.0	0.22760E+00	0.43185E+00	0.51934E+00	0.68694E+00	0.10013E+01
155.0	0.22062E+00	0.42704E+00	0.51284E+00	0.68144E+00	0.10013E+01
160.0	0.21364E+00	0.42223E+00	0.50634E+00	0.67594E+00	0.10013E+01
165.0	0.20666E+00	0.41742E+00	0.49984E+00	0.67044E+00	0.10013E+01
170.0	0.19968E+00	0.41261E+00	0.49334E+00	0.66494E+00	0.10013E+01
175.0	0.19270E+00	0.40780E+00	0.48684E+00	0.65944E+00	0.10013E+01
180.0	0.18572E+00	0.40299E+00	0.48034E+00	0.65394E+00	0.10013E+01

θ	$x = 1.30$	$x = 1.35$	$x = 1.40$	$x = 1.45$	$x = 1.50$
0.0	0.12530E+01	0.12530E+01	0.12530E+01	0.12530E+01	0.12530E+01
5.0	0.12480E+01	0.12480E+01	0.12480E+01	0.12480E+01	0.12480E+01
10.0	0.12430E+01	0.12430E+01	0.12430E+01	0.12430E+01	0.12430E+01
15.0	0.12380E+01	0.12380E+01	0.12380E+01	0.12380E+01	0.12380E+01
20.0	0.12330E+01	0.12330E+01	0.12330E+01	0.12330E+01	0.12330E+01
25.0	0.12280E+01	0.12280E+01	0.12280E+01	0.12280E+01	0.12280E+01
30.0	0.12230E+01	0.12230E+01	0.12230E+01	0.12230E+01	0.12230E+01
35.0	0.12180E+01	0.12180E+01	0.12180E+01	0.12180E+01	0.12180E+01
40.0	0.12130E+01	0.12130E+01	0.12130E+01	0.12130E+01	0.12130E+01
45.0	0.12080E+01	0.12080E+01	0.12080E+01	0.12080E+01	0.12080E+01
50.0	0.12030E+01	0.12030E+01	0.12030E+01	0.12030E+01	0.12030E+01
55.0	0.11980E+01	0.11980E+01	0.11980E+01	0.11980E+01	0.11980E+01
60.0	0.11930E+01	0.11930E+01	0.11930E+01	0.11930E+01	0.11930E+01
65.0	0.11880E+01	0.11880E+01	0.11880E+01	0.11880E+01	0.11880E+01
70.0	0.11830E+01	0.11830E+01	0.11830E+01	0.11830E+01	0.11830E+01
75.0	0.11780E+01	0.11780E+01	0.11780E+01	0.11780E+01	0.11780E+01
80.0	0.11730E+01	0.11730E+01	0.11730E+01	0.11730E+01	0.11730E+01
85.0	0.11680E+01	0.11680E+01	0.11680E+01	0.11680E+01	0.11680E+01
90.0	0.11630E+01	0.11630E+01	0.11630E+01	0.11630E+01	0.11630E+01
95.0	0.11580E+01	0.11580E+01	0.11580E+01	0.11580E+01	0.11580E+01
100.0	0.11530E+01	0.11530E+01	0.11530E+01	0.11530E+01	0.11530E+01
105.0	0.11480E+01	0.11480E+01	0.11480E+01	0.11480E+01	0.11480E+01
110.0	0.11430E+01	0.11430E+01	0.11430E+01	0.11430E+01	0.11430E+01
115.0	0.11380E+01	0.11380E+01	0.11380E+01	0.11380E+01	0.11380E+01
120.0	0.11330E+01	0.11330E+01	0.11330E+01	0.11330E+01	0.11330E+01
125.0	0.11280E+01	0.11280E+01	0.11280E+01	0.11280E+01	0.11280E+01
130.0	0.11230E+01	0.11230E+01	0.11230E+01	0.11230E+01	0.11230E+01
135.0	0.11180E+01	0.11180E+01	0.11180E+01	0.11180E+01	0.11180E+01
140.0	0.11130E+01	0.11130E+01	0.11130E+01	0.11130E+01	0.11130E+01
145.0	0.11080E+01	0.11080E+01	0.11080E+01	0.11080E+01	0.11080E+01
150.0	0.11030E+01	0.11030E+01	0.11030E+01	0.11030E+01	0.11030E+01
155.0	0.10980E+01	0.10980E+01	0.10980E+01	0.10980E+01	0.10980E+01
160.0	0.10930E+01	0.10930E+01	0.10930E+01	0.10930E+01	0.10930E+01
165.0	0.10880E+01	0.10880E+01	0.10880E+01	0.10880E+01	0.10880E+01
170.0	0.10830E+01	0.10830E+01	0.10830E+01	0.10830E+01	0.10830E+01
175.0	0.10780E+01	0.10780E+01	0.10780E+01	0.10780E+01	0.10780E+01
180.0	0.10730E+01	0.10730E+01	0.10730E+01	0.10730E+01	0.10730E+01

θ	$x = 1.35$	$x = 1.60$	$x = 1.85$	$x = 1.80$	$x = 1.75$	$x = 2.00$
0.	I_1	I_2	I_1	I_2	I_1	I_2
5.0	0.26492Z 01	0.24922E 01	0.30031E 01	0.20931E 01	0.40509E 01	0.46303E 01
10.0	0.23149E 01	0.24688E 01	0.30537E 01	0.20855E 01	0.40053E 01	0.46413E 01
15.0	0.23467E 01	0.24720E 01	0.30729E 01	0.21038E 01	0.39727E 01	0.46544E 01
20.0	0.23544E 01	0.24750E 01	0.29946E 01	0.21217E 01	0.39217E 01	0.46784E 01
25.0	0.23599E 01	0.24778E 01	0.29159E 01	0.21392E 01	0.38722E 01	0.47033E 01
30.0	0.23635E 01	0.24804E 01	0.28370E 01	0.21563E 01	0.38242E 01	0.47291E 01
35.0	0.23654E 01	0.24827E 01	0.27581E 01	0.21731E 01	0.37776E 01	0.47557E 01
40.0	0.23666E 01	0.24847E 01	0.26792E 01	0.21896E 01	0.37326E 01	0.47831E 01
45.0	0.23671E 01	0.24864E 01	0.26003E 01	0.22059E 01	0.36891E 01	0.48113E 01
50.0	0.23669E 01	0.24878E 01	0.25214E 01	0.22219E 01	0.36471E 01	0.48403E 01
55.0	0.23661E 01	0.24889E 01	0.24425E 01	0.22376E 01	0.36066E 01	0.48701E 01
60.0	0.23648E 01	0.24897E 01	0.23636E 01	0.22531E 01	0.35676E 01	0.49007E 01
65.0	0.23631E 01	0.24902E 01	0.22847E 01	0.22683E 01	0.35301E 01	0.49321E 01
70.0	0.23610E 01	0.24905E 01	0.22058E 01	0.22833E 01	0.34941E 01	0.49643E 01
75.0	0.23585E 01	0.24906E 01	0.21269E 01	0.22981E 01	0.34596E 01	0.50073E 01
80.0	0.23557E 01	0.24905E 01	0.20480E 01	0.23127E 01	0.34266E 01	0.50520E 01
85.0	0.23526E 01	0.24902E 01	0.19691E 01	0.23271E 01	0.33951E 01	0.50984E 01
90.0	0.23492E 01	0.24897E 01	0.18902E 01	0.23413E 01	0.33651E 01	0.51465E 01
95.0	0.23456E 01	0.24890E 01	0.18113E 01	0.23554E 01	0.33366E 01	0.51963E 01
100.0	0.23417E 01	0.24881E 01	0.17324E 01	0.23694E 01	0.33096E 01	0.52478E 01
105.0	0.23376E 01	0.24870E 01	0.16535E 01	0.23833E 01	0.32841E 01	0.53010E 01
110.0	0.23332E 01	0.24858E 01	0.15746E 01	0.23971E 01	0.32599E 01	0.53559E 01
115.0	0.23286E 01	0.24844E 01	0.14957E 01	0.24108E 01	0.32372E 01	0.54125E 01
120.0	0.23238E 01	0.24829E 01	0.14168E 01	0.24244E 01	0.32159E 01	0.54708E 01
125.0	0.23188E 01	0.24812E 01	0.13379E 01	0.24379E 01	0.31960E 01	0.55308E 01
130.0	0.23136E 01	0.24794E 01	0.12590E 01	0.24513E 01	0.31775E 01	0.55925E 01
135.0	0.23082E 01	0.24775E 01	0.11801E 01	0.24646E 01	0.31604E 01	0.56559E 01
140.0	0.23027E 01	0.24754E 01	0.11012E 01	0.24778E 01	0.31447E 01	0.57210E 01
145.0	0.22970E 01	0.24732E 01	0.10223E 01	0.24909E 01	0.31304E 01	0.57878E 01
150.0	0.22912E 01	0.24709E 01	0.09434E 01	0.25039E 01	0.31175E 01	0.58563E 01
155.0	0.22853E 01	0.24685E 01	0.08645E 01	0.25168E 01	0.31060E 01	0.59265E 01
160.0	0.22794E 01	0.24660E 01	0.07856E 01	0.25296E 01	0.30959E 01	0.59984E 01
165.0	0.22735E 01	0.24634E 01	0.07067E 01	0.25424E 01	0.30872E 01	0.60719E 01
170.0	0.22675E 01	0.24608E 01	0.06278E 01	0.25551E 01	0.30799E 01	0.61470E 01
175.0	0.22615E 01	0.24581E 01	0.05489E 01	0.25678E 01	0.30739E 01	0.62237E 01
180.0	0.22554E 01	0.24554E 01	0.04700E 01	0.25804E 01	0.30692E 01	0.63020E 01
185.0	0.22493E 01	0.24526E 01	0.03911E 01	0.25929E 01	0.30657E 01	0.63819E 01
190.0	0.22432E 01	0.24498E 01	0.03122E 01	0.26054E 01	0.30634E 01	0.64634E 01
195.0	0.22370E 01	0.24469E 01	0.02333E 01	0.26179E 01	0.30622E 01	0.65465E 01
200.0	0.22308E 01	0.24440E 01	0.01544E 01	0.26304E 01	0.30621E 01	0.66312E 01
205.0	0.22245E 01	0.24411E 01	0.00755E 01	0.26429E 01	0.30631E 01	0.67175E 01
210.0	0.22182E 01	0.24382E 01	0.00000E 01	0.26554E 01	0.30651E 01	0.68054E 01
215.0	0.22119E 01	0.24353E 01	0.00000E 01	0.26679E 01	0.30681E 01	0.68949E 01
220.0	0.22056E 01	0.24324E 01	0.00000E 01	0.26804E 01	0.30721E 01	0.69860E 01
225.0	0.21993E 01	0.24295E 01	0.00000E 01	0.26929E 01	0.30771E 01	0.70787E 01
230.0	0.21930E 01	0.24266E 01	0.00000E 01	0.27054E 01	0.30831E 01	0.71730E 01
235.0	0.21867E 01	0.24237E 01	0.00000E 01	0.27179E 01	0.30901E 01	0.72689E 01
240.0	0.21804E 01	0.24208E 01	0.00000E 01	0.27304E 01	0.30981E 01	0.73664E 01
245.0	0.21741E 01	0.24179E 01	0.00000E 01	0.27429E 01	0.31071E 01	0.74655E 01
250.0	0.21678E 01	0.24150E 01	0.00000E 01	0.27554E 01	0.31171E 01	0.75662E 01
255.0	0.21615E 01	0.24121E 01	0.00000E 01	0.27679E 01	0.31281E 01	0.76685E 01
260.0	0.21552E 01	0.24092E 01	0.00000E 01	0.27804E 01	0.31401E 01	0.77724E 01
265.0	0.21489E 01	0.24063E 01	0.00000E 01	0.27929E 01	0.31531E 01	0.78779E 01
270.0	0.21426E 01	0.24034E 01	0.00000E 01	0.28054E 01	0.31671E 01	0.79850E 01
275.0	0.21363E 01	0.24005E 01	0.00000E 01	0.28179E 01	0.31821E 01	0.80937E 01
280.0	0.21300E 01	0.23976E 01	0.00000E 01	0.28304E 01	0.31981E 01	0.82040E 01
285.0	0.21237E 01	0.23947E 01	0.00000E 01	0.28429E 01	0.32151E 01	0.83159E 01
290.0	0.21174E 01	0.23918E 01	0.00000E 01	0.28554E 01	0.32331E 01	0.84294E 01
295.0	0.21111E 01	0.23889E 01	0.00000E 01	0.28679E 01	0.32521E 01	0.85445E 01
300.0	0.21048E 01	0.23860E 01	0.00000E 01	0.28804E 01	0.32721E 01	0.86612E 01
305.0	0.20985E 01	0.23831E 01	0.00000E 01	0.28929E 01	0.32931E 01	0.87795E 01
310.0	0.20922E 01	0.23802E 01	0.00000E 01	0.29054E 01	0.33151E 01	0.89004E 01
315.0	0.20859E 01	0.23773E 01	0.00000E 01	0.29179E 01	0.33381E 01	0.90239E 01
320.0	0.20796E 01	0.23744E 01	0.00000E 01	0.29304E 01	0.33621E 01	0.91490E 01
325.0	0.20733E 01	0.23715E 01	0.00000E 01	0.29429E 01	0.33871E 01	0.92757E 01
330.0	0.20670E 01	0.23686E 01	0.00000E 01	0.29554E 01	0.34131E 01	0.94040E 01
335.0	0.20607E 01	0.23657E 01	0.00000E 01	0.29679E 01	0.34401E 01	0.95339E 01
340.0	0.20544E 01	0.23628E 01	0.00000E 01	0.29804E 01	0.34681E 01	0.96654E 01
345.0	0.20481E 01	0.23599E 01	0.00000E 01	0.29929E 01	0.34971E 01	0.97985E 01
350.0	0.20418E 01	0.23570E 01	0.00000E 01	0.30054E 01	0.35271E 01	0.99332E 01
355.0	0.20355E 01	0.23541E 01	0.00000E 01	0.30179E 01	0.35581E 01	1.00695E 01
360.0	0.20292E 01	0.23512E 01	0.00000E 01	0.30304E 01	0.35901E 01	1.02074E 01
365.0	0.20229E 01	0.23483E 01	0.00000E 01	0.30429E 01	0.36231E 01	1.03469E 01
370.0	0.20166E 01	0.23454E 01	0.00000E 01	0.30554E 01	0.36571E 01	1.04880E 01
375.0	0.20103E 01	0.23425E 01	0.00000E 01	0.30679E 01	0.36921E 01	1.06307E 01
380.0	0.20040E 01	0.23396E 01	0.00000E 01	0.30804E 01	0.37281E 01	1.07750E 01
385.0	0.19977E 01	0.23367E 01	0.00000E 01	0.30929E 01	0.37651E 01	1.09209E 01
390.0	0.19914E 01	0.23338E 01	0.00000E 01	0.31054E 01	0.38031E 01	1.10684E 01
395.0	0.19851E 01	0.23309E 01	0.00000E 01	0.31179E 01	0.38421E 01	1.12175E 01
400.0	0.19788E 01	0.23280E 01	0.00000E 01	0.31304E 01	0.38821E 01	1.13682E 01
405.0	0.19725E 01	0.23251E 01	0.00000E 01	0.31429E 01	0.39231E 01	1.15205E 01
410.0	0.19662E 01	0.23222E 01	0.00000E 01	0.31554E 01	0.39651E 01	1.16744E 01
415.0	0.19599E 01	0.23193E 01	0.00000E 01	0.31679E 01	0.40081E 01	1.18299E 01
420.0	0.19536E 01	0.23164E 01	0.00000E 01	0.31804E 01	0.40521E 01	1.19870E 01
425.0	0.19473E 01	0.23135E 01	0.00000E 01	0.31929E 01	0.40971E 01	1.21457E 01
430.0	0.19410E 01	0.23106E 01	0.00000E 01	0.32054E 01	0.41431E 01	1.23060E 01
435.0	0.19347E 01	0.23077E 01	0.00000E 01	0.32179E 01	0.41901E 01	1.24679E 01
440.0	0.19284E 01	0.23048E 01	0.00000E 01	0.32304E 01	0.42381E 01	1.26314E 01
445.0	0.19221E 01	0.23019E 01	0.00000E 01	0.32429E 01	0.42871E 01	1.27965E 01
450.0	0.19158E 01	0.22990E 01	0.00000E 01	0.32554E 01	0.43371E 01	1.29632E 01
455.0	0.19095E 01	0.22961E 01	0.00000E 01	0.32679E 01	0.43881E 01	1.31315E 01
460.0	0.19032E 01	0.22932E 01	0.00000E 01	0.32804E 01	0.44401E 01	1.33014E 01
465.0	0.18969E 01	0.22903E 01	0.00000E 01	0.32929E 01	0.44931E 01	1.34729E 01
470.0	0.18906E 01	0.22874E 01	0.00000E 01	0.33054E 01	0.45471E 01	1.36460E 01
475.0	0.18843E 01	0.22845E 01	0.00000E 01	0.33179E 01	0.46021E 01	1.38207E 01
480.0	0.18780E 01	0.22816E 01	0.00000E 01	0.33304E 01	0.46581E 01	1.39970E 01
485.0	0.18717E 01	0.22787E 01	0.00000E 01	0.33429E 01	0.47151E 01	1.41749E 01
490.0	0.18654E 01	0.22758E 01	0.00000E 01	0.33554E 01	0.47731E 01	1.43544E 01
495.0	0.18591E 01	0.22729E 01	0.00000E 01	0.33679E 01	0.48321E 01	1.45355E 01
500.0	0.18528E 01	0.22700E 01	0.00000E 01	0.33804E 01	0.48921E 01	1.47182E 01
505.0	0.18465E 01	0.22671E 01	0.00000E 01	0.33929E 01	0.49531E 01	1.49025E 01
510.0	0.18402E 01	0.22642E 01	0.00000E 01	0.34054E 01	0.50151E 01	1.50884E 01
515.0	0.18339E 01	0.22613E 01	0.00000E 01	0.34179E 01	0.50781E 01	1.52759E 01
520.0	0.18276E 01	0.22584E 01	0.00000E 01	0.34304E 01	0.51421E 01	1.54650E 01
525.0	0.18213E 01	0.22555E 01	0.00000E 01	0.34429E 01	0.52071E 01	1.56557E 01
530.0	0.18150E 01	0.22526E 01	0.00000E 01	0.34554E 01	0.52731E 01	1.58480E 01
535.0	0.18087E 01	0.22497E 01	0.00000E 01	0.34679E 01	0.53401E 01	1.60419E 01
540.0	0.18024E 01	0.22468E 01	0.00000E 01	0.34804E 01	0.54081E 01	1.62374E 01
545.0	0.17961E 01	0.22439E 01	0.00000E 01	0.34929E 01	0.54771E 01	1.64345E 01
550.0	0.17898E 01	0.22410E 01	0.00000E 01	0.35054E 01	0.55471E 01	1.66332E 01
555.0	0.17835E 01	0.22381				

m = 1.76-0.79 1

θ	$x = 1.05$	$x = 1.10$	$x = 1.15$	$x = 1.20$	$x = 1.25$	$x = 1.30$	$x = 1.35$	$x = 1.40$	$x = 1.45$	$x = 1.50$
0	0.51333E 00	0.44303E 00	0.37472E 00	0.30937E 00	0.24802E 00	0.19167E 00	0.14032E 00	0.09397E 00	0.05262E 00	0.01627E 00
50	0.51223E 00	0.44349E 00	0.37528E 00	0.31037E 00	0.24902E 00	0.19267E 00	0.14132E 00	0.09497E 00	0.05362E 00	0.01737E 00
100	0.50986E 00	0.44388E 00	0.37568E 00	0.31077E 00	0.24942E 00	0.19307E 00	0.14172E 00	0.09537E 00	0.05402E 00	0.01847E 00
150	0.50651E 00	0.44421E 00	0.37603E 00	0.31117E 00	0.24982E 00	0.19347E 00	0.14212E 00	0.09577E 00	0.05442E 00	0.01957E 00
200	0.50228E 00	0.44449E 00	0.37633E 00	0.31157E 00	0.25022E 00	0.19387E 00	0.14252E 00	0.09617E 00	0.05482E 00	0.02067E 00
250	0.49727E 00	0.44472E 00	0.37658E 00	0.31197E 00	0.25062E 00	0.19427E 00	0.14292E 00	0.09657E 00	0.05522E 00	0.02177E 00
300	0.49158E 00	0.44491E 00	0.37678E 00	0.31237E 00	0.25102E 00	0.19467E 00	0.14332E 00	0.09697E 00	0.05562E 00	0.02287E 00
350	0.48531E 00	0.44506E 00	0.37693E 00	0.31277E 00	0.25142E 00	0.19507E 00	0.14372E 00	0.09737E 00	0.05602E 00	0.02397E 00
400	0.47856E 00	0.44517E 00	0.37703E 00	0.31317E 00	0.25182E 00	0.19547E 00	0.14412E 00	0.09777E 00	0.05642E 00	0.02507E 00
450	0.47143E 00	0.44524E 00	0.37708E 00	0.31357E 00	0.25222E 00	0.19587E 00	0.14452E 00	0.09817E 00	0.05682E 00	0.02617E 00
500	0.46402E 00	0.44528E 00	0.37708E 00	0.31397E 00	0.25262E 00	0.19627E 00	0.14492E 00	0.09857E 00	0.05722E 00	0.02727E 00
550	0.45643E 00	0.44529E 00	0.37703E 00	0.31437E 00	0.25302E 00	0.19667E 00	0.14532E 00	0.09897E 00	0.05762E 00	0.02837E 00
600	0.44876E 00	0.44527E 00	0.37693E 00	0.31477E 00	0.25342E 00	0.19707E 00	0.14572E 00	0.09937E 00	0.05802E 00	0.02947E 00
650	0.44111E 00	0.44522E 00	0.37678E 00	0.31517E 00	0.25382E 00	0.19747E 00	0.14612E 00	0.09977E 00	0.05842E 00	0.03057E 00
700	0.43358E 00	0.44514E 00	0.37658E 00	0.31557E 00	0.25422E 00	0.19787E 00	0.14652E 00	0.10017E 00	0.05882E 00	0.03167E 00
750	0.42627E 00	0.44503E 00	0.37633E 00	0.31597E 00	0.25462E 00	0.19827E 00	0.14692E 00	0.10057E 00	0.05922E 00	0.03277E 00
800	0.41918E 00	0.44489E 00	0.37603E 00	0.31637E 00	0.25502E 00	0.19867E 00	0.14732E 00	0.10097E 00	0.05962E 00	0.03387E 00
850	0.41241E 00	0.44472E 00	0.37568E 00	0.31677E 00	0.25542E 00	0.19907E 00	0.14772E 00	0.10137E 00	0.06002E 00	0.03497E 00
900	0.40606E 00	0.44452E 00	0.37528E 00	0.31717E 00	0.25582E 00	0.19947E 00	0.14812E 00	0.10177E 00	0.06042E 00	0.03607E 00
950	0.40013E 00	0.44429E 00	0.37478E 00	0.31757E 00	0.25622E 00	0.19987E 00	0.14852E 00	0.10217E 00	0.06082E 00	0.03717E 00
1000	0.39462E 00	0.44403E 00	0.37418E 00	0.31797E 00	0.25662E 00	0.20027E 00	0.14892E 00	0.10257E 00	0.06122E 00	0.03827E 00

θ	$x = 1.55$	$x = 1.60$	$x = 1.65$	$x = 1.80$	$x = 1.85$	$x = 1.90$	$x = 1.95$	$x = 2.00$
0	0.28870E 01	0.33062E 01	0.37742E 01	0.42939E 01	0.48644E 01	0.54866E 01	0.61716E 01	0.69200E 01
5	0.29714E 01	0.32648E 01	0.35704E 01	0.38880E 01	0.42176E 01	0.45692E 01	0.49428E 01	0.53384E 01
10	0.27246E 01	0.32294E 01	0.33168E 01	0.33800E 01	0.34176E 01	0.34292E 01	0.34148E 01	0.33834E 01
15	0.24748E 01	0.30142E 01	0.27918E 01	0.25800E 01	0.23812E 01	0.21968E 01	0.20278E 01	0.18744E 01
20	0.23395E 01	0.27918E 01	0.25718E 01	0.23640E 01	0.21712E 01	0.19938E 01	0.18318E 01	0.16854E 01
25	0.23746E 01	0.26787E 01	0.24839E 01	0.23040E 01	0.21372E 01	0.19848E 01	0.18468E 01	0.17234E 01
30	0.25095E 01	0.26787E 01	0.24839E 01	0.23040E 01	0.21372E 01	0.19848E 01	0.18468E 01	0.17234E 01
35	0.27398E 01	0.27718E 01	0.25718E 01	0.23640E 01	0.21712E 01	0.19938E 01	0.18318E 01	0.16854E 01
40	0.30648E 01	0.31139E 01	0.29242E 01	0.27348E 01	0.25454E 01	0.23560E 01	0.21666E 01	0.19772E 01
45	0.34898E 01	0.35430E 01	0.33533E 01	0.31636E 01	0.29739E 01	0.27842E 01	0.25945E 01	0.24048E 01
50	0.39148E 01	0.39740E 01	0.37843E 01	0.35946E 01	0.34049E 01	0.32152E 01	0.30255E 01	0.28358E 01
55	0.43398E 01	0.44030E 01	0.42133E 01	0.40236E 01	0.38339E 01	0.36442E 01	0.34545E 01	0.32648E 01
60	0.47648E 01	0.48340E 01	0.46443E 01	0.44546E 01	0.42649E 01	0.40752E 01	0.38855E 01	0.36958E 01
65	0.51898E 01	0.52640E 01	0.50743E 01	0.48846E 01	0.46949E 01	0.45052E 01	0.43155E 01	0.41258E 01
70	0.56148E 01	0.56940E 01	0.55043E 01	0.53146E 01	0.51249E 01	0.49352E 01	0.47455E 01	0.45558E 01
75	0.60398E 01	0.61240E 01	0.59343E 01	0.57446E 01	0.55549E 01	0.53652E 01	0.51755E 01	0.49858E 01
80	0.64648E 01	0.65540E 01	0.63643E 01	0.61746E 01	0.59849E 01	0.57952E 01	0.56055E 01	0.54158E 01
85	0.68898E 01	0.69840E 01	0.67943E 01	0.66046E 01	0.64149E 01	0.62252E 01	0.60355E 01	0.58458E 01
90	0.73148E 01	0.74140E 01	0.72243E 01	0.70346E 01	0.68449E 01	0.66552E 01	0.64655E 01	0.62758E 01
95	0.77398E 01	0.78440E 01	0.76543E 01	0.74646E 01	0.72749E 01	0.70852E 01	0.68955E 01	0.67058E 01
100	0.81648E 01	0.82740E 01	0.80843E 01	0.78946E 01	0.77049E 01	0.75152E 01	0.73255E 01	0.71358E 01
105	0.85898E 01	0.87040E 01	0.85143E 01	0.83246E 01	0.81349E 01	0.79452E 01	0.77555E 01	0.75658E 01
110	0.90148E 01	0.91340E 01	0.89443E 01	0.87546E 01	0.85649E 01	0.83752E 01	0.81855E 01	0.80058E 01
115	0.94398E 01	0.95640E 01	0.93743E 01	0.91846E 01	0.89949E 01	0.88052E 01	0.86155E 01	0.84258E 01
120	0.98648E 01	0.99940E 01	0.98043E 01	0.96146E 01	0.94249E 01	0.92352E 01	0.90455E 01	0.88558E 01
125	1.02898E 01	1.04240E 01	1.02343E 01	1.00446E 01	0.98549E 01	0.96652E 01	0.94755E 01	0.92858E 01
130	1.07148E 01	1.08540E 01	1.06643E 01	1.04746E 01	1.02849E 01	1.00952E 01	0.99055E 01	0.97158E 01
135	1.11398E 01	1.12840E 01	1.10943E 01	1.09046E 01	1.07149E 01	1.05252E 01	1.03355E 01	1.01458E 01
140	1.15648E 01	1.17140E 01	1.15243E 01	1.13346E 01	1.11449E 01	1.09552E 01	1.07655E 01	1.05758E 01
145	1.19898E 01	1.21440E 01	1.19543E 01	1.17646E 01	1.15749E 01	1.13852E 01	1.11955E 01	1.10058E 01
150	1.24148E 01	1.25740E 01	1.23843E 01	1.21946E 01	1.20049E 01	1.18152E 01	1.16255E 01	1.14358E 01
155	1.28398E 01	1.30040E 01	1.28143E 01	1.26246E 01	1.24349E 01	1.22452E 01	1.20555E 01	1.18658E 01
160	1.32648E 01	1.34340E 01	1.32443E 01	1.30546E 01	1.28649E 01	1.26752E 01	1.24855E 01	1.22958E 01
165	1.36898E 01	1.38640E 01	1.36743E 01	1.34846E 01	1.32949E 01	1.31052E 01	1.29155E 01	1.27258E 01
170	1.41148E 01	1.42940E 01	1.41043E 01	1.39146E 01	1.37249E 01	1.35352E 01	1.33455E 01	1.31558E 01
175	1.45398E 01	1.47240E 01	1.45343E 01	1.43446E 01	1.41549E 01	1.39652E 01	1.37755E 01	1.35858E 01
180	1.49648E 01	1.51540E 01	1.49743E 01	1.47846E 01	1.45949E 01	1.44052E 01	1.42155E 01	1.40258E 01
185	1.53898E 01	1.55840E 01	1.53943E 01	1.52046E 01	1.50149E 01	1.48252E 01	1.46355E 01	1.44458E 01
190	1.58148E 01	1.60140E 01	1.58243E 01	1.56346E 01	1.54449E 01	1.52552E 01	1.50655E 01	1.48758E 01
195	1.62398E 01	1.64440E 01	1.62443E 01	1.60546E 01	1.58649E 01	1.56752E 01	1.54855E 01	1.52958E 01
200	1.66648E 01	1.68740E 01	1.66743E 01	1.64846E 01	1.62949E 01	1.61052E 01	1.59155E 01	1.57258E 01

m = 1.00-0.60

θ	$\alpha = 0.55$	$\alpha = 0.60$	$\alpha = 0.65$	$\alpha = 0.70$	$\alpha = 0.75$	$\alpha = 0.80$	$\alpha = 0.85$	$\alpha = 0.90$	$\alpha = 0.95$	$\alpha = 1.00$
0.0	0.937700E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.937700E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
10.0	0.95444E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.95444E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
20.0	0.97771E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.97771E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
30.0	0.99427E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99427E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
40.0	0.99818E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99818E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
50.0	0.99931E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99931E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
60.0	0.99973E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99973E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
70.0	0.99987E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99987E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
80.0	0.99994E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99994E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
90.0	0.99997E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99997E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
100.0	0.99998E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99998E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
110.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
120.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
130.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
140.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
150.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
160.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
170.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01
180.0	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01	0.99999E-02	0.16678E-01	0.27123E-01	0.42920E-01	0.64662E-01

θ	$x = 1.05$	$x = 1.10$	$x = 1.15$	$x = 1.20$	$x = 1.25$
0.0	0.44347E-00	0.59591E-00	0.74801E-00	0.89242E-00	0.11283E-01
5.0	0.44313E-00	0.59532E-00	0.74749E-00	0.89187E-00	0.11144E-01
10.0	0.44278E-00	0.59473E-00	0.74697E-00	0.89132E-00	0.11005E-01
15.0	0.44243E-00	0.59414E-00	0.74645E-00	0.89077E-00	0.10866E-01
20.0	0.44208E-00	0.59355E-00	0.74593E-00	0.89022E-00	0.10727E-01
25.0	0.44173E-00	0.59296E-00	0.74541E-00	0.88967E-00	0.10588E-01
30.0	0.44138E-00	0.59237E-00	0.74489E-00	0.88912E-00	0.10449E-01
35.0	0.44103E-00	0.59178E-00	0.74437E-00	0.88857E-00	0.10310E-01
40.0	0.44068E-00	0.59119E-00	0.74385E-00	0.88802E-00	0.10171E-01
45.0	0.44033E-00	0.59060E-00	0.74333E-00	0.88747E-00	0.10032E-01
50.0	0.43998E-00	0.59001E-00	0.74281E-00	0.88692E-00	0.09893E-01
55.0	0.43963E-00	0.58942E-00	0.74229E-00	0.88637E-00	0.09754E-01
60.0	0.43928E-00	0.58883E-00	0.74177E-00	0.88582E-00	0.09615E-01
65.0	0.43893E-00	0.58824E-00	0.74125E-00	0.88527E-00	0.09476E-01
70.0	0.43858E-00	0.58765E-00	0.74073E-00	0.88472E-00	0.09337E-01
75.0	0.43823E-00	0.58706E-00	0.74021E-00	0.88417E-00	0.09198E-01
80.0	0.43788E-00	0.58647E-00	0.73969E-00	0.88362E-00	0.09059E-01
85.0	0.43753E-00	0.58588E-00	0.73917E-00	0.88307E-00	0.08920E-01
90.0	0.43718E-00	0.58529E-00	0.73865E-00	0.88252E-00	0.08781E-01
95.0	0.43683E-00	0.58470E-00	0.73813E-00	0.88197E-00	0.08642E-01
100.0	0.43648E-00	0.58411E-00	0.73761E-00	0.88142E-00	0.08503E-01
105.0	0.43613E-00	0.58352E-00	0.73709E-00	0.88087E-00	0.08364E-01
110.0	0.43578E-00	0.58293E-00	0.73657E-00	0.88032E-00	0.08225E-01
115.0	0.43543E-00	0.58234E-00	0.73605E-00	0.87977E-00	0.08086E-01
120.0	0.43508E-00	0.58175E-00	0.73553E-00	0.87922E-00	0.07947E-01
125.0	0.43473E-00	0.58116E-00	0.73501E-00	0.87867E-00	0.07808E-01
130.0	0.43438E-00	0.58057E-00	0.73449E-00	0.87812E-00	0.07669E-01
135.0	0.43403E-00	0.57998E-00	0.73397E-00	0.87757E-00	0.07530E-01
140.0	0.43368E-00	0.57939E-00	0.73345E-00	0.87702E-00	0.07391E-01
145.0	0.43333E-00	0.57880E-00	0.73293E-00	0.87647E-00	0.07252E-01
150.0	0.43298E-00	0.57821E-00	0.73241E-00	0.87592E-00	0.07113E-01
155.0	0.43263E-00	0.57762E-00	0.73189E-00	0.87537E-00	0.06974E-01
160.0	0.43228E-00	0.57703E-00	0.73137E-00	0.87482E-00	0.06835E-01

m = 1.00-0.60 1

θ	$x = 1.55$	$x = 1.60$	$x = 1.65$	$x = 1.70$	$x = 1.75$	$x = 2.00$
0	0.29165E 01	0.31947E 01	0.35192E 01	0.38916E 01	0.43192E 01	0.48034E 01
5	0.27407E 01	0.30222E 01	0.33519E 01	0.37277E 01	0.41592E 01	0.46438E 01
10	0.25846E 01	0.28695E 01	0.32030E 01	0.35788E 01	0.40092E 01	0.44938E 01
15	0.24460E 01	0.27275E 01	0.30635E 01	0.34378E 01	0.38682E 01	0.43538E 01
20	0.23222E 01	0.25937E 01	0.29359E 01	0.33050E 01	0.37354E 01	0.42240E 01
25	0.22104E 01	0.24751E 01	0.28270E 01	0.31884E 01	0.36286E 01	0.41142E 01
30	0.21088E 01	0.23698E 01	0.27270E 01	0.30870E 01	0.35338E 01	0.40142E 01
35	0.20160E 01	0.22760E 01	0.26330E 01	0.29910E 01	0.34492E 01	0.39242E 01
40	0.19308E 01	0.21920E 01	0.25450E 01	0.29010E 01	0.33742E 01	0.38442E 01
45	0.18522E 01	0.21170E 01	0.24630E 01	0.28170E 01	0.33082E 01	0.37742E 01
50	0.17792E 01	0.20490E 01	0.23870E 01	0.27390E 01	0.32502E 01	0.37142E 01
55	0.17118E 01	0.19880E 01	0.23270E 01	0.26670E 01	0.32002E 01	0.36642E 01
60	0.16492E 01	0.19330E 01	0.22730E 01	0.26010E 01	0.31582E 01	0.36242E 01
65	0.15912E 01	0.18840E 01	0.22250E 01	0.25410E 01	0.31232E 01	0.35942E 01
70	0.15378E 01	0.18410E 01	0.21820E 01	0.24870E 01	0.30942E 01	0.35742E 01
75	0.14888E 01	0.18030E 01	0.21440E 01	0.24390E 01	0.30712E 01	0.35642E 01
80	0.14442E 01	0.17700E 01	0.21110E 01	0.23970E 01	0.30542E 01	0.35642E 01
85	0.14040E 01	0.17410E 01	0.20830E 01	0.23610E 01	0.30432E 01	0.35742E 01
90	0.13682E 01	0.17160E 01	0.20590E 01	0.23310E 01	0.30382E 01	0.35942E 01
95	0.13368E 01	0.16940E 01	0.20390E 01	0.23070E 01	0.30392E 01	0.36242E 01
100	0.13090E 01	0.16750E 01	0.20220E 01	0.22890E 01	0.30462E 01	0.36642E 01
105	0.12848E 01	0.16590E 01	0.20080E 01	0.22760E 01	0.30592E 01	0.37142E 01
110	0.12632E 01	0.16460E 01	0.19970E 01	0.22670E 01	0.30782E 01	0.37742E 01
115	0.12442E 01	0.16350E 01	0.19890E 01	0.22610E 01	0.31032E 01	0.38442E 01
120	0.12278E 01	0.16260E 01	0.19830E 01	0.22570E 01	0.31342E 01	0.39242E 01
125	0.12138E 01	0.16190E 01	0.19790E 01	0.22550E 01	0.31712E 01	0.40142E 01
130	0.12022E 01	0.16140E 01	0.19760E 01	0.22540E 01	0.32142E 01	0.41142E 01
135	0.11928E 01	0.16100E 01	0.19740E 01	0.22540E 01	0.32632E 01	0.42240E 01
140	0.11852E 01	0.16070E 01	0.19730E 01	0.22540E 01	0.33182E 01	0.43442E 01
145	0.11792E 01	0.16050E 01	0.19730E 01	0.22540E 01	0.33792E 01	0.44742E 01
150	0.11748E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.34462E 01	0.46142E 01
155	0.11718E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.35192E 01	0.47642E 01
160	0.11702E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.35982E 01	0.49242E 01
165	0.11698E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.36832E 01	0.50942E 01
170	0.11702E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.37742E 01	0.52742E 01
175	0.11718E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.38712E 01	0.54642E 01
180	0.11748E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.39742E 01	0.56642E 01
185	0.11792E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.40832E 01	0.58742E 01
190	0.11848E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.41982E 01	0.60942E 01
195	0.11918E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.43192E 01	0.63242E 01
200	0.12002E 01	0.16040E 01	0.19730E 01	0.22540E 01	0.44462E 01	0.65642E 01

m = 1.80-0.80 1

θ	$x = 1.05$	$x = 1.10$	$x = 1.15$	$x = 1.20$	$x = 1.25$
0.	0.32742E 00	0.65579E 00	0.80641E 00	0.9194E 00	0.9814E 00
5.0	0.31700E 00	0.65042E 00	0.80047E 00	0.9148E 00	0.9772E 00
10.0	0.31293E 00	0.64532E 00	0.79547E 00	0.9102E 00	0.9727E 00
15.0	0.31293E 00	0.64032E 00	0.79047E 00	0.9056E 00	0.9682E 00
20.0	0.31293E 00	0.63532E 00	0.78547E 00	0.9010E 00	0.9637E 00
25.0	0.31293E 00	0.63032E 00	0.78047E 00	0.8964E 00	0.9592E 00
30.0	0.31293E 00	0.62532E 00	0.77547E 00	0.8918E 00	0.9547E 00
35.0	0.31293E 00	0.62032E 00	0.77047E 00	0.8872E 00	0.9502E 00
40.0	0.31293E 00	0.61532E 00	0.76547E 00	0.8826E 00	0.9457E 00
45.0	0.31293E 00	0.61032E 00	0.76047E 00	0.8780E 00	0.9412E 00
50.0	0.31293E 00	0.60532E 00	0.75547E 00	0.8734E 00	0.9367E 00
55.0	0.31293E 00	0.60032E 00	0.75047E 00	0.8688E 00	0.9322E 00
60.0	0.31293E 00	0.59532E 00	0.74547E 00	0.8642E 00	0.9277E 00
65.0	0.31293E 00	0.59032E 00	0.74047E 00	0.8596E 00	0.9232E 00
70.0	0.31293E 00	0.58532E 00	0.73547E 00	0.8550E 00	0.9187E 00
75.0	0.31293E 00	0.58032E 00	0.73047E 00	0.8504E 00	0.9142E 00
80.0	0.31293E 00	0.57532E 00	0.72547E 00	0.8458E 00	0.9097E 00
85.0	0.31293E 00	0.57032E 00	0.72047E 00	0.8412E 00	0.9052E 00
90.0	0.31293E 00	0.56532E 00	0.71547E 00	0.8366E 00	0.9007E 00
95.0	0.31293E 00	0.56032E 00	0.71047E 00	0.8320E 00	0.8962E 00
100.0	0.31293E 00	0.55532E 00	0.70547E 00	0.8274E 00	0.8917E 00
105.0	0.31293E 00	0.55032E 00	0.70047E 00	0.8228E 00	0.8872E 00
110.0	0.31293E 00	0.54532E 00	0.69547E 00	0.8182E 00	0.8827E 00
115.0	0.31293E 00	0.54032E 00	0.69047E 00	0.8136E 00	0.8782E 00
120.0	0.31293E 00	0.53532E 00	0.68547E 00	0.8090E 00	0.8737E 00
125.0	0.31293E 00	0.53032E 00	0.68047E 00	0.8044E 00	0.8692E 00
130.0	0.31293E 00	0.52532E 00	0.67547E 00	0.7998E 00	0.8647E 00
135.0	0.31293E 00	0.52032E 00	0.67047E 00	0.7952E 00	0.8602E 00
140.0	0.31293E 00	0.51532E 00	0.66547E 00	0.7906E 00	0.8557E 00
145.0	0.31293E 00	0.51032E 00	0.66047E 00	0.7860E 00	0.8512E 00
150.0	0.31293E 00	0.50532E 00	0.65547E 00	0.7814E 00	0.8467E 00
155.0	0.31293E 00	0.50032E 00	0.65047E 00	0.7768E 00	0.8422E 00
160.0	0.31293E 00	0.49532E 00	0.64547E 00	0.7722E 00	0.8377E 00
165.0	0.31293E 00	0.49032E 00	0.64047E 00	0.7676E 00	0.8332E 00
170.0	0.31293E 00	0.48532E 00	0.63547E 00	0.7630E 00	0.8287E 00
175.0	0.31293E 00	0.48032E 00	0.63047E 00	0.7584E 00	0.8242E 00
180.0	0.31293E 00	0.47532E 00	0.62547E 00	0.7538E 00	0.8197E 00

θ	$x = 1.30$	$x = 1.35$	$x = 1.40$	$x = 1.45$	$x = 1.50$
0.	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
5.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
10.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
15.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
20.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
25.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
30.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
35.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
40.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
45.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
50.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
55.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
60.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
65.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
70.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
75.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
80.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
85.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
90.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
95.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
100.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
105.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
110.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
115.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
120.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
125.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
130.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
135.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
140.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
145.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
150.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
155.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
160.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
165.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
170.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
175.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01
180.0	0.13913E 01	0.16321E 01	0.19003E 01	0.21999E 01	0.25353E 01

m = 1.80-0.80 1

θ	$x = 1.55$	$x = 1.60$	$x = 1.65$	$x = 1.80$	$x = 1.85$	$x = 1.90$	$x = 1.95$	$x = 2.00$
0.0	I_1	I_2	I_1	I_2	I_1	I_2	I_1	I_2
5.0	0.29115E 01	0.29115E 01	0.33350E 01	0.33350E 01	0.43284E 01	0.43284E 01	0.63266E 01	0.63266E 01
10.0	0.29776E 01	0.29776E 01	0.33535E 01	0.33535E 01	0.43792E 01	0.43792E 01	0.64096E 01	0.64096E 01
15.0	0.27872E 01	0.27872E 01	0.32554E 01	0.32554E 01	0.42739E 01	0.42739E 01	0.62954E 01	0.62954E 01
20.0	0.26689E 01	0.26689E 01	0.31392E 01	0.31392E 01	0.41512E 01	0.41512E 01	0.61611E 01	0.61611E 01
25.0	0.25419E 01	0.25419E 01	0.30038E 01	0.30038E 01	0.39979E 01	0.39979E 01	0.59979E 01	0.59979E 01
30.0	0.24082E 01	0.24082E 01	0.28504E 01	0.28504E 01	0.38127E 01	0.38127E 01	0.57872E 01	0.57872E 01
35.0	0.22707E 01	0.22707E 01	0.26808E 01	0.26808E 01	0.35989E 01	0.35989E 01	0.55487E 01	0.55487E 01
40.0	0.21311E 01	0.21311E 01	0.24974E 01	0.24974E 01	0.33502E 01	0.33502E 01	0.52733E 01	0.52733E 01
45.0	0.19897E 01	0.19897E 01	0.22932E 01	0.22932E 01	0.30727E 01	0.30727E 01	0.49562E 01	0.49562E 01
50.0	0.18467E 01	0.18467E 01	0.20714E 01	0.20714E 01	0.27672E 01	0.27672E 01	0.45937E 01	0.45937E 01
55.0	0.17024E 01	0.17024E 01	0.18351E 01	0.18351E 01	0.24387E 01	0.24387E 01	0.41897E 01	0.41897E 01
60.0	0.15579E 01	0.15579E 01	0.15864E 01	0.15864E 01	0.20912E 01	0.20912E 01	0.37472E 01	0.37472E 01
65.0	0.14134E 01	0.14134E 01	0.13272E 01	0.13272E 01	0.17287E 01	0.17287E 01	0.32697E 01	0.32697E 01
70.0	0.12689E 01	0.12689E 01	0.10597E 01	0.10597E 01	0.13562E 01	0.13562E 01	0.27597E 01	0.27597E 01
75.0	0.11244E 01	0.11244E 01	0.07852E 01	0.07852E 01	0.09757E 01	0.09757E 01	0.22197E 01	0.22197E 01
80.0	0.9799E 00	0.9799E 00	0.05147E 01	0.05147E 01	0.06002E 01	0.06002E 01	0.16547E 01	0.16547E 01
85.0	0.8364E 00	0.8364E 00	0.02502E 01	0.02502E 01	0.03427E 01	0.03427E 01	0.10747E 01	0.10747E 01
90.0	0.6929E 00	0.6929E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.05000E 01	0.05000E 01
95.0	0.5494E 00	0.5494E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
100.0	0.4059E 00	0.4059E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
105.0	0.2624E 00	0.2624E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
110.0	0.1189E 00	0.1189E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
115.0	0.2249E 00	0.2249E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
120.0	0.3289E 00	0.3289E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
125.0	0.4329E 00	0.4329E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
130.0	0.5369E 00	0.5369E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
135.0	0.6409E 00	0.6409E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
140.0	0.7449E 00	0.7449E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
145.0	0.8489E 00	0.8489E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
150.0	0.9529E 00	0.9529E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
155.0	1.0569E 00	1.0569E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
160.0	1.1609E 00	1.1609E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
165.0	1.2649E 00	1.2649E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
170.0	1.3689E 00	1.3689E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
175.0	1.4729E 00	1.4729E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01
180.0	1.5769E 00	1.5769E 00	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01	0.00000E 01

m = 1.60-1.00 i

θ	$x = 1.55$	$x = 1.60$	$x = 1.65$	$x = 1.70$	$x = 1.75$	$x = 1.80$	$x = 1.85$	$x = 1.90$	$x = 1.95$	$x = 2.00$
	i_1	i_2	i_1	i_2	i_1	i_2	i_1	i_2	i_1	i_2
0.0	0.20133E 01	0.620133E 01	0.36637E 01	0.92456E 01	0.66586E 01	0.46586E 01	0.39244E 01	0.76004E 01	0.65970E 01	0.85970E 01
5.0	0.27872E 01	0.27872E 01	0.46206E 01	0.52018E 01	0.44206E 01	0.30184E 01	0.30184E 01	0.76709E 01	0.65137E 01	0.85278E 01
10.0	0.28708E 01	0.27966E 01	0.52631E 01	0.57194E 01	0.44298E 01	0.35719E 01	0.35719E 01	0.77207E 01	0.65137E 01	0.85278E 01
15.0	0.28708E 01	0.27966E 01	0.57194E 01	0.61770E 01	0.44298E 01	0.40298E 01	0.40298E 01	0.77705E 01	0.65137E 01	0.85278E 01
20.0	0.28708E 01	0.27966E 01	0.61770E 01	0.66346E 01	0.44298E 01	0.45798E 01	0.45798E 01	0.78203E 01	0.65137E 01	0.85278E 01
25.0	0.28708E 01	0.27966E 01	0.66346E 01	0.70912E 01	0.44298E 01	0.51298E 01	0.51298E 01	0.78701E 01	0.65137E 01	0.85278E 01
30.0	0.28708E 01	0.27966E 01	0.70912E 01	0.75478E 01	0.44298E 01	0.56798E 01	0.56798E 01	0.79200E 01	0.65137E 01	0.85278E 01
35.0	0.28708E 01	0.27966E 01	0.75478E 01	0.80044E 01	0.44298E 01	0.62298E 01	0.62298E 01	0.79700E 01	0.65137E 01	0.85278E 01
40.0	0.28708E 01	0.27966E 01	0.80044E 01	0.84610E 01	0.44298E 01	0.67798E 01	0.67798E 01	0.80200E 01	0.65137E 01	0.85278E 01
45.0	0.28708E 01	0.27966E 01	0.84610E 01	0.89176E 01	0.44298E 01	0.73298E 01	0.73298E 01	0.80700E 01	0.65137E 01	0.85278E 01
50.0	0.28708E 01	0.27966E 01	0.89176E 01	0.93742E 01	0.44298E 01	0.78798E 01	0.78798E 01	0.81200E 01	0.65137E 01	0.85278E 01
55.0	0.28708E 01	0.27966E 01	0.93742E 01	0.98308E 01	0.44298E 01	0.84298E 01	0.84298E 01	0.81700E 01	0.65137E 01	0.85278E 01
60.0	0.28708E 01	0.27966E 01	0.98308E 01	1.02874E 01	0.44298E 01	0.89798E 01	0.89798E 01	0.82200E 01	0.65137E 01	0.85278E 01
65.0	0.28708E 01	0.27966E 01	1.02874E 01	1.07440E 01	0.44298E 01	0.95298E 01	0.95298E 01	0.82700E 01	0.65137E 01	0.85278E 01
70.0	0.28708E 01	0.27966E 01	1.07440E 01	1.12006E 01	0.44298E 01	1.00798E 01	1.00798E 01	0.83200E 01	0.65137E 01	0.85278E 01
75.0	0.28708E 01	0.27966E 01	1.12006E 01	1.16572E 01	0.44298E 01	1.06298E 01	1.06298E 01	0.83700E 01	0.65137E 01	0.85278E 01
80.0	0.28708E 01	0.27966E 01	1.16572E 01	1.21138E 01	0.44298E 01	1.11798E 01	1.11798E 01	0.84200E 01	0.65137E 01	0.85278E 01
85.0	0.28708E 01	0.27966E 01	1.21138E 01	1.25704E 01	0.44298E 01	1.17298E 01	1.17298E 01	0.84700E 01	0.65137E 01	0.85278E 01
90.0	0.28708E 01	0.27966E 01	1.25704E 01	1.30270E 01	0.44298E 01	1.22798E 01	1.22798E 01	0.85200E 01	0.65137E 01	0.85278E 01
95.0	0.28708E 01	0.27966E 01	1.30270E 01	1.34836E 01	0.44298E 01	1.28298E 01	1.28298E 01	0.85700E 01	0.65137E 01	0.85278E 01
100.0	0.28708E 01	0.27966E 01	1.34836E 01	1.39402E 01	0.44298E 01	1.33798E 01	1.33798E 01	0.86200E 01	0.65137E 01	0.85278E 01
105.0	0.28708E 01	0.27966E 01	1.39402E 01	1.43968E 01	0.44298E 01	1.39298E 01	1.39298E 01	0.86700E 01	0.65137E 01	0.85278E 01
110.0	0.28708E 01	0.27966E 01	1.43968E 01	1.48534E 01	0.44298E 01	1.44798E 01	1.44798E 01	0.87200E 01	0.65137E 01	0.85278E 01
115.0	0.28708E 01	0.27966E 01	1.48534E 01	1.53100E 01	0.44298E 01	1.50298E 01	1.50298E 01	0.87700E 01	0.65137E 01	0.85278E 01
120.0	0.28708E 01	0.27966E 01	1.53100E 01	1.57666E 01	0.44298E 01	1.55798E 01	1.55798E 01	0.88200E 01	0.65137E 01	0.85278E 01
125.0	0.28708E 01	0.27966E 01	1.57666E 01	1.62232E 01	0.44298E 01	1.61298E 01	1.61298E 01	0.88700E 01	0.65137E 01	0.85278E 01
130.0	0.28708E 01	0.27966E 01	1.62232E 01	1.66798E 01	0.44298E 01	1.66798E 01	1.66798E 01	0.89200E 01	0.65137E 01	0.85278E 01
135.0	0.28708E 01	0.27966E 01	1.66798E 01	1.71364E 01	0.44298E 01	1.72298E 01	1.72298E 01	0.89700E 01	0.65137E 01	0.85278E 01
140.0	0.28708E 01	0.27966E 01	1.71364E 01	1.75930E 01	0.44298E 01	1.77798E 01	1.77798E 01	0.90200E 01	0.65137E 01	0.85278E 01
145.0	0.28708E 01	0.27966E 01	1.75930E 01	1.80496E 01	0.44298E 01	1.83298E 01	1.83298E 01	0.90700E 01	0.65137E 01	0.85278E 01
150.0	0.28708E 01	0.27966E 01	1.80496E 01	1.85062E 01	0.44298E 01	1.88798E 01	1.88798E 01	0.91200E 01	0.65137E 01	0.85278E 01
155.0	0.28708E 01	0.27966E 01	1.85062E 01	1.89628E 01	0.44298E 01	1.94298E 01	1.94298E 01	0.91700E 01	0.65137E 01	0.85278E 01
160.0	0.28708E 01	0.27966E 01	1.89628E 01	1.94194E 01	0.44298E 01	1.99798E 01	1.99798E 01	0.92200E 01	0.65137E 01	0.85278E 01
165.0	0.28708E 01	0.27966E 01	1.94194E 01	1.98760E 01	0.44298E 01	2.05298E 01	2.05298E 01	0.92700E 01	0.65137E 01	0.85278E 01
170.0	0.28708E 01	0.27966E 01	1.98760E 01	2.03326E 01	0.44298E 01	2.10798E 01	2.10798E 01	0.93200E 01	0.65137E 01	0.85278E 01
175.0	0.28708E 01	0.27966E 01	2.03326E 01	2.07892E 01	0.44298E 01	2.16298E 01	2.16298E 01	0.93700E 01	0.65137E 01	0.85278E 01
180.0	0.28708E 01	0.27966E 01	2.07892E 01	2.12458E 01	0.44298E 01	2.21798E 01	2.21798E 01	0.94200E 01	0.65137E 01	0.85278E 01
185.0	0.28708E 01	0.27966E 01	2.12458E 01	2.17024E 01	0.44298E 01	2.27298E 01	2.27298E 01	0.94700E 01	0.65137E 01	0.85278E 01
190.0	0.28708E 01	0.27966E 01	2.17024E 01	2.21590E 01	0.44298E 01	2.32798E 01	2.32798E 01	0.95200E 01	0.65137E 01	0.85278E 01
195.0	0.28708E 01	0.27966E 01	2.21590E 01	2.26156E 01	0.44298E 01	2.38298E 01	2.38298E 01	0.95700E 01	0.65137E 01	0.85278E 01
200.0	0.28708E 01	0.27966E 01	2.26156E 01	2.30722E 01	0.44298E 01	2.43798E 01	2.43798E 01	0.96200E 01	0.65137E 01	0.85278E 01

m = 1.90, 0.681

Table with 3 columns: theta (θ), x, and a series of values (I1, I2). The x values are 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50. The table lists values for theta from 0.0 to 1.90 in increments of 0.10.

m = 1.00-0.68 1

θ	$x = 1.05$	$x = 1.10$	$x = 1.15$	$x = 1.20$	$x = 1.25$	$x = 1.30$	$x = 1.35$	$x = 1.40$	$x = 1.45$	$x = 1.50$
0	0.52782E 00	0.70757E 00	0.87989E 00	0.10784E 01	0.16704E 01	0.22035E 01	0.27405E 01	0.32816E 01	0.38268E 01	0.43761E 01
5.0	0.55684E 00	0.73660E 00	0.90902E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
10.0	0.59281E 00	0.77257E 00	0.94500E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
15.0	0.58488E 00	0.76464E 00	0.93707E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
20.0	0.57695E 00	0.75671E 00	0.92914E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
25.0	0.56902E 00	0.74878E 00	0.92121E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
30.0	0.56109E 00	0.74085E 00	0.91328E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
35.0	0.55316E 00	0.73292E 00	0.90535E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
40.0	0.54523E 00	0.72499E 00	0.89742E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
45.0	0.53730E 00	0.71706E 00	0.88949E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
50.0	0.52937E 00	0.70913E 00	0.88156E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
55.0	0.52144E 00	0.70120E 00	0.87363E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
60.0	0.51351E 00	0.69327E 00	0.86570E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
65.0	0.50558E 00	0.68534E 00	0.85777E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
70.0	0.49765E 00	0.67741E 00	0.84984E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
75.0	0.48972E 00	0.66948E 00	0.84191E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
80.0	0.48179E 00	0.66155E 00	0.83398E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
85.0	0.47386E 00	0.65362E 00	0.82605E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
90.0	0.46593E 00	0.64569E 00	0.81812E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
95.0	0.45800E 00	0.63776E 00	0.81019E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
100.0	0.45007E 00	0.62983E 00	0.80226E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
105.0	0.44214E 00	0.62190E 00	0.79433E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
110.0	0.43421E 00	0.61397E 00	0.78640E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
115.0	0.42628E 00	0.60604E 00	0.77847E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
120.0	0.41835E 00	0.59811E 00	0.77054E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
125.0	0.41042E 00	0.59018E 00	0.76261E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
130.0	0.40249E 00	0.58225E 00	0.75468E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
135.0	0.39456E 00	0.57432E 00	0.74675E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
140.0	0.38663E 00	0.56639E 00	0.73882E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
145.0	0.37870E 00	0.55846E 00	0.73089E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
150.0	0.37077E 00	0.55053E 00	0.72296E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
155.0	0.36284E 00	0.54260E 00	0.71503E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00
160.0	0.35491E 00	0.53467E 00	0.70710E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00	0.87989E 00

m = 1.96-0.05 1

θ	$\alpha = 0.05$	$\alpha = 0.10$	$\alpha = 0.15$	$\alpha = 0.20$	$\alpha = 0.25$
5.0	0.54437E-04	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
10.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
15.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
20.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
25.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
30.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
35.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
40.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
45.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
50.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
55.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
60.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
65.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
70.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
75.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
80.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
85.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
90.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
95.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
100.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
105.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
110.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
115.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
120.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
125.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
130.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
135.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
140.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
145.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
150.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
155.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
160.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
165.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
170.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
175.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04
180.0	0.54437E-08	0.35094E-06	0.40453E-05	0.23099E-04	0.65087E-04

p	x = 1.05		x = 1.10		x = 1.15		x = 1.20		x = 1.25	
	I ₁	I ₂	I ₁	I ₂	I ₁	I ₂	I ₁	I ₂	I ₁	I ₂
0.0	0.60103F 00	0.60103E 00	0.76332E 00	0.76332E 00	0.94924E 00	0.94924E 00	0.11579E 01	0.11579E 01	0.13984E 01	0.13984E 01
5.0	0.59896E 00	0.59896E 00	0.76117E 00	0.76117E 00	0.94845E 00	0.94845E 00	0.11582E 01	0.11582E 01	0.13987E 01	0.13987E 01
10.0	0.59689E 00	0.59689E 00	0.75931E 00	0.75931E 00	0.94766E 00	0.94766E 00	0.11585E 01	0.11585E 01	0.13990E 01	0.13990E 01
15.0	0.59482E 00	0.59482E 00	0.75745E 00	0.75745E 00	0.94687E 00	0.94687E 00	0.11588E 01	0.11588E 01	0.13993E 01	0.13993E 01
20.0	0.59275E 00	0.59275E 00	0.75559E 00	0.75559E 00	0.94608E 00	0.94608E 00	0.11591E 01	0.11591E 01	0.13996E 01	0.13996E 01
25.0	0.59068E 00	0.59068E 00	0.75373E 00	0.75373E 00	0.94529E 00	0.94529E 00	0.11594E 01	0.11594E 01	0.13999E 01	0.13999E 01
30.0	0.58861E 00	0.58861E 00	0.75187E 00	0.75187E 00	0.94450E 00	0.94450E 00	0.11597E 01	0.11597E 01	0.14002E 01	0.14002E 01
35.0	0.58654E 00	0.58654E 00	0.75001E 00	0.75001E 00	0.94371E 00	0.94371E 00	0.11600E 01	0.11600E 01	0.14005E 01	0.14005E 01
40.0	0.58447E 00	0.58447E 00	0.74815E 00	0.74815E 00	0.94292E 00	0.94292E 00	0.11603E 01	0.11603E 01	0.14008E 01	0.14008E 01
45.0	0.58240E 00	0.58240E 00	0.74629E 00	0.74629E 00	0.94213E 00	0.94213E 00	0.11606E 01	0.11606E 01	0.14011E 01	0.14011E 01
50.0	0.58033E 00	0.58033E 00	0.74443E 00	0.74443E 00	0.94134E 00	0.94134E 00	0.11609E 01	0.11609E 01	0.14014E 01	0.14014E 01
55.0	0.57826E 00	0.57826E 00	0.74257E 00	0.74257E 00	0.94055E 00	0.94055E 00	0.11612E 01	0.11612E 01	0.14017E 01	0.14017E 01
60.0	0.57619E 00	0.57619E 00	0.74071E 00	0.74071E 00	0.93976E 00	0.93976E 00	0.11615E 01	0.11615E 01	0.14020E 01	0.14020E 01
65.0	0.57412E 00	0.57412E 00	0.73885E 00	0.73885E 00	0.93897E 00	0.93897E 00	0.11618E 01	0.11618E 01	0.14023E 01	0.14023E 01
70.0	0.57205E 00	0.57205E 00	0.73699E 00	0.73699E 00	0.93818E 00	0.93818E 00	0.11621E 01	0.11621E 01	0.14026E 01	0.14026E 01
75.0	0.57000E 00	0.57000E 00	0.73513E 00	0.73513E 00	0.93739E 00	0.93739E 00	0.11624E 01	0.11624E 01	0.14029E 01	0.14029E 01
80.0	0.56795E 00	0.56795E 00	0.73327E 00	0.73327E 00	0.93660E 00	0.93660E 00	0.11627E 01	0.11627E 01	0.14032E 01	0.14032E 01
85.0	0.56590E 00	0.56590E 00	0.73141E 00	0.73141E 00	0.93581E 00	0.93581E 00	0.11630E 01	0.11630E 01	0.14035E 01	0.14035E 01
90.0	0.56385E 00	0.56385E 00	0.72955E 00	0.72955E 00	0.93502E 00	0.93502E 00	0.11633E 01	0.11633E 01	0.14038E 01	0.14038E 01
95.0	0.56180E 00	0.56180E 00	0.72769E 00	0.72769E 00	0.93423E 00	0.93423E 00	0.11636E 01	0.11636E 01	0.14041E 01	0.14041E 01
100.0	0.55975E 00	0.55975E 00	0.72583E 00	0.72583E 00	0.93344E 00	0.93344E 00	0.11639E 01	0.11639E 01	0.14044E 01	0.14044E 01
105.0	0.55770E 00	0.55770E 00	0.72397E 00	0.72397E 00	0.93265E 00	0.93265E 00	0.11642E 01	0.11642E 01	0.14049E 01	0.14049E 01
110.0	0.55565E 00	0.55565E 00	0.72211E 00	0.72211E 00	0.93186E 00	0.93186E 00	0.11645E 01	0.11645E 01	0.14054E 01	0.14054E 01
115.0	0.55360E 00	0.55360E 00	0.72025E 00	0.72025E 00	0.93107E 00	0.93107E 00	0.11648E 01	0.11648E 01	0.14059E 01	0.14059E 01
120.0	0.55155E 00	0.55155E 00	0.71839E 00	0.71839E 00	0.93028E 00	0.93028E 00	0.11651E 01	0.11651E 01	0.14064E 01	0.14064E 01
125.0	0.54950E 00	0.54950E 00	0.71653E 00	0.71653E 00	0.92949E 00	0.92949E 00	0.11654E 01	0.11654E 01	0.14069E 01	0.14069E 01
130.0	0.54745E 00	0.54745E 00	0.71467E 00	0.71467E 00	0.92870E 00	0.92870E 00	0.11657E 01	0.11657E 01	0.14074E 01	0.14074E 01
135.0	0.54540E 00	0.54540E 00	0.71281E 00	0.71281E 00	0.92791E 00	0.92791E 00	0.11660E 01	0.11660E 01	0.14079E 01	0.14079E 01
140.0	0.54335E 00	0.54335E 00	0.71095E 00	0.71095E 00	0.92712E 00	0.92712E 00	0.11663E 01	0.11663E 01	0.14084E 01	0.14084E 01
145.0	0.54130E 00	0.54130E 00	0.70909E 00	0.70909E 00	0.92633E 00	0.92633E 00	0.11666E 01	0.11666E 01	0.14089E 01	0.14089E 01
150.0	0.53925E 00	0.53925E 00	0.70723E 00	0.70723E 00	0.92554E 00	0.92554E 00	0.11669E 01	0.11669E 01	0.14094E 01	0.14094E 01
155.0	0.53720E 00	0.53720E 00	0.70537E 00	0.70537E 00	0.92475E 00	0.92475E 00	0.11672E 01	0.11672E 01	0.14099E 01	0.14099E 01
160.0	0.53515E 00	0.53515E 00	0.70351E 00	0.70351E 00	0.92396E 00	0.92396E 00	0.11675E 01	0.11675E 01	0.14104E 01	0.14104E 01

m = 1.96-0.66 1

θ	x - 1.55	x - 1.50	x - 1.65	x - 1.70	x - 1.75	x - 2.00
0.	0.33178E 01	0.37783E 01	0.42968E 01	0.48777E 01	0.55225E 01	0.63411E 01
5.0	0.32699E 01	0.37353E 01	0.42544E 01	0.48354E 01	0.54796E 01	0.62972E 01
10.0	0.32242E 01	0.36929E 01	0.42144E 01	0.47930E 01	0.54371E 01	0.62547E 01
15.0	0.31815E 01	0.36526E 01	0.41761E 01	0.47527E 01	0.53956E 01	0.62132E 01
20.0	0.31418E 01	0.36142E 01	0.41404E 01	0.47136E 01	0.53550E 01	0.61727E 01
25.0	0.31050E 01	0.35776E 01	0.41065E 01	0.46757E 01	0.53152E 01	0.61332E 01
30.0	0.30711E 01	0.35428E 01	0.40742E 01	0.46390E 01	0.52762E 01	0.60947E 01
35.0	0.30391E 01	0.35097E 01	0.40434E 01	0.46035E 01	0.52380E 01	0.60572E 01
40.0	0.30090E 01	0.34783E 01	0.40141E 01	0.45691E 01	0.52006E 01	0.60207E 01
45.0	0.29808E 01	0.34485E 01	0.39862E 01	0.45358E 01	0.51640E 01	0.59852E 01
50.0	0.29545E 01	0.34202E 01	0.39604E 01	0.45036E 01	0.51282E 01	0.59507E 01
55.0	0.29299E 01	0.33934E 01	0.39358E 01	0.44725E 01	0.50932E 01	0.59172E 01
60.0	0.29069E 01	0.33681E 01	0.39124E 01	0.44425E 01	0.50590E 01	0.58847E 01
65.0	0.28854E 01	0.33442E 01	0.38901E 01	0.44136E 01	0.50256E 01	0.58532E 01
70.0	0.28654E 01	0.33217E 01	0.38689E 01	0.43857E 01	0.49929E 01	0.58227E 01
75.0	0.28468E 01	0.33006E 01	0.38488E 01	0.43588E 01	0.49609E 01	0.57932E 01
80.0	0.28295E 01	0.32808E 01	0.38298E 01	0.43329E 01	0.49295E 01	0.57647E 01
85.0	0.28135E 01	0.32623E 01	0.38118E 01	0.43079E 01	0.48987E 01	0.57372E 01
90.0	0.27987E 01	0.32450E 01	0.37948E 01	0.42838E 01	0.48685E 01	0.57107E 01
95.0	0.27850E 01	0.32289E 01	0.37788E 01	0.42605E 01	0.48388E 01	0.56852E 01
100.0	0.27724E 01	0.32139E 01	0.37638E 01	0.42380E 01	0.48096E 01	0.56607E 01
105.0	0.27608E 01	0.31999E 01	0.37497E 01	0.42162E 01	0.47809E 01	0.56372E 01
110.0	0.27501E 01	0.31868E 01	0.37365E 01	0.41951E 01	0.47527E 01	0.56147E 01
115.0	0.27403E 01	0.31746E 01	0.37242E 01	0.41747E 01	0.47249E 01	0.55932E 01
120.0	0.27313E 01	0.31632E 01	0.37128E 01	0.41549E 01	0.46975E 01	0.55727E 01
125.0	0.27230E 01	0.31526E 01	0.37022E 01	0.41357E 01	0.46706E 01	0.55532E 01
130.0	0.27154E 01	0.31427E 01	0.36924E 01	0.41171E 01	0.46442E 01	0.55347E 01
135.0	0.27085E 01	0.31335E 01	0.36833E 01	0.40991E 01	0.46183E 01	0.55172E 01
140.0	0.27023E 01	0.31249E 01	0.36749E 01	0.40817E 01	0.45929E 01	0.55007E 01
145.0	0.26967E 01	0.31169E 01	0.36672E 01	0.40649E 01	0.45680E 01	0.54852E 01
150.0	0.26916E 01	0.31095E 01	0.36602E 01	0.40487E 01	0.45436E 01	0.54707E 01
155.0	0.26870E 01	0.31026E 01	0.36538E 01	0.40331E 01	0.45197E 01	0.54572E 01
160.0	0.26828E 01	0.30962E 01	0.36480E 01	0.40181E 01	0.44963E 01	0.54447E 01
165.0	0.26790E 01	0.30902E 01	0.36428E 01	0.40037E 01	0.44734E 01	0.54332E 01
170.0	0.26755E 01	0.30846E 01	0.36381E 01	0.39899E 01	0.44510E 01	0.54227E 01
175.0	0.26724E 01	0.30793E 01	0.36339E 01	0.39767E 01	0.44291E 01	0.54132E 01
180.0	0.26696E 01	0.30743E 01	0.36301E 01	0.39640E 01	0.44077E 01	0.54047E 01
185.0	0.26671E 01	0.30695E 01	0.36267E 01	0.39518E 01	0.43868E 01	0.53972E 01
190.0	0.26648E 01	0.30649E 01	0.36237E 01	0.39401E 01	0.43664E 01	0.53907E 01
195.0	0.26627E 01	0.30605E 01	0.36210E 01	0.39289E 01	0.43465E 01	0.53852E 01
200.0	0.26608E 01	0.30563E 01	0.36185E 01	0.39182E 01	0.43271E 01	0.53807E 01

θ	$x = 0.05$	$x = 0.10$	$x = 0.15$	$x = 0.20$	$x = 0.25$
0.0	0.63355E-08	0.40992E-04	0.40728E-03	0.27017E-04	0.10522E-03
10.0	0.63555E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
20.0	0.63755E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
30.0	0.63955E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
40.0	0.64155E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
50.0	0.64355E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
60.0	0.64555E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
70.0	0.64755E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
80.0	0.64955E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
90.0	0.65155E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
100.0	0.65355E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
110.0	0.65555E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
120.0	0.65755E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
130.0	0.65955E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
140.0	0.66155E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
150.0	0.66355E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
160.0	0.66555E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
170.0	0.66755E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
180.0	0.66955E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
190.0	0.67155E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03
200.0	0.67355E-08	0.40992E-06	0.47279E-05	0.27017E-04	0.10522E-03

θ	$x = 0.30$	$x = 0.35$	$x = 0.40$	$x = 0.45$	$x = 0.50$
0.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
10.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
20.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
30.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
40.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
50.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
60.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
70.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
80.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
90.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
100.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
110.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
120.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
130.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
140.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
150.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
160.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
170.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
180.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
190.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02
200.0	0.32186E-03	0.83261E-03	0.19115E-02	0.39222E-02	0.77392E-02

x = 1.05

i	i ₁	i ₂
0	0	0
5	0.64321E+00	0.64321E+00
10	0.64304E+00	0.64304E+00
15	0.64287E+00	0.64287E+00
20	0.64270E+00	0.64270E+00
25	0.64253E+00	0.64253E+00
30	0.64236E+00	0.64236E+00
35	0.64219E+00	0.64219E+00
40	0.64202E+00	0.64202E+00
45	0.64185E+00	0.64185E+00
50	0.64168E+00	0.64168E+00
55	0.64151E+00	0.64151E+00
60	0.64134E+00	0.64134E+00
65	0.64117E+00	0.64117E+00
70	0.64100E+00	0.64100E+00
75	0.64083E+00	0.64083E+00
80	0.64066E+00	0.64066E+00
85	0.64049E+00	0.64049E+00
90	0.64032E+00	0.64032E+00
95	0.64015E+00	0.64015E+00
100	0.64000E+00	0.64000E+00
105	0.63985E+00	0.63985E+00
110	0.63970E+00	0.63970E+00
115	0.63955E+00	0.63955E+00
120	0.63940E+00	0.63940E+00
125	0.63925E+00	0.63925E+00
130	0.63910E+00	0.63910E+00
135	0.63895E+00	0.63895E+00
140	0.63880E+00	0.63880E+00
145	0.63865E+00	0.63865E+00
150	0.63850E+00	0.63850E+00
155	0.63835E+00	0.63835E+00
160	0.63820E+00	0.63820E+00
165	0.63805E+00	0.63805E+00
170	0.63790E+00	0.63790E+00
175	0.63775E+00	0.63775E+00
180	0.63760E+00	0.63760E+00

x = 1.10

i	i ₁	i ₂
0	0	0
5	0.81533E+00	0.81533E+00
10	0.81530E+00	0.81530E+00
15	0.81527E+00	0.81527E+00
20	0.81524E+00	0.81524E+00
25	0.81521E+00	0.81521E+00
30	0.81518E+00	0.81518E+00
35	0.81515E+00	0.81515E+00
40	0.81512E+00	0.81512E+00
45	0.81509E+00	0.81509E+00
50	0.81506E+00	0.81506E+00
55	0.81503E+00	0.81503E+00
60	0.81500E+00	0.81500E+00
65	0.81497E+00	0.81497E+00
70	0.81494E+00	0.81494E+00
75	0.81491E+00	0.81491E+00
80	0.81488E+00	0.81488E+00
85	0.81485E+00	0.81485E+00
90	0.81482E+00	0.81482E+00
95	0.81479E+00	0.81479E+00
100	0.81476E+00	0.81476E+00
105	0.81473E+00	0.81473E+00
110	0.81470E+00	0.81470E+00
115	0.81467E+00	0.81467E+00
120	0.81464E+00	0.81464E+00
125	0.81461E+00	0.81461E+00
130	0.81458E+00	0.81458E+00
135	0.81455E+00	0.81455E+00
140	0.81452E+00	0.81452E+00
145	0.81449E+00	0.81449E+00
150	0.81446E+00	0.81446E+00
155	0.81443E+00	0.81443E+00
160	0.81440E+00	0.81440E+00
165	0.81437E+00	0.81437E+00
170	0.81434E+00	0.81434E+00
175	0.81431E+00	0.81431E+00
180	0.81428E+00	0.81428E+00

x = 1.15

i	i ₁	i ₂
0	0	0
5	0.95932E+00	0.95932E+00
10	0.95929E+00	0.95929E+00
15	0.95926E+00	0.95926E+00
20	0.95923E+00	0.95923E+00
25	0.95920E+00	0.95920E+00
30	0.95917E+00	0.95917E+00
35	0.95914E+00	0.95914E+00
40	0.95911E+00	0.95911E+00
45	0.95908E+00	0.95908E+00
50	0.95905E+00	0.95905E+00
55	0.95902E+00	0.95902E+00
60	0.95899E+00	0.95899E+00
65	0.95896E+00	0.95896E+00
70	0.95893E+00	0.95893E+00
75	0.95890E+00	0.95890E+00
80	0.95887E+00	0.95887E+00
85	0.95884E+00	0.95884E+00
90	0.95881E+00	0.95881E+00
95	0.95878E+00	0.95878E+00
100	0.95875E+00	0.95875E+00
105	0.95872E+00	0.95872E+00
110	0.95869E+00	0.95869E+00
115	0.95866E+00	0.95866E+00
120	0.95863E+00	0.95863E+00
125	0.95860E+00	0.95860E+00
130	0.95857E+00	0.95857E+00
135	0.95854E+00	0.95854E+00
140	0.95851E+00	0.95851E+00
145	0.95848E+00	0.95848E+00
150	0.95845E+00	0.95845E+00
155	0.95842E+00	0.95842E+00
160	0.95839E+00	0.95839E+00
165	0.95836E+00	0.95836E+00
170	0.95833E+00	0.95833E+00
175	0.95830E+00	0.95830E+00
180	0.95827E+00	0.95827E+00

x = 1.20

i	i ₁	i ₂
0	0	0
5	0.12002E+01	0.12002E+01
10	0.11999E+01	0.11999E+01
15	0.11996E+01	0.11996E+01
20	0.11993E+01	0.11993E+01
25	0.11990E+01	0.11990E+01
30	0.11987E+01	0.11987E+01
35	0.11984E+01	0.11984E+01
40	0.11981E+01	0.11981E+01
45	0.11978E+01	0.11978E+01
50	0.11975E+01	0.11975E+01
55	0.11972E+01	0.11972E+01
60	0.11969E+01	0.11969E+01
65	0.11966E+01	0.11966E+01
70	0.11963E+01	0.11963E+01
75	0.11960E+01	0.11960E+01
80	0.11957E+01	0.11957E+01
85	0.11954E+01	0.11954E+01
90	0.11951E+01	0.11951E+01
95	0.11948E+01	0.11948E+01
100	0.11945E+01	0.11945E+01
105	0.11942E+01	0.11942E+01
110	0.11939E+01	0.11939E+01
115	0.11936E+01	0.11936E+01
120	0.11933E+01	0.11933E+01
125	0.11930E+01	0.11930E+01
130	0.11927E+01	0.11927E+01
135	0.11924E+01	0.11924E+01
140	0.11921E+01	0.11921E+01
145	0.11918E+01	0.11918E+01
150	0.11915E+01	0.11915E+01
155	0.11912E+01	0.11912E+01
160	0.11909E+01	0.11909E+01
165	0.11906E+01	0.11906E+01
170	0.11903E+01	0.11903E+01
175	0.11900E+01	0.11900E+01
180	0.11897E+01	0.11897E+01

x = 1.25

i	i ₁	i ₂
0	0	0
5	0.14207E+01	0.14207E+01
10	0.14204E+01	0.14204E+01
15	0.14201E+01	0.14201E+01
20	0.14198E+01	0.14198E+01
25	0.14195E+01	0.14195E+01
30	0.14192E+01	0.14192E+01
35	0.14189E+01	0.14189E+01
40	0.14186E+01	0.14186E+01
45	0.14183E+01	0.14183E+01
50	0.14180E+01	0.14180E+01
55	0.14177E+01	0.14177E+01
60	0.14174E+01	0.14174E+01
65	0.14171E+01	0.14171E+01
70	0.14168E+01	0.14168E+01
75	0.14165E+01	0.14165E+01
80	0.14162E+01	0.14162E+01
85	0.14159E+01	0.14159E+01
90	0.14156E+01	0.14156E+01
95	0.14153E+01	0.14153E+01
100	0.14150E+01	0.14150E+01
105	0.14147E+01	0.14147E+01
110	0.14144E+01	0.14144E+01
115	0.14141E+01	0.14141E+01
120	0.14138E+01	0.14138E+01
125	0.14135E+01	0.14135E+01
130	0.14132E+01	0.14132E+01
135	0.14129E+01	0.14129E+01
140	0.14126E+01	0.14126E+01
145	0.14123E+01	0.14123E+01
150	0.14120E+01	0.14120E+01
155	0.14117E+01	0.14117E+01
160	0.14114E+01	0.14114E+01
165	0.14111E+01	0.14111E+01
170	0.14108E+01	0.14108E+01
175	0.14105E+01	0.14105E+01
180	0.14102E+01	0.14102E+01

x = 1.30

i	i ₁	i ₂
0	0	0
5	0.16610E+01	0.16610E+01
10	0.16607E+01	0.16607E+01
15	0.16604E+01	0.16604E+01
20	0.16601E+01	0.16601E+01
25	0.16598E+01	0.16598E+01
30	0.16595E+01	0.16595E+01
35	0.16592E+01	0.16592E+01
40	0.16589E+01	0.16589E+01
45	0.16586E+01	0.16586E+01
50	0.16583E+01	0.16583E+01
55	0.16580E+01	0.16580E+01
60	0.16577E+01	0.16577E+01
65	0.16574E+01	0.16574E+01
70	0.16571E+01	0.16571E+01
75	0.16568E+01	0.16568E+01
80	0.16565E+01	0.16565E+01
85	0.16562E+01	0.16562E+01
90	0.16559E+01	0.16559E+01
95	0.16556E+01	0.16556E+01
100	0.16553E+01	0.16553E+01
105	0.16550E+01	0.16550E+01
110	0.16547E+01	0.16547E+01
115	0.16544E+01	0.16544E+01
120	0.16541E+01	0.16541E+01
125	0.16538E+01	0.16538E+01
130	0.16535E+01	0.16535E+01
135	0.16532E+01	0.16532E+01
140	0.16529E+01	0.16529E+01
145	0.16526E+01	0.16526E+01
150	0.16523E+01	0.16523E+01
155	0.16520E+01	0.16520E+01
160	0.16517E+01	0.16517E+01
165	0.16514E+01	0.16514E+01
170	0.16511E+01	0.16511E+01
175	0.16508E+01	0.16508E+01
180	0.16505E+01	0.16505E+01

x = 1.40

i	i ₁	i ₂
0	0	0
5	0.22124E+01	0.22124E+01
10	0.22121E+01	0.22121E+01
15	0.22118E+01	0.22118E+01
20	0.22115E+01	0.22115E+01
25	0.22112E+01	0.22112E+01
30	0.22109E+01	0.22109E+01
35	0.22106E+01	0.22106E+01
40	0.22103E+01	0.22103E+01
45	0.22100E+01	0.22100E+01
50	0.22097E+01	0.22097E+01
55	0.22094E+01	0.22094E+01
60	0.22091E+01	0.22091E+01
65	0.22088E+01	0.22088E+01
70	0.22085E+01	0.22085E+01
75	0.22082E+01	0.22082E+01
80	0.22079E+01	0.22079E+01
85	0.22076E+01	0.22076E+01
90	0.22073E+01	0.22073E+01
95	0.22070E+01	0.22070E+01
100	0.22067E+01	0.22067E+01
105	0.22064E+01	0.22064E+01
110	0.22061E+01	0.22061E+01
115	0.22058E+01	0.22058E+01
120	0.22055E+01	0.22055E+01
125	0.22052E+01	0.22052E+01
130	0.22049E+01	0.22049E+01
135	0.22046E+01	0.22046E+01
140	0.22043E+01	0.22043E+01
145	0.22040E+01	0.22040E+01
150	0.22037E+01	0.22037E+01
155	0.22034E+01	0.22034E+01
160	0.22031E+01	0.22031E+01
165	0.22028E+01	0.22028E+01
170	0.22025E+01	0.22025E+01
175	0.22022E+01	0.22022E+01
180	0.22019E+01	0.22019E+01

x = 1.45

i	i ₁	i ₂
0	0	0
5	0.25236E+01	0.25236E+01
10	0.25233E+01	0.25233E+01
15	0.25230E+01	0.25230E+01
20	0.25227E+01	0.25227E+01
25	0.25224E+01	0.25224E+01
30	0.25221E+01	0.25221E+01
35	0.25218E+01	0.25218E+01

θ	$x = 0.05$	$x = 0.10$	$x = 0.15$	$x = 0.20$	$x = 0.25$
0.0					
0.05					
1.0					
1.05					
1.10					
1.15					
1.20					
1.25					
1.30					
1.35					
1.40					
1.45					
1.50					
1.55					
1.60					
1.65					
1.70					
1.75					
1.80					
1.85					
1.90					
1.95					
2.00					
2.05					
2.10					
2.15					
2.20					
2.25					
2.30					
2.35					
2.40					
2.45					
2.50					
2.55					
2.60					
2.65					
2.70					
2.75					
2.80					
2.85					
2.90					
2.95					
3.00					

θ	$x = 0.30$	$x = 0.35$	$x = 0.40$	$x = 0.45$	$x = 0.50$
0.0					
0.05					
1.0					
1.05					
1.10					
1.15					
1.20					
1.25					
1.30					
1.35					
1.40					
1.45					
1.50					
1.55					
1.60					
1.65					
1.70					
1.75					
1.80					
1.85					
1.90					
1.95					
2.00					
2.05					
2.10					
2.15					
2.20					
2.25					
2.30					
2.35					
2.40					
2.45					
2.50					
2.55					
2.60					
2.65					
2.70					
2.75					
2.80					
2.85					
2.90					
2.95					
3.00					

$x = 0.55$

θ	I_1	I_2	I_1	I_2
0	0.14908E-01	0.14908E-01	0.29138E-01	0.29138E-01
5	0.14888E-01	0.14888E-01	0.29118E-01	0.29118E-01
10	0.14868E-01	0.14868E-01	0.29098E-01	0.29098E-01
15	0.14848E-01	0.14848E-01	0.29078E-01	0.29078E-01
20	0.14828E-01	0.14828E-01	0.29058E-01	0.29058E-01
25	0.14808E-01	0.14808E-01	0.29038E-01	0.29038E-01
30	0.14788E-01	0.14788E-01	0.29018E-01	0.29018E-01
35	0.14768E-01	0.14768E-01	0.28998E-01	0.28998E-01
40	0.14748E-01	0.14748E-01	0.28978E-01	0.28978E-01
45	0.14728E-01	0.14728E-01	0.28958E-01	0.28958E-01
50	0.14708E-01	0.14708E-01	0.28938E-01	0.28938E-01
55	0.14688E-01	0.14688E-01	0.28918E-01	0.28918E-01
60	0.14668E-01	0.14668E-01	0.28898E-01	0.28898E-01
65	0.14648E-01	0.14648E-01	0.28878E-01	0.28878E-01
70	0.14628E-01	0.14628E-01	0.28858E-01	0.28858E-01
75	0.14608E-01	0.14608E-01	0.28838E-01	0.28838E-01
80	0.14588E-01	0.14588E-01	0.28818E-01	0.28818E-01
85	0.14568E-01	0.14568E-01	0.28798E-01	0.28798E-01
90	0.14548E-01	0.14548E-01	0.28778E-01	0.28778E-01
95	0.14528E-01	0.14528E-01	0.28758E-01	0.28758E-01
100	0.14508E-01	0.14508E-01	0.28738E-01	0.28738E-01
105	0.14488E-01	0.14488E-01	0.28718E-01	0.28718E-01
110	0.14468E-01	0.14468E-01	0.28698E-01	0.28698E-01
115	0.14448E-01	0.14448E-01	0.28678E-01	0.28678E-01
120	0.14428E-01	0.14428E-01	0.28658E-01	0.28658E-01
125	0.14408E-01	0.14408E-01	0.28638E-01	0.28638E-01
130	0.14388E-01	0.14388E-01	0.28618E-01	0.28618E-01
135	0.14368E-01	0.14368E-01	0.28598E-01	0.28598E-01
140	0.14348E-01	0.14348E-01	0.28578E-01	0.28578E-01
145	0.14328E-01	0.14328E-01	0.28558E-01	0.28558E-01
150	0.14308E-01	0.14308E-01	0.28538E-01	0.28538E-01
155	0.14288E-01	0.14288E-01	0.28518E-01	0.28518E-01
160	0.14268E-01	0.14268E-01	0.28498E-01	0.28498E-01
165	0.14248E-01	0.14248E-01	0.28478E-01	0.28478E-01
170	0.14228E-01	0.14228E-01	0.28458E-01	0.28458E-01
175	0.14208E-01	0.14208E-01	0.28438E-01	0.28438E-01
180	0.14188E-01	0.14188E-01	0.28418E-01	0.28418E-01
185	0.14168E-01	0.14168E-01	0.28398E-01	0.28398E-01
190	0.14148E-01	0.14148E-01	0.28378E-01	0.28378E-01
195	0.14128E-01	0.14128E-01	0.28358E-01	0.28358E-01
200	0.14108E-01	0.14108E-01	0.28338E-01	0.28338E-01

$x = 0.80$

θ	I_1	I_2	I_1	I_2
0	0.29138E-01	0.29138E-01	0.58276E-01	0.58276E-01
5	0.29118E-01	0.29118E-01	0.58256E-01	0.58256E-01
10	0.29098E-01	0.29098E-01	0.58236E-01	0.58236E-01
15	0.29078E-01	0.29078E-01	0.58216E-01	0.58216E-01
20	0.29058E-01	0.29058E-01	0.58196E-01	0.58196E-01
25	0.29038E-01	0.29038E-01	0.58176E-01	0.58176E-01
30	0.29018E-01	0.29018E-01	0.58156E-01	0.58156E-01
35	0.28998E-01	0.28998E-01	0.58136E-01	0.58136E-01
40	0.28978E-01	0.28978E-01	0.58116E-01	0.58116E-01
45	0.28958E-01	0.28958E-01	0.58096E-01	0.58096E-01
50	0.28938E-01	0.28938E-01	0.58076E-01	0.58076E-01
55	0.28918E-01	0.28918E-01	0.58056E-01	0.58056E-01
60	0.28898E-01	0.28898E-01	0.58036E-01	0.58036E-01
65	0.28878E-01	0.28878E-01	0.58016E-01	0.58016E-01
70	0.28858E-01	0.28858E-01	0.57996E-01	0.57996E-01
75	0.28838E-01	0.28838E-01	0.57976E-01	0.57976E-01
80	0.28818E-01	0.28818E-01	0.57956E-01	0.57956E-01
85	0.28798E-01	0.28798E-01	0.57936E-01	0.57936E-01
90	0.28778E-01	0.28778E-01	0.57916E-01	0.57916E-01
95	0.28758E-01	0.28758E-01	0.57896E-01	0.57896E-01
100	0.28738E-01	0.28738E-01	0.57876E-01	0.57876E-01
105	0.28718E-01	0.28718E-01	0.57856E-01	0.57856E-01
110	0.28698E-01	0.28698E-01	0.57836E-01	0.57836E-01
115	0.28678E-01	0.28678E-01	0.57816E-01	0.57816E-01
120	0.28658E-01	0.28658E-01	0.57796E-01	0.57796E-01
125	0.28638E-01	0.28638E-01	0.57776E-01	0.57776E-01
130	0.28618E-01	0.28618E-01	0.57756E-01	0.57756E-01
135	0.28598E-01	0.28598E-01	0.57736E-01	0.57736E-01
140	0.28578E-01	0.28578E-01	0.57716E-01	0.57716E-01
145	0.28558E-01	0.28558E-01	0.57696E-01	0.57696E-01
150	0.28538E-01	0.28538E-01	0.57676E-01	0.57676E-01
155	0.28518E-01	0.28518E-01	0.57656E-01	0.57656E-01
160	0.28498E-01	0.28498E-01	0.57636E-01	0.57636E-01
165	0.28478E-01	0.28478E-01	0.57616E-01	0.57616E-01
170	0.28458E-01	0.28458E-01	0.57596E-01	0.57596E-01
175	0.28438E-01	0.28438E-01	0.57576E-01	0.57576E-01
180	0.28418E-01	0.28418E-01	0.57556E-01	0.57556E-01
185	0.28398E-01	0.28398E-01	0.57536E-01	0.57536E-01
190	0.28378E-01	0.28378E-01	0.57516E-01	0.57516E-01
195	0.28358E-01	0.28358E-01	0.57496E-01	0.57496E-01
200	0.28338E-01	0.28338E-01	0.57476E-01	0.57476E-01

$x = 1.00$

θ	I_1	I_2	I_1	I_2
0	0.58276E-01	0.58276E-01	0.11655E-00	0.11655E-00
5	0.58256E-01	0.58256E-01	0.11635E-00	0.11635E-00
10	0.58236E-01	0.58236E-01	0.11615E-00	0.11615E-00
15	0.58216E-01	0.58216E-01	0.11595E-00	0.11595E-00
20	0.58196E-01	0.58196E-01	0.11575E-00	0.11575E-00
25	0.58176E-01	0.58176E-01	0.11555E-00	0.11555E-00
30	0.58156E-01	0.58156E-01	0.11535E-00	0.11535E-00
35	0.58136E-01	0.58136E-01	0.11515E-00	0.11515E-00
40	0.58116E-01	0.58116E-01	0.11495E-00	0.11495E-00
45	0.58096E-01	0.58096E-01	0.11475E-00	0.11475E-00
50	0.58076E-01	0.58076E-01	0.11455E-00	0.11455E-00
55	0.58056E-01	0.58056E-01	0.11435E-00	0.11435E-00
60	0.58036E-01	0.58036E-01	0.11415E-00	0.11415E-00
65	0.58016E-01	0.58016E-01	0.11395E-00	0.11395E-00
70	0.57996E-01	0.57996E-01	0.11375E-00	0.11375E-00
75	0.57976E-01	0.57976E-01	0.11355E-00	0.11355E-00
80	0.57956E-01	0.57956E-01	0.11335E-00	0.11335E-00
85	0.57936E-01	0.57936E-01	0.11315E-00	0.11315E-00
90	0.57916E-01	0.57916E-01	0.11295E-00	0.11295E-00
95	0.57896E-01	0.57896E-01	0.11275E-00	0.11275E-00
100	0.57876E-01	0.57876E-01	0.11255E-00	0.11255E-00
105	0.57856E-01	0.57856E-01	0.11235E-00	0.11235E-00
110	0.57836E-01	0.57836E-01	0.11215E-00	0.11215E-00
115	0.57816E-01	0.57816E-01	0.11195E-00	0.11195E-00
120	0.57796E-01	0.57796E-01	0.11175E-00	0.11175E-00
125	0.57776E-01	0.57776E-01	0.11155E-00	0.11155E-00
130	0.57756E-01	0.57756E-01	0.11135E-00	0.11135E-00
135	0.57736E-01	0.57736E-01	0.11115E-00	0.11115E-00
140	0.57716E-01	0.57716E-01	0.11095E-00	0.11095E-00
145	0.57696E-01	0.57696E-01	0.11075E-00	0.11075E-00
150	0.57676E-01	0.57676E-01	0.11055E-00	0.11055E-00
155	0.57656E-01	0.57656E-01	0.11035E-00	0.11035E-00
160	0.57636E-01	0.57636E-01	0.11015E-00	0.11015E-00
165	0.57616E-01	0.57616E-01	0.10995E-00	0.10995E-00
170	0.57596E-01	0.57596E-01	0.10975E-00	0.10975E-00
175	0.57576E-01	0.57576E-01	0.10955E-00	0.10955E-00
180	0.57556E-01	0.57556E-01	0.10935E-00	0.10935E-00
185	0.57536E-01	0.57536E-01	0.10915E-00	0.10915E-00
190	0.57516E-01	0.57516E-01	0.10895E-00	0.10895E-00
195	0.57496E-01	0.57496E-01	0.10875E-00	0.10875E-00
200	0.57476E-01	0.57476E-01	0.10855E-00	0.10855E-00

θ	$x = 1.05$			$x = 1.10$			$x = 1.15$			$x = 1.20$			$x = 1.25$		
	i_1	i_2	i_3	i_1	i_2	i_3	i_1	i_2	i_3	i_1	i_2	i_3	i_1	i_2	i_3
0	0.66915E-00	0.688915E-00	0.71901E-00	0.74965E-00	0.78077E-00	0.81236E-00	0.84440E-00	0.87690E-00	0.90985E-00	0.94325E-00	0.97708E-00	0.10113E-01	0.11939E-01	0.14198E-01	0.16819E-01
5.0	0.67264E-00	0.69345E-00	0.72484E-00	0.75652E-00	0.78868E-00	0.82131E-00	0.85440E-00	0.88796E-00	0.92198E-00	0.95645E-00	0.99137E-00	0.10214E-01	0.12061E-01	0.14349E-01	0.17026E-01
10.0	0.67615E-00	0.69752E-00	0.72956E-00	0.76172E-00	0.79427E-00	0.82739E-00	0.86100E-00	0.89510E-00	0.92968E-00	0.96474E-00	0.10000E-01	0.11867E-01	0.14175E-01	0.16888E-01	0.19566E-01
15.0	0.67968E-00	0.70149E-00	0.73406E-00	0.76677E-00	0.79981E-00	0.83336E-00	0.86744E-00	0.90205E-00	0.93719E-00	0.97287E-00	0.10192E-01	0.12077E-01	0.14406E-01	0.17152E-01	0.19889E-01
20.0	0.68323E-00	0.70547E-00	0.73852E-00	0.77164E-00	0.80517E-00	0.83921E-00	0.87378E-00	0.90887E-00	0.94449E-00	0.98065E-00	0.10385E-01	0.12288E-01	0.14637E-01	0.17417E-01	0.20199E-01
25.0	0.68679E-00	0.70944E-00	0.74306E-00	0.77652E-00	0.81054E-00	0.84461E-00	0.87919E-00	0.91428E-00	0.94989E-00	0.98603E-00	0.10579E-01	0.12499E-01	0.14868E-01	0.17681E-01	0.20499E-01
30.0	0.69036E-00	0.71372E-00	0.74872E-00	0.78304E-00	0.81743E-00	0.85191E-00	0.88649E-00	0.92118E-00	0.95589E-00	0.99162E-00	0.10773E-01	0.12711E-01	0.15099E-01	0.17936E-01	0.20779E-01
35.0	0.69394E-00	0.71822E-00	0.75372E-00	0.78852E-00	0.82327E-00	0.85801E-00	0.89275E-00	0.92750E-00	0.96226E-00	0.99803E-00	0.10967E-01	0.12923E-01	0.15331E-01	0.18182E-01	0.21049E-01
40.0	0.69752E-00	0.72283E-00	0.75872E-00	0.79362E-00	0.82871E-00	0.86380E-00	0.89889E-00	0.93400E-00	0.96912E-00	0.10153E-01	0.13117E-01	0.15556E-01	0.18429E-01	0.21317E-01	0.21420E-01
45.0	0.70111E-00	0.72746E-00	0.76372E-00	0.79882E-00	0.83427E-00	0.86972E-00	0.90517E-00	0.94062E-00	0.97608E-00	0.10249E-01	0.13319E-01	0.15797E-01	0.18684E-01	0.21567E-01	0.21523E-01
50.0	0.70471E-00	0.73211E-00	0.76872E-00	0.80382E-00	0.83957E-00	0.87532E-00	0.91107E-00	0.94682E-00	0.98258E-00	0.10345E-01	0.13519E-01	0.16027E-01	0.18929E-01	0.21820E-01	0.21579E-01
55.0	0.70832E-00	0.73681E-00	0.77372E-00	0.80892E-00	0.84487E-00	0.88082E-00	0.91677E-00	0.95272E-00	0.98868E-00	0.10441E-01	0.13717E-01	0.16255E-01	0.19174E-01	0.22071E-01	0.21639E-01
60.0	0.71194E-00	0.74151E-00	0.78072E-00	0.81402E-00	0.85027E-00	0.88652E-00	0.92277E-00	0.95902E-00	0.10000E-01	0.13913E-01	0.16451E-01	0.19394E-01	0.22322E-01	0.21888E-01	0.21708E-01
65.0	0.71556E-00	0.74622E-00	0.78652E-00	0.81932E-00	0.85587E-00	0.89242E-00	0.92897E-00	0.96552E-00	0.10000E-01	0.14105E-01	0.16649E-01	0.19609E-01	0.22573E-01	0.21997E-01	0.21777E-01
70.0	0.71918E-00	0.75092E-00	0.79272E-00	0.82462E-00	0.86247E-00	0.89932E-00	0.93617E-00	0.97302E-00	0.10000E-01	0.14297E-01	0.16847E-01	0.19829E-01	0.22824E-01	0.22106E-01	0.21886E-01
75.0	0.72280E-00	0.75563E-00	0.79802E-00	0.83012E-00	0.86827E-00	0.90542E-00	0.94257E-00	0.97972E-00	0.10000E-01	0.14489E-01	0.17045E-01	0.20031E-01	0.23075E-01	0.22215E-01	0.21995E-01
80.0	0.72642E-00	0.76033E-00	0.80372E-00	0.83602E-00	0.87447E-00	0.91192E-00	0.94937E-00	0.98682E-00	0.10000E-01	0.14681E-01	0.17241E-01	0.20233E-01	0.23326E-01	0.22324E-01	0.22104E-01
85.0	0.73004E-00	0.76504E-00	0.81012E-00	0.84192E-00	0.88077E-00	0.91822E-00	0.95567E-00	0.99312E-00	0.10000E-01	0.14873E-01	0.17437E-01	0.20435E-01	0.23577E-01	0.22433E-01	0.22213E-01
90.0	0.73366E-00	0.76974E-00	0.81522E-00	0.84702E-00	0.88607E-00	0.92352E-00	0.96097E-00	0.99842E-00	0.10000E-01	0.15065E-01	0.17633E-01	0.20637E-01	0.23828E-01	0.22542E-01	0.22322E-01
95.0	0.73728E-00	0.77445E-00	0.82032E-00	0.85212E-00	0.89047E-00	0.92792E-00	0.96537E-00	1.00282E-00	0.10000E-01	0.15257E-01	0.17829E-01	0.20839E-01	0.24079E-01	0.22651E-01	0.22431E-01
100.0	0.74090E-00	0.77915E-00	0.82542E-00	0.85722E-00	0.89557E-00	0.93282E-00	0.97027E-00	1.00772E-00	0.10000E-01	0.15449E-01	0.18025E-01	0.21041E-01	0.24330E-01	0.22760E-01	0.22540E-01
105.0	0.74452E-00	0.78386E-00	0.83052E-00	0.86232E-00	0.90067E-00	0.93772E-00	0.97517E-00	1.01262E-00	0.10000E-01	0.15641E-01	0.18221E-01	0.21243E-01	0.24581E-01	0.22869E-01	0.22649E-01
110.0	0.74814E-00	0.78856E-00	0.83562E-00	0.86742E-00	0.90577E-00	0.94262E-00	0.97962E-00	1.01752E-00	0.10000E-01	0.15833E-01	0.18417E-01	0.21445E-01	0.24832E-01	0.22978E-01	0.22758E-01
115.0	0.75176E-00	0.79327E-00	0.84072E-00	0.87252E-00	0.91087E-00	0.94752E-00	0.98407E-00	1.02242E-00	0.10000E-01	0.16025E-01	0.18613E-01	0.21647E-01	0.25083E-01	0.23087E-01	0.22867E-01
120.0	0.75538E-00	0.79797E-00	0.84582E-00	0.87762E-00	0.91597E-00	0.95242E-00	0.98852E-00	1.02732E-00	0.10000E-01	0.16217E-01	0.18809E-01	0.21849E-01	0.25334E-01	0.23196E-01	0.22976E-01
125.0	0.75900E-00	0.80268E-00	0.85092E-00	0.88272E-00	0.92107E-00	0.95732E-00	0.99307E-00	1.03222E-00	0.10000E-01	0.16409E-01	0.18995E-01	0.22051E-01	0.25585E-01	0.23305E-01	0.23085E-01
130.0	0.76262E-00	0.80738E-00	0.85602E-00	0.88782E-00	0.92617E-00	0.96222E-00	0.99752E-00	1.03712E-00	0.10000E-01	0.16601E-01	0.19181E-01	0.22253E-01	0.25836E-01	0.23414E-01	0.23194E-01
135.0	0.76624E-00	0.81209E-00	0.86112E-00	0.89292E-00	0.93127E-00	0.96712E-00	1.00247E-00	1.04202E-00	0.10000E-01	0.16793E-01	0.19367E-01	0.22455E-01	0.26087E-01	0.23523E-01	0.23303E-01
140.0	0.76986E-00	0.81679E-00	0.86622E-00	0.89802E-00	0.93637E-00	0.97202E-00	1.00737E-00	1.04692E-00	0.10000E-01	0.16985E-01	0.19553E-01	0.22657E-01	0.26338E-01	0.23632E-01	0.23412E-01
145.0	0.77348E-00	0.82150E-00	0.87132E-00	0.90312E-00	0.94147E-00	0.97692E-00	1.01227E-00	1.05182E-00	0.10000E-01	0.17177E-01	0.19739E-01	0.22859E-01	0.26589E-01	0.23741E-01	0.23521E-01
150.0	0.77710E-00	0.82620E-00	0.87642E-00	0.90822E-00	0.94657E-00	0.98182E-00	1.01717E-00	1.05672E-00	0.10000E-01	0.17369E-01	0.19925E-01	0.23061E-01	0.26840E-01	0.23850E-01	0.23630E-01
155.0	0.78072E-00	0.83091E-00	0.88152E-00	0.91332E-00	0.95167E-00	0.98672E-00	1.02207E-00	1.06162E-00	0.10000E-01	0.17561E-01	0.20111E-01	0.23263E-01	0.27091E-01	0.23959E-01	0.23739E-01
160.0	0.78434E-00	0.83561E-00	0.88662E-00	0.91842E-00	0.95677E-00	0.99162E-00	1.02697E-00	1.06652E-00	0.10000E-01	0.17753E-01	0.20297E-01	0.23465E-01	0.27342E-01	0.24068E-01	0.23848E-01
165.0	0.78796E-00	0.84032E-00	0.89172E-00	0.92352E-00	0.96187E-00	0.99652E-00	1.03187E-00	1.07142E-00	0.10000E-01	0.17945E-01	0.20483E-01	0.23667E-01	0.27593E-01	0.24177E-01	0.23957E-01
170.0	0.79158E-00	0.84502E-00	0.89682E-00	0.92862E-00	0.96697E-00	1.00142E-00	1.03677E-00	1.07632E-00	0.10000E-01	0.18137E-01	0.20669E-01	0.23869E-01	0.27844E-01	0.24286E-01	0.24066E-01
175.0	0.79520E-00	0.84973E-00	0.90192E-00	0.93372E-00	0.97207E-00	1.00632E-00	1.04167E-00	1.08122E-00	0.10000E-01	0.18329E-01	0.20855E-01	0.24071E-01	0.28095E-01	0.24395E-01	0.24175E-01
180.0	0.79882E-00	0.85443E-00	0.90702E-00	0.93882E-00	0.97717E-00	1.01122E-00	1.04657E-00	1.08612E-00	0.10000E-01	0.18521E-01	0.21041E-01	0.24273E-01	0.28346E-01	0.24504E-01	0.24284E-01

m = 2.00-1.00 1

θ	$x = 1.75$	$x = 1.70$	$x = 1.65$	$x = 1.60$	$x = 1.55$	$x = 1.50$	$x = 1.45$	$x = 1.40$	$x = 1.35$	$x = 1.30$	$x = 1.25$	$x = 1.20$
0	0.53944E-01	0.47874E-01	0.42747E-01	0.37717E-01	0.32742E-01	0.27877E-01	0.23171E-01	0.18669E-01	0.14429E-01	0.10504E-01	0.06952E-01	0.03739E-01
5	0.53160E-01	0.47186E-01	0.42059E-01	0.37029E-01	0.32054E-01	0.27189E-01	0.22483E-01	0.17981E-01	0.13741E-01	0.09816E-01	0.06264E-01	0.03051E-01
10	0.50909E-01	0.44935E-01	0.40808E-01	0.35778E-01	0.30803E-01	0.25938E-01	0.21232E-01	0.16730E-01	0.12490E-01	0.08565E-01	0.05013E-01	0.01800E-01
15	0.47798E-01	0.42824E-01	0.38697E-01	0.33667E-01	0.28692E-01	0.23827E-01	0.19121E-01	0.14619E-01	0.10379E-01	0.06454E-01	0.02902E-01	0.00689E-01
20	0.44396E-01	0.39422E-01	0.35295E-01	0.30265E-01	0.25290E-01	0.20425E-01	0.15719E-01	0.11217E-01	0.06977E-01	0.03052E-01	0.00560E-01	0.00147E-01
25	0.40794E-01	0.35820E-01	0.31693E-01	0.26663E-01	0.21688E-01	0.16823E-01	0.12321E-01	0.08081E-01	0.04056E-01	0.01504E-01	0.00322E-01	0.00080E-01
30	0.37092E-01	0.32118E-01	0.28091E-01	0.23061E-01	0.18086E-01	0.13221E-01	0.08719E-01	0.04694E-01	0.01942E-01	0.00590E-01	0.00188E-01	0.00046E-01
35	0.33290E-01	0.28316E-01	0.24289E-01	0.19259E-01	0.14284E-01	0.09419E-01	0.05017E-01	0.02265E-01	0.00713E-01	0.00211E-01	0.00059E-01	0.00017E-01
40	0.29488E-01	0.24514E-01	0.20487E-01	0.15457E-01	0.10482E-01	0.05617E-01	0.02865E-01	0.00913E-01	0.00261E-01	0.00079E-01	0.00027E-01	0.00005E-01
45	0.25686E-01	0.20712E-01	0.16685E-01	0.11655E-01	0.06680E-01	0.02815E-01	0.00963E-01	0.00211E-01	0.00059E-01	0.00017E-01	0.00005E-01	0.00001E-01
50	0.21884E-01	0.16910E-01	0.12883E-01	0.07853E-01	0.02878E-01	0.00926E-01	0.00274E-01	0.00072E-01	0.00020E-01	0.00006E-01	0.00002E-01	0.00000E-01
55	0.18082E-01	0.13108E-01	0.09081E-01	0.04051E-01	0.00076E-01	0.00024E-01	0.00008E-01	0.00002E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
60	0.14280E-01	0.09306E-01	0.05279E-01	0.00249E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
65	0.10478E-01	0.05504E-01	0.01477E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
70	0.06676E-01	0.01702E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
75	0.02874E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
80	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
85	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
90	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
95	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
100	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
105	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
110	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
115	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
120	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
125	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
130	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
135	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
140	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
145	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
150	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
155	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
160	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
165	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
170	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
175	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01
180	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01	0.00000E-01

0*	0.31025E-01	0.54233E-01	0.89998E-01	0.1162E-00	0.21231E-00
5*	0.31005E-01	0.54194E-01	0.89980E-01	0.11502E-00	0.21202E-00
10*	0.30985E-01	0.54154E-01	0.89961E-01	0.11375E-00	0.21172E-00
15*	0.30965E-01	0.54114E-01	0.89942E-01	0.11249E-00	0.21142E-00
20*	0.30945E-01	0.54074E-01	0.89923E-01	0.11123E-00	0.21112E-00
25*	0.30925E-01	0.54034E-01	0.89904E-01	0.10997E-00	0.21082E-00
30*	0.30905E-01	0.53994E-01	0.89885E-01	0.10871E-00	0.21052E-00
35*	0.30885E-01	0.53954E-01	0.89866E-01	0.10745E-00	0.21022E-00
40*	0.30865E-01	0.53914E-01	0.89847E-01	0.10619E-00	0.20992E-00
45*	0.30845E-01	0.53874E-01	0.89828E-01	0.10493E-00	0.20962E-00
50*	0.30825E-01	0.53834E-01	0.89809E-01	0.10367E-00	0.20932E-00
55*	0.30805E-01	0.53794E-01	0.89790E-01	0.10241E-00	0.20902E-00
60*	0.30785E-01	0.53754E-01	0.89771E-01	0.10115E-00	0.20872E-00
65*	0.30765E-01	0.53714E-01	0.89752E-01	0.09989E-00	0.20842E-00
70*	0.30745E-01	0.53674E-01	0.89733E-01	0.09863E-00	0.20812E-00
75*	0.30725E-01	0.53634E-01	0.89714E-01	0.09737E-00	0.20782E-00
80*	0.30705E-01	0.53594E-01	0.89695E-01	0.09611E-00	0.20752E-00
85*	0.30685E-01	0.53554E-01	0.89676E-01	0.09485E-00	0.20722E-00
90*	0.30665E-01	0.53514E-01	0.89657E-01	0.09359E-00	0.20692E-00
95*	0.30645E-01	0.53474E-01	0.89638E-01	0.09233E-00	0.20662E-00
100*	0.30625E-01	0.53434E-01	0.89619E-01	0.09107E-00	0.20632E-00
105*	0.30605E-01	0.53394E-01	0.89600E-01	0.08981E-00	0.20602E-00
110*	0.30585E-01	0.53354E-01	0.89581E-01	0.08855E-00	0.20572E-00
115*	0.30565E-01	0.53314E-01	0.89562E-01	0.08729E-00	0.20542E-00
120*	0.30545E-01	0.53274E-01	0.89543E-01	0.08603E-00	0.20512E-00
125*	0.30525E-01	0.53234E-01	0.89524E-01	0.08477E-00	0.20482E-00
130*	0.30505E-01	0.53194E-01	0.89505E-01	0.08351E-00	0.20452E-00
135*	0.30485E-01	0.53154E-01	0.89486E-01	0.08225E-00	0.20422E-00
140*	0.30465E-01	0.53114E-01	0.89467E-01	0.08099E-00	0.20392E-00
145*	0.30445E-01	0.53074E-01	0.89448E-01	0.07973E-00	0.20362E-00
150*	0.30425E-01	0.53034E-01	0.89429E-01	0.07847E-00	0.20332E-00
155*	0.30405E-01	0.52994E-01	0.89410E-01	0.07721E-00	0.20302E-00
160*	0.30385E-01	0.52954E-01	0.89391E-01	0.07595E-00	0.20272E-00
165*	0.30365E-01	0.52914E-01	0.89372E-01	0.07469E-00	0.20242E-00
170*	0.30345E-01	0.52874E-01	0.89353E-01	0.07343E-00	0.20212E-00
175*	0.30325E-01	0.52834E-01	0.89334E-01	0.07217E-00	0.20182E-00
180*	0.30305E-01	0.52794E-01	0.89315E-01	0.07091E-00	0.20152E-00
185*	0.30285E-01	0.52754E-01	0.89296E-01	0.06965E-00	0.20122E-00
190*	0.30265E-01	0.52714E-01	0.89277E-01	0.06839E-00	0.20092E-00
195*	0.30245E-01	0.52674E-01	0.89258E-01	0.06713E-00	0.20062E-00
200*	0.30225E-01	0.52634E-01	0.89239E-01	0.06587E-00	0.20032E-00

0*	0.31031E-00	0.54239E-00	0.89999E-00	0.11623E-00	0.21232E-00
5*	0.31011E-00	0.54199E-00	0.89981E-00	0.11503E-00	0.21203E-00
10*	0.30991E-00	0.54159E-00	0.89962E-00	0.11377E-00	0.21173E-00
15*	0.30971E-00	0.54119E-00	0.89943E-00	0.11251E-00	0.21143E-00
20*	0.30951E-00	0.54079E-00	0.89924E-00	0.11125E-00	0.21113E-00
25*	0.30931E-00	0.54039E-00	0.89905E-00	0.10999E-00	0.21083E-00
30*	0.30911E-00	0.53999E-00	0.89886E-00	0.10873E-00	0.21053E-00
35*	0.30891E-00	0.53959E-00	0.89867E-00	0.10747E-00	0.21023E-00
40*	0.30871E-00	0.53919E-00	0.89848E-00	0.10621E-00	0.20993E-00
45*	0.30851E-00	0.53879E-00	0.89829E-00	0.10495E-00	0.20963E-00
50*	0.30831E-00	0.53839E-00	0.89810E-00	0.10369E-00	0.20933E-00
55*	0.30811E-00	0.53799E-00	0.89791E-00	0.10243E-00	0.20903E-00
60*	0.30791E-00	0.53759E-00	0.89772E-00	0.10117E-00	0.20873E-00
65*	0.30771E-00	0.53719E-00	0.89753E-00	0.09991E-00	0.20843E-00
70*	0.30751E-00	0.53679E-00	0.89734E-00	0.09865E-00	0.20813E-00
75*	0.30731E-00	0.53639E-00	0.89715E-00	0.09739E-00	0.20783E-00
80*	0.30711E-00	0.53599E-00	0.89696E-00	0.09613E-00	0.20753E-00
85*	0.30691E-00	0.53559E-00	0.89677E-00	0.09487E-00	0.20723E-00
90*	0.30671E-00	0.53519E-00	0.89658E-00	0.09361E-00	0.20693E-00
95*	0.30651E-00	0.53479E-00	0.89639E-00	0.09235E-00	0.20663E-00
100*	0.30631E-00	0.53439E-00	0.89620E-00	0.09109E-00	0.20633E-00
105*	0.30611E-00	0.53399E-00	0.89601E-00	0.08983E-00	0.20603E-00
110*	0.30591E-00	0.53359E-00	0.89582E-00	0.08857E-00	0.20573E-00
115*	0.30571E-00	0.53319E-00	0.89563E-00	0.08731E-00	0.20543E-00
120*	0.30551E-00	0.53279E-00	0.89544E-00	0.08605E-00	0.20513E-00
125*	0.30531E-00	0.53239E-00	0.89525E-00	0.08479E-00	0.20483E-00
130*	0.30511E-00	0.53199E-00	0.89506E-00	0.08353E-00	0.20453E-00
135*	0.30491E-00	0.53159E-00	0.89487E-00	0.08227E-00	0.20423E-00
140*	0.30471E-00	0.53119E-00	0.89468E-00	0.08101E-00	0.20393E-00
145*	0.30451E-00	0.53079E-00	0.89449E-00	0.07975E-00	0.20363E-00
150*	0.30431E-00	0.53039E-00	0.89430E-00	0.07849E-00	0.20333E-00
155*	0.30411E-00	0.52999E-00	0.89411E-00	0.07723E-00	0.20303E-00
160*	0.30391E-00	0.52959E-00	0.89392E-00	0.07597E-00	0.20273E-00
165*	0.30371E-00	0.52919E-00	0.89373E-00	0.07471E-00	0.20243E-00
170*	0.30351E-00	0.52879E-00	0.89354E-00	0.07345E-00	0.20213E-00
175*	0.30331E-00	0.52839E-00	0.89335E-00	0.07219E-00	0.20183E-00
180*	0.30311E-00	0.52799E-00	0.89316E-00	0.07093E-00	0.20153E-00

0*	0.31037E-00	0.54245E-00	0.90000E-00	0.11629E-00	0.21238E-00
5*	0.31017E-00	0.54205E-00	0.90001E-00	0.11509E-00	0.21209E-00
10*	0.30997E-00	0.54165E-00	0.90002E-00	0.11383E-00	0.21179E-00
15*	0.30977E-00	0.54125E-00	0.90003E-00	0.11257E-00	0.21149E-00
20*	0.30957E-00	0.54085E-00	0.90004E-00	0.11131E-00	0.21119E-00
25*	0.30937E-00	0.54045E-00	0.90005E-00	0.11005E-00	0.21089E-00
30*	0.30917E-00	0.54005E-00	0.90006E-00	0.10879E-00	0.21059E-00
35*	0.30897E-00	0.53965E-00	0.90007E-00	0.10753E-00	0.21029E-00
40*	0.30877E-00	0.53925E-00	0.90008E-00	0.10627E-00	0.20999E-00
45*	0.30857E-00	0.53885E-00	0.90009E-00	0.10501E-00	0.20969E-00
50*	0.30837E-00	0.53845E-00	0.90010E-00	0.10375E-00	0.20939E-00
55*	0.30817E-00	0.53805E-00	0.90011E-00	0.10249E-00	0.20909E-00
60*	0.30797E-00	0.53765E-00	0.90012E-00	0.10123E-00	0.20879E-00
65*	0.30777E-00	0.53725E-00	0.90013E-00	0.09997E-00	0.20849E-00
70*	0.30757E-00	0.53685E-00	0.90014E-00	0.09871E-00	0.20819E-00
75*	0.30737E-00	0.53645E-00	0.90015E-00	0.09745E-00	0.20789E-00
80*	0.30717E-00	0.53605E-00	0.90016E-00	0.09619E-00	0.20759E-00
85*	0.30697E-00	0.53565E-00	0.90017E-00	0.09493E-00	0.20729E-00
90*	0.30677E-00	0.53525E-00	0.90018E-00	0.09367E-00	0.20699E-00
95*	0.30657E-00	0.53485E-00	0.90019E-00	0.09241E-00	0.20669E-00
100*	0.30637E-00	0.53445E-00	0.90020E-00	0.09115E-00	0.20639E-00
105*	0.30617E-00	0.53405E-00	0.90021E-00	0.08989E-00	0.20609E-00
110*	0.30597E-00	0.53365E-00	0.90022E-00	0.08863E-00	0.20579E-00
115*	0.30577E-00	0.53325E-00	0.90023E-00	0.08737E-00	0.20549E-00
120*	0.30557E-00	0.53285E-00	0.90024E-00	0.08611E-00	0.20519E-00
125*	0.30537E-00	0.53245E-00	0.90025E-00	0.08485E-00	0.20489E-00
130*	0.30517E-00	0.53205E-00	0.90026E-00	0.08359E-00	0.20459E-00
135*	0.30497E-00	0.53165E-00	0.90027E-00	0.08233E-00	0.20429E-00
140*	0.30477E-00	0.53125E-00	0.90028E-00	0.08107E-00	0.20399E-00
145*	0.30457E-00	0.53085E-00	0.90029E-00	0.07981E-00	0.20369E-00
150*	0.30437E-00	0.53045E-00	0.90030E-00	0.07855E-00	0.20339E-00
155*	0.30417E-00	0.53005E-00	0.90031E-00	0.07729E-00	0.20309E-00
160*	0.30397E-00	0.52965E-00	0.90032E-00	0.07603E-00	0.20279E-00
165*	0.30377E-00	0.52925E-00	0.90033E-00	0.07477E-00	0.20249E-00
170*	0.30357E-00	0.52885E-00	0.90034E-00	0.07351E-00	0.20219E-00
175*	0.30337E-00	0.52845E-00	0.90035E-00	0.07225E-00	0.20189E-00
180*	0.30317E-00	0.52805E-00	0.90036E-00	0.07099E-00	0.20159E-00

0*	0.31043E-00	0.54251E-00	0.90001E-00	0.11635E-00	0.21244E-00
5*	0.31023E-00	0.54211E-00	0.90002E-00	0.11515E-00	0.21215E-00
10*	0.31003E-00	0.54171E-00	0.90003E-00	0.11389E-00	0.21185E-00
15*	0.30983E-00	0.54131E-00	0.90004E-00	0.11263E-00	0.21155E-00
20*	0.30963E-00	0.54091E-00	0.90005E-00	0.11137E-00	0.21125E-00
25*	0.30943E-00	0.54051E-00	0.90006E-00	0.11011E-00	0.21095E-00
30*	0.30923E-00	0.54011			

x = 1.05

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.30

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.10

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.35

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.15

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.40

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.20

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.45

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.25

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

x = 1.50

Table with 10 columns labeled I1, I2, I1, I2, I1, I2, I1, I2, I1, I2. Rows contain numerical values for various indices from 0 to 180.

θ	$x = 1.55$	$x = 1.60$	$x = 1.65$	$x = 1.70$	$x = 1.75$
0.	0.33640E 01	0.30240E 01	0.43377E 01	0.44898E 01	0.46937E 01
5.0	0.33646E 01	0.31751E 01	0.43377E 01	0.44898E 01	0.46937E 01
10.0	0.33652E 01	0.32856E 01	0.43377E 01	0.44898E 01	0.46937E 01
15.0	0.33658E 01	0.33961E 01	0.43377E 01	0.44898E 01	0.46937E 01
20.0	0.33664E 01	0.35066E 01	0.43377E 01	0.44898E 01	0.46937E 01
25.0	0.33670E 01	0.36171E 01	0.43377E 01	0.44898E 01	0.46937E 01
30.0	0.33676E 01	0.37276E 01	0.43377E 01	0.44898E 01	0.46937E 01
35.0	0.33682E 01	0.38381E 01	0.43377E 01	0.44898E 01	0.46937E 01
40.0	0.33688E 01	0.39486E 01	0.43377E 01	0.44898E 01	0.46937E 01
45.0	0.33694E 01	0.40591E 01	0.43377E 01	0.44898E 01	0.46937E 01
50.0	0.33700E 01	0.41696E 01	0.43377E 01	0.44898E 01	0.46937E 01
55.0	0.33706E 01	0.42801E 01	0.43377E 01	0.44898E 01	0.46937E 01
60.0	0.33712E 01	0.43906E 01	0.43377E 01	0.44898E 01	0.46937E 01
65.0	0.33718E 01	0.45011E 01	0.43377E 01	0.44898E 01	0.46937E 01
70.0	0.33724E 01	0.46116E 01	0.43377E 01	0.44898E 01	0.46937E 01
75.0	0.33730E 01	0.47221E 01	0.43377E 01	0.44898E 01	0.46937E 01
80.0	0.33736E 01	0.48326E 01	0.43377E 01	0.44898E 01	0.46937E 01
85.0	0.33742E 01	0.49431E 01	0.43377E 01	0.44898E 01	0.46937E 01
90.0	0.33748E 01	0.50536E 01	0.43377E 01	0.44898E 01	0.46937E 01
95.0	0.33754E 01	0.51641E 01	0.43377E 01	0.44898E 01	0.46937E 01
100.0	0.33760E 01	0.52746E 01	0.43377E 01	0.44898E 01	0.46937E 01
105.0	0.33766E 01	0.53851E 01	0.43377E 01	0.44898E 01	0.46937E 01
110.0	0.33772E 01	0.54956E 01	0.43377E 01	0.44898E 01	0.46937E 01
115.0	0.33778E 01	0.56061E 01	0.43377E 01	0.44898E 01	0.46937E 01
120.0	0.33784E 01	0.57166E 01	0.43377E 01	0.44898E 01	0.46937E 01
125.0	0.33790E 01	0.58271E 01	0.43377E 01	0.44898E 01	0.46937E 01
130.0	0.33796E 01	0.59376E 01	0.43377E 01	0.44898E 01	0.46937E 01
135.0	0.33802E 01	0.60481E 01	0.43377E 01	0.44898E 01	0.46937E 01
140.0	0.33808E 01	0.61586E 01	0.43377E 01	0.44898E 01	0.46937E 01
145.0	0.33814E 01	0.62691E 01	0.43377E 01	0.44898E 01	0.46937E 01
150.0	0.33820E 01	0.63796E 01	0.43377E 01	0.44898E 01	0.46937E 01
155.0	0.33826E 01	0.64901E 01	0.43377E 01	0.44898E 01	0.46937E 01
160.0	0.33832E 01	0.66006E 01	0.43377E 01	0.44898E 01	0.46937E 01
165.0	0.33838E 01	0.67111E 01	0.43377E 01	0.44898E 01	0.46937E 01
170.0	0.33844E 01	0.68216E 01	0.43377E 01	0.44898E 01	0.46937E 01
175.0	0.33850E 01	0.69321E 01	0.43377E 01	0.44898E 01	0.46937E 01
180.0	0.33856E 01	0.70426E 01	0.43377E 01	0.44898E 01	0.46937E 01

m = 1.60-0.80 1

x = 0.05										x = 0.55									
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ							
1	0.22527E+04	0.34100E-04	0.40882E-04	0.12246E-07	0.34452E+01	0.41693E-01	0.22691E-02												
2	0.48002E-09	0.44248E-03	0.70882E-04	0.76245E-10	0.44464E-03	0.76138E-03	0.18546E-04					0.11907E-02							
3	-0.43416E-12	0.93120E-12	-0.7647E-09	-0.32863E-07	0.35188E-05	0.61460E-05	0.88551E-07					0.53207E-07							
4					0.15843E-07	0.20801E-07	0.32857E-06					0.19637E-06							
5					0.45663E-10	0.10475E-09	0.83484E-11					0.21823E-10							
6					-0.21489E-17	0.47106E-12	-0.30437E-11					0.63448E-11							
x = 0.10										x = 0.60									
1	0.18071E-03	0.27265E-03	0.42447E-06	0.26668E-06	0.45633E-01	0.52638E-01	0.34314E-07					0.17866E-02							
2	0.91224E-07	0.11808E-05	-0.17548E-04	-0.22854E-09	0.71913E-03	0.11699E-02	0.14097E-04					0.19792E-04							
3	-0.91190E-10	0.94031E-10	-0.16372E-09	-0.48035E-09	0.44489E-05	0.11242E-04	0.19340E-06					0.11579E-06							
4					0.34504E-07	0.62047E-07	0.77467E-09					0.52014E-05							
5					0.10626E-09	0.25299E-09	-0.40912E-12					0.41793E-10							
6					-0.65832E-12	0.13831E-11	-0.92426E-11					0.88262E-11							
x = 0.15										x = 0.65									
1	0.61435E-03	0.91915E-03	0.32453E-05	0.20092E-05	0.59102E+01	0.64490E-01	0.51482E-02					0.25747E-07							
2	0.69930E-06	0.11808E-05	0.21828E-08	0.90715E-09	0.10755E-02	0.17338E-02	0.59702E-04					0.34175E-04							
3	0.53798E-09	0.66713E-09	0.11375E-09	-0.76454E-13	0.11261E-04	0.19577E-04	0.39635E-06					0.23574E-06							
4					0.70549E-07	0.12676E-06	0.17323E-08					0.11025E-08							
5					0.27273E-09	0.55489E-09	-0.31941E-11					0.36091E-10							
6					-0.15548E-11	0.32512E-11	-0.92690E-11					0.65279E-11							
x = 0.20										x = 0.70									
1	0.14690E-02	0.21741E-07	0.13703E-04	0.84122E-05	0.75004E-01	0.77578E-01	0.74977E-02					0.55782E-02							
2	0.29469E-05	0.44686E-05	0.16710E-07	0.94254E-08	0.15625E-02	0.24935E-02	0.10631E-03					0.58318E-04							
3	0.32604E-08	0.55675E-08	0.35074E-09	0.56800E-09	0.18881E-04	0.32688E-04	0.77100E-06					0.45405E-06							
4	-0.37778E-11	0.91327E-11	0.40442E-10	0.12317E-09	0.13701E-06	0.24575E-06	0.38943E-08					0.25332E-08							
5	-0.47100E-14	0.35580E-14	-0.18134E-11	0.12023E-11	0.59434E-09	0.12390E-08	-0.23823E-10					0.96950E-10							
6	-0.47192E-18	0.97231E-18	-0.77733E-15	0.48441E-15	-0.44104E-11	0.94448E-11	-0.28317E-10					0.13768E-10							
x = 0.25										x = 0.75									
1	0.24019E-02	0.42315E-02	0.41896E-04	0.25907E-04	0.93406E-01	0.70963E-01	0.10640E-01					0.48086E-02							
2	0.89880E-05	0.15130E-04	0.73472E-07	0.45967E-07	0.22142E-02	0.34930E-02	0.16260E-03					0.90028E-04							
3	0.14093E-07	0.24930E-07	-0.16691E-09	-0.15285E-09	0.30475E-04	0.52635E-04	0.14308E-05					0.49464E-08							
4	-0.46701E-10	0.35780E-10	-0.17472E-10	-0.10527E-09	0.25394E-06	0.45425E-06	0.81778E-09					0.64309E-10							
5	-0.17890E-13	0.41342E-13	-0.26448E-10	0.59910E-11	0.13710E-08	0.25663E-08	0.30210E-10					0.10935E-10							
6	-0.85594E-17	0.17647E-16	-0.90334E-14	0.56228E-14	-0.22833E-11	0.14705E-10	-0.10464E-10												
x = 0.30										x = 0.80									
1	0.50844E-02	0.72732E-02	0.10452E-03	0.62848E-04	0.11427E-00	0.10444E-00	0.14754E-01					0.82599E-07							
2	0.22368E-04	0.37946E-04	0.26755E-06	0.16398E-06	0.30717E-02	0.47813E-02	0.29542E-03					0.13874E-02							
3	0.51270E-07	0.90284E-07	0.67895E-08	0.44222E-08	0.47725E-04	0.82121E-04	0.25520E-05					0.14774E-07							
4	0.45990E-10	0.21035E-09	0.27693E-10	0.11894E-09	0.45189E-06	0.80701E-06	0.16453E-07					0.99637E-08							
5	-0.14559E-12	0.30448E-12	-0.17775E-10	0.22841E-10	0.27984E-08	0.51537E-08	0.38466E-10					0.10274E-09							
6	-0.91951E-16	0.18830E-15	-0.66552E-13	0.441221E-13	-0.38882E-11	0.25966E-10	-0.21661E-10					0.62941E-11							
x = 0.35										x = 0.85									
1	0.82049E-02	0.11462E-01	0.22660E-03	0.13423E-03	0.13745E-00	0.11760E-00	0.20043E-01					0.75980E-02							
2	0.48351E-04	0.80892E-04	0.78534E-06	0.47859E-06	0.41202E-02	0.64118E-02	0.39050E-03					0.20760E-03							
3	0.15029E-06	0.26433E-06	0.19548E-08	0.11489E-08	0.78716E-04	0.12460E-03	0.43937E-05					0.25183E-05							
4	0.27567E-09	0.63866E-09	0.64775E-10	0.15384E-09	0.77349E-06	0.13834E-05	0.31896E-07					0.18977E-07							
5	-0.78198E-12	0.16398E-11	-0.20406E-10	0.45408E-10	0.34283E-08	0.99277E-08	0.13458E-07					0.13342E-09							
6	-0.67565E-15	0.13423E-14	-0.35542E-12	0.21976E-12	0.18222E-10	0.44892E-10	-0.14304E-10					0.35864E-11							
x = 0.40										x = 0.90									
1	0.12471E-01	0.16932E-01	0.44338E-03	0.25795E-03	0.18265E-00	0.13003E-00	0.26709E-01					0.96543E-02							
2	0.94291E-04	0.15713E-03	0.19961E-05	0.12089E-05	0.58013E-02	0.94417E-02	0.58288E-03					0.30249E-02							
3	0.39112E-06	0.66948E-06	0.50609E-08	0.30551E-08	0.10814E-03	0.18445E-03	0.73328E-05					0.41303E-05							
4	0.82092E-09	0.18328E-08	0.21088E-10	-0.36422E-11	0.12926E-05	0.22481E-05	0.59774E-07					0.33281E-07							
5	0.31978E-11	0.31359E-11	0.32879E-11	0.72408E-12	0.20100E-07	0.18557E-07	0.31060E-09					0.31887E-09							
6	-0.37915E-14	0.78894E-14	-0.19680E-12	0.13999E-11	0.29425E-10	0.11387E-09	-0.31356E-10					0.23490E-10							
x = 0.45										x = 0.95									
1	0.18108E-01	0.23777E-01	0.80226E-03	0.45682E-03	0.18950E-00	0.14136E-00	0.34961E-01					0.11417E-01							
2	0.17001E-03	0.42819E-03	0.45527E-05	0.27329E-05	0.73944E-02	0.10930E-01	0.83119E-03					0.43019E-03							
3	0.84732E-06	0.15223E-05	0.14777E-07	0.89082E-08	0.15737E-03	0.26708E-03	0.11890E-04					0.46892E-04							
4	0.24422E-08	0.47724E-08	0.41411E-10	0.71936E-10	0.20921E-05	0.37109E-05	0.10783E-06					0.42949E-07							
5	-0.12483E-11	0.20061E-10	0.91328E-12	0.25300E-10	0.21827E-07	0.33321E-07	0.66804E-09					0.49921E-05							
6	-0.17513E-15	0.36127E-13	-0.29356E-11	0.24465E-11	0.85825E-10	0.21688E-09	-0.23024E-10					0.21594E-10							
x = 0.50										x = 1.00									
1	0.29354E-01	0.32039E-01	0.13649E-02	0.75777E-02	0.21750E-00	0.15133E-00	0.44489E-01					0.10325E-01							
2	0.28819E-03	0.47326E-03	0.45516E-05	0.56959E-05	0.96188E-02	0.13938E-01	0.12191E-02					0.59825E-03							
3	0.18092E-05	0.31689E-05	0.37563E-07	0.22797E-07	0.22483E-03	0.37911E-03	0.18831E-04					0.10382E-04							
4	0.67263E-08	0.12120E-07	0.10326E-09	0.65688E-10	0.35027E-05	0.58425E-05	0.18868E-06					0.10903E-06							
5	0.13286E-10	0.33426E-10	0.40752E-12	0.42653E-11	0.32023E-07	0.58068E-07	0.13081E-08					0.80206E-09							
6	-0.61375E-13	0.13225E-12	-0.84917E-17	0.10342E-11	0.21104E-09	0.40276E-09	-0.60737E-12					0.77572E-11							

x = 1.05

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.24613E+00	0.15977E-00	0.56946E-01	0.14267E-01	0.47422E-00	0.17901E-00	0.25264E-00	-0.40543E-01
2	0.12415E-01	0.17523E-01	0.17156E-02	0.31476E-03	0.96439E-01	0.89336E-01	0.25451E-01	0.61150E-01
3	0.31510E-03	0.52859E-03	0.29136E-04	0.81476E-05	0.47431E-02	0.71436E-02	0.37676E-05	0.40346E-03
4	0.50985E-05	0.89907E-05	0.32182E-06	0.18436E-06	0.15065E-03	0.27011E-03	0.22293E-04	0.12748E-04
5	0.13440E-07	0.98703E-07	0.24802E-08	0.15948E-08	0.33667E-05	0.65938E-05	0.37254E-05	0.20221E-05
6	0.37191E-09	0.77450E-09	-0.16331E-10	0.44341E-10	0.60620E-07	0.10985E-06	0.45136E-08	0.26340E-06

x = 1.10

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.27884E+00	0.16661E-00	0.70925E+01	0.14891E-01	0.48661E-00	0.17812E-00	0.28584E-00	-0.53165E-01
2	0.15828E-01	0.21740E-01	0.23739E-02	0.10379E-02	0.11329E-00	0.98679E-01	0.31431E-01	0.65488E-02
3	0.43939E-03	0.72495E-03	0.44162E-04	0.23609E-04	0.59361E-02	0.87810E-02	0.12423E-02	0.1575E-03
4	0.77038E-05	0.13950E-04	0.53467E-06	0.30335E-06	0.21110E-03	0.34501E-03	0.31444E-04	0.15588E-04
5	0.90351E-07	0.16336E-06	0.45195E-08	0.27910E-08	0.52014E-05	0.91639E-05	0.55987E-06	0.30020E-06
6	0.70610E-09	0.11935E-08	-0.51821E-11	0.56660E-10	0.90971E-07	0.16435E-06	0.73065E-08	0.41234E-06

x = 1.15

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.30313E+00	0.17189E-00	0.86946E-01	0.14418E+01	0.49697E-00	0.17717E-00	0.30852E-00	-0.46167E-01
2	0.19987E-01	0.26837E-01	0.32424E-02	0.14253E-02	0.13194E-00	0.10749E-00	0.16315E-02	0.67251E-02
3	0.59227E-03	0.97951E-03	0.56995E-04	0.34523E-04	0.73789E-02	0.11070E-01	0.38436E-01	0.65108E-03
4	0.11428E-04	0.20036E-04	0.88802E-06	0.48762E-06	0.27671E-03	0.46232E-03	0.43864E-04	0.21344E-04
5	0.14645E-06	0.26416E-06	0.79619E-08	0.47528E-08	0.72389E-05	0.12711E-04	0.83001E-05	0.44024E-06
6	0.12879E-08	0.24264E-08	0.19744E-10	0.47850E-10	0.13462E-06	0.24277E-04	0.11515E-07	0.64848E-08

x = 1.20

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.33052E+00	0.17574E-00	0.10492E-00	0.13165E-01	0.50936E 00	0.17618E-00	0.33062E-00	-0.79213E-01
2	0.25015E-01	0.32247E-01	0.43034E-02	0.18331E-02	0.15231E-00	0.11611E-00	0.46937E-01	0.62499E-02
3	0.77982E-03	0.13054E-02	0.96068E-04	0.56995E-04	0.91200E-02	0.29959E-01	0.21231E-02	0.81170E-03
4	0.15644E-04	0.29117E-04	0.13807E-05	0.7673 7E-06	0.38973E-03	0.59668E-03	0.60561E-04	0.28890E-04
5	0.23248E-06	0.41888E-06	0.23346E-07	0.13956E-07	0.99719E-05	0.17448E-04	0.12160E-05	0.53714E-06
6	0.22228E-08	0.41992E-08	0.48737E-10	0.97340E-10	0.19640E-06	0.35419E-06	0.17953E-07	0.99614E-08

x = 1.25

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.35442E+00	0.17833E-00	0.12468E-00	0.10283E-01	0.51187E 00	0.17515E-00	0.35213E-00	-0.91994E-01
2	0.11091E-01	0.38989E-01	0.58036E-02	0.23147E-02	0.17421E-00	0.12364E-00	0.59783E-01	0.58127E-02
3	0.10547E-02	0.17179E-02	0.13829E-03	0.69911E-04	0.41121E-01	0.15561E-01	0.27409E-02	0.99917E-03
4	0.23191E-04	0.41639E-04	0.21336E-05	0.11834E-05	0.46412E-03	0.76424E-03	0.82608E-04	0.35675E-04
5	0.36192E-06	0.64997E-06	0.13892E-07	0.13556E-07	0.13804E-04	0.23716E-04	0.17614E-05	0.91121E-06
6	0.38132E-08	0.70533E-08	0.13603E-09	0.12213E-09	0.28446E-06	0.51085E-06	0.27596E-07	0.15158E-07

x = 1.30

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.38113E+00	0.17889E-00	0.14595E-00	0.57842E-01	0.51658E 00	0.17404E-00	0.17905E-00	-0.10424E-00
2	0.38237E-01	0.43655E-01	0.76251E-02	0.28595E-02	0.19740E-00	0.11010E-00	0.66190E-01	0.44421E-02
3	0.13880E-02	0.22142E-02	0.19518E-03	0.97049E-04	0.13714E-01	0.19597E-01	0.35107E-02	0.12140E-02
4	0.39838E-04	0.58673E-04	0.13014E-05	0.17915E-05	0.59448E-03	0.97089E-03	0.11219E-03	0.51228E-04
5	0.55369E-06	0.99182E-06	0.18922E-07	0.22251E-07	0.7532E-03	0.12455E-02	0.15068E-03	0.87181E-04
6	0.63461E-08	0.11700E-07	0.10609E-09	0.25235E-09	0.40709E-06	0.31094E-06	0.25238E-05	0.12863E-06

x = 1.35

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.40389E+00	0.18062E-00	0.16839E-00	-0.42574E-03	0.51956E 00	0.17283E-00	0.39342E-00	-0.11571E-00
2	0.46672E-01	0.53413E-01	0.99049E-02	0.34896E-02	0.22158E-00	0.13824E-00	0.77735E-01	0.22657E-02
3	0.18091E-02	0.28740E-02	0.27460E-03	0.13269E-03	0.15894E-01	0.21973E-01	0.44627E-02	0.14552E-01
4	0.47230E-04	0.91548E-04	0.49771E-05	0.25666E-05	0.53632E-03	0.12455E-02	0.15068E-03	0.67163E-04
5	0.89277E-06	0.14888E-06	0.65114E-07	0.35788E-07	0.24651E-04	0.42823E-04	0.35795E-05	0.10015E-05
6	0.10304E-07	0.18911E-07	0.53183E-09	0.35823E-09	0.57632E-06	0.10289E-05	0.62746E-07	0.33705E-07

x = 1.40

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.44555E+00	0.14073E-00	0.19163E-00	-0.88310E-02	0.52093E 00	0.17145E-00	0.41329E-00	-0.12623E-00
2	0.36440E-01	0.61790E-01	0.12735E-01	0.41594E-03	0.24839E-00	0.13896E-00	0.90358E-01	-0.85493E-02
3	0.23243E-02	0.36594E-02	0.17895E-03	0.17880E-03	0.20230E-01	0.25859E-01	0.56315E-02	0.17194E-01
4	0.66510E-04	0.11191E-03	0.73001E-05	0.39037E-05	0.98612E-03	0.15335E-02	0.20071E-03	0.87181E-03
5	0.12337E-05	0.21994E-05	0.10679E-06	0.56405E-07	0.32772E-04	0.56414E-04	0.30270E-06	0.24943E-07
6	0.16423E-07	0.30079E-07	0.42335E-09	0.54250E-09	0.60791E-06	0.14386E-05	0.73055E-07	0.449475E-07

x = 1.45

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.44121E+00	0.18041E-00	0.21530E-00	-0.17814E-01	0.52076E 00	0.16986E-00	0.43267E-00	-0.13564E-00
2	0.68189E-01	0.70478E-01	0.16202E-01	0.48512E-02	0.27143E-00	0.14121E-00	0.13398E-00	-0.50336E-02
3	0.29728E-02	0.46149E-02	0.51884E-03	0.23763E-03	0.24405E-01	0.30163E-01	0.70558E-02	0.70003E-02
4	0.88125E-04	0.15175E-03	0.10818E-04	0.86341E-05	0.12015E-02	0.19074E-02	0.26525E-03	0.11207E-03
5	0.13820E-05	0.32034E-05	0.15834E-06	0.87735E-07	0.93234E-04	0.74075E-04	0.69977E-05	0.34166E-05
6	0.25837E-07	0.44704E-07	0.16659E-08	0.10266E-08	0.11223E-05	0.19927E-05	0.13648E-06	0.71821E-07

x = 1.50

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.45977E+00	0.17940E-00	0.23965E-00	-0.28848E-01	0.51917E 00	0.16800E-00	0.45165E-00	-0.14382E-00
2	0.81416E-01	0.79925E-01	0.20407E-01	0.52228E-02	0.29632E-00	0.14200E-00	0.11839E-00	-0.10358E-01
3	0.37671E-02	0.57672E-02	0.70091E-03	0.31164E-03	0.29314E-01	0.34965E-01	0.87789E-02	0.22874E-02
4	0.11961E-03	0.20352E-03	0.15627E-04	0.80141E-04	0.15014E-02	0.23974E-02	0.34795E-03	0.14270E-03
5	0.25970E-05	0.46038E-05	0.24446E-06	0.13412E-06	0.56629E-04	0.8529E-04	0.86339E-05	0.46366E-05
6	0.39882E-07	0.72404E-07	0.27820E-08	0.16306E-08	0.15454E-05	0.27357E-05	0.19819E-06	0.10298E-06

x = 1.55

x = 1.60

x = 1.65

x = 1.70

x = 1.75

x = 1.80

x = 1.85

x = 1.90

x = 1.95

x = 2.00

m = 1.60-0.80

x = 0.05				x = 0.55				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.29226E-04	0.38629E-04	0.10199E-07	0.11335E-07	0.45034E-01	0.45612E-01	0.28799E-02	0.76944E-03
2	0.11204E-08	0.42389E-08	-0.26571E-08	-0.96694E-09	0.54319E-03	0.80462E-03	0.24516E-04	0.78230E-05
3	-0.40084E-12	0.48049E-12	-0.50188E-09	-0.6830E-09	0.44354E-05	0.69849E-05	0.11741E-06	0.39503E-07
4					0.19794E-07	0.32358E-07	0.36657E-09	0.17449E-09
5					0.44422E-10	0.40142E-09	-0.10669E-10	0.11809E-10
6					-0.22228E-12	0.38931E-12	-0.46143E-11	-0.48444E-12
x = 0.10				x = 0.60				
1	0.23488E-03	0.30872E-03	0.57105E-06	0.20124E-06	0.59529E-01	0.56968E-01	0.44463E-02	0.11020E-02
2	0.11749E-04	0.17748E-04	0.95111E-09	0.23828E-09	0.91951E-03	0.13276E-02	0.44992E-04	0.14003E-04
3	-0.21532E-10	0.10634E-09	0.10178E-09	0.23133E-09	0.81374E-05	0.12777E-04	0.25605E-06	0.85048E-07
4					0.43182E-07	0.70422E-07	0.91812E-09	0.37325E-09
5					0.13392E-09	0.24975E-09	-0.13860E-10	0.79442E-11
6					-0.76622E-12	0.10190E-11	-0.47114E-11	-0.25410E-11
x = 0.15				x = 0.65				
1	0.79834E-03	0.10402E-02	0.43239E-05	0.15259E-05	0.76826E-01	0.69112E-01	0.66235E-02	0.14947E-02
2	0.48819E-06	0.13425E-05	0.31024E-08	0.10451E-08	0.13770E-02	0.19673E-02	0.74621E-04	0.38584E-04
3	0.50484E-09	0.90601E-09	0.47992E-10	0.92849E-10	0.14217E-04	0.22246E-04	0.52472E-06	0.23740E-06
4					0.88522E-07	0.14199E-06	0.22550E-08	0.17153E-08
5					0.34988E-09	0.60945E-09	-0.45933E-11	0.82048E-09
6					-0.14745E-11	0.21965E-11	-0.46224E-11	-0.39594E-12
x = 0.20				x = 0.70				
1	0.19312E-02	0.24878E-02	0.18750E-04	0.65947E-05	0.97012E-01	0.81837E-01	0.95639E-02	0.19359E-02
2	0.37613E-05	0.56473E-05	0.21741E-07	0.74926E-08	0.20034E-02	0.28276E-02	0.13176E-03	0.36635E-04
3	0.37921E-08	0.63177E-08	-0.15891E-09	0.25994E-09	0.23826E-04	0.37146E-04	0.10191E-05	0.32794E-06
4	-0.34935E-11	0.75818E-11	-0.40269E-10	0.85071E-10	0.17181E-06	0.27902E-06	0.49958E-08	0.82048E-09
5	-0.15979E-14	0.30567E-14	-0.16737E-11	0.54173E-12	0.77368E-09	0.13452E-08	-0.23761E-10	0.17850E-10
6	-0.43553E-18	0.83413E-18	-0.71803E-15	0.25656E-15	-0.49822E-11	0.38423E-11	-0.10700E-10	-0.76986E-11
x = 0.25				x = 0.75				
1	0.37806E-02	0.47740E-02	0.35666E-04	0.19029E-04	0.12002E-00	0.94072E-01	0.13435E-01	0.23680E-02
2	0.11423E-04	0.17194E-04	0.99219E-07	0.34650E-07	0.28439E-02	0.39578E-02	0.21299E-03	0.60135E-04
3	0.18019E-07	0.28671E-07	0.16846E-09	0.58799E-10	0.25994E-04	0.39813E-04	0.18895E-05	0.59697E-05
4	0.10465E-10	0.43524E-10	0.70845E-11	0.22102E-10	0.31857E-04	0.51605E-05	0.10640E-07	0.36368E-09
5	-0.18213E-13	0.39387E-13	-0.36550E-11	0.33712E-11	0.17028E-08	0.24850E-09	-0.51761E-11	0.83881E-11
6	-0.79061E-17	0.15139E-16	-0.83110E-14	0.29494E-14	0.27304E-12	-0.15392E-12	-0.51497E-11	-0.10327E-10
x = 0.30				x = 0.80				
1	0.46633E-02	0.61903E-02	0.13863E-03	0.46249E-04	0.14463E-00	0.10593E-00	0.18412E-01	0.27212E-02
2	0.28444E-04	0.42468E-04	0.35545E-06	0.12344E-06	0.39905E-02	0.54120E-02	0.33362E-03	0.49037E-04
3	0.44237E-07	0.10267E-06	0.61896E-09	0.52074E-09	0.60374E-04	0.93312E-04	0.33455E-05	0.10420E-05
4	0.15956E-10	0.18181E-09	-0.66941E-10	0.49510E-10	0.56735E-06	0.91676E-06	0.21459E-07	9.71732E-08
5	-0.13992E-12	0.26094E-12	-0.24077E-10	0.29655E-11	0.34859E-08	0.57869E-08	0.66225E-10	0.23811E-10
6	-0.84381E-16	0.16153E-15	-0.61773E-13	0.21339E-13	0.14905E-10	0.15098E-10	-0.30647E-11	-0.93493E-11
x = 0.35				x = 0.85				
1	0.40718E-01	0.12864E-01	0.29989E-03	0.97203E-04	0.17347E-00	0.11675E-00	0.26668E-01	0.28881E-02
2	0.61523E-04	0.91921E-04	0.10430E-05	0.35828E-06	0.53874E-02	0.72480E-02	0.50825E-03	0.13137E-03
3	0.18876E-09	0.30042E-08	0.21127E-08	0.10652E-08	0.92060E-04	0.14137E-03	0.57886E-05	0.7320E-05
4	0.23059E-09	0.60605E-09	-0.70447E-10	0.89191E-10	0.97519E-06	0.15718E-05	0.42169E-07	0.13701E-07
5	-0.74109E-12	0.13728E-11	-0.32009E-10	-0.35989E-12	0.67801E-08	0.11251E-07	0.18897E-09	0.84494E-10
6	-0.62422E-15	0.11944E-14	-0.33612E-12	0.10724E-12	0.28195E-10	0.50096E-10	-0.69350E-11	-0.34819E-11
x = 0.40				x = 0.90				
1	0.14309E-01	0.18926E-01	0.58519E-03	0.18305E-03	0.20301E-00	0.12617E-00	0.32340E-01	0.27257E-02
2	0.12007E-03	0.17854E-03	0.26503E-05	0.89491E-06	0.72277E-02	0.95264E-02	0.75539E-03	0.18509E-03
3	0.44801E-06	0.76147E-06	0.67419E-08	0.21030E-08	0.13702E-03	0.20954E-03	0.96376E-05	0.28494E-05
4	0.11440E-08	0.18663E-08	0.21042E-10	0.61570E-11	0.14242E-05	0.26108E-05	0.39584E-09	0.29221E-07
5	0.98398E-12	0.50490E-11	0.12983E-10	0.29987E-11	0.12658E-07	0.20994E-07	0.20994E-09	0.18185E-09
6	-0.36921E-14	0.67285E-14	-0.46800E-12	0.45190E-12	0.62773E-10	0.10362E-09	-0.10812E-10	-0.96746E-11
x = 0.45				x = 0.95				
1	0.25849E-01	0.24429E-01	0.10553E-02	0.31612E-03	0.23345E-00	0.13393E-00	0.11614E-01	0.20568E-02
2	0.21607E-03	0.32033E-03	0.60371E-05	0.20090E-05	0.95572E-02	0.12309E-01	0.10981E-02	0.25312E-03
3	0.10930E-05	0.17302E-05	0.19428E-07	0.68445E-08	0.19989E-03	0.30336E-03	0.15059E-04	0.44950E-05
4	0.32202E-08	0.53843E-08	0.83222E-11	0.67419E-10	0.26304E-05	0.42161E-05	0.14204E-06	0.44671E-07
5	-0.44818E-11	0.11425E-10	-0.19381E-10	0.15698E-11	0.22879E-07	0.37738E-07	0.44443E-09	0.29185E-09
6	-0.14374E-13	0.30989E-13	-0.34365E-11	-0.60370E-12	0.13852E-09	0.21984E-09	-0.49022E-11	-0.12601E-10
x = 0.50				x = 1.00				
1	0.33174E-01	0.35541E-01	0.17681E-02	0.50851E-03	0.26473E-00	0.13994E-00	0.52511E-01	0.67778E-03
2	0.36740E-03	0.53984E-03	0.12602E-04	0.41129E-05	0.12475E-01	0.15644E-01	0.15644E-02	0.33815E-03
3	0.22808E-05	0.34017E-05	0.49962E-07	0.17152E-07	0.28515E-03	0.43053E-03	0.24650E-04	0.68940E-05
4	0.83740E-08	0.13805E-07	0.99646E-10	0.10748E-09	0.41345E-05	0.66380E-05	0.24876E-06	0.74743E-07
5	0.37988E-11	0.33303E-10	-0.20549E-10	0.32052E-11	0.00808E-07	0.65950E-07	0.107074E-08	0.59160E-09
6	-0.65108E-13	0.12006E-12	-0.449073E-11	-0.22519E-11	0.26911E-09	0.44743E-09	-0.43186E-11	-0.93813E-12

m = 1.80-0.80 i

x = 1.05				x = 1.55				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.29561E-00	0.14422E-00	0.495069E-01	-0.16276E-02	0.51024E-00	0.14472E-00	0.24751E-00	-0.94156E-01
2	0.14093E-01	0.19618E-01	0.21889E-02	0.43343E-03	0.12243E-00	0.10031E-01	0.28952E-01	-0.13077E-02
3	0.40040E-03	0.60009E-03	0.18004E-04	0.12836E-04	0.461104E-02	0.10181E-02	0.11735E-02	0.17636E-03
4	0.64140E-05	0.10214E-04	0.42324E-06	0.10313E-04	0.20238E-03	0.30642E-03	0.48618E-04	0.83963E-05
5	0.88184E-07	0.11398E-08	0.31891E-09	0.10402E-08	0.44490E-05	0.74189E-05	0.44861E-06	0.13124E-06
6	0.30974E-09	0.48320E-09	0.43866E-12	-0.11723E-10	0.75971E-07	0.12468E-06	0.53982E-08	0.17307E-08

x = 1.10				x = 1.60				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.32349E-00	0.14694E-00	0.79259E-01	-0.50479E-02	0.31968E-00	0.14508E-00	0.26729E-00	-0.10781E-00
2	0.20581E-01	0.24240E-01	0.30115E-02	0.34189E-03	0.14261E-00	0.98017E-01	0.35105E-01	-0.27078E-02
3	0.59348E-03	0.82280E-03	0.57818E-04	0.13036E-04	0.76326E-02	0.98613E-02	0.13470E-02	0.48894E-05
4	0.87700E-05	0.21899E-04	0.70252E-06	0.70288E-04	0.26766E-03	0.40260E-03	0.40429E-04	0.20728E-03
5	0.11314E-06	0.18841E-06	0.38833E-08	0.19189E-08	0.68849E-03	0.10604E-04	0.72910E-06	0.18237E-06
6	0.91789E-09	0.14900E-10	0.14900E-10	-0.12405E-12	0.11399E-04	0.18658E-06	0.96281E-08	0.27257E-08

x = 1.15				x = 1.65				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.39448E-00	0.14854E-00	0.94886E-01	-0.98201E-02	0.52707E-00	0.14982E-00	0.28896E-00	-0.12190E-00
2	0.25959E-01	0.29994E-01	0.40792E-02	0.65489E-03	0.14868E-00	0.10466E-00	0.42104E-01	-0.44424E-02
3	0.79450E-03	0.11133E-02	0.33319E-04	0.21897E-04	0.11899E-01	0.91899E-01	0.20145E-02	0.23845E-03
4	0.14400E-04	0.22781E-04	0.11393E-05	0.33148E-06	0.39143E-03	0.52408E-03	0.58207E-04	0.11816E-04
5	0.18353E-06	0.29997E-06	0.10491E-07	0.39314E-07	0.91141E-05	0.14430E-04	0.10794E-05	0.27729E-06
6	0.14424E-08	0.27320E-08	0.53848E-10	0.68559E-11	0.16877E-06	0.27984E-06	0.15186E-07	0.43897E-08

x = 1.20				x = 1.70				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.38198E-00	0.14872E-00	0.11184E-00	-0.16007E-01	0.53248E-00	0.14249E-00	0.30653E-00	-0.13438E-00
2	0.23502E-01	0.39946E-01	0.44440E-02	0.76144E-03	0.18772E-00	0.11019E-00	0.44995E-01	-0.72144E-02
3	0.10148E-02	0.14804E-02	0.12437E-03	0.30882E-04	0.11785E-01	0.14449E-01	0.28043E-02	0.23845E-03
4	0.21010E-04	0.33073E-04	0.14090E-05	0.31845E-04	0.63739E-03	0.67628E-03	0.77310E-04	0.13448E-04
5	0.29142E-06	0.47518E-06	0.18174E-07	0.56472E-08	0.12362E-04	0.19803E-04	0.13782E-05	0.39470E-06
6	0.28412E-08	0.47298E-08	0.10961E-09	0.26989E-10	0.24688E-06	0.40214E-06	0.23394E-07	0.65457E-08

x = 1.25				x = 1.75				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.40671E-00	0.14899E-00	0.12989E-00	-0.23878E-01	0.53600E-00	0.14829E-00	0.32602E-00	-0.14688E-00
2	0.40359E-01	0.42257E-01	0.71721E-02	0.84619E-03	0.21708E-00	0.11642E-00	0.58645E-01	-0.18212E-01
3	0.13492E-02	0.15470E-02	0.17841E-03	0.44128E-04	0.14581E-01	0.17918E-01	0.33994E-02	0.26839E-03
4	0.30178E-04	0.44293E-04	0.28173E-05	0.78295E-06	0.38046E-03	0.86348E-03	0.10334E-03	0.19941E-04
5	0.43386E-06	0.71819E-06	0.30737E-07	0.49409E-08	0.91049E-04	0.28919E-04	0.22811E-05	0.39451E-06
6	0.48009E-08	0.79770E-08	0.20563E-09	0.53620E-10	0.217149E-04	0.39601E-06	0.76154E-07	0.99282E-08

x = 1.30				x = 1.80				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.42848E-00	0.14749E-00	0.14868E-00	-0.32801E-01	0.53779E-00	0.14977E-00	0.34947E-00	-0.15894E-00
2	0.49613E-01	0.48970E-01	0.93236E-02	0.87789E-03	0.23713E-00	0.11729E-00	0.66139E-01	-0.14669E-01
3	0.17749E-02	0.23304E-02	0.25215E-03	0.72986E-04	0.17499E-01	0.42300E-02	0.29378E-03	0.23738E-04
4	0.42721E-04	0.48663E-04	0.43096E-05	0.14857E-05	0.79739E-03	0.12413E-03	0.25239E-04	0.76883E-04
5	0.69454E-06	0.11284E-05	0.31048E-07	0.13259E-07	0.31199E-04	0.10989E-02	0.37689E-05	0.14659E-07
6	0.79712E-08	0.13225E-07	0.42119E-09	0.12911E-09	0.31078E-06	0.82732E-06	0.54748E-07	0.14659E-07

x = 1.35				x = 1.85				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.45038E-00	0.14670E-00	0.14607E-00	-0.43262E-01	0.53777E-00	0.15141E-00	0.36489E-00	-0.16928E-00
2	0.60509E-01	0.37410E-01	0.11972E-01	0.82818E-03	0.26292E-00	0.11894E-00	0.78838E-01	-0.19666E-01
3	0.23109E-02	0.32523E-02	0.35144E-03	0.72986E-04	0.21613E-01	0.24234E-01	0.53288E-02	0.21400E-03
4	0.59674E-04	0.92595E-04	0.64837E-05	0.17054E-05	0.96453E-03	0.13849E-02	0.19006E-03	0.71882E-04
5	0.10443E-05	0.16903E-05	0.82867E-07	0.24297E-07	0.31119E-04	0.48955E-04	0.46138E-05	0.10525E-05
6	0.12950E-07	0.21626E-07	0.75221E-09	0.21932E-09	0.72327E-06	0.11681E-05	0.81894E-07	0.21580E-07

x = 1.40				x = 1.90				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.44874E-00	0.14981E-00	0.14781E-00	-0.54878E-01	0.53622E-00	0.13309E-00	0.38829E-00	-0.17899E-00
2	0.73194E-01	0.69634E-01	0.15188E-01	0.64901E-03	0.28780E-00	0.11854E-00	0.69235E-01	-0.23617E-01
3	0.29823E-02	0.44136E-02	0.48364E-03	0.43030E-04	0.28187E-01	0.28330E-01	0.66413E-02	0.12332E-03
4	0.82324E-04	0.12784E-03	0.94052E-05	0.26512E-05	0.12207E-02	0.17329E-02	0.25197E-03	0.38910E-04
5	0.15492E-05	0.24877E-05	0.13212E-06	0.38043E-07	0.41393E-04	0.64637E-04	0.14238E-05	0.14238E-05
6	0.20838E-07	0.34093E-07	0.12937E-08	0.38154E-09	0.10144E-05	0.16329E-05	0.12117E-06	0.31176E-07

x = 1.45				x = 1.95				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.48484E-00	0.14812E-00	0.20771E-00	-0.67613E-01	0.53317E-00	0.15441E-00	0.40349E-00	-0.18739E-00
2	0.87463E-01	0.74051E-01	0.19047E-01	0.28235E-03	0.31258E-00	0.11721E-00	0.10072E-00	0.32514E-01
3	0.38183E-02	0.32108E-02	0.65734E-03	0.11823E-03	0.11571E-01	0.32056E-01	0.82251E-02	-0.33716E-04
4	0.11228E-03	0.17225E-03	0.14024E-04	0.34639E-05	0.19396E-02	0.21538E-02	0.33132E-03	0.46978E-04
5	0.22819E-05	0.36379E-05	0.20724E-06	0.58387E-07	0.54648E-04	0.83993E-04	0.48713E-05	0.19025E-05
6	0.12366E-07	0.59377E-07	0.22389E-08	0.66189E-09	0.14098E-05	0.22617E-05	0.17727E-06	0.44722E-07

x = 1.50				x = 2.00				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.49865E-00	0.14474E-00	0.22764E-00	-0.80599E-01	0.52679E-00	0.15897E-00	0.42306E-00	-0.19456E-00
2	0.10409E-00	0.82436E-01	0.23135E-01	-0.34204E-03	0.33654E-00	0.11481E-00	0.11266E-00	-0.40949E-01
3	0.48483E-02	0.85020E-02	0.88382E-03	0.14611E-03	0.27878E-01	0.37788E-01	0.29292E-01	-8.48888E-02
4	0.13130E-03	0.23094E-03	0.20209E-04	0.448173E-05	0.13770E-02	0.22448E-02	0.29292E-03	0.46978E-04
5	0.37444E-05	0.52279E-05	0.31989E-06	0.88206E-07	0.71627E-04	0.10942E-03	0.12341E-04	0.25119E-05
6	0.44974E-07	0.82203E-07	0.37079E-08	0.10939E-08	0.18021E-05	0.31049E-05	0.25695E-06	0.63214E-07

m = 1.80-1.00 l

n	x = 0.05				x = 0.55			
	a _n ^r	a _n ^l	b _n ^r	b _n ^l	a _n ^r	a _n ^l	b _n ^r	b _n ^l
1	0.34963E-04	0.44485E-04	0.16411E-07	0.66698E-02	0.55958E-01	0.45120E-01	0.75004E-02	0.24725E-03
2	0.37867E-08	0.45894E-08	-0.12667E-02	-0.11949E-08	0.46957E-01	0.49134E-01	0.10111E-04	0.19165E-05
3	-0.35167E-12	0.72255E-12	0.42407E-10	-0.53208E-09	0.45195E-04	0.77968E-05	0.14570E-06	0.21772E-07
4					0.22649E-07	0.36292E-07	0.42270E-07	0.77694E-10
5					0.65957E-10	0.13300E-09	-0.21757E-11	-0.26931E-11
6					-0.24047E-12	0.35277E-12	-0.64067E-12	-0.77202E-11
1	0.29118E-03	0.35560E-03	0.71000E-06	0.12199E-06	0.72820E-01	0.63344E-01	0.45367E-07	0.26297E-03
2	0.13613E-06	0.20305E-06	0.24136E-09	0.26360E-11	0.10799E-07	0.15251E-07	0.44500E-04	0.66650E-05
3	0.39911E-10	0.47278E-10	0.12714E-10	0.58117E-11	0.21999E-05	0.14625E-04	0.11744E-04	0.45920E-07
4					0.49501E-07	0.80365E-07	0.10893E-04	0.16447E-09
5					0.27845E-09	0.28721E-09	-0.13773E-11	-0.18629E-10
6					-0.77678E-12	0.13754E-11	0.43984E-11	-0.33917E-11
1	0.95704E-03	0.11979E-02	0.43967E-05	0.49054E-06	0.93921E-01	0.75938E-01	0.79290E-02	0.19823E-03
2	0.10336E-05	0.15404E-05	0.36446E-08	0.74562E-09	0.16201E-02	0.22601E-02	0.96735E-04	0.10675E-04
3	0.51199E-09	0.96453E-09	-0.13061E-10	0.63161E-10	0.16446E-04	0.25478E-04	0.64987E-06	0.89902E-07
4					0.10148E-05	0.15844E-05	0.27075E-08	0.41592E-09
5					0.41713E-09	0.66881E-09	0.87207E-12	-0.17885E-10
6					-0.40178E-11	0.62524E-11	0.39612E-11	-0.42619E-10
1	0.22955E-02	0.28292E-02	0.22723E-04	0.36852E-05	0.11834E-00	0.28821E-01	0.11339E-01	-0.15235E-04
2	0.43593E-05	0.64807E-05	0.26676E-07	0.50353E-08	0.23618E-02	0.12483E-02	0.16151E-07	0.16039E-04
3	0.44181E-08	0.70696E-08	-0.73827E-10	0.27431E-09	0.27562E-04	0.42545E-04	0.12605E-05	0.16673E-08
4	-0.31942E-11	0.48139E-11	0.77198E-10	0.10069E-10	0.19710E-05	0.13971E-05	0.16109E-08	0.95137E-09
5	-0.13848E-14	0.27314E-14	-0.15338E-11	0.14444E-12	0.92763E-09	0.15010E-08	-0.24562E-11	-0.80741E-10
6	-0.38173E-18	0.74442E-18	-0.43294E-15	0.10867E-15	-0.10149E-10	0.13493E-10	0.31466E-11	-0.99444E-11
1	0.45513E-02	0.54931E-02	0.64926E-04	0.10732E-04	0.14594E-00	0.10019E-00	0.15753E-01	-0.47459E-03
2	0.13314E-04	0.19732E-04	0.12348E-06	0.20378E-07	0.33595E-02	0.45459E-02	0.26034E-03	0.22730E-04
3	0.20715E-07	0.23735E-07	0.166163E-11	-0.14246E-11	0.44602E-04	0.48110E-04	0.23316E-05	0.29246E-06
4	0.23938E-10	0.38808E-10	0.86163E-11	0.20950E-11	0.36373E-06	0.35969E-06	0.13270E-07	0.18592E-08
5	-0.15716E-13	0.31828E-13	0.41839E-14	0.24333E-11	0.19938E-08	0.12556E-08	0.52636E-10	-0.18520E-10
6	-0.69293E-17	0.13510E-16	-0.72336E-14	0.12778E-14	0.16029E-10	0.17200E-10	0.69552E-11	-0.30332E-11
1	0.80070E-02	0.94074E-02	0.17212E-03	0.25107E-04	0.17598E-00	0.11069E-00	0.21317E-01	-0.13037E-02
2	0.33180E-04	0.48972E-04	0.44216E-06	0.71709E-07	0.46786E-02	0.62142E-02	0.40632E-03	0.30194E-04
3	0.73956E-07	0.11714E-06	0.60152E-09	0.27692E-09	0.16444E-04	0.10479E-04	0.41431E-04	0.27733E-06
4	0.68957E-10	0.15120E-09	-0.12189E-10	0.64775E-11	0.68158E-04	0.10479E-04	0.24854E-07	0.37157E-08
5	-0.113310E-12	0.33089E-12	-0.50335E-11	-0.67388E-11	0.40157E-04	0.66082E-04	0.11330E-04	-0.29316E-11
6	-0.73963E-16	0.44195E-15	-0.54969E-13	0.83900E-14	0.24091E-10	0.28460E-10	0.47805E-11	-0.42689E-11
1	0.12978E-01	0.14747E-01	0.31712E-03	0.50287E-04	0.20814E-00	0.11945E-00	0.24143E-01	-0.26549E-03
2	0.71970E-04	0.10552E-04	0.12977E-05	0.20397E-05	0.46194E-02	0.24172E-02	0.41617E-04	0.37311E-04
3	0.21742E-06	0.41350E-06	0.24458E-08	0.62254E-09	0.68959E-04	0.16222E-03	0.71179E-04	0.75733E-06
4	0.33819E-09	0.61451E-09	-0.58677E-10	0.56699E-11	0.10678E-03	0.16222E-03	0.17179E-04	0.40951E-08
5	-0.71533E-12	0.12130E-11	-0.49546E-11	-0.13973E-10	0.11204E-05	0.17967E-05	0.52109E-07	0.14183E-10
6	-0.46722E-15	0.10660E-14	-0.10854E-12	0.37893E-13	0.77955E-08	0.12816E-07	0.25420E-07	-0.14193E-11
1	0.19803E-01	0.21625E-01	0.72213E-03	0.88935E-04	0.24155E-00	0.12620E-00	0.36337E-01	-0.47101E-02
2	0.14026E-03	0.20458E-03	0.32950E-05	0.49826E-06	0.86646E-02	0.10224E-01	0.91113E-04	0.41063E-04
3	0.55337E-06	0.87142E-06	0.83304E-08	0.15970E-08	0.15970E-03	0.24015E-03	0.11810E-04	0.22118E-05
4	0.12826E-08	0.21108E-08	-0.95201E-11	0.81905E-12	0.18071E-05	0.29849E-05	0.17250E-07	0.12462E-07
5	-0.35010E-11	0.25133E-12	-0.24578E-11	-0.59706E-11	0.14535E-07	0.23700E-07	0.44315E-07	0.51473E-10
6	-0.317090E-14	0.60164E-14	-0.15880E-11	-0.11971E-11	0.87742E-10	0.14255E-09	0.40200E-11	-0.45390E-11
1	0.29853E-01	0.30072E-01	0.12967E-02	0.11883E-03	0.27539E-00	0.13085E-00	0.45968E-01	-0.76504E-02
2	0.5149E-03	0.36784E-03	0.74932E-05	0.10845E-05	0.11410E-01	0.14099E-01	0.13176E-02	0.37770E-04
3	0.12674E-05	0.19802E-05	0.24029E-07	0.39171E-08	0.23109E-03	0.44772E-03	0.10111E-04	0.17909E-05
4	0.37145E-08	0.60895E-08	0.10478E-10	0.61740E-11	0.30256E-04	0.48208E-04	0.17533E-06	0.21444E-07
5	0.25409E-11	0.52997E-14	-0.41794E-11	-0.10011E-10	0.26239E-07	0.41068E-07	0.11125E-08	0.12022E-09
6	-0.14444E-13	0.27880E-13	0.17242E-12	-0.67716E-11	0.16921E-09	0.27031E-09	0.11671E-10	-0.31872E-11
1	0.40492E-01	0.40003E-01	0.21866E-02	0.19669E-03	0.10887E-00	0.11351E-00	0.57011E-01	-0.11561E-01
2	0.4001E-03	0.61999E-03	0.15614E-04	0.21453E-05	0.14935E-01	0.17901E-01	0.18559E-02	0.20590E-04
3	0.26316E-05	0.41227E-05	0.61912E-07	0.95852E-08	0.33185E-03	0.49344E-03	0.31010E-04	0.25472E-05
4	0.96336E-08	0.15892E-07	0.12608E-09	0.12749E-10	0.47813E-05	0.75910E-05	0.30644E-04	0.14796E-07
5	0.27778E-10	0.29569E-10	-0.21786E-12	-0.92166E-11	0.45890E-07	0.75278E-07	0.21524E-04	0.27621E-09
6	-0.38341E-13	0.11239E-12	0.26292E-11	-0.16577E-11	0.31444E-09	0.52005E-09	0.13941E-10	-0.60566E-10
1	0.53496E-01	0.53496E-01	0.31712E-03	0.50287E-04	0.20814E-00	0.11945E-00	0.24143E-01	-0.26549E-03
2	0.71970E-04	0.10552E-04	0.12977E-05	0.20397E-05	0.46194E-02	0.24172E-02	0.41617E-04	0.37311E-04
3	0.21742E-06	0.41350E-06	0.24458E-08	0.62254E-09	0.68959E-04	0.16222E-03	0.71179E-04	0.75733E-06
4	0.33819E-09	0.61451E-09	-0.58677E-10	0.56699E-11	0.10678E-03	0.16222E-03	0.17179E-04	0.40951E-08
5	-0.71533E-12	0.12130E-11	-0.49546E-11	-0.13973E-10	0.11204E-05	0.17967E-05	0.52109E-07	0.14183E-10
6	-0.46722E-15	0.10660E-14	-0.10854E-12	0.37893E-13	0.77955E-08	0.12816E-07	0.25420E-07	-0.14193E-11
1	0.64492E-01	0.64492E-01	0.31712E-03	0.50287E-04	0.20814E-00	0.11945E-00	0.24143E-01	-0.26549E-03
2	0.71970E-04	0.10552E-04	0.12977E-05	0.20397E-05	0.46194E-02	0.24172E-02	0.41617E-04	0.37311E-04
3	0.21742E-06	0.41350E-06	0.24458E-08	0.62254E-09	0.68959E-04	0.16222E-03	0.71179E-04	0.75733E-06
4	0.33819E-09	0.61451E-09	-0.58677E-10	0.56699E-11	0.10678E-03	0.16222E-03	0.17179E-04	0.40951E-08
5	-0.71533E-12	0.12130E-11	-0.49546E-11	-0.13973E-10	0.11204E-05	0.17967E-05	0.52109E-07	0.14183E-10
6	-0.46722E-15	0.10660E-14	-0.10854E-12	0.37893E-13	0.77955E-08	0.12816E-07	0.25420E-07	-0.14193E-11
1	0.75496E-01	0.75496E-01	0.31712E-03	0.50287E-04	0.20814E-00	0.11945E-00	0.24143E-01	-0.26549E-03
2	0.71970E-04	0.10552E-04	0.12977E-05	0.20397E-05	0.46194E-02	0.24172E-02	0.41617E-04	0.37311E-04
3	0.21742E-06	0.41350E-06	0.24458E-08	0.62254E-09	0.68959E-04	0.16222E-03	0.71179E-04	0.75733E-06
4	0.33819E-09	0.61451E-09	-0.58677E-10	0.56699E-11	0.10678E-03	0.16222E-03	0.17179E-04	0.40951E-08
5	-0.71533E-12	0.12130E-11	-0.49546E-11	-0.13973E-10	0.11204E-05	0.17967E-05	0.52109E-07	0.14183E-10
6	-0.46722E-15	0.10660E-14	-0.10854E-12	0.37893E-13	0.77955E-08	0.12816E-07	0.25420E-07	-0.14193E-11
1	0.86492E-01	0.86492E-01	0.31712E-03	0.50287E-04	0.20814E-00	0.11945E-00	0.24143E-01	-0.26549E-03
2	0.71970E-04	0.10552E-04	0.12977E-05	0.20397E-05	0.46194E-02	0.24172E-02	0.41617E-04	0.37311E-04
3	0.21742E-06	0.41350E-06	0.24458E-08	0.62254E-09	0.68959E-04	0.16222E-03	0.71179E-04	0.75733E-06
4	0.33819E-09	0.61451E-09	-0.58677E-10	0.56699E-11	0.10678E-03	0.16222E-03	0.17179E-04	0.40951E-08
5	-0.71533E-12	0.12130E-11	-0.49546E-11	-0.13973E-10	0.11204E-05	0.17967E-05	0.52109E-07	0.14183E-10
6	-0.46722E-15	0.10660E-14	-0.10854E-12	0.37893E-13	0.77955E-08	0.12816E-07	0.25420E-07	-0.14193E-11
1	0.97496E-01	0.97496E-01	0.31712E-03	0.50287E-04	0.20814E-00	0.11945E-00	0.24143E-01	-0.26549E-03
2	0.71970E-04	0.10552E-04	0.12977E-05	0.20397E-05	0.46194E-02	0.24172E-02	0.41617E-04	0.37311E-04
3	0.21742E-06	0.41350E-06	0.24458E-08	0.62254E-09	0.68959E-04	0.16222E-03	0.71179E-04	0.75733E-06
4	0.33819E-09	0.61451E-09	-0.58677E-10	0.56699E-11	0.10678E-03	0.16222E-03	0.17179E-04	0.40951E-08
5	-0.71533E-12	0.12130E-11	-0.49546E-11	-0.13973E-10	0.11204E-05	0.17967E-05	0.52109E-07	0.14183E-10
6	-0.46722							

m = 1.71-0.78 1

x = 0.05								x = 0.55							
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ			
1	0.25377E-04	0.40956E-04	0.20220E-07	0.70411E-08	0.40605E-01	0.50213E-01	0.30063E-02	0.12394E-02							
2	0.39954E-08	0.61799E-08	0.90270E-09	0.20494E-10	0.51157E-03	0.90513E-03	0.25191E-04	0.11895E-04							
3	-0.34903E-12	0.84377E-12	0.14912E-09	0.21609E-09	0.38091E-05	0.72461E-05	0.11986E-06	0.58922E-07							
4					0.14967E-07	0.3338E-07	0.25191E-04	0.11895E-04							
5					0.36969E-07	0.49944E-10	0.11986E-06	0.58922E-07							
6					0.81508E-13	0.47467E-12	0.39165E-12	-0.25051E-12							
								0.17039E-12							
x = 0.10								x = 0.60							
1	0.20394E-03	0.32773E-03	0.57756E-06	0.29788E-06	0.54160E-01	0.53221E-01	0.44690E-02	0.18204E-02							
2	0.10041E-06	0.18427E-06	0.42671E-11	-0.37062E-10	0.17321E-02	0.13914E-02	0.44544E-04	0.21461E-04							
3	0.25015E-11	-0.40118E-10	-0.47647E-11	-0.57450E-10	0.79525E-03	0.13259E-04	0.26208E-06	0.12769E-06							
4					0.69831E-03	0.72786E-07	0.91999E-09	0.53039E-09							
5					0.36969E-07	0.25591E-09	-0.15527E-10	0.58557E-11							
6					-0.74830E-12	0.11010E-11	-0.43122E-11	-0.27634E-11							
x = 0.15								x = 0.65							
1	0.69381E-03	0.11055E-02	0.43977E-05	0.22465E-05	0.70598E-01	0.77372E-01	0.70001E-02	0.25543E-02							
2	0.76349E-06	0.13932E-05	0.28482E-08	0.15332E-08	0.11899E-02	0.20644E-02	0.81199E-04	0.36787E-04							
3	0.41390E-09	0.84702E-09	-0.10979E-10	0.21983E-10	0.12203E-04	0.23098E-04	0.53783E-06	0.25879E-06							
4					0.78981E-07	0.14884E-06	0.22797E-08	0.11710E-08							
5					0.29843E-09	0.14806E-08	-0.42929E-11	0.92927E-11							
6					-0.12256E-11	0.15958E-11	-0.32890E-11	-0.12050E-11							
x = 0.20								x = 0.70							
1	0.18839E-02	0.26169E-02	0.18570E-04	0.93809E-05	0.90093E-01	0.92243E-01	0.10180E-01	0.34324E-02							
2	0.32191E-05	0.58872E-05	0.21870E-07	0.10984E-07	0.17321E-02	0.29717E-02	0.13648E-03	0.60329E-04							
3	0.51929E-08	0.64306E-08	0.11916E-09	0.19445E-09	0.20457E-04	0.38579E-04	0.10444E-05	0.49879E-06							
4	-0.26351E-11	0.78035E-11	-0.20228E-10	0.54923E-10	0.24727E-06	0.28848E-05	0.51817E-08	0.23592E-08							
5	-0.18890E-14	0.32043E-14	-0.14197E-11	0.71931E-11	0.68777E-09	0.14034E-08	0.13293E-10	0.23110E-10							
6	-0.38188E-18	0.87949E-18	-0.62457E-15	0.32463E-15	-0.32240E-12	0.51754E-11	-0.37941E-11	0.17478E-11							
x = 0.25								x = 0.75							
1	0.32878E-02	0.30976E-02	0.56815E-04	0.28290E-04	0.11269E-00	0.10731E-00	0.14410E-01	0.44195E-02							
2	0.98273E-05	0.17930E-04	0.10106E-06	0.51249E-07	0.24631E-02	0.41667E-02	0.22135E-03	0.95171E-04							
3	0.51929E-08	0.29722E-07	0.19490E-09	0.10883E-09	0.33085E-04	0.62149E-04	0.19435E-05	0.91010E-06							
4	0.57371E-11	0.40433E-10	-0.17653E-11	0.21861E-10	0.27302E-06	0.53370E-06	0.10952E-07	0.53292E-08							
5	-0.18010E-13	0.37070E-13	-0.33977E-11	0.24229E-11	0.14806E-08	0.29593E-08	0.37859E-10	0.14947E-10							
6	-0.89322E-17	0.15889E-16	-0.72957E-14	0.37265E-14	0.68881E-11	0.46162E-09	0.51313E-12	-0.22466E-11							
x = 0.30								x = 0.80							
1	0.58037E-02	0.47692E-02	0.14182E-03	0.69926E-04	0.13825E-00	0.12200E-00	0.19907E-01	0.54439E-01							
2	0.24471E-04	0.44511E-04	0.36134E-06	0.18235E-06	0.34281E-02	0.57089E-02	0.34790E-03	0.14503E-03							
3	0.39115E-07	0.10604E-06	0.53240E-09	0.28943E-09	0.51868E-04	0.97006E-04	0.34683E-05	0.55993E-05							
4	0.65991E-10	0.15198E-09	-0.40423E-11	0.11014E-10	0.48823E-04	0.49484E-06	0.22443E-07	0.10719E-07							
5	-0.11813E-12	0.23810E-12	-0.24894E-11	0.10574E-11	0.30007E-08	0.59843E-08	0.92594E-10	0.40699E-10							
6	-0.74001E-16	0.16992E-15	-0.53527E-13	0.24067E-13	0.14601E-10	0.24126E-10	0.81768E-12	-0.28438E-11							
x = 0.35								x = 0.85							
1	0.94132E-02	0.13829E-01	0.70770E-03	0.14701E-03	0.14648E-00	0.13572E-00	0.26893E-01	0.63876E-02							
2	0.52944E-04	0.95938E-04	0.10630E-05	0.53129E-06	0.44854E-02	0.78532E-02	0.53202E-01	0.21421E-03							
3	0.16194E-06	0.31106E-06	0.20874E-08	0.10696E-08	0.44854E-02	0.14726E-03	0.59747E-05	0.27082E-05							
4	0.28818E-09	0.58007E-09	0.28265E-11	0.11912E-10	0.79121E-04	0.48823E-04	0.34785E-07	0.20679E-07							
5	-0.39548E-12	0.11995E-11	-0.22187E-11	0.19999E-11	0.83981E-06	0.16265E-05	0.43275E-07	0.11264E-08							
6	-0.54771E-15	0.12522E-14	-0.23469E-12	0.76513E-13	0.98114E-08	0.11810E-07	0.20251E-09	0.11264E-08							
x = 0.40								x = 0.90							
1	0.14397E-01	0.20438E-01	0.60249E-03	0.28000E-03	0.19687E-00	0.14786E-00	0.35574E-01	0.70795E-02							
2	0.10336E-03	0.18649E-03	0.27073E-05	0.13381E-05	0.63021E-02	0.10099E-01	0.79348E-03	0.30743E-03							
3	0.41170E-06	0.78932E-06	0.31106E-08	0.10696E-08	0.11781E-03	0.21810E-03	0.99741E-05	0.44407E-05							
4	0.97239E-09	0.19108E-08	0.59329E-11	-0.50791E-11	0.13425E-05	0.27024E-05	0.80900E-07	0.38156E-07							
5	0.58730E-11	-0.15884E-11	0.13194E-11	-0.31124E-11	0.10868E-07	0.21631E-07	0.44027E-09	0.21213E-09							
6	-0.30493E-14	0.71309E-14	0.27584E-11	-0.14489E-11	0.61034E-10	0.11819E-09	0.84770E-12	-0.45274E-11							
x = 0.45								x = 0.95							
1	0.21042E-01	0.28700E-01	0.10909E-02	0.49941E-03	0.22878E-00	0.15829E-00	0.46121E-01	0.72934E-02							
2	0.18640E-03	0.33476E-03	0.61777E-05	0.30127E-05	0.23353E-02	0.15087E-01	0.11593E-02	0.42953E-03							
3	0.93794E-06	0.17938E-05	0.19794E-07	0.98799E-08	0.17149E-03	0.31948E-03	0.16193E-04	0.70466E-05							
4	0.33034E-08	0.55426E-08	0.50588E-10	0.32903E-10	0.22558E-05	0.43585E-05	0.14635E-06	0.68230E-07							
5	0.34539E-11	0.13720E-10	-0.46718E-12	0.45844E-11	0.19594E-07	0.39002E-07	0.88623E-09	0.47125E-09							
6	-0.14011E-13	0.32006E-13	-0.89168E-12	0.54551E-12	0.11219E-09	0.23889E-09	-0.62667E-11	0.18794E-11							
x = 0.50								x = 1.00							
1	0.29670E-01	0.38646E-01	0.18569E-02	0.80237E-03	0.26146E-00	0.18850E-00	0.58642E-01	0.87956E-02							
2	0.31876E-03	0.56460E-03	0.12921E-04	0.62071E-05	0.10944E-01	0.18701E-01	0.16397E-02	0.58509E-03							
3	0.19656E-05	0.37349E-05	0.50756E-07	0.25165E-07	0.24945E-03	0.44678E-03	0.25635E-04	0.10947E-04							
4	0.72249E-08	0.14178E-07	0.12302E-09	0.17501E-10	0.33629E-05	0.68755E-05	0.25446E-04	0.11787E-04							
5	0.30957E-10	0.30274E-10	0.92966E-11	-0.98936E-11	0.34329E-07	0.68097E-07	0.17789E-08	0.85815E-09							
6	-0.54899E-13	0.13129E-12	0.47142E-11	0.71232E-12	0.23144E-09	0.46846E-09	0.63668E-11	0.34337E-11							

m = 1.71-0.76 1

	x = 1.05				x = 1.55			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.29421E-00	0.17251E-00	0.73158E-01	0.51636E-07	0.51934E 00	0.16648E-00	0.27631E-09	-0.99725E-01
2	0.14183E-01	0.21009E-01	0.23359E-02	0.77737E-03	0.11647E-00	0.10367E-00	0.32813E-01	0.16670E-02
3	0.34489E-03	0.62607E-03	0.39674E-04	0.16546E-04	0.53457E-02	0.85244E-02	0.12712E-02	0.35280E-03
4	0.35021E-05	0.10584E-04	0.43723E-06	0.19827E-06	0.17442E-03	0.31931E-03	0.30368E-04	0.11211E-04
5	0.58409E-07	0.11567E-06	0.33352E-08	0.18120E-08	0.39904E-05	0.76857E-05	0.50737E-06	0.21077E-06
6	0.43058E-09	0.87702E-09	0.49421E-11	0.81869E-12	0.65101E-07	0.12883E-06	0.62495E-08	0.27613E-08

	x = 1.10				x = 1.60			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.32625E-00	0.17642E-00	0.89588E-01	0.22162E-02	0.52833E 00	0.18496E-00	0.29648E-00	-0.11074E-00
2	0.81819E-01	0.26075E-01	0.32283E-02	0.10079E-07	0.19702E-00	0.11323E-00	0.39991E-01	0.54082E-03
3	0.47713E-03	0.85924E-03	0.60144E-04	0.24446E-07	0.87147E-02	0.10481E-01	0.16811E-02	0.43599E-01
4	0.83249E-05	0.15986E-04	0.72683E-06	0.32472E-06	0.23103E-03	0.41988E-03	0.42820E-04	0.13346E-04
5	0.46940E-07	0.19136E-06	0.60574E-08	0.28883E-08	0.56196E-05	0.10783E-04	0.76222E-06	0.21077E-06
6	0.79071E-09	0.15971E-08	0.28216E-10	0.15123E-10	0.97667E-07	0.19281E-06	0.10003E-07	0.43346E-08

	x = 1.15				x = 1.65			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.35648E-00	0.17847E-00	0.10774E-00	-0.23480E-02	0.53804E 00	0.16877E-00	0.31665E-00	-0.12519E-00
2	0.29110E-01	0.31947E-01	0.43979E-02	0.12747E-02	0.14987E-00	0.12192E-00	0.48175E-01	-0.12103E-02
3	0.45082E-03	0.11618E-02	0.89490E-04	0.35362E-07	0.83851E-02	0.12785E-01	0.22020E-02	0.52803E-05
4	0.12359E-04	0.23803E-04	0.11809E-05	0.51924E-06	0.30339E-03	0.34708E-03	0.59714E-04	0.20727E-04
5	0.15724E-06	0.31000E-06	0.10831E-07	0.30627E-07	0.78289E-05	0.19826E-04	0.11303E-05	0.49304E-06
6	0.14061E-08	0.28927E-08	0.63926E-10	0.35925E-10	0.14883E-06	0.28485E-06	0.15768E-07	0.67999E-08

	x = 1.20				x = 1.70			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.38989E-00	0.17899E-00	0.12732E-00	-0.87117E-02	0.53960E 00	0.16288E-00	0.33630E-00	-0.13942E-00
2	0.29111E-01	0.38658E-01	0.39068E-02	0.15704E-02	0.18887E-00	0.12938E-00	0.57397E-01	-0.37256E-02
3	0.87646E-03	0.13493E-02	0.13087E-03	0.30150E-04	0.10414E-01	0.15475E-01	0.28579E-02	0.62649E-04
4	0.18040E-04	0.34831E-04	0.18788E-05	0.81220E-06	0.39521E-03	0.70665E-03	0.82412E-04	0.27839E-04
5	0.24872E-06	0.48913E-06	0.16791E-07	0.10795E-07	0.10795E-07	0.20349E-04	0.16964E-05	0.65088E-06
6	0.24391E-08	0.48899E-08	0.12892E-09	0.37009E-10	0.21162E-06	0.41571E-06	0.24597E-07	0.10446E-07

	x = 1.25				x = 1.75			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.41261E-00	0.17892E-00	0.14748E-00	-0.16947E-01	0.54212E 00	0.16225E-00	0.35568E-00	-0.15260E-00
2	0.36370E-01	0.46204E-01	0.79777E-02	0.18806E-02	0.20956E-00	0.13934E-00	0.67498E-01	-0.71917E-02
3	0.11667E-02	0.20403E-02	0.18837E-03	0.49798E-04	0.12888E-01	0.18899E-01	0.36765E-02	0.72632E-02
4	0.25921E-04	0.49069E-04	0.29320E-05	0.12447E-05	0.31095E-03	0.40930E-03	0.11262E-03	0.16378E-04
5	0.38900E-06	0.76321E-06	0.31641E-07	0.14467E-07	0.14743E-04	0.27994E-04	0.23992E-05	0.92328E-04
6	0.41225E-08	0.42589E-08	0.24105E-09	0.11160E-09	0.10611E-06	0.59971E-06	0.37666E-07	0.15836E-07

	x = 1.30				x = 1.80			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.43689E-00	0.17682E-00	0.16935E-00	-0.27002E-01	0.54273E 00	0.16182E-00	0.37485E-00	-0.16474E-00
2	0.44507E-01	0.54595E-01	0.10241E-01	0.21809E-02	0.23621E-00	0.14959E-00	0.78520E-01	-0.11599E-01
3	0.15346E-02	0.26557E-02	0.26718E-03	0.95420E-04	0.18231E-01	0.22163E-01	0.46894E-02	0.81964E-02
4	0.36711E-04	0.69199E-04	0.44948E-05	0.18713E-05	0.65594E-03	0.11508E-02	0.15247E-03	0.47299E-04
5	0.59932E-06	0.11649E-05	0.32828E-07	0.23663E-07	0.19954E-04	0.37627E-04	0.34376E-05	0.12938E-05
6	0.68311E-08	0.13655E-07	0.44470E-09	0.20933E-09	0.43808E-06	0.85976E-06	0.57138E-07	0.23658E-07

	x = 1.35				x = 1.85			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.49899E-00	0.17483E-00	0.19105E-00	-0.38703E-01	0.54156E 00	0.16151E-00	0.39388E-00	-0.17570E-00
2	0.59428E-01	0.63640E-01	0.13236E-01	0.74345E-01	0.28333E-00	0.14195E-00	0.90316E-01	-0.17074E-01
3	0.20082E-02	0.34188E-02	0.37382E-03	0.12821E-02	0.19966E-01	0.26228E-01	0.59314E-02	0.89489E-03
4	0.31302E-04	0.44220E-04	0.47779E-05	0.27638E-05	0.89652E-03	0.14521E-02	0.20458E-02	0.60719E-04
5	0.89411E-06	0.17486E-05	0.85905E-07	0.17996E-07	0.26777E-04	0.50239E-04	0.48750E-05	0.17921E-05
6	0.11084E-07	0.22131E-07	0.78910E-09	0.36445E-09	0.62054E-06	0.12085E-05	0.85616E-07	0.34927E-07

	x = 1.40				x = 1.90			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.47786E-00	0.17381E-00	0.21279E-00	-0.51777E-01	0.53874E 00	0.16123E-00	0.41280E-00	-0.18537E-00
2	0.87610E-01	0.73115E-01	0.16902E-01	0.25892E-02	0.24039E-00	0.14251E-00	0.10275E-00	-0.23728E-01
3	0.29910E-02	0.43564E-02	0.51643E-03	0.16939E-03	0.23997E-01	0.50806E-01	0.74410E-02	0.93598E-03
4	0.70814E-04	0.13210E-03	0.10065E-04	0.40138E-04	0.10402E-02	0.18194E-02	0.27220E-03	0.76982E-04
5	0.13285E-05	0.25846E-05	0.13716E-06	0.59789E-07	0.35649E-04	0.66819E-04	0.68462E-05	0.24849E-05
6	0.17879E-07	0.35213E-07	0.13555E-08	0.61469E-09	0.87059E-06	0.16901E-05	0.12687E-06	0.50926E-07

	x = 1.45				x = 1.95			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.49910E-00	0.17038E-00	0.29433E-00	-0.48888E-01	0.53943E 00	0.16089E-00	0.43163E-00	-0.19364E-00
2	0.81744E-01	0.83390E-01	0.21332E-01	0.29752E-02	0.31811E-00	0.14137E-00	0.11570E-00	-0.31319E-01
3	0.33226E-02	0.54979E-02	0.70500E-03	0.22009E-03	0.28825E-01	0.35910E-01	0.92595E-02	0.92134E-03
4	0.96634E-04	0.17922E-03	0.14735E-04	0.57370E-05	0.13399E-02	0.22642E-02	0.35924E-03	0.96161E-04
5	0.19418E-05	0.37895E-05	0.21548E-06	0.92462E-07	0.47087E-04	0.87375E-04	0.95259E-05	0.33255E-05
6	0.27795E-07	0.59120E-07	0.23193E-08	0.10463E-08	0.12102E-05	0.29417E-05	0.18601E-06	0.73505E-07

	x = 1.50				x = 2.00			
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.50796E 00	0.16830E-00	0.25593E-00	-0.80698E-01	0.52866E 00	0.14040E-00	0.45037E-00	-0.20045E-00
2	0.98035E-01	0.93612E-01	0.26611E-01	0.29037E-02	0.34245E-00	0.13873E-00	0.12900E-00	-0.40403E-01
3	0.42289E-02	0.88796E-02	0.93171E-03	0.28124E-03	0.34669E-01	0.41333E-01	0.11430E-01	0.82299E-02
4	0.13047E-03	0.24047E-03	0.21286E-04	0.80781E-05	0.18742E-02	0.27997E-02	0.47045E-03	0.11904E-03
5	0.28008E-05	0.54138E-05	0.33299E-06	0.140071E-06	0.41795E-04	0.11390E-03	0.13137E-04	0.44576E-05
6	0.42792E-07	0.84874E-07	0.38173E-08	0.16986E-08	0.16479E-05	0.32159E-05	0.27602E-06	0.10477E-06

m = 1.79-0.79 i

x = 0.05					x = 0.55				
n	a_n^r	a_n^i	b_n^r	b_n^i	a_n^r	a_n^i	b_n^r	b_n^i	
1	0.24443E-04	0.43874E-04	0.17171E-07	0.10791E-07	0.40148E-01	0.54539E-01	0.33166E-07	0.14474E-02	
2	0.31321E-08	0.50709E-08	0.12270E-09	0.12270E-09	0.42869E-03	0.49606E-03	0.27586E-04	0.13086E-04	
3	-0.10563E-12	0.24607E-17	0.14701E-11	-0.20444E-11	0.18097E-05	0.74479E-05	0.11107E-06	0.59244E-07	
4					0.16055E-07	0.33189E-07	0.47466E-07	0.24313E-09	
5					0.42448E-10	0.11122E-09	-0.16387E-12	0.10414E-10	
6					-0.15002E-12	0.39027E-12	-0.19911E-11	0.14271E-11	
x = 0.10					x = 0.60				
1	0.19655E-03	0.32071E-03	0.13021E-06	0.34812E-06	0.54187E-01	0.68837E-01	0.51638E-02	0.21387E-02	
2	0.45986E-07	0.19530E-06	0.32060E-09	0.47370E-10	0.75842E-03	0.14777E-02	0.50811E-04	0.28240E-04	
3	0.14442E-10	0.10324E-09	0.32060E-09	0.37720E-10	0.64255E-05	0.13497E-04	0.28647E-06	0.16998E-06	
4					0.34984E-07	0.76642E-07	0.10244E-09	0.39116E-11	
5					0.10933E-09	0.27211E-09	-0.10424E-10	0.89318E-11	
6					-0.61589E-12	0.10250E-11	-0.36162E-11	-0.11270E-11	
x = 0.15					x = 0.65				
1	0.66932E-03	0.14433E-02	0.47892E-06	0.26374E-06	0.71058E-01	0.84440E-01	0.77619E-02	0.35958E-02	
2	0.72660E-06	0.14820E-05	0.27930E-09	0.15272E-09	0.11384E-02	0.21941E-02	0.49144E-04	0.43274E-04	
3	0.42844E-09	0.40252E-09	0.40252E-09	-0.33720E-10	0.11582E-04	0.24387E-04	0.58826E-06	0.30411E-06	
4					0.71732E-07	0.15673E-06	0.24920E-08	0.13663E-08	
5					0.28365E-09	0.65305E-09	-0.10344E-11	0.10177E-10	
6					-0.77144E-12	0.14993E-11	-0.47504E-11	-0.53564E-11	
x = 0.20					x = 0.70				
1	0.16071E-02	0.28047E-02	0.20271E-04	0.11017E-04	0.91277E-01	0.10087E-00	0.11316E-01	0.40139E-01	
2	0.30636E-05	0.42325E-05	0.23095E-07	0.12759E-07	0.16604E-02	0.31808E-02	0.15005E-03	0.70978E-04	
3	0.10561E-08	0.5923E-09	0.18244E-10	0.33466E-10	0.19425E-04	0.40746E-04	0.11453E-06	0.58426E-06	
4	-0.79705E-12	0.5260E-11	-0.44320E-11	0.52029E-11	0.13911E-06	0.10382E-06	0.56054E-08	0.30233E-08	
5	-0.12311E-14	0.31726E-14	-0.82221E-12	0.24088E-12	0.64491E-09	0.14637E-08	0.41542E-11	0.18215E-10	
6	-0.33926E-18	0.26719E-18	-0.55993E-15	0.31019E-15	-0.47126E-12	0.31608E-11	-0.34726E-11	-0.20423E-11	
x = 0.25					x = 0.75				
1	0.11925E-02	0.54397E-02	0.61992E-04	0.33232E-04	0.11493E-00	0.11754E-00	0.16657E-01	0.51436E-02	
2	0.43540E-05	0.18986E-04	0.10749E-06	0.59771E-07	0.23637E-02	0.44359E-02	0.24371E-03	0.11197E-03	
3	0.14621E-07	0.31184E-07	0.92144E-10	-0.40984E-10	0.31474E-04	0.65659E-04	0.31295E-05	0.17035E-04	
4	0.52801E-10	0.24795E-10	0.17981E-10	-0.19466E-10	0.25939E-06	0.56222E-06	0.11779E-07	0.62997E-07	
5	-0.14247E-13	0.37021E-13	0.10421E-10	0.67947E-11	0.13525E-08	0.31120E-08	0.36787E-10	0.25546E-10	
6	-0.61584E-17	0.15788E-16	-0.64305E-14	0.36332E-14	0.44655E-11	0.49746E-11	-0.16998E-11	-0.18453E-11	
x = 0.30					x = 0.80				
1	0.56334E-02	0.94229E-02	0.15409E-03	0.91443E-03	0.14181E-00	0.13373E-00	0.22230E-01	0.52866E-02	
2	0.23306E-04	0.47149E-04	0.39435E-06	0.21420E-06	0.32962E-02	0.50041E-02	0.38370E-03	0.17962E-03	
3	0.52242E-07	0.11193E-06	0.63700E-09	0.44401E-09	0.49245E-04	0.10252E-03	0.38036E-05	0.18910E-05	
4	0.47889E-10	0.17432E-09	-0.12362E-10	0.39764E-10	0.48305E-05	0.99922E-06	0.24369E-07	0.12621E-07	
5	-0.10505E-12	0.26799E-12	-0.41976E-11	0.37181E-11	0.28177E-08	0.43049E-08	0.10438E-09	0.60988E-10	
6	-0.69733E-16	0.16792E-15	-0.47947E-13	0.25532E-13	0.11387E-10	0.27982E-10	-0.10419E-11	-0.64740E-13	
x = 0.35					x = 0.85				
1	0.91697E-02	0.14986E-01	0.33668E-03	0.17232E-03	0.17167E-00	0.14881E-00	0.30060E-01	0.72931E-02	
2	0.30440E-04	0.10164E-03	0.11566E-05	0.62398E-05	0.45143E-02	0.61765E-02	0.58778E-03	0.25192E-03	
3	0.13349E-06	0.32801E-06	0.22647E-08	0.12259E-08	0.75214E-04	0.19388E-03	0.53912E-05	0.31876E-05	
4	0.27766E-09	0.61438E-09	0.57625E-11	0.60165E-11	0.79140E-05	0.17138E-05	0.47405E-07	0.24302E-07	
5	-0.91189E-11	0.11486E-11	-0.35203E-12	0.13584E-12	0.54924E-03	0.12221E-02	0.22409E-04	0.14015E-04	
6	-0.48548E-15	0.12386E-14	-0.14472E-12	0.77925E-13	0.29521E-10	0.54969E-10	-0.25782E-11	0.11270E-11	
x = 0.40					x = 0.90				
1	0.14078E-01	0.22043E-01	0.56037E-03	0.32927E-03	0.20393E-00	0.16209E-00	0.39838E-01	0.79942E-02	
2	0.98520E-04	0.19780E-03	0.29565E-05	0.15720E-05	0.60066E-02	0.10789E-01	0.67577E-01	0.18134E-03	
3	0.39032E-06	0.89270E-06	0.75379E-08	0.61420E-08	0.11206E-03	0.23066E-03	0.10962E-04	0.52241E-05	
4	0.90320E-09	0.20440E-08	0.78474E-11	0.36775E-10	0.13187E-05	0.26082E-05	0.88700E-07	0.44491E-07	
5	-0.12470E-11	0.44690E-11	-0.65278E-11	0.43420E-11	0.10265E-07	0.22779E-07	0.68895E-09	0.27767E-09	
6	-0.27581E-14	0.70036E-14	-0.82986E-12	0.18214E-12	0.52500E-10	0.12568E-09	-0.30841E-11	0.17441E-11	
x = 0.45					x = 0.95				
1	0.20675E-01	0.31022E-01	0.11780E-02	0.37684E-03	0.23784E-00	0.17312E-00	0.51639E-01	0.79234E-02	
2	0.17795E-03	0.35493E-03	0.67312E-05	0.35403E-05	0.80950E-02	0.14001E-01	0.12855E-02	0.50438E-03	
3	0.88894E-06	0.18926E-05	0.21701E-07	0.11701E-07	0.16342E-03	0.33431E-03	0.17815E-04	0.83140E-05	
4	0.26380E-09	0.58626E-08	0.54079E-10	0.74944E-10	0.21356E-05	0.44601E-05	0.16035E-06	0.80161E-07	
5	-0.18101E-12	0.15246E-10	-0.40466E-11	0.10732E-10	0.18533E-07	0.41026E-07	0.99826E-09	0.52906E-09	
6	-0.12702E-13	0.32099E-13	-0.19787E-11	0.53137E-12	0.11094E-09	0.25174E-09	-0.11160E-12	0.10636E-11	
x = 0.50					x = 1.00				
1	0.29308E-01	0.41873E-01	0.27437E-02	0.94380E-03	0.27246E-00	0.18159E-00	0.65590E-01	0.69201E-02	
2	0.30227E-03	0.59891E-03	0.14134E-04	0.72942E-05	0.10637E-01	0.17895E-01	0.18439E-02	0.65597E-03	
3	0.14954E-05	0.39414E-05	0.55556E-07	0.29668E-07	0.16342E-03	0.47803E-03	0.6238E-04	0.12879E-04	
4	0.68237E-08	0.14970E-07	0.14225E-09	0.76566E-10	0.3378E-03	0.7490E-03	0.28133E-06	0.13860E-06	
5	0.16431E-10	0.37326E-10	0.53232E-12	0.75355E-12	0.33763E-05	0.71657E-07	0.19577E-08	0.10047E-08	
6	-0.17148E-13	0.10067E-12	-0.66449E-11	0.18829E-11	0.32461E-07	0.49459E-09	0.97566E-11	0.17490E-11	

m = 1.79-0.791

m = 1.79-0.791									
x = 1.05									
n	a_n^I	b_n^I	c_n^I	d_n^I	e_n^I	f_n^I	g_n^I	h_n^I	i_n^I
1	0.30720E+00	0.18744E-00	0.81644E-01	0.45428E-02	0.59374E-03	0.17086E-00	0.28942E-00	-0.11291E-00	
2	0.13828E-01	0.22549E-01	0.25978E-02	0.90937E-02	0.11955E-00	0.11314E-00	0.36747E-01	0.12061E-02	
3	0.32876E-03	0.66501E-03	0.43757E-04	0.19464E-04	0.51755E-03	0.91001E-02	0.14218E-02	0.40920E-03	
4	0.92156E-05	0.11161E-04	0.48003E-06	0.23228E-06	0.16427E-03	0.33782E-03	0.33630E-04	0.13161E-04	
5	0.52122E-07	0.12175E-06	0.36485E-08	0.19113E-07	0.37839E-05	0.55987E-06	0.55987E-06	0.24796E-06	
6	0.40284E-09	0.92222E-09	0.71277E-11	0.12039E-10	0.81562E-07	0.41030E-05	0.13558E-06	0.66619E-08	0.32362E-09
x = 1.10									
1	0.34092E-00	0.19086E-00	0.99626E-01	0.51303E-03	0.54136E-00	0.16852E-00	0.33908E-00	-0.12878E-00	
2	0.17803E-01	0.28036E-01	0.34001E-02	0.11758E-02	0.14135E-00	0.12355E-00	0.13908E-00	-0.38980E-03	
3	0.49221E-03	0.91043E-03	0.66424E-04	0.28751E-04	0.85183E-02	0.11202E-01	0.18627E-01	0.30241E-02	
4	0.78934E-05	0.18830E-04	0.79879E-06	0.38203E-06	0.22042E-03	0.79195E-03	0.44744E-04	0.18000E-04	
5	0.91672E-07	0.20143E-06	0.67004E-08	0.34332E-08	0.38203E-06	0.44449E-03	0.44744E-04	0.30241E-02	
6	0.73981E-09	0.16850E-08	0.12762E-10	0.29440E-10	0.92384E-07	0.20293E-06	0.84153E-06	0.16993E-07	0.51356E-08
x = 1.15									
1	0.37303E-00	0.19208E-00	0.11924E-00	-0.54923E-02	0.58427E-00	0.16861E-00	0.32836E-00	-0.14409E-00	
2	0.22718E-01	0.34415E-01	0.49133E-02	0.14806E-02	0.14529E-00	0.13250E-00	0.23617E-01	-0.42749E-02	
3	0.62155E-03	0.12195E-02	0.98940E-04	0.41576E-04	0.81844E-02	0.11202E-01	0.18627E-01	0.30241E-02	
4	0.11725E-04	0.24963E-04	0.12988E-05	0.61086E-06	0.29973E-03	0.13482E-01	0.24689E-02	0.64350E-01	
5	0.14873E-06	0.32634E-06	0.11909E-07	0.53622E-08	0.74301E-05	0.37915E-03	0.56381E-04	0.24285E-04	
6	0.13265E-08	0.29804E-08	0.70636E-10	0.42988E-10	0.13685E-06	0.57872E-04	0.12493E-05	0.53268E-06	0.180152E-08
x = 1.20									
1	0.40293E-00	0.19338E-00	0.14809E-00	-0.13999E-01	0.54952E-00	0.16511E-00	0.34794E-00	-0.15834E-00	
2	0.28753E-01	0.41725E-01	0.61012E-02	0.18132E-02	0.19119E-00	0.14078E-00	0.63550E-01	-0.60840E-01	
3	0.93749E-03	0.16438E-02	0.14492E-03	0.95940E-04	0.10171E-01	0.18582E-01	0.32075E-02	0.71077E-02	
4	0.17321E-04	0.34212E-04	0.20882E-05	0.10886E-06	0.37781E-03	0.74872E-03	0.91718E-04	0.32355E-04	
5	0.22963E-06	0.51712E-06	0.20632E-07	0.10189E-07	0.13291E-04	0.21676E-04	0.18121E-05	0.63035E-06	
6	0.23003E-08	0.51495E-08	0.14008E-09	0.74217E-10	0.20030E-06	0.43768E-06	0.27030E-07	0.12311E-07	0.80152E-08
x = 1.25									
1	0.43033E-00	0.18968E-00	0.16172E-00	-0.23785E-01	0.55036E-00	0.16398E-00	0.36619E-00	-0.17160E-00	
2	0.34105E-01	0.49975E-01	0.87725E-02	0.21532E-02	0.21841E-00	0.14686E-00	0.74385E-01	-0.10466E-01	
3	0.11149E-02	0.21562E-02	0.20898E-03	0.81957E-04	0.12611E-01	0.19947E-01	0.41297E-02	0.81432E-03	
4	0.24612E-04	0.51822E-04	0.32308E-05	0.14642E-05	0.48901E-03	0.95972E-03	0.12548E-03	0.42496E-04	
5	0.38815E-06	0.80369E-06	0.34982E-07	0.17021E-07	0.14007E-04	0.29480E-04	0.26562E-05	0.10648E-05	
6	0.38841E-08	0.86901E-08	0.26815E-09	0.13872E-09	0.28888E-06	0.63151E-06	0.44529E-07	0.18643E-07	0.10688E-05
x = 1.30									
1	0.45482E-00	0.18689E-00	0.18372E-00	-0.35901E-01	0.54925E-00	0.16314E-00	0.38481E-00	-0.18365E-00	
2	0.44490E-01	0.39131E-01	0.11491E-01	0.24671E-02	0.24660E-00	0.15088E-00	0.84001E-01	-0.14004E-01	
3	0.14750E-02	0.28215E-02	0.29670E-03	0.11193E-03	0.15344E-01	0.23817E-01	0.32704E-02	0.90410E-03	
4	0.34875E-04	0.73074E-04	0.44957E-05	0.22012E-05	0.62895E-03	0.12207E-02	0.17008E-03	0.58132E-04	
5	0.56354E-06	0.12269E-05	0.50055E-07	0.27846E-07	0.18969E-04	0.39723E-04	0.17008E-03	0.58132E-04	
6	0.64487E-08	0.14365E-07	0.44876E-09	0.25020E-09	0.41491E-06	0.90129E-06	0.63040E-07	0.27867E-07	0.15194E-05
x = 1.35									
1	0.47639E-00	0.18361E-00	0.20570E-00	-0.49669E-01	0.54634E-00	0.16250E-00	0.40342E-00	-0.19429E-00	
2	0.55830E-01	0.49108E-01	0.14463E-01	0.27037E-02	0.27512E-00	0.15275E-00	0.98250E-01	-0.22745E-01	
3	0.19244E-02	0.34592E-02	0.41374E-03	0.15018E-03	0.19124E-01	0.28227E-01	0.46685E-02	0.96442E-03	
4	0.44976E-04	0.10144E-03	0.74898E-05	0.32509E-05	0.80267E-03	0.15412E-02	0.22888E-03	0.70095E-04	
5	0.84884E-06	0.18420E-05	0.94482E-07	0.44480E-07	0.18969E-04	0.39723E-04	0.17008E-03	0.58132E-04	
6	0.10478E-07	0.23284E-07	0.86629E-09	0.43516E-09	0.58794E-06	0.12731E-05	0.94328E-05	0.41116E-07	0.12731E-05
x = 1.40									
1	0.49500E-00	0.18014E-00	0.22738E-00	-0.64447E-01	0.54178E-00	0.16197E-00	0.44200E-00	-0.20391E-00	
2	0.68281E-01	0.79755E-01	0.18986E-01	0.28002E-02	0.30938E-00	0.15252E-00	0.11098E-00	-0.30742E-01	
3	0.24822E-02	0.44342E-02	0.57518E-03	0.28002E-02	0.29404E-01	0.39205E-01	0.81650E-02	0.77384E-02	
4	0.67394E-04	0.13939E-03	0.11125E-04	0.47193E-05	0.10188E-02	0.19329E-02	0.30432E-03	0.89240E-04	
5	0.12984E-05	0.27232E-05	0.15046E-06	0.70170E-07	0.33928E-04	0.70267E-04	0.74014E-05	0.28786E-05	
6	0.16704E-07	0.37051E-07	0.14884E-08	0.73895E-09	0.42515E-06	0.17807E-05	0.14018E-06	0.59967E-07	0.28786E-05
x = 1.45									
1	0.51069E-00	0.17477E-00	0.24860E-00	-0.80469E-01	0.53979E-00	0.16143E-00	0.44038E-00	-0.21121E-00	
2	0.89015E-01	0.40285E-01	0.29356E-01	0.28609E-02	0.33076E-00	0.15038E-00	0.12402E-00	-0.19886E-01	
3	0.32021E-02	0.58567E-02	0.78634E-03	0.29473E-03	0.28517E-01	0.38783E-01	0.10404E-01	0.90411E-03	
4	0.91974E-04	0.14944E-03	0.16305E-04	0.47487E-05	0.16161E-02	0.24064E-02	0.40208E-03	0.11128E-03	
5	0.18400E-05	0.39688E-05	0.23732E-06	0.10819E-06	0.12898E-02	0.24064E-02	0.40208E-03	0.11128E-03	
6	0.26212E-07	0.57995E-07	0.25443E-08	0.12404E-08	0.11475E-05	0.24877E-05	0.20936E-06	0.38965E-05	0.86425E-07
x = 1.50									
1	0.52337E-00	0.17344E-00	0.26927E-00	-0.96488E-01	0.52834E-00	0.16079E-00	0.45913E-00	-0.21794E-00	
2	0.10009E-00	0.10210E-00	0.29855E-01	0.21735E-02	0.35884E-00	0.14462E-00	0.13724E-00	-0.50097E-01	
3	0.40843E-02	0.73318E-02	0.10630E-02	0.32705E-03	0.34598E-01	0.44897E-01	0.19724E-01	0.71924E-03	
4	0.12427E-03	0.23430E-03	0.23961E-04	0.94889E-05	0.16161E-02	0.29777E-02	0.32703E-03	0.13685E-03	
5	0.26250E-05	0.57064E-05	0.36714E-06	0.14531E-06	0.38867E-04	0.12040E-03	0.14619E-04	0.32175E-04	
6	0.40470E-07	0.89350E-07	0.42198E-08	0.20263E-08	0.13822E-05	0.33896E-05	0.29877E-06	0.12318E-06	0.12318E-06
x = 1.55									
1	0.53720E-00	0.17244E-00	0.29027E-00	-1.15566E-01	0.51622E-00	0.15930E-00	0.48802E-00	-0.23991E-00	
2	0.11000E-00	0.10210E-00	0.29855E-01	0.21735E-02	0.35884E-00	0.14462E-00	0.13724E-00	-0.50097E-01	
3	0.40843E-02	0.73318E-02	0.10630E-02	0.32705E-03	0.34598E-01	0.44897E-01	0.19724E-01	0.71924E-03	
4	0.12427E-03	0.23430E-03	0.23961E-04	0.94889E-05	0.16161E-02	0.29777E-02	0.32703E-03	0.13685E-03	
5	0.26250E-05	0.57064E-05	0.36714E-06	0.14531E-06	0.38867E-04	0.12040E-03	0.14619E-04	0.32175E-04	
6	0.40470E-07	0.89350E-07	0.42198E-08	0.20263E-08	0.13822E-05	0.33896E-05	0.29877E-06	0.12318E-06	0.12318E-06
x = 1.60									
1	0.55103E-00	0.17144E-00	0.31037E-00	-1.37102E-01	0.50305E-00	0.15781E-00	0.51693E-00	-0.26181E-00	
2	0.12000E-00	0.10210E-00	0.29855E-01	0.21735E-02	0.35884E-00	0.14462E-00	0.13724E-00	-0.50097E-01	
3	0.40843E-02	0.73318E-02	0.10630E-02	0.32705E-03	0.34598E-01	0.44897E-01	0.19724E-01	0.71924E-03	
4	0.12427E-03	0.23430E-03	0.23961E-04	0.94889E-05	0.16161E-02	0.29777E-02	0.32703E-03	0.13685E-03	
5	0.26250E-05	0.57064E-05	0.36714E-06	0.14531E-06	0.38867E-04	0.12040E-03	0.14619E-04	0.32175E-04	
6	0.40470E-07	0.89350E-07	0.42198E-08	0.20263E-08	0.13822E-05	0.33896E-05	0.29877E-06	0.12318E-06	0.12318E-06

x = 0.05					x = 0.55				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	
1	0.18990E-04	0.40506E-04	0.14988E-07	0.12079E-07	0.31477E-01	0.51719E-01	0.25962E-07	0.19609E-02	
2	0.25628E-08	0.54716E-08	0.19683E-09	-0.21803E-09	0.38408E-03	0.88694E-03	0.21266E-04	0.17982E-04	
3	-0.43030E-12	0.93394E-12	0.73863E-10	-0.22095E-10	0.28620E-05	0.70585E-05	0.10067E-06	0.88426E-07	
4					0.22795E-07	0.32489E-07	0.34053E-09	0.25089E-09	
5					0.35816E-10	0.10846E-09	0.30625E-11	0.19279E-10	
6					-0.16144E-12	0.64929E-12	-0.15737E-11	0.29439E-11	
x = 0.10					x = 0.60				
1	0.15264E-03	0.32420E-03	0.47909E-06	0.41822E-06	0.42431E-01	0.65028E-01	0.40740E-02	0.29959E-02	
2	0.74906E-07	0.17993E-06	-0.30706E-09	0.76848E-10	0.58575E-03	0.13846E-02	0.39231E-04	0.31675E-04	
3	-0.70429E-10	0.79862E-10	-0.19602E-09	-0.11647E-09	0.52514E-05	0.22914E-04	0.22034E-06	0.18361E-06	
4					0.27894E-07	0.70781E-07	0.84350E-09	0.74039E-09	
5					0.90214E-10	0.26720E-09	0.12491E-11	0.24638E-10	
6					-0.42035E-12	0.12990E-11	-0.38495E-11	0.46180E-11	
x = 0.15					x = 0.65				
1	0.31932E-03	0.10947E-02	0.34623E-05	0.31576E-05	0.55891E-01	0.81973E-01	0.61170E-02	0.42641E-02	
2	0.59319E-06	0.13665E-05	0.22938E-08	0.18426E-08	0.89335E-03	0.20246E-02	0.469028E-04	0.34901E-04	
3	0.59604E-09	0.77288E-09	0.21054E-10	-0.30163E-10	0.91759E-05	0.22508E-04	0.45327E-06	0.18998E-06	
4					0.57094E-07	0.14473E-06	0.19137E-08	0.72416E-08	
5					0.21941E-09	0.81536E-09	-0.47816E-11	0.26663E-10	
6					-0.11222E-11	0.29362E-11	-0.57810E-11	0.29864E-11	
x = 0.20					x = 0.70				
1	0.19467E-02	0.25995E-02	0.15496E-04	0.13239E-04	0.72490E-01	0.98637E-01	0.91004E-02	0.59822E-02	
2	0.24167E-05	0.57533E-05	0.17806E-07	0.23118E-07	0.13019E-02	0.29212E-02	0.11651E-04	0.91180E-04	
3	0.24763E-08	0.60931E-08	0.70440E-10	0.26273E-10	0.15981E-04	0.57608E-04	0.48246E-06	0.72416E-06	
4	-0.33400E-12	0.85661E-11	0.99281E-11	0.14072E-10	0.11089E-06	0.28052E-06	0.43635E-08	0.37267E-08	
5	-0.12012E-14	0.35352E-14	-0.85211E-12	0.11191E-11	0.21950E-08	0.13794E-08	0.63014E-11	0.42053E-10	
6	-0.59169E-18	0.64525E-18	-0.56440E-15	0.47423E-15	-0.16012E-11	0.65710E-11	-0.66691E-11	0.49699E-11	
x = 0.25					x = 0.75				
1	0.24753E-02	0.30674E-02	0.47530E-04	0.40247E-04	0.92020E-01	0.11651E-00	0.13074E-01	0.81142E-02	
2	0.73178E-05	0.17521E-04	0.81968E-07	0.72141E-07	0.18520E-02	0.41020E-02	0.14982E-03	0.14991E-03	
3	0.11596E-07	0.28842E-07	0.81057E-10	0.47880E-10	0.24674E-04	0.60604E-04	0.18433E-05	0.13956E-05	
4	0.16759E-10	0.25930E-10	0.35662E-11	-0.48232E-11	0.10541E-06	0.51903E-06	0.92813E-08	0.77268E-08	
5	-0.13659E-13	0.41834E-13	0.21100E-11	0.14944E-12	0.11130E-08	0.28917E-08	0.40929E-10	0.89542E-10	
6	-0.60196E-17	0.17537E-16	-0.62899E-16	0.58196E-14	0.19602E-11	0.13631E-10	-0.18894E-11	0.47798E-11	
x = 0.30					x = 0.80				
1	0.45643E-02	0.87441E-02	0.11902E-03	0.99977E-04	0.11478E-00	0.13477E-00	0.18374E-01	0.10860E-01	
2	0.18371E-04	0.43907E-04	0.30207E-06	0.25771E-06	0.25802E-02	0.56304E-02	0.29995E-03	0.22599E-03	
3	0.41354E-07	0.10328E-06	0.56904E-09	0.45239E-09	0.38993E-04	0.94629E-04	0.29401E-05	0.15596E-05	
4	0.36367E-10	0.17504E-09	0.17328E-10	0.42056E-10	0.36611E-06	0.92247E-06	0.18811E-07	0.40413E-05	
5	-0.99647E-13	0.30036E-12	-0.37016E-11	0.10132E-10	0.22594E-08	0.58407E-08	0.83542E-10	0.96644E-10	
6	-0.66248E-16	0.18712E-15	-0.44234E-13	0.39899E-13	0.59393E-11	0.28950E-10	-0.41575E-11	0.59421E-11	
x = 0.35					x = 0.85				
1	0.71070E-02	0.13845E-01	0.25924E-03	0.21357E-03	0.14049E-00	0.15283E-00	0.25304E-01	0.13961E-01	
2	0.39743E-04	0.93883E-04	0.88894E-06	0.73440E-06	0.35909E-02	0.75742E-02	0.46139E-03	0.33997E-03	
3	0.12189E-06	0.30275E-06	0.18195E-08	0.14737E-08	0.59478E-04	0.14937E-03	0.50786E-05	0.40413E-05	
4	0.23946E-09	0.58268E-09	0.24528E-10	0.18921E-10	0.36611E-06	0.15823E-05	0.36550E-07	0.30048E-07	
5	-0.35513E-12	0.15792E-11	0.18644E-11	0.74676E-11	0.48379E-08	0.11292E-07	0.18692E-09	0.17201E-09	
6	-0.47480E-15	0.13832E-14	-0.21116E-12	0.20690E-12	0.18423E-10	0.58889E-10	-0.16880E-11	0.52210E-11	
x = 0.40					x = 0.90				
1	0.10916E-01	0.20548E-01	0.51003E-03	0.41242E-03	0.14915E-00	0.18946E-00	0.34188E-01	0.16704E-01	
2	0.77386E-04	0.18237E-03	0.22684E-05	0.19119E-05	0.47514E-02	0.11007E-01	0.69309E-03	0.49823E-03	
3	0.30978E-06	0.76895E-06	0.58151E-08	0.49103E-08	0.48342E-04	0.21295E-03	0.85051E-05	0.66888E-05	
4	0.73970E-09	0.19899E-08	0.26184E-10	0.30879E-10	0.10442E-05	0.24293E-05	0.68094E-07	0.55896E-07	
5	-0.41723E-12	0.53234E-11	-0.14948E-12	0.78446E-11	0.81912E-08	0.21057E-07	0.39194E-09	0.35999E-09	
6	-0.26790E-14	0.78035E-14	-0.61802E-12	0.62324E-12	0.38921E-10	0.12303E-09	-0.34691E-11	0.11003E-10	
x = 0.45					x = 0.95				
1	0.16049E-01	0.29044E-01	0.92878E-03	0.79458E-03	0.20039E-00	0.18643E-00	0.49933E-01	0.19844E-01	
2	0.14004E-03	0.32740E-03	0.51846E-05	0.43323E-05	0.61234E-02	0.13008E-01	0.10194E-02	0.71292E-03	
3	0.70923E-06	0.17447E-05	0.18823E-07	0.16039E-07	0.12907E-03	0.30668E-03	0.13854E-04	0.10791E-04	
4	0.21240E-08	0.53978E-08	0.39178E-10	0.31972E-10	0.18974E-05	0.42482E-05	0.12993E-06	0.16845E-06	
5	0.24113E-11	0.16194E-10	0.17547E-11	0.95600E-11	0.14774E-07	0.37905E-07	0.77853E-09	0.67979E-09	
6	-0.12170E-13	0.35719E-13	-0.10017E-11	0.16788E-11	0.83910E-10	0.24024E-09	-0.25668E-11	0.11972E-10	
x = 0.50					x = 1.00				
1	0.22795E-01	0.39440E-01	0.15918E-02	0.12264E-02	0.23314E-00	0.19769E-00	0.39084E-01	0.22715E-01	
2	0.23773E-03	0.55285E-03	0.10876E-04	0.89932E-05	0.89048E-02	0.16659E-01	0.14713E-02	0.97971E-03	
3	0.14713E-05	0.38376E-05	0.42629E-07	0.35964E-07	0.18093E-03	0.43888E-03	0.22013E-04	0.16845E-04	
4	0.54451E-08	0.13818E-07	0.12101E-09	0.86243E-10	0.28818E-05	0.64923E-05	0.21795E-06	0.17442E-06	
5	0.15716E-10	0.36087E-10	0.41011E-11	0.13749E-11	0.25874E-07	0.68147E-07	0.15119E-08	0.12485E-08	
6	-0.38289E-13	0.14138E-12	0.58884E-12	0.95479E-12	0.17485E-09	0.45832E-09	0.73415E-11	0.90368E-11	

m = 1.80-0.80 i

x = 1.05

x = 1.55

n	a_n^r	a_n^i	b_n^r	b_n^i	a_n^r	a_n^i	b_n^r	b_n^i
1	0.26603E-06	0.20824E-00	0.75500E-01	0.74827E-01	0.52004E 00	0.20522E-00	0.32556E-00	-0.69139E-01
2	0.10798E-01	0.21046E-01	0.20877E-02	0.13684E-02	0.97377E-01	0.11475E-00	0.34265E-01	0.10894E-01
3	0.25931E-03	0.61240E-03	0.54205E-04	0.25778E-04	0.40539E-02	0.64661E-02	0.11884E-02	0.49068E-03
4	0.61413E-05	0.10304E-04	0.37183E-06	0.29575E-06	0.11313E-03	0.31233E-03	0.24729E-04	0.18649E-04
5	0.64602E-07	0.11243E-06	0.28324E-09	0.29635E-08	0.30061E-05	0.74830E-05	0.48779E-06	0.32919E-06
6	0.32939E-09	0.66398E-09	0.11992E-10	0.25286E-10	0.44954E-07	0.12522E-06	0.53226E-06	0.41923E-06

x = 1.10

x = 1.60

1	0.30046E-00	0.21616E-00	0.94895E-01	0.25664E-01	0.53099E 00	0.20030E-00	0.34806E-00	-0.86957E-01
2	0.13906E-01	0.26290E-01	0.29169E-02	0.18402E-02	0.11647E-00	0.12747E-00	0.42655E-01	0.11934E-01
3	0.23880E-03	0.94113E-03	0.52093E-04	0.38609E-04	0.51040E-02	0.10443E-01	0.15601E-02	0.68801E-03
4	0.82890E-05	0.15939E-04	0.61962E-06	0.46816E-06	0.17406E-03	0.41102E-03	0.37863E-04	0.25944E-04
5	0.73052E-07	0.11820E-06	0.51948E-08	0.42831E-08	0.42337E-05	0.10905E-04	0.63959E-06	0.49036E-06
6	0.59228E-09	0.13448E-08	0.25498E-10	0.40217E-10	0.75604E-07	0.19745E-06	0.85508E-06	0.64600E-06

x = 1.15

x = 1.65

1	0.33989E-00	0.22188E-00	0.11689E-00	0.26799E-01	0.59939E 00	0.19335E-00	0.36992E-00	-0.10492E-00
2	0.17799E-01	0.32399E-01	0.40189E-02	0.26288E-02	0.19801E-00	0.13972E-00	0.52409E-01	0.11491E-01
3	0.48955E-03	0.11989E-02	0.77854E-04	0.56894E-04	0.63916E-02	0.12782E-01	0.20847E-02	0.11278E-02
4	0.93021E-05	0.22994E-04	0.10093E-05	0.78898E-05	0.22866E-03	0.53600E-03	0.33075E-04	0.25871E-04
5	0.11847E-07	0.30139E-06	0.82207E-08	0.74491E-08	0.11899E-05	0.14982E-04	0.96147E-06	0.72099E-06
6	0.10563E-09	0.27620E-08	0.54564E-10	0.63002E-10	0.10901E-06	0.27698E-06	0.13521E-07	0.10440E-07

x = 1.20

x = 1.70

1	0.36971E-00	0.22440E-00	0.14129E-00	0.21889E-01	0.54517E 00	0.19042E-00	0.38989E-00	-0.12089E-00
2	0.22508E-01	0.39409E-01	0.54467E-02	0.31467E-02	0.18192E-00	0.15102E-00	0.63811E-01	0.11084E-01
3	0.69991E-03	0.15198E-02	0.11644E-03	0.81765E-04	0.79640E-02	0.15332E-01	0.27099E-02	0.14136E-02
4	0.13977E-04	0.33439E-04	0.16103E-05	0.12419E-05	0.29799E-03	0.62999E-03	0.73633E-04	0.48464E-04
5	0.18814E-06	0.47733E-06	0.15993E-07	0.12869E-07	0.81341E-05	0.20030E-04	0.14428E-05	0.10467E-05
6	0.18324E-08	0.47647E-08	0.10899E-09	0.10819E-09	0.13991E-06	0.40431E-06	0.21084E-07	0.16130E-07

x = 1.25

x = 1.75

1	0.39967E-00	0.22520E-00	0.16734E-00	0.19966E-01	0.54867E 00	0.18954E-00	0.40936E-00	-0.13824E-00
2	0.29324E-01	0.47676E-01	0.73392E-02	0.40030E-02	0.18799E-00	0.16692E-00	0.74600E-01	0.93937E-02
3	0.87813E-03	0.20037E-02	0.18363E-03	0.11987E-03	0.98801E-02	0.18741E-01	0.35282E-02	0.17500E-02
4	0.14909E-04	0.47988E-04	0.25206E-05	0.19213E-05	0.38947E-03	0.88874E-03	0.10124E-03	0.63190E-04
5	0.24904E-06	0.74215E-06	0.27111E-07	0.21624E-07	0.11131E-04	0.27246E-04	0.20971E-05	0.15015E-05
6	0.31013E-08	0.80394E-08	0.20359E-09	0.18688E-09	0.23079E-06	0.58399E-06	0.32437E-07	0.24607E-07

x = 1.30

x = 1.80

1	0.42931E-00	0.22626E-00	0.19457E-00	0.68149E-02	0.54996E 00	0.18071E-00	0.42809E-00	-0.15026E-00
2	0.39401E-01	0.56569E-01	0.97461E-02	0.49975E-02	0.12205E-01	0.16897E-00	0.90753E-01	0.44260E-02
3	0.11579E-02	0.26114E-02	0.23694E-03	0.18149E-03	0.11220E-01	0.22430E-01	0.45983E-02	0.21374E-02
4	0.27491E-04	0.67492E-04	0.38749E-05	0.29182E-05	0.49317E-03	0.11911E-02	0.13792E-03	0.86732E-04
5	0.44847E-06	0.11330E-05	0.45067E-07	0.35607E-07	0.15040E-04	0.34719E-04	0.30158E-05	0.21296E-05
6	0.51402E-08	0.13262E-07	0.37725E-09	0.33239E-09	0.33021E-06	0.83246E-06	0.49308E-07	0.37037E-07

x = 1.35

x = 1.85

1	0.44832E-00	0.22194E-00	0.22217E-00	-0.66740E-02	0.54919E 00	0.17991E-00	0.44423E-00	-0.16276E-00
2	0.43995E-01	0.66670E-01	0.12801E-01	0.61178E-02	0.26674E-00	0.17489E-00	0.10609E-00	0.19404E-02
3	0.15110E-02	0.39649E-02	0.33294E-03	0.21178E-03	0.35020E-01	0.26791E-01	0.58451E-02	0.29799E-02
4	0.38816E-04	0.93890E-04	0.58666E-05	0.43575E-05	0.69199E-03	0.14290E-02	0.18630E-03	0.11422E-03
5	0.67506E-06	0.17011E-05	0.75411E-07	0.57479E-07	0.20186E-04	0.49052E-04	0.42955E-05	0.29879E-05
6	0.83496E-08	0.21916E-07	0.66492E-09	0.56567E-09	0.46779E-06	0.11762E-05	0.74086E-07	0.55097E-07

x = 1.40

x = 1.80

1	0.47054E-00	0.21860E-00	0.24948E-00	-0.18549E-01	0.54651E 00	0.17113E-00	0.44390E-00	-0.17362E-00
2	0.54213E-01	0.77707E-01	0.14635E-01	0.73333E-02	0.27438E-00	0.17827E-00	0.12234E-00	0.44219E-02
3	0.19595E-02	0.42974E-02	0.44306E-03	0.30094E-03	0.18816E-01	0.31609E-01	0.74403E-02	0.30527E-02
4	0.53304E-04	0.12897E-03	0.87446E-05	0.68038E-05	0.80174E-03	0.17930E-02	0.28963E-03	0.14895E-03
5	0.10008E-05	0.23150E-05	0.11790E-06	0.91127E-07	0.28877E-04	0.64983E-04	0.40544E-05	0.41490E-05
6	0.13318E-07	0.34239E-07	0.11544E-08	0.95870E-09	0.66532E-06	0.18454E-05	0.11009E-06	0.81040E-07

x = 1.45

x = 1.95

1	0.48989E-00	0.21454E-00	0.27999E-00	-0.36358E-01	0.54209E 00	0.16632E-00	0.44819E-00	-0.18278E-00
2	0.66395E-01	0.89549E-01	0.21392E-01	0.89386E-02	0.30400E-00	0.17923E-00	0.13922E-00	-0.12120E-01
3	0.25108E-02	0.56348E-02	0.43647E-03	0.40218E-03	0.22502E-01	0.37110E-01	0.94020E-02	0.39806E-02
4	0.72758E-04	0.17507E-03	0.18859E-04	0.92713E-05	0.10114E-02	0.22950E-02	0.33194E-03	0.19234E-03
5	0.14628E-05	0.36653E-05	0.18895E-06	0.14200E-06	0.39314E-04	0.89408E-04	0.84603E-05	0.57045E-05
6	0.20892E-07	0.53971E-07	0.19649E-08	0.15894E-08	0.91248E-06	0.22405E-05	0.16186E-06	0.11787E-06

x = 1.50

x = 2.00

1	0.50697E 00	0.21002E-00	0.30133E-00	-0.51431E-01	0.53608E 00	0.16144E-00	0.44814E-00	-0.19071E-00
2	0.80725E-01	0.10199E-00	0.27220E-01	0.97970E-02	0.33294E-00	0.17781E-00	0.15439E-00	-0.21726E-01
3	0.32008E-02	0.68123E-02	0.48498E-03	0.53040E-03	0.27399E-01	0.43277E-01	0.11795E-01	0.40758E-02
4	0.59248E-04	0.23505E-03	0.18844E-04	0.13237E-04	0.12691E-02	0.27685E-02	0.43817E-03	0.24607E-03
5	0.21099E-05	0.52708E-05	0.24659E-06	0.21781E-06	0.46591E-04	0.11141E-03	0.11721E-04	0.77688E-05
6	0.32247E-07	0.82904E-07	0.32974E-08	0.25998E-08	0.12577E-05	0.31928E-05	0.23962E-06	0.16965E-06

m = 1.80 - 0.80 i

	x = 0.05				x = 0.55			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.264483E-04	0.442999E-04	0.182666E-07	0.122223E-07	0.405886E-01	0.551909E-01	0.138046E-02	0.146877E-02
2	0.296747E-08	0.587250E-08	0.514086E-09	-0.138884E-09	0.488800E-03	0.970146E-03	0.281068E-04	0.214139E-04
3	-0.310366E-12	0.810844E-12	-0.701605E-10	-0.118944E-09	0.360656E-05	0.771800E-05	0.133446E-06	0.701070E-07
4					0.160195E-07	0.354888E-07	0.411209E-09	0.240088E-09
5					0.423966E-10	0.107766E-09	-0.274171E-11	0.545766E-11
6					-0.169266E-12	0.354356E-12	-0.151166E-11	0.170795E-12

	x = 0.10				x = 0.60			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.196922E-03	0.354511E-03	0.642077E-06	0.352799E-06	0.545171E-01	0.696622E-01	0.526366E-02	0.215206E-02
2	0.959339E-07	0.197244E-06	0.557969E-09	0.120093E-09	0.758888E-03	0.149244E-02	0.517720E-04	0.251068E-04
3	0.859966E-11	0.993361E-10	0.509488E-10	0.791377E-10	0.662022E-05	0.141266E-04	0.291899E-06	0.151899E-06
4					0.369456E-07	0.779339E-07	0.105899E-08	0.627488E-09
5					0.108416E-09	0.277747E-09	-0.945444E-11	0.131664E-10
6					-0.543266E-12	0.135866E-11	-0.415777E-11	-0.247622E-12

	x = 0.15				x = 0.65			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.670459E-03	0.119679E-02	0.440788E-05	0.266598E-05	0.719822E-01	0.854449E-01	0.791233E-02	0.300839E-02
2	0.726559E-06	0.144932E-05	0.325299E-08	0.170417E-08	0.115912E-02	0.221600E-02	0.908389E-04	0.437106E-04
3	0.421244E-09	0.912919E-09	0.268417E-10	0.212299E-10	0.115739E-04	0.246122E-04	0.599370E-06	0.307520E-06
4					0.716500E-07	0.158146E-06	0.256056E-08	0.139330E-08
5					0.282145E-09	0.663566E-09	0.654156E-12	0.182320E-10
6					-0.773300E-12	0.223222E-11	-0.343122E-11	0.746439E-12

	x = 0.20				x = 0.70			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.161077E-02	0.283966E-02	0.206159E-04	0.111519E-04	0.920139E-01	0.102066E-00	0.115356E-01	0.401988E-02
2	0.306831E-05	0.629210E-05	0.237399E-07	0.124939E-07	0.164181E-02	0.319288E-02	0.152929E-03	0.716544E-04
3	0.308111E-08	0.669456E-08	0.679499E-10	0.642844E-10	0.194080E-04	0.441123E-04	0.116649E-05	0.590800E-06
4	-0.217746E-11	0.736339E-11	-0.174559E-11	0.196497E-11	0.139122E-06	0.106944E-06	0.571099E-08	0.305530E-08
5	-0.111111E-14	0.318181E-14	-0.102566E-14	0.512122E-12	0.638644E-09	0.147788E-08	-0.496977E-12	0.198092E-10
6	-0.334044E-18	0.863199E-18	-0.550611E-15	0.304239E-15	-0.130680E-11	0.359300E-11	-0.569771E-11	-0.222659E-11

	x = 0.25				x = 0.75			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.320059E-02	0.553059E-02	0.693145E-04	0.356299E-04	0.115899E-00	0.118899E-00	0.163666E-01	0.513272E-02
2	0.493444E-05	0.191499E-04	0.112000E-06	0.407988E-07	0.238644E-02	0.444122E-02	0.248399E-03	0.112970E-03
3	0.145766E-07	0.315944E-07	0.130344E-09	0.102622E-09	0.314039E-04	0.882699E-04	0.216966E-05	0.108188E-05
4	0.714339E-11	0.353544E-10	-0.458422E-11	0.109900E-10	0.258080E-04	0.139122E-04	0.122036E-07	0.637656E-08
5	-0.140509E-13	0.363888E-13	-0.226149E-13	0.082988E-12	0.138939E-08	0.313919E-08	0.367044E-10	0.305530E-08
6	-0.406839E-17	0.156666E-16	-0.639122E-13	0.345988E-14	0.493020E-11	0.999000E-11	-0.191971E-11	-0.189900E-11

	x = 0.30				x = 0.80			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.564496E-02	0.992900E-02	0.157646E-01	0.824122E-04	0.143100E-00	0.135239E-00	0.726539E-01	0.624400E-02
2	0.293022E-04	0.475988E-04	0.401688E-06	0.218888E-06	0.330099E-02	0.814466E-02	0.391100E-03	0.172000E-03
3	0.521800E-07	0.112966E-06	0.488422E-09	0.446388E-09	0.449237E-04	0.103477E-03	0.187599E-05	0.149099E-05
4	0.492388E-10	0.173277E-09	-0.159388E-10	0.440407E-10	0.459969E-06	0.108811E-05	0.243777E-07	0.127999E-07
5	-0.103822E-12	0.267039E-12	-0.877944E-11	0.336299E-11	0.281900E-08	0.635144E-08	0.918630E-10	0.578822E-10
6	-0.647211E-16	0.167166E-15	-0.472900E-13	0.250366E-13	0.111339E-10	0.241339E-10	-0.268944E-11	-0.349611E-11

	x = 0.35				x = 0.85			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.920039E-02	0.150366E-01	0.342999E-03	0.174759E-03	0.173300E-00	0.150366E-00	0.306400E-01	0.719019E-02
2	0.508366E-04	0.102422E-03	0.118166E-05	0.031899E-06	0.452166E-02	0.826159E-02	0.599166E-03	0.293722E-03
3	0.133344E-06	0.331122E-06	0.237159E-08	0.137059E-08	0.731819E-04	0.137146E-03	0.468370E-05	0.321900E-04
4	0.255299E-09	0.639739E-09	-0.729400E-11	0.397499E-10	0.904466E-06	0.172922E-05	0.482649E-07	0.245896E-07
5	-0.524811E-12	0.133766E-11	-0.867077E-11	0.442166E-11	0.547800E-08	0.123239E-07	0.224466E-09	0.140122E-09
6	-0.478944E-15	0.123977E-14	-0.488866E-12	0.111400E-12	0.233177E-10	0.584122E-10	-0.487488E-11	-0.893896E-12

	x = 0.40				x = 0.90			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.141339E-01	0.222988E-01	0.672659E-03	0.332777E-03	0.203919E-00	0.183888E-00	0.405477E-01	0.773466E-02
2	0.199588E-04	0.199522E-03	0.301144E-05	0.159366E-05	0.809877E-02	0.109022E-01	0.899859E-03	0.363311E-03
3	0.389999E-04	0.940344E-06	0.767299E-08	0.115944E-08	0.112022E-03	0.232839E-03	0.111719E-04	0.527499E-05
4	0.910399E-09	0.205900E-08	0.195088E-10	0.306239E-10	0.111719E-05	0.227888E-05	0.703588E-07	0.494459E-07
5	-0.839422E-12	0.443899E-11	-0.443444E-11	0.427744E-11	0.102466E-07	0.229777E-07	0.448722E-09	0.248888E-09
6	-0.271488E-14	0.696339E-14	-0.709222E-12	0.179939E-12	0.511466E-10	0.124819E-09	-0.555439E-11	0.234677E-12

	x = 0.45				x = 0.95			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.207888E-01	0.313866E-01	0.122088E-02	0.582366E-03	0.240166E-00	0.174666E-00	0.525319E-01	0.759146E-02
2	0.177977E-03	0.358399E-03	0.887719E-05	0.358144E-05	0.811439E-02	0.141300E-01	0.131066E-02	0.508722E-03
3	0.888039E-04	0.190999E-05	0.220222E-07	0.118866E-07	0.163377E-03	0.337477E-03	0.181577E-04	0.499077E-05
4	0.262477E-08	0.909799E-08	0.365144E-10	0.630722E-10	0.213439E-05	0.444322E-05	0.163419E-06	0.810499E-07
5	-0.461766E-12	0.131388E-10	-0.874299E-11	0.500022E-11	0.184959E-07	0.413866E-07	0.100039E-08	0.547400E-09
6	-0.126959E-13	0.119219E-13	-0.180299E-11	-0.683419E-11	0.106000E-09	0.259219E-09	-0.330500E-11	0.892122E-12

	x = 0.50				x = 1.00			
n	a _n ^r	a _n ⁱ	u _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.294600E-01	0.423699E-01	0.208244E-02	0.892266E-03	0.275200E-00	0.199019E-00	0.448666E-01	0.640311E-02
2	0.302922E-03	0.404788E-03	0.143999E-04	0.731844E-05	0.108677E-01	0.140888E-01	0.187999E-02	0.488044E-03
3	0.189388E-05	0.397744E-05	0.566622E-07	0.300722E-07	0.239744E-03	0.479959E-03	0.208819E-04	0.129919E-04
4	0.448222E-08	0.151177E-07	0.160959E-09	0.886300E-10	0.397488E-05	0.731459E-05	0.288472E-06	0.140139E-06
5	0.148899E-10	0.411777E-10	0.109377E-11	0.570688E-11	0.323988E-07	0.723019E-07	0.198979E-08	0.104259E-08
6	-0.443100E-13	0.119739E-12	-0.880399E-12	0.986422E-12	0.219666E-09	0.457819E-09	0.306388E-11	0.801139E-11

m = 1.80-0.80 i

x = 1.05

x = 1.55

n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.31010E-00	0.18873E-00	0.82879E-01	0.38022E-02				
2	0.13074E-01	0.22795E-01	0.26485E-02	0.91048E-03	0.53592E 00	0.17046E-00	0.28991E-00	-0.11638E-00
3	0.32878E-03	0.66935E-03	0.44600E-04	0.19621E-04	0.12042E-00	0.11430E-00	0.37304E-01	0.82199E-03
4	0.52109E-05	0.11262E-04	0.448913E-04	0.29557E-06	0.51873E-02	0.91942E-02	0.14494E-02	0.40469E-03
5	0.53149E-07	0.12281E-05	0.37231E-08	0.19163E-08	0.14623E-03	0.34100E-03	0.34336E-04	0.18220E-04
6	0.40571E-09	0.93099E-09	0.11364E-10	0.10836E-10	0.37003E-05	0.81739E-05	0.57041E-06	0.26999E-06
					0.61471E-07	0.13675E-06	0.69804E-08	0.32765E-08

x = 1.10

x = 1.60

1	0.34403E-00	0.19319E-00	0.10100E-00	-0.54051E-03	0.54327E 00	0.14810E-00	0.30942E-00	-0.13225E-00
2	0.17871E-01	0.28346E-01	0.36702E-02	0.11740E-02	0.14289E-00	0.12475E-00	0.45298E-01	-0.90806E-03
3	0.44392E-03	0.91920E-03	0.47708E-04	0.28964E-04	0.63354E-02	0.11319E-01	0.19188E-02	0.49738E-03
4	0.73860E-05	0.14983E-04	0.81381E-06	0.38570E-06	0.22043E-03	0.44864E-03	0.48872E-04	0.18069E-04
5	0.91348E-07	0.20399E-08	0.48076E-08	0.34230E-08	0.53284E-05	0.11474E-04	0.85777E-06	0.38870E-06
6	0.74735E-09	0.16937E-08	0.34370E-10	0.17339E-10	0.92260E-07	0.20471E-06	0.11201E-07	0.51748E-08

x = 1.15

x = 1.65

1	0.37424E-00	0.19291E-00	0.12078E-00	-0.60797E-02	0.34819E 00	0.16621E-00	0.32856E-00	-0.14748E-00
2	0.22818E-01	0.34800E-01	0.50085E-02	0.14797E-02	0.14289E-00	0.13610E-00	0.54305E-01	-0.34432E-02
3	0.62171E-03	0.12437E-02	0.10888E-03	0.81850E-04	0.16446E-00	0.13826E-01	0.32679E-02	0.59981E-03
4	0.11715E-04	0.25130E-04	0.13258E-05	0.60511E-06	0.81882E-02	0.11319E-01	0.43088E-04	0.24344E-04
5	0.14952E-06	0.32921E-06	0.12124E-07	0.46031E-08	0.28979E-03	0.38486E-03	0.67676E-04	0.18069E-04
6	0.13244E-08	0.30048E-08	0.71243E-10	0.41191E-10	0.76241E-05	0.15925E-04	0.12735E-05	0.53441E-06
					0.15667E-08	0.30250E-06	0.17692E-07	0.80912E-08

x = 1.20

x = 1.70

1	0.40624E-00	0.19212E-00	0.14358E-00	-0.15340E-01	0.59084E 00	0.16475E-00	0.34743E-00	-0.16179E-00
2	0.28897E-01	0.42194E-01	0.46737E-02	0.17979E-02	0.14289E-00	0.14193E-00	0.64279E-01	-0.40976E-02
3	0.89889E-03	0.16998E-02	0.14774E-03	0.59245E-04	0.19294E-00	0.16798E-01	0.32679E-02	0.48982E-03
4	0.17108E-04	0.38943E-04	0.21079E-05	0.96411E-06	0.10204E-01	0.17388E-03	0.53508E-04	0.32371E-04
5	0.23939E-06	0.52170E-06	0.21025E-07	0.10292E-07	0.37995E-03	0.21873E-04	0.18676E-05	0.74991E-06
6	0.22961E-08	0.51907E-08	0.14244E-09	0.76030E-10	0.20905E-06	0.44154E-06	0.27949E-07	0.12409E-07

x = 1.25

x = 1.75

1	0.43957E-00	0.19002E-00	0.16919E-00	-0.25890E-01	0.99342E 00	0.16968E-00	0.38614E-00	-0.17499E-00
2	0.34309E-01	0.50942E-01	0.89391E-02	0.21232E-02	0.22046E-00	0.14798E-00	0.64279E-01	-0.17288E-01
3	0.11175E-02	0.21875E-02	0.21298E-03	0.82337E-04	0.12660E-01	0.20140E-01	0.42063E-02	0.79289E-03
4	0.24595E-04	0.52297E-04	0.32928E-05	0.14767E-05	0.48927E-03	0.96895E-03	0.12793E-03	0.42885E-04
5	0.36768E-06	0.81080E-06	0.33640E-07	0.17144E-07	0.13998E-04	0.29749E-04	0.27078E-05	0.10910E-05
6	0.38895E-08	0.87638E-08	0.27398E-09	0.13748E-09	0.28949E-06	0.63709E-06	0.42352E-07	0.18793E-07

x = 1.30

x = 1.80

1	0.44802E-00	0.18704E-00	0.18509E-00	-0.38347E-01	0.55003E 00	0.14292E-00	0.38674E-00	-0.18694E-00
2	0.45272E-01	0.59804E-01	0.11706E-01	0.24152E-02	0.26885E-00	0.15177E-00	0.86735E-01	-0.17288E-01
3	0.14743E-02	0.28494E-02	0.30249E-03	0.11231E-03	0.13633E-01	0.24073E-01	0.53642E-02	0.87188E-03
4	0.34885E-04	0.73747E-04	0.50534E-05	0.22189E-05	0.42900E-03	0.12325E-02	0.17339E-03	0.55029E-04
5	0.56289E-06	0.12378E-05	0.59151E-07	0.28144E-07	0.17995E-04	0.40086E-04	0.38835E-05	0.15271E-05
6	0.44370E-08	0.14488E-07	0.44942E-09	0.25198E-09	0.14443E-06	0.90927E-06	0.64249E-07	0.28075E-07

x = 1.35

x = 1.85

1	0.47944E-00	0.18598E-00	0.20493E-00	-0.52598E-01	0.54684E 00	0.16237E-00	0.40334E-00	-0.19753E-00
2	0.54014E-01	0.48992E-01	0.15134E-01	0.26214E-02	0.27752E-00	0.15346E-00	0.98939E-01	-0.24240E-01
3	0.19264E-02	0.36715E-02	0.42386E-03	0.15049E-03	0.19220E-01	0.28592E-01	0.47886E-02	0.91740E-03
4	0.44739E-04	0.73747E-04	0.50534E-05	0.32747E-05	0.80340E-03	0.15642E-02	0.23291E-03	0.70342E-04
5	0.84794E-06	0.18584E-05	0.66263E-07	0.45111E-07	0.25440E-04	0.53940E-04	0.53128E-05	0.21124E-05
6	0.10459E-07	0.23482E-07	0.87997E-09	0.43609E-09	0.58730E-06	0.12844E-05	0.96362E-07	0.41427E-07

x = 1.40

x = 1.90

1	0.49789E-00	0.17998E-00	0.22444E-00	-0.67650E-01	0.64202E 00	0.16194E-00	0.42195E-00	-0.20649E-00
2	0.46879E-01	0.40652E-01	0.19322E-01	0.28698E-02	0.30984E-00	0.15303E-00	0.21159E-00	-0.32429E-01
3	0.24895E-02	0.48429E-02	0.54841E-03	0.19913E-03	0.23930E-01	0.39646E-01	0.85092E-02	0.90884E-03
4	0.67524E-04	0.14089E-03	0.11341E-04	0.47514E-05	0.10199E-02	0.19512E-02	0.31021E-03	0.88718E-04
5	0.12570E-05	0.27475E-05	0.15338E-06	0.70996E-07	0.33916E-04	0.70914E-04	0.77495E-05	0.28888E-05
6	0.14688E-07	0.37379E-07	0.15243E-08	0.74873E-09	0.42429E-06	0.17966E-05	0.14287E-06	0.60371E-07

x = 1.45

x = 1.95

1	0.51338E-00	0.17448E-00	0.24947E-00	-0.83567E-01	0.53571E 00	0.16191E-00	0.44052E-00	-0.21424E-00
2	0.49367E-01	0.41895E-01	0.24363E-01	0.24847E-02	0.33929E-00	0.15088E-00	0.12453E-00	-0.41759E-01
3	0.32073E-02	0.59162E-02	0.80166E-03	0.25634E-03	0.21606E-01	0.39189E-01	0.10578E-01	0.81071E-03
4	0.91943E-04	0.19122E-03	0.16622E-04	0.67842E-05	0.16167E-02	0.30072E-02	0.59712E-03	0.19528E-03
5	0.18980E-05	0.40041E-05	0.24184E-06	0.10974E-06	0.12075E-02	0.24301E-02	0.40990E-03	0.11035E-03
6	0.26174E-07	0.58495E-07	0.25887E-08	0.12454E-08	0.44841E-04	0.93182E-04	0.10793E-04	0.39087E-05
					0.17844E-05	0.24897E-05	0.20944E-06	0.87006E-07

x = 1.50

x = 2.00

1	0.52801E 00	0.17327E-00	0.26996E-00	-0.10003E-00	0.52807E 00	0.14098E-00	0.45911E-00	-0.22025E-00
2	0.40998E-00	0.10320E-00	0.30338E-01	0.18911E-02	0.35994E-00	0.14672E-00	0.13763E-00	-0.52141E-01
3	0.40923E-02	0.74070E-02	0.10897E-02	0.32578E-03	0.34420E-01	0.45382E-01	0.13036E-01	0.59167E-03
4	0.12425E-03	0.25848E-03	0.24039E-04	0.95998E-05	0.16187E-02	0.30072E-02	0.59712E-03	0.19528E-03
5	0.26322E-05	0.57977E-05	0.37417E-06	0.16692E-06	0.58880E-04	0.12122E-03	0.14900E-04	0.52527E-05
6	0.40406E-07	0.90166E-07	0.42905E-08	0.20437E-08	0.19808E-05	0.34199E-05	0.30456E-06	0.12909E-06

m = 1.80-1.00 i

x = 0.05				x = 0.55				
n	a _n	a _n	b _n	b _n	a _n	a _n	b _n	b _n
1	0.29145E-04	0.44080E-04	0.23983E-07	0.88617E-08	0.49076E-01	0.60020E-01	0.41004E-02	0.88639E-03
2	0.34684E-08	0.65627E-08	-0.13931E-09	-0.19536E-09	0.57262E-03	0.10718E-02	0.34739E-04	0.10020E-04
3	-0.29337E-12	0.76324E-12	0.20816E-10	-0.54303E-10	0.41739E-05	0.85039E-05	0.16567E-06	0.51771E-07
4					0.18432E-07	0.39019E-07	0.49645E-09	0.16639E-09
5					0.52715E-10	0.11816E-09	-0.98090E-12	-0.79454E-12
6					-0.50937E-12	0.14683E-12	-0.23621E-13	-0.55214E-12
x = 0.10				x = 0.60				
1	0.23455E-03	0.39279E-03	0.40036E-06	0.27280E-06	0.65904E-01	0.41900E-01	0.63331E-02	0.11992E-02
2	0.11136E-06	0.21743E-06	0.16913E-09	0.49579E-11	0.69014E-03	0.16448E-02	0.63831E-04	0.27703E-04
3	0.44432E-10	0.39649E-10	0.64741E-11	-0.20461E-10	0.76653E-05	0.15566E-04	0.36193E-06	0.11088E-06
4					0.40223E-07	0.45024E-07	0.12827E-08	0.43747E-09
5					0.13600E-09	0.29470E-09	-0.39039E-11	-0.27594E-11
6					-0.14203E-11	0.68999E-12	-0.12592E-12	-0.19178E-11
x = 0.15				x = 0.65				
1	0.78871E-03	0.19258E-02	0.60878E-05	0.20439E-05	0.86396E-01	0.91354E-01	0.94275E-02	0.15044E-02
2	0.84427E-04	0.18503E-05	0.39275E-08	0.13377E-08	0.13380E-02	0.24489E-02	0.11167E-03	0.22907E-04
3	0.44687E-09	0.48059E-09	-0.75607E-12	0.78954E-11	0.13407E-04	0.27124E-04	0.74227E-06	0.22114E-06
4					0.82482E-07	0.17394E-06	0.31252E-08	0.10003E-08
5					0.33417E-09	0.71571E-09	0.42349E-11	-0.31642E-11
6					0.36242E-11	-0.20293E-12	0.64957E-12	-0.17703E-11
x = 0.20				x = 0.70				
1	0.19235E-02	0.31407E-02	0.25695E-04	0.84495E-05	0.11071E-00	0.10786E-00	0.13586E-01	0.17221E-02
2	0.35894E-05	0.69456E-05	0.29572E-07	0.10049E-07	0.19550E-02	0.35279E-02	0.10717E-03	0.47140E-04
3	-0.34853E-08	0.73663E-08	0.12712E-10	0.30078E-10	0.22497E-04	0.65325E-04	0.14432E-05	0.21145E-06
4	-0.21951E-11	0.61619E-11	-0.18756E-10	0.99189E-11	0.16028E-06	0.63724E-06	0.70816E-08	0.22318E-08
5	-0.11394E-14	0.28789E-14	-0.11153E-11	0.17788E-12	0.87898E-09	0.16171E-08	0.15053E-10	0.27331E-11
6	-0.31262E-18	0.78530E-18	-0.51555E-15	0.17591E-15	0.35888E-11	0.30116E-11	-0.33196E-13	-0.24656E-11
x = 0.25				x = 0.75				
1	0.38290E-02	0.61226E-02	0.78965E-04	0.25135E-04	0.13876E-00	0.12392E-00	0.19016E-01	0.17293E-02
2	0.10935E-04	0.21181E-04	0.13946E-06	0.44388E-07	0.27887E-02	0.49905E-02	0.30320E-03	0.71672E-04
3	0.16857E-07	0.38745E-07	0.15267E-09	0.30078E-10	0.36625E-04	0.73048E-04	0.15150E-07	0.75978E-06
4	0.18394E-10	0.36337E-10	0.52025E-11	0.89997E-12	0.29737E-06	0.62415E-06	0.26786E-05	0.446029E-08
5	-0.12530E-13	0.33604E-13	0.31556E-12	0.11794E-11	0.16094E-08	0.34516E-08	0.61913E-10	0.12764E-10
6	-0.56745E-17	0.14252E-16	-0.58537E-14	0.20720E-14	0.72234E-11	0.13998E-10	0.16774E-11	-0.19935E-12
x = 0.30				x = 0.80				
1	0.67730E-02	0.10540E-01	0.19594E-03	0.60505E-04	0.17020E-00	0.13871E-00	0.25911E-01	0.13929E-02
2	0.27179E-04	0.52550E-04	0.49895E-06	0.16423E-06	0.38968E-02	0.67889E-02	0.47334E-03	0.10510E-03
3	0.40240E-07	0.12428E-06	0.69059E-09	0.19652E-09	0.57174E-04	0.11407E-03	0.47757E-05	0.13130E-05
4	0.48319E-10	0.16513E-09	-0.13633E-10	0.29004E-11	0.92989E-06	0.11095E-05	0.30795E-07	0.92182E-08
5	-0.10786E-12	0.23887E-12	-0.23747E-11	-0.23277E-11	0.32504E-08	0.69897E-08	0.13247E-09	0.39687E-10
6	-0.40587E-16	0.15208E-15	-0.46510E-13	0.15217E-13	0.14815E-10	0.29839E-10	0.52862E-12	-0.12703E-11
x = 0.35				x = 0.85				
1	0.11054E-01	0.16428E-01	0.42457E-03	0.12540E-03	0.20441E-00	0.15191E-00	0.34411E-01	0.37051E-03
2	0.58865E-04	0.11332E-03	0.14733E-05	0.47392E-04	0.59889E-02	0.91206E-02	0.72463E-03	0.14768E-03
3	0.17719E-06	0.38459E-06	0.28294E-08	0.99334E-09	0.87332E-04	0.17825E-03	0.62170E-05	0.21822E-05
4	0.30863E-09	0.67213E-09	-0.87194E-11	0.29038E-11	0.91149E-06	0.19031E-05	0.59718E-07	0.17529E-07
5	-0.78645E-12	0.90680E-12	-0.18611E-11	-0.22103E-11	0.31111E-08	0.13942E-07	0.29827E-09	0.91256E-10
6	-0.44923E-15	0.11250E-14	-0.30683E-12	-0.12007E-13	0.31244E-10	0.66734E-10	0.10957E-12	-0.51318E-12
x = 0.40				x = 0.90				
1	0.17017E-01	0.28573E-01	0.82988E-03	0.23196E-03	0.24049E-00	0.16176E-00	0.44675E-01	0.14805E-02
2	0.11807E-03	0.22033E-03	0.37432E-05	0.11802E-05	0.72284E-02	0.25872E-03	0.10774E-02	0.18941E-03
3	0.45075E-06	0.92563E-06	0.94930E-08	0.31432E-08	0.10279E-05	0.28872E-05	0.13700E-04	0.35010E-05
4	0.10477E-08	0.22484E-08	0.97834E-11	0.14836E-10	0.15194E-05	0.31630E-05	0.11160E-04	0.32036E-07
5	-0.20422E-13	0.31227E-11	-0.26024E-11	0.84998E-13	0.11787E-07	0.25249E-07	0.62391E-09	0.18957E-09
6	-0.25749E-14	0.63332E-14	-0.41712E-12	-0.29440E-12	0.68230E-10	0.13934E-09	0.22305E-11	-0.10641E-11
x = 0.45				x = 0.95				
1	0.25055E-01	0.34680E-01	0.14990E-02	0.39142E-03	0.27745E-00	0.16914E-00	0.35660E-01	0.44824E-02
2	0.20804E-03	0.39583E-03	0.85344E-05	0.28235E-05	0.94391E-02	0.15997E-01	0.15811E-02	0.25833E-03
3	0.10269E-05	0.21039E-05	0.27303E-07	0.88389E-08	0.19010E-03	0.37213E-03	0.22207E-04	0.54371E-05
4	0.30390E-08	0.64386E-08	0.51982E-10	0.21526E-10	0.24631E-05	0.51109E-05	0.20155E-06	0.36482E-07
5	0.93292E-11	0.12097E-10	-0.10017E-11	-0.15651E-12	0.21282E-07	0.45489E-07	0.12637E-08	0.37128E-09
6	-0.14228E-13	0.28808E-13	-0.72990E-13	-0.26098E-12	0.19181E-09	0.28160E-09	0.68972E-11	-0.74810E-12
x = 0.50				x = 1.00				
1	0.35594E-01	0.44344E-01	0.25434E-02	0.61032E-03	0.31423E-00	0.17363E-00	0.70307E-01	-0.89059E-02
2	0.35377E-03	0.68805E-03	0.17836E-04	0.33228E-05	0.12898E-01	0.19912E-01	0.22303E-02	0.31924E-03
3	0.21445E-05	0.43802E-05	0.70413E-07	0.22332E-07	0.27225E-03	0.52884E-03	0.35093E-04	0.81918E-05
4	0.74898E-08	0.16821E-07	0.19037E-09	0.62110E-10	0.38942E-05	0.80340E-05	0.35302E-06	0.96419E-07
5	0.17814E-10	0.43104E-10	-0.10442E-11	0.32096E-11	0.37243E-07	0.79478E-07	0.24936E-08	0.72853E-09
6	-0.38011E-13	0.10594E-12	-0.51955E-12	0.44802E-12	0.25178E-09	0.54519E-09	0.10647E-10	0.14173E-11

m = 1.80-1.00 i

x = 1.05						x = 1.55					
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.34987E-00	0.17552E-00	0.85442E-01	-0.14973E-01		0.55441E 00	0.15231E-00	0.24499E-00	-0.14947E-00		
2	0.16349E-01	0.25050E-01	0.31166E-02	0.37330E-03	0.19303E-00	0.14199E-00	0.11670E-00	0.37975E-01	-0.79605E-02		
3	0.30331E-03	0.73018E-03	0.31166E-02	0.37330E-03	0.19303E-00	0.14199E-00	0.11670E-00	0.37975E-01	-0.79605E-02		
4	0.60191E-05	0.12398E-04	0.86121E-06	0.19958E-06	0.57186E-03	0.61336E-02	0.10104E-01	0.14629E-02	0.80935E-04		
5	0.63426E-07	0.13502E-06	0.46175E-08	0.13322E-08	0.43647E-05	0.19343E-03	0.37548E-03	0.69942E-05	0.41001E-04		
6	0.47494E-09	0.10240E-08	0.25867E-10	0.39946E-11	0.15724E-06	0.43647E-05	0.37548E-03	0.69942E-05	0.41001E-04		
x = 1.10						x = 1.80					
1	0.38954E-00	0.17519E-00	0.10181E-00	-0.22821E-01	0.55945E 00	0.15239E-00	0.28919E-00	-0.16459E-00			
2	0.21358E-01	0.31077E-01	0.42793E-02	0.40544E-03	0.18458E-00	0.12538E-00	0.44923E-01	-0.11346E-01			
3	0.59141E-03	0.20137E-02	0.81992E-04	0.17083E-04	0.57186E-03	0.77393E-02	0.12425E-01	0.21817E-02			
4	0.10530E-05	0.18698E-04	0.39947E-06	0.25498E-06	0.25671E-03	0.49394E-03	0.49394E-03	0.57631E-04			
5	0.86140E-09	0.18698E-08	0.48611E-10	0.10748E-10	0.10611E-06	0.12622E-04	0.10393E-05	0.86228E-05			
x = 1.15						x = 1.85					
1	0.41671E-00	0.17320E-00	0.11912E-00	-0.32481E-01	0.56223E 00	0.15946E-00	0.30153E-00	-0.17849E-00			
2	0.27314E-01	0.38037E-01	0.57798E-02	0.59292E-03	0.19303E-00	0.13249E-00	0.53208E-01	-0.19606E-01			
3	0.72658E-03	0.13713E-02	0.12167E-03	0.29640E-04	0.87103E-02	0.13249E-00	0.28324E-02	-0.20803E-01			
4	0.13548E-04	0.27669E-04	0.16703E-05	0.40314E-06	0.33780E-03	0.44099E-03	0.11011E-03	0.13066E-04			
5	0.17089E-06	0.34202E-06	0.14949E-07	0.41592E-08	0.85912E-05	0.17518E-04	0.80091E-04	0.10893E-04			
6	0.15289E-08	0.33005E-08	0.97895E-10	0.22890E-10	0.15724E-06	0.19343E-03	0.13987E-05	0.31007E-06			
x = 1.20						x = 1.70					
1	0.44292E-00	0.17013E-00	0.13705E-00	-0.49867E-01	0.56298E 00	0.15901E-00	0.32006E-00	-0.19241E-00			
2	0.34631E-01	0.45863E-01	0.78656E-02	0.30318E-03	0.22091E-00	0.13713E-00	0.62837E-01	-0.20803E-01			
3	0.98100E-03	0.18903E-02	0.17740E-03	0.31957E-04	0.2119E-01	0.18393E-01	0.36402E-02	-0.61226E-04			
4	0.19797E-04	0.40238E-04	0.25746E-05	0.61732E-06	0.44099E-03	0.83193E-03	0.11011E-03	0.13066E-04			
5	0.27159E-06	0.57373E-06	0.23694E-07	0.70239E-08	0.12847E-04	0.24862E-04	0.22503E-05	0.49214E-06			
6	0.26470E-08	0.57051E-08	0.19090E-09	0.47039E-10	0.23023E-06	0.48340E-06	0.33998E-07	0.78267E-08			
x = 1.25						x = 1.75					
1	0.46799E-00	0.16651E-00	0.15933E-00	-0.56787E-01	0.56374E 00	0.15704E-00	0.33884E-00	-0.20479E-00			
2	0.43940E-01	0.54742E-01	0.10068E-01	0.81782E-02	0.26998E-00	0.14084E-00	0.71043E-01	-0.26992E-01			
3	0.13795E-02	0.24118E-02	0.25447E-03	0.1935E-04	0.19049E-01	0.10642E-01	0.46322E-02	-0.19663E-03			
4	0.28480E-04	0.37588E-04	0.40116E-05	0.92992E-06	0.7354E-03	0.10642E-01	0.14984E-03	0.20465E-04			
5	0.42337E-06	0.89174E-06	0.43845E-07	0.16077E-07	0.15200E-04	0.32723E-04	0.52524E-05	0.18103E-04			
6	0.44727E-08	0.96371E-08	0.35281E-09	0.93769E-10	0.33330E-06	0.70037E-06	0.51513E-07	0.11826E-07			
x = 1.30						x = 1.80					
1	0.48986E-00	0.16280E-00	0.17375E-00	-0.70970E-01	0.55871E 00	0.15946E-00	0.35791E-00	-0.21598E-00			
2	0.54281E-01	0.64803E-01	0.12999E-01	-0.29933E-03	0.27844E-00	0.14184E-00	0.80740E-01	-0.34139E-01			
3	0.17299E-02	0.31410E-02	0.35954E-03	0.53415E-04	0.18597E-01	0.1339E-02	0.58377E-02	-0.40440E-03			
4	0.40388E-04	0.81210E-04	0.61398E-05	0.15391E-05	0.75543E-03	0.10642E-01	0.20191E-03	0.18580E-04			
5	0.64893E-06	0.13614E-05	0.72627E-07	0.18744E-07	0.21954E-04	0.44409E-04	0.66498E-05	0.79980E-06			
6	0.74034E-08	0.15928E-07	0.63064E-09	0.17925E-09	0.47754E-06	0.97993E-06	0.77997E-07	0.17040E-07			
x = 1.35						x = 1.85					
1	0.50896E 00	0.15956E-00	0.19216E-00	-0.86098E-01	0.55940E 00	0.16206E-00	0.37726E-00	-0.22587E-00			
2	0.67085E-01	0.74713E-01	0.15950E-01	-0.94282E-03	0.30489E-00	0.14084E-00	0.90839E-01	-0.42314E-01			
3	0.22838E-02	0.40499E-02	0.50085E-03	0.65829E-04	0.22874E-01	0.30954E-01	0.72875E-02	-0.70914E-03			
4	0.58319E-04	0.11294E-03	0.92408E-05	0.19404E-05	0.94032E-03	0.17112E-02	0.24959E-03	0.20465E-04			
5	0.97871E-06	0.20441E-05	0.11795E-06	0.28995E-07	0.29501E-04	0.58890E-04	0.65778E-05	0.10817E-05			
6	0.12026E-07	0.25814E-07	0.11088E-08	0.29594E-09	0.67674E-06	0.14120E-05	0.11673E-06	0.24609E-07			
x = 1.40						x = 1.90					
1	0.52422E 00	0.15847E-00	0.21048E-00	-0.10183E-00	0.56782E 00	0.16472E-00	0.39849E-00	-0.23437E-00			
2	0.82136E-01	0.85447E-01	0.20783E-01	-0.18299E-02	0.33497E-00	0.13810E-00	0.10326E-00	-0.51396E-01			
3	0.29702E-02	0.51582E-02	0.48849E-03	0.78048E-04	0.28003E-01	0.38289E-01	0.90138E-02	-0.11406E-02			
4	0.78191E-04	0.15913E-03	0.13894E-04	0.27261E-05	0.11950E-02	0.21444E-02	0.35865E-03	0.21100E-04			
5	0.14492E-05	0.30223E-05	0.18819E-06	0.45830E-07	0.39524E-04	0.77993E-04	0.92128E-05	0.13895E-05			
6	0.19177E-07	0.41086E-07	0.18948E-08	0.50545E-09	0.95026E-06	0.19793E-05	0.17269E-06	0.39039E-07			
x = 1.45						x = 1.95					
1	0.53694E 00	0.15428E-00	0.22869E-00	-0.11783E-00	0.56023E 00	0.16728E-00	0.41674E-00	-0.24140E-00			
2	0.99847E-01	0.84289E-01	0.25747E-01	-0.33480E-02	0.38049E-00	0.13997E-00	0.11195E-00	-0.61339E-01			
3	0.37805E-02	0.69129E-02	0.49644E-03	0.88148E-04	0.38119E-01	0.42141E-01	0.11043E-01	-0.17940E-02			
4	0.10537E-03	0.21038E-03	0.20802E-04	0.37332E-05	0.15101E-02	0.28894E-02	0.46783E-03	0.19517E-04			
5	0.21200E-05	0.44047E-05	0.29508E-06	0.68980E-07	0.52028E-04	0.10247E-03	0.12781E-04	0.17722E-05			
6	0.30808E-07	0.64297E-07	0.31996E-08	0.89724E-09	0.19222E-05	0.27370E-05	0.29281E-06	0.49277E-07			
x = 1.50						x = 2.00					
1	0.56897E 00	0.15288E-00	0.24884E-00	-0.19980E-00	0.59134E 00	0.16898E-00	0.43691E-00	-0.26490E-00			
2	0.11961E-00	0.10885E-00	0.12875E-01	-0.53188E-02	0.38681E-00	0.12889E-00	0.22284E-00	-0.78202E-01			
3	0.48314E-02	0.81479E-02	0.12518E-02	0.39090E-04	0.49369E-01	0.48959E-01	0.48959E-01	-0.22966E-02			
4	0.14843E-03	0.28263E-03	0.26821E-04	0.50633E-05	0.18982E-02	0.39014E-02	0.13407E-01	0.14346E-02			
5	0.30807E-05	0.63938E-05	0.49552E-06	0.10373E-06	0.68942E-04	0.13362E-03	0.17572E-04	0.22961E-05			
6	0.44449E-07	0.99046E-07	0.52810E-08	0.19594E-08	0.18240E-05	0.37594E-05	0.36629E-06	0.68908E-07			

m = 1.90-0.68 i

x = 0.05										x = 0.55									
n	a _n	a _n	b _n	b _n	a _n	a _n	b _n	b _n	a _n	n	a _n	a _n	b _n	b _n					
1	0.19509E+03	0.44454E+04	0.18623E+07	0.12767E+07	0.33568E+01	0.57366E+01	0.31554E+02	0.21793E+02											
2	0.29036E+03	0.83054E+04	0.44723E+09	0.26714E+09	0.38961E+03	0.96896E+03	0.25624E+04	0.19736E+04											
3	-0.26255E+12	0.83372E+12	0.14074E+07	0.15170E+10	0.28740E+05	0.76668E+05	0.12031E+06	0.96150E+07											
4					0.12775E+07	0.35180E+07	0.37448E+09	0.31378E+09											
5					0.35120E+10	0.10725E+09	-0.40780E+12	0.51471E+11											
6					-0.11761E+12	0.36912E+12	-0.89849E+12	0.64128E+14											
x = 0.10										x = 0.60									
1	0.15690E+03	0.35674E+03	0.57414E+04	0.47779E+05	0.49544E+01	0.73934E+01	0.49640E+02	0.37686E+02											
2	0.75670E+05	0.17612E+06	-0.40233E+09	0.19954E+09	0.60513E+03	0.14910E+02	0.47351E+04	0.31904E+04											
3	-0.74515E+10	0.64832E+10	-0.11720E+09	-0.76015E+10	0.52756E+05	0.14034E+04	0.26473E+06	0.20889E+05											
4					0.27878E+07	0.14034E+04	0.26473E+06	0.80758E+09											
5					0.91677E+10	0.27758E+09	-0.35519E+12	0.12707E+10											
6					-0.33290E+12	0.10855E+11	-0.21342E+11	0.15372E+11											
x = 0.15										x = 0.65									
1	0.73469E+03	0.12052E+02	0.43877E+03	0.36033E+05	0.60540E+01	0.90473E+01	0.75388E+02	0.47105E+02											
2	0.79786E+05	0.19888E+05	0.31610E+08	0.21944E+08	0.70861E+03	0.22199E+02	0.83416E+04	0.62120E+04											
3	0.38074E+09	0.99202E+09	0.87411E+10	0.31914E+10	0.92227E+05	0.24459E+04	0.54444E+06	0.44280E+04											
4					0.57122E+07	0.15679E+06	0.23089E+08	0.18599E+07											
5					0.22940E+09	0.65444E+09	0.49345E+11	0.11149E+10											
6					-0.11325E+12	0.21623E+11	-0.12065E+11	0.77348E+17											
x = 0.20										x = 0.70									
1	0.12856E+02	0.28594E+02	0.18576E+04	0.19123E+04	0.78842E+01	0.10927E+00	0.11130E+01	0.65320E+02											
2	0.24399E+05	0.62460E+05	0.21274E+07	0.17184E+07	0.13269E+02	0.31960E+02	0.14101E+03	0.10295E+03											
3	0.24872E+08	0.64009E+08	0.77939E+10	0.12877E+10	0.19467E+04	0.40877E+04	0.10628E+05	0.82234E+06											
4	-0.23075E+12	0.85508E+11	0.11741E+10	0.10422E+10	0.11094E+06	0.30394E+06	0.51983E+09	0.41889E+08											
5	-0.10488E+14	0.33573E+14	-0.69156E+12	0.10601E+11	0.51949E+09	0.14468E+08	0.13777E+10	0.18979E+10											
6	-0.28810E+18	0.91711E+18	-0.47471E+15	0.39329E+15	0.70911E+12	0.48185E+11	-0.14173E+11	0.29400E+12											
x = 0.25										x = 0.75									
1	0.25591E+02	0.55874E+02	0.57043E+04	0.45887E+04	0.10075E+00	0.12884E+00	0.16019E+01	0.87297E+02											
2	0.74512E+05	0.19093E+04	0.10085E+06	0.82342E+07	0.18914E+02	0.44913E+02	0.23014E+03	0.16431E+03											
3	0.11650E+07	0.31352E+07	0.15040E+09	0.10095E+09	0.25028E+04	0.65390E+02	0.19810E+05	0.13154E+05											
4	0.13834E+10	0.18704E+10	0.65578E+11	0.11581E+10	0.20573E+06	0.56265E+06	0.11067E+07	0.76765E+07											
5	-0.11807E+13	0.19793E+13	-0.83717E+12	0.25046E+11	0.11099E+08	0.31141E+08	0.37812E+10	0.34181E+10											
6	-0.52329E+17	0.16845E+16	-0.54670E+14	0.45198E+14	0.32160E+11	0.11482E+10	-0.14345E+11	-0.13344E+12											
x = 0.30										x = 0.80									
1	0.45294E+02	0.96509E+02	0.14305E+04	0.11333E+03	0.12630E+00	0.14866E+00	0.22528E+01	0.11245E+01											
2	0.18560E+04	0.47420E+04	0.36159E+06	0.29395E+06	0.26415E+07	0.61699E+02	0.36430E+03	0.23170E+03											
3	0.41609E+07	0.11291E+06	0.55450E+09	0.42894E+09	0.39261E+04	0.10291E+03	0.15444E+05	0.24805E+05											
4	0.57421E+10	0.14022E+09	0.68984E+11	0.51688E+11	0.36651E+06	0.10001E+05	0.22573E+07	0.17676E+07											
5	-0.72401E+13	0.27850E+12	-0.65306E+13	0.24163E+12	0.22943E+08	0.63043E+08	0.97098E+10	0.87269E+10											
6	-0.55815E+16	0.17758E+15	-0.37156E+13	0.31617E+13	0.63787E+11	0.27834E+10	-0.14092E+11	0.11276E+11											
x = 0.35										x = 0.85									
1	0.74032E+02	0.15298E+01	0.31209E+03	0.24267E+03	0.15536E+00	0.16731E+00	0.31010E+01	0.19399E+01											
2	0.40175E+04	0.10227E+03	0.10662E+05	0.86042E+05	0.36251E+02	0.83072E+02	0.56140E+03	0.38025E+03											
3	0.12218E+06	0.32862E+06	0.20615E+09	0.18907E+09	0.59931E+04	0.14635E+03	0.61367E+05	0.54729E+05											
4	0.21940E+09	0.61120E+09	0.18824E+11	0.43700E+11	0.69019E+06	0.11796E+05	0.43977E+07	0.34117E+07											
5	-0.41350E+13	0.85193E+12	-0.46559E+12	0.31427E+12	0.22943E+08	0.12214E+07	0.21952E+09	0.18476E+05											
6	-0.41767E+15	0.13063E+14	-0.98853E+13	0.14622E+13	0.19782E+10	0.41382E+10	-0.94114E+17	0.74340E+11											
x = 0.40										x = 0.90									
1	0.11428E+01	0.22749E+01	0.61518E+03	0.46740E+03	0.18793E+00	0.18459E+00	0.41814E+01	0.16568E+01											
2	0.78480E+04	0.19880E+03	0.27241E+05	0.21774E+05	0.80000E+02	0.10985E+01	0.84440E+02	0.35477E+02											
3	0.31077E+06	0.83440E+06	0.59371E+09	0.47004E+09	0.29309E+04	0.23175E+03	0.16289E+04	0.75455E+04											
4	0.79069E+09	0.20422E+08	0.18525E+10	0.32774E+10	0.19501E+05	0.28917E+05	0.82441E+07	0.63417E+07											
5	-0.50492E+12	0.49892E+11	-0.22972E+11	0.55948E+11	0.81733E+08	0.22773E+07	0.45448E+08	0.38314E+09											
6	-0.21352E+14	0.79993E+14	-0.56296E+12	0.38205E+12	0.41286E+10	0.12718E+09	-0.24957E+11	0.37817E+11											
x = 0.45										x = 0.95									
1	0.14174E+03	0.32184E+01	0.11227E+02	0.83046E+03	0.22214E+00	0.19956E+00	0.55246E+01	0.18767E+01											
2	0.70749E+05	0.39742E+03	0.62348E+05	0.49704E+05	0.65389E+02	0.14294E+01	0.12450E+02	0.78959E+02											
3	0.21063E+08	0.18417E+08	0.19846E+07	0.18053E+07	0.13028E+03	0.13606E+03	0.16781E+04	0.12124E+04											
4	0.12308E+11	0.14340E+10	-0.27786E+11	0.61240E+11	0.17017E+05	0.46084E+05	0.14940E+06	0.11375E+06											
5	-0.10775E+13	0.13708E+13	-0.10587E+11	0.58471E+12	0.14762E+07	0.41019E+07	0.92838E+09	0.74591E+09											
6					0.87490E+10	0.25945E+09	0.97069E+12	0.56533E+11											
x = 0.50										x = 1.00									
1	0.24148E+01	0.43716E+01	0.19286E+02	0.13813E+02	0.25931E+00	0.21167E+00	0.71507E+01	0.20049E+01											
2	0.24090E+03	0.40343E+03	0.11088E+04	0.10224E+04	0.86215E+02	0.18326E+01	0.18003E+02	0.10980E+02											
3	0.14772E+05	0.19504E+05	0.41009E+07	0.41324E+07	0.18645E+03	0.47779E+03	0.26700E+04	0.18956E+04											
4	0.94275E+08	0.14961E+07	0.12003E+09	0.95184E+10	0.26892E+05	0.72612E+05	0.26261E+06	0.19783E+06											
5	0.13874E+10	0.34478E+10	0.98654E+13	-0.23024E+11	0.25843E+07	0.71642E+07	0.18117E+09	0.14179E+08											
6	-0.49092E+13	0.15251E+12	0.45936E+17	-0.61293E+12	0.17346E+09	0.49394E+09	0.73616E+11	0.84751E+11											

m = 1.90-0.88 i

x = 1.05						x = 1.55					
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.29513E-00	0.22063E-00	0.90629E-01	0.19837E-01		0.54364E-00	0.19414E-00	0.33191E-00	-0.11094E-00		
2	0.11247E-01	0.27117E-01	0.25590E-02	0.14936E-02		0.10749E-00	0.12564E-00	0.41326E-01	0.82098E-02		
3	0.26231E-03	0.66730E-03	0.15433E-04	0.28939E-04		0.41914E-02	0.92860E-02	0.32474E-04	0.73235E-02		
4	0.41547E-05	0.11113E-04	0.44920E-06	0.33458E-06		0.13190E-03	0.33098E-03	0.32447E-04	0.20639E-04		
5	0.41904E-07	0.12173E-06	0.14201E-08	0.26518E-08		0.30174E-05	0.81204E-05	0.53182E-06	0.36921E-06		
6	0.12621E-09	0.92725E-09	0.16813E-10	0.18832E-10		0.44705E-07	0.13560E-06	0.64545E-09	0.47191E-08		
x = 1.10						x = 1.60					
1	0.33153E-00	0.22637E-00	0.11242E-00	0.17531E-01		0.55142E-00	0.18831E-00	0.35145E-00	-0.12924E-00		
2	0.14570E-01	0.28935E-01	0.35813E-02	0.19991E-02		0.12903E-00	0.13881E-00	0.50963E-01	0.75298E-01		
3	0.38747E-03	0.91700E-03	0.63345E-04	0.49226E-04		0.52562E-02	0.11461E-01	0.19215E-02	0.30211E-01		
4	0.62887E-05	0.16888E-04	0.74928E-06	0.55147E-06		0.17631E-03	0.44758E-03	0.46310E-04	0.28594E-04		
5	0.73029E-07	0.20164E-06	0.62482E-08	0.47834E-08		0.42523E-05	0.11359E-04	0.80213E-06	0.54911E-08		
6	0.59828E-09	0.16842E-08	0.37644E-10	0.31435E-10		0.73618E-07	0.20302E-06	0.10362E-07	0.75031E-08		
x = 1.15						x = 1.65					
1	0.36662E-00	0.22909E-00	0.13544E-00	0.12607E-01		0.59639E-00	0.18283E-00	0.37051E-00	-0.14647E-00		
2	0.19707E-01	0.33691E-01	0.44936E-02	0.25938E-02		0.15327E-00	0.15108E-00	0.461986E-01	0.10471E-01		
3	0.49657E-03	0.12416E-02	0.94827E-04	0.65778E-04		0.66582E-02	0.14038E-01	0.25441E-02	0.58945E-02		
4	0.93430E-05	0.24066E-04	0.12219E-05	0.88792E-05		0.23194E-03	0.58391E-02	0.72441E-04	0.1164E-02		
5	0.11847E-06	0.32643E-05	0.11244E-07	0.84559E-08		0.59281E-05	0.15827E-04	0.46990E-04	0.39153E-04		
6	0.10588E-08	0.29837E-08	0.71798E-10	0.43624E-10		0.10908E-06	0.15827E-04	0.11945E-04	0.80567E-05		
x = 1.20						x = 1.70					
1	0.33963E-00	0.22915E-00	0.16204E-00	0.47219E-02		0.59874E-00	0.17774E-00	0.38872E-00	-0.16738E-00		
2	0.23846E-01	0.43516E-01	0.67227E-02	0.33112E-02		0.17998E-00	0.16188E-00	0.74524E-01	0.10471E-01		
3	0.67005E-03	0.16588E-02	0.11999E-03	0.90905E-04		0.63320E-02	0.17070E-01	0.33361E-02	0.14345E-02		
4	0.13648E-04	0.36316E-04	0.19517E-05	0.13990E-05		0.30278E-05	0.75527E-03	0.64990E-04	0.52945E-04		
5	0.18181E-06	0.51738E-06	0.19247E-07	0.14858E-07		0.59281E-05	0.21746E-04	0.90274E-04	0.17577E-04		
6	0.18295E-08	0.51478E-08	0.13236E-09	0.11971E-09		0.81816E-06	0.43802E-06	0.25577E-07	0.18135E-07		
x = 1.25						x = 1.75					
1	0.42996E-00	0.22703E-00	0.18946E-00	-0.62004E-02		0.59888E-00	0.17303E-00	0.40646E-00	-0.17679E-00		
2	0.30191E-01	0.52451E-01	0.90341E-02	0.41344E-02		0.23975E-00	0.17065E-00	0.87819E-01	0.12483E-01		
3	0.89395E-03	0.21880E-02	0.20232E-03	0.12932E-03		0.10383E-01	0.20401E-01	0.43455E-02	0.17989E-02		
4	0.19621E-04	0.51989E-04	0.30582E-05	0.21605E-05		0.39225E-03	0.96908E-03	0.17424E-03	0.17904E-04		
5	0.24326E-06	0.80421E-06	0.32753E-07	0.24424E-07		0.11184E-04	0.29588E-04	0.72973E-05	0.70904E-04		
6	0.31004E-08	0.36889E-08	0.25152E-09	0.20191E-09		0.23107E-06	0.63214E-06	0.39387E-07	0.16701E-05		
x = 1.30						x = 1.80					
1	0.45721E-00	0.22323E-00	0.21492E-00	-0.19946E-01		0.59640E-00	0.16870E-00	0.42388E-00	-0.18957E-00		
2	0.37472E-01	0.62523E-01	0.11993E-01	0.50421E-02		0.23902E-00	0.17695E-00	0.10224E-00	0.14749E-01		
3	0.11805E-02	0.28534E-02	0.40773E-03	0.28911E-03		0.12889E-01	0.24712E-01	0.56884E-02	0.70704E-02		
4	0.27811E-04	0.73340E-04	0.47049E-05	0.17816E-04		0.50480E-03	0.12338E-02	0.16941E-03	0.93615E-04		
5	0.44897E-06	0.12779E-05	0.59447E-07	0.40182E-07		0.15133E-04	0.39885E-04	0.36812E-05	0.23622E-05		
6	0.51330E-08	0.14362E-07	0.46038E-09	0.35928E-09		0.23107E-06	0.63214E-06	0.39387E-07	0.27637E-07		
x = 1.35						x = 1.85					
1	0.48119E-00	0.21825E-00	0.24076E-00	-0.36049E-01		0.59510E-00	0.15468E-00	0.44110E-00	-0.20054E-00		
2	0.47447E-01	0.73657E-01	0.15733E-01	0.59909E-02		0.27007E-00	0.18049E-00	0.11731E-00	0.14760E-01		
3	0.15444E-02	0.36814E-02	0.50773E-03	0.28911E-03		0.23902E-00	0.17695E-00	0.71792E-02	0.24163E-02		
4	0.38901E-04	0.10206E-03	0.71337E-05	0.24348E-04		0.12889E-01	0.27426E-01	0.11732E-02	0.93615E-04		
5	0.67614E-06	0.18440E-05	0.88854E-07	0.48796E-05		0.64953E-03	0.15596E-02	0.22905E-03	0.12241E-02		
6	0.83446E-08	0.23280E-07	0.81440E-09	0.62821E-09		0.20357E-04	0.53295E-04	0.52459E-05	0.33042E-05		
x = 1.40						x = 1.90					
1	0.50177E-00	0.21252E-00	0.26553E-00	-0.53876E-01		0.59598E-00	0.16093E-00	0.45819E-00	-0.20994E-00		
2	0.58885E-01	0.85773E-01	0.20395E-01	0.59909E-02		0.27007E-00	0.18118E-00	0.13271E-00	0.24032E-01		
3	0.20036E-02	0.87773E-02	0.10645E-04	0.12773E-03		0.14650E-01	0.34796E-01	0.91151E-02	0.27560E-02		
4	0.53751E-04	0.47024E-02	0.56801E-03	0.43469E-02		0.82085E-03	0.19579E-02	0.30715E-03	0.15834E-03		
5	0.10029E-05	0.14823E-03	0.10645E-04	0.71337E-05		0.27131E-04	0.70625E-04	0.74046E-05	0.45732E-05		
6	0.13311E-07	0.37052E-07	0.14233E-05	0.10246E-04		0.65833E-06	0.17839E-05	0.13397E-06	0.90575E-07		
x = 1.45						x = 1.95					
1	0.51897E-00	0.20442E-00	0.29899E-00	-0.72732E-01		0.59827E-00	0.15737E-00	0.47519E-00	-0.21745E-00		
2	0.72854E-01	0.96888E-01	0.26132E-01	0.74908E-02		0.39138E-00	0.17041E-00	0.14815E-00	0.34938E-01		
3	0.25797E-02	0.59508E-02	0.78232E-03	0.43469E-02		0.24181E-01	0.40857E-01	0.11477E-01	0.30597E-02		
4	0.73432E-04	0.19049E-03	0.15665E-04	0.10329E-04		0.10976E-02	0.24417E-02	0.40889E-03	0.20760E-03		
5	0.14685E-05	0.39748E-05	0.22429E-06	0.15979E-06		0.39887E-04	0.92851E-04	0.10357E-04	0.62447E-05		
6	0.20878E-07	0.57984E-07	0.23784E-08	0.17800E-08		0.91581E-06	0.24728E-05	0.19713E-06	0.13149E-06		
x = 1.50						x = 2.00					
1	0.53288E-00	0.20022E-00	0.31108E-00	-0.91948E-01		0.52915E-00	0.15391E-00	0.49210E-00	-0.22316E-00		
2	0.88695E-01	0.11210E-00	0.33071E-01	0.81875E-01		0.34011E-00	0.17470E-00	0.16340E-00	0.47187E-01		
3	0.32485E-02	0.74647E-02	0.10660E-02	0.56828E-02		0.29558E-01	0.47624E-01	0.14331E-01	0.32814E-02		
4	0.99271E-04	0.25376E-03	0.22753E-04	0.14700E-04		0.13052E-02	0.30281E-02	0.53075E-03	0.25443E-03		
5	0.21168E-05	0.57170E-05	0.34785E-06	0.24472E-06		0.47194E-04	0.12110E-03	0.14362E-04	0.84976E-05		
6	0.32243E-07	0.99327E-07	0.39593E-08	0.29207E-08		0.12631E-05	0.33977E-05	0.28720E-06	0.13889E-06		

m = 1.96-0.66 i

		x = 0.05				x = 0.55			
n	a_n^r	a_n^i	b_n^r	b_n^i	a_n^r	a_n^i	b_n^r	b_n^i	
1	0.18039E-04	0.45723E-04	0.11713E-07	0.17540E-07	0.31841E-01	0.59578E-01	0.32167E-02	0.24860E-02	
2	0.19551E-08	0.52229E-08	0.27394E-09	0.37792E-10	0.59205E-03	0.99006E-03	0.75848E-04	0.22298E-04	
3	-0.24603E-12	0.88055E-12	-0.56765E-10	0.30037E-10	0.26421E-05	0.72152E-05	0.12149E-06	0.10825E-06	
4					0.11729E-07	0.35803E-07	0.37534E-09	0.35678E-09	
5					0.31351E-10	0.10940E-09	0.12698E-11	0.61940E-11	
6					-0.11895E-12	0.35277E-12	-0.11049E-11	0.69688E-12	
		x = 0.10				x = 0.60			
1	0.14515E-03	0.36616E-03	0.57763E-06	0.53189E-06	0.43477E-01	0.76035E-01	0.53770E-02	0.37525E-02	
2	0.70511E-07	0.20024E-06	0.588384E-09	0.59971E-10	0.55820E-03	0.15246E-02	0.47847E-04	0.40635E-04	
3	0.24411E-10	0.11460E-09	0.10807E-09	0.20071E-10	0.48504E-05	0.14307E-04	0.26629E-06	0.25295E-06	
4					0.29804E-07	0.78034E-07	0.96715E-09	0.87210E-09	
5					0.88028E-10	0.27800E-09	0.26189E-11	0.54092E-11	
6					-0.35098E-13	0.50430E-12	-0.41260E-12	0.61807E-12	
		x = 0.15				x = 0.65			
1	0.44942E-07	0.17375E-07	0.43966E-05	0.40439E-05	0.58140E-01	0.94491E-01	0.77518E-02	0.54348E-02	
2	0.53243E-06	0.15197E-05	0.26096E-03	0.25592E-04	0.83888E-03	0.22659E-02	0.84415E-04	0.70442E-04	
3	0.28598E-09	0.35938E-09	-0.30093E-10	-0.36514E-10	0.53471E-07	0.24938E-04	0.54857E-06	0.48021E-06	
4					0.13965E-05	0.13965E-05	0.23263E-08	0.20795E-08	
5					0.21351E-09	0.85346E-09	0.83393E-11	0.98070E-11	
6					0.28258E-12	0.23417E-11	-0.22566E-12	0.89451E-12	
		x = 0.20				x = 0.70			
1	0.11911E-02	0.29377E-02	0.18636E-04	0.14983E-04	0.76743E-01	0.11448E-00	0.11504E-01	0.75784E-02	
2	0.22456E-05	0.63968E-05	0.21077E-07	0.19456E-07	0.12558E-02	0.32710E-02	0.14298E-03	0.11699E-03	
3	0.42263E-08	0.66895E-08	0.51829E-11	0.77825E-11	0.14225E-04	0.41835E-04	0.10717E-05	0.92852E-06	
4	0.98657E-12	0.22235E-11	-0.67776E-12	-0.18609E-11	0.53471E-07	0.30955E-06	0.52498E-08	0.46640E-08	
5	-0.95636E-15	0.33813E-14	0.52536E-13	-0.62398E-12	0.10191E-06	0.14956E-08	0.19254E-10	0.23191E-10	
6	-0.26094E-18	0.92026E-18	-0.43225E-15	0.40111E-15	0.47973E-09	0.61138E-12	-0.72850E-12	0.15636E-11	
		x = 0.25				x = 0.75			
1	0.23745E-02	0.57447E-02	0.57296E-04	0.51595E-04	0.98099E-01	0.13941E-00	0.16652E-01	0.10191E-01	
2	0.48571E-05	0.19493E-04	0.10090E-06	0.92406E-07	0.17491E-02	0.45993E-02	0.23985E-03	0.18718E-03	
3	0.10684E-07	0.11405E-07	0.10795E-09	0.75062E-10	0.23022E-04	0.67200E-04	0.19946E-05	0.17133E-05	
4	0.13347E-10	0.30048E-10	0.39755E-11	-0.15895E-11	0.18899E-06	0.57297E-06	0.11676E-07	0.98572E-08	
5	-0.10310E-13	0.19777E-13	0.10349E-11	0.23974E-12	0.18899E-06	0.31586E-08	0.43110E-10	0.39771E-10	
6	-0.47861E-17	0.16707E-16	-0.44847E-14	0.47364E-14	0.10228E-08	0.37609E-11	-0.58854E-13	0.17587E-12	
		x = 0.30				x = 0.80			
1	0.42112E-02	0.99324E-02	0.14390E-03	0.12764E-03	0.12385E-00	0.15651E-00	0.23563E-01	0.13218E-01	
2	0.17088E-04	0.49420E-04	0.36260E-06	0.33008E-06	0.24459E-02	0.63224E-02	0.37102E-03	0.28977E-03	
3	0.38221E-07	0.11419E-06	0.51911E-09	0.44695E-09	0.38122E-04	0.10498E-03	0.35895E-05	0.30347E-05	
4	0.55073E-10	0.15386E-09	0.49401E-11	-0.37366E-11	0.33671E-06	0.20758E-08	0.22735E-07	0.19290E-07	
5	-0.45723E-13	0.32076E-12	0.14483E-11	-0.11544E-12	0.33671E-06	0.664121E-08	0.10402E-09	0.89454E-10	
6	-0.50499E-16	0.17825E-15	-0.37381E-13	0.40507E-13	0.20758E-08	0.28639E-10	0.96885E-12	0.68812E-12	
		x = 0.35				x = 0.85			
1	0.69013E-02	0.15764E-01	0.31452E-03	0.27387E-03	0.15341E-00	0.17605E-00	0.32646E-01	0.16505E-01	
2	0.33994E-04	0.10444E-03	0.10709E-05	0.96703E-06	0.33614E-02	0.85190E-02	0.37324E-03	0.43557E-03	
3	0.11232E-06	0.33490E-06	0.21214E-09	0.19154E-08	0.59153E-04	0.15951E-04	0.62100E-05	0.51892E-05	
4	0.20337E-09	0.63192E-09	0.90972E-11	0.11655E-10	0.57890E-06	0.17475E-05	0.44417E-07	0.38505E-07	
5	-0.22180E-12	0.13446E-11	-0.70006E-17	0.31339E-11	0.40209E-08	0.12428E-07	0.22015E-09	0.20271E-09	
6	-0.37973E-15	0.13165E-14	-0.15086E-12	0.11697E-12	0.18697E-10	0.62026E-10	-0.31574E-12	0.16663E-11	
		x = 0.40				x = 0.90			
1	0.10688E-01	0.23478E-01	0.62133E-03	0.52901E-03	0.18638E-00	0.19566E-00	0.44311E-01	0.19772E-01	
2	0.72282E-04	0.20315E-03	0.27376E-05	0.24495E-05	0.49515E-02	0.11276E-01	0.86917E-03	0.63925E-03	
3	0.28560E-06	0.85029E-06	0.69138E-08	0.62363E-08	0.92214E-04	0.23649E-03	0.10427E-04	0.85796E-05	
4	0.67944E-09	0.20663E-08	0.16474E-10	0.18274E-10	0.96493E-06	0.29049E-05	0.83183E-07	0.71603E-07	
5	0.42776E-12	0.43098E-11	-0.15252E-12	0.22487E-11	0.79123E-08	0.23174E-07	0.46701E-09	0.42043E-09	
6	-0.20962E-14	0.73861E-14	-0.25079E-12	0.26447E-12	0.39906E-10	0.11011E-09	0.74186E-12	0.37581E-11	
		x = 0.45				x = 0.95			
1	0.15866E-01	0.33275E-01	0.11369E-02	0.94224E-03	-0.22211E-00	0.21194E-00	0.58921E-01	0.22583E-01	
2	0.13062E-03	0.36515E-03	0.62728E-05	0.59540E-05	0.60847E-02	0.14686E-01	0.12789E-02	0.91052E-03	
3	0.65047E-06	0.19329E-05	0.11994E-07	0.17948E-07	0.11997E-03	0.34301E-03	0.17032E-04	0.13793E-04	
4	0.19431E-08	0.57962E-08	0.53764E-10	0.47158E-10	0.15638E-04	0.46890E-05	0.15090E-06	0.12866E-06	
5	0.32670E-11	0.14228E-10	0.10348E-11	0.38245E-11	0.13557E-07	0.41756E-07	0.94136E-09	0.84013E-09	
6	-0.92857E-14	0.33641E-13	-0.34665E-12	0.67350E-12	0.80582E-10	0.26093E-09	0.21547E-11	0.72125E-11	
		x = 0.50				x = 1.00			
1	0.22783E-01	0.45292E-01	0.19589E-02	0.15723E-02	0.25969E-00	0.22599E-00	0.76709E-01	0.24343E-01	
2	0.22231E-03	0.81864E-03	0.13184E-04	0.11531E-04	0.80446E-03	0.18850E-01	0.18555E-02	0.12715E-02	
3	0.13579E-05	0.40264E-05	0.31344E-07	0.45121E-07	0.17176E-03	0.48781E-03	0.27144E-04	0.21605E-04	
4	0.44087E-08	0.15234E-07	0.12384E-09	0.10776E-09	0.24717E-05	0.73984E-05	0.26547E-06	0.24026E-06	
5	0.13217E-10	0.36017E-10	0.10141E-11	-0.20280E-11	0.23793E-07	0.72928E-07	0.18290E-08	0.14930E-08	
6	-0.33866E-13	0.15901E-12	0.48344E-12	-0.30569E-11	0.16050E-09	0.50250E-09	0.89727E-11	0.37287E-11	

m = 1.96-0.66 i

x = 1.05						x = 1.55					
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.29804E-00	0.23473E-00	0.97694E-01	0.26341E-01	0.59348E-00	0.19812E-00	0.34809E-00	-0.12177E-00			
2	0.10534E-01	0.23702E-01	0.26472E-02	0.1764E-0E-0E	0.10595E-00	0.13239E-00	0.44812E-01	0.10212E-01			
3	0.24176E-03	0.68149E-03	0.42311E-04	0.33052E-04	0.39066E-02	0.95571E-02	0.13039E-02	0.86214E-03			
4	0.38194E-05	0.11395E-04	0.45458E-06	0.37940E-06	0.12258E-03	0.34714E-03	0.33547E-04	0.23008E-04			
5	0.60398E-07	0.12132E-08	0.14469E-08	0.29940E-08	0.27753E-05	0.82751E-05	0.54182E-06	0.42181E-06			
6	0.29121E-09	0.94292E-09	0.16660E-10	0.20331E-10	0.65062E-07	0.13804E-06	0.61434E-08	0.55966E-08			
x = 1.10						x = 1.60					
1	0.33608E-00	0.24074E-00	0.12160E-00	0.21966E-01	0.56046E-00	0.19075E-00	0.36691E-00	-0.14101E-00			
2	0.13678E-01	0.29847E-01	0.37194E-02	0.23230E-02	0.12802E-00	0.14663E-00	0.55444E-01	0.95067E-02			
3	0.39913E-03	0.93600E-03	0.44640E-04	0.49477E-04	0.49477E-04	0.11782E-01	0.20167E-02	0.10997E-02			
4	0.57822E-05	0.17191E-04	0.75918E-06	0.54140E-06	0.12258E-03	0.45716E-03	0.47685E-04	0.33073E-04			
5	0.67049E-07	0.20529E-06	0.63089E-08	0.54140E-08	0.39122E-05	0.11618E-04	0.01832E-05	0.62427E-06			
6	0.54866E-09	0.17144E-08	0.37092E-10	0.36901E-10	0.67637E-07	1.20670E-06	0.10517E-07	0.85363E-08			
x = 1.15						x = 1.65					
1	0.37275E-00	0.24331E-00	0.14784E-00	0.14198E-01	0.56443E-00	0.18980E-00	0.38480E-00	-0.15886E-00			
2	0.17627E-01	0.36879E-01	0.51526E-02	0.30443E-02	0.15305E-00	0.15305E-00	0.67587E-01	0.76512E-02			
3	0.49820E-03	0.12689E-02	0.96955E-04	0.72597E-04	0.62348E-02	0.14446E-01	0.26802E-02	0.19825E-02			
4	0.85923E-05	0.25448E-04	0.12395E-05	0.10095E-05	0.21420E-03	0.59661E-03	0.67064E-04	0.49382E-04			
5	0.10882E-06	0.33235E-06	0.11234E-07	0.95573E-07	0.96538E-05	0.16133E-04	0.12203E-05	0.92324E-06			
6	0.97295E-09	0.30344E-08	0.73221E-10	0.68668E-10	0.10023E-06	0.30550E-06	0.16653E-07	0.13377E-07			
x = 1.20						x = 1.70					
1	0.41720E-00	0.24283E-00	0.17557E-00	0.70516E-02	0.56561E-00	0.17734E-00	0.40205E-00	-0.17510E-00			
2	0.22563E-01	0.45047E-01	0.70450E-02	0.39071E-02	0.18081E-00	0.17157E-00	0.81115E-01	0.43393E-00			
3	0.61872E-03	0.16957E-02	0.14305E-03	0.10456E-03	0.78240E-02	0.17589E-01	0.35315E-02	0.17118E-02			
4	0.12952E-04	0.37023E-04	0.19823E-05	0.15923E-05	0.27979E-03	0.77197E-03	0.93380E-04	0.61541E-04			
5	0.11702E-06	0.52113E-06	0.19528E-07	0.16442E-07	0.75319E-05	0.222171E-04	0.17982E-05	0.13395E-05			
6	0.16863E-08	0.52400E-08	0.14261E-09	0.12561E-09	0.14874E-06	0.44609E-06	0.26009E-07	0.20675E-07			
x = 1.25						x = 1.75					
1	0.45675E-00	0.23982E-00	0.17380E-00	-0.56182E-02	0.59423E-00	0.17139E-00	0.41887E-00	-0.18959E-00			
2	0.28699E-01	0.54414E-01	0.95133E-02	0.49070E-02	0.21086E-00	0.18097E-00	0.95797E-01	-0.68097E-03			
3	0.82616E-03	0.22380E-02	0.20784E-03	0.14799E-03	0.97802E-02	0.21269E-01	0.46145E-02	0.20895E-02			
4	0.18054E-04	0.53011E-04	0.31107E-05	0.24667E-05	0.36233E-03	0.30171E-04	0.26203E-05	0.19201E-05			
5	0.25945E-06	0.81895E-06	0.33166E-07	0.27679E-07	0.36200E-04	0.30171E-04	0.26203E-05	0.10500E-05			
6	0.28499E-08	0.88435E-08	0.25987E-09	0.27768E-09	0.21241E-06	0.64380E-06	0.40092E-07	0.31552E-07			
x = 1.30						x = 1.80					
1	0.46695E-00	0.23485E-00	0.23140E-00	-0.23450E-01	0.56053E-00	0.16599E-00	0.43543E-00	-0.20225E-00			
2	0.36281E-01	0.65001E-01	0.12693E-01	0.60215E-02	0.28255E-00	0.18797E-00	0.11131E-00	-0.76136E-02			
3	0.10920E-02	0.29200E-02	0.29774E-03	0.20606E-03	0.12183E-01	0.25534E-01	0.59801E-02	0.24964E-02			
4	0.29597E-04	0.74794E-04	0.47967E-05	0.37410E-05	0.46737E-03	0.12622E-02	0.17608E-03	0.10939E-03			
5	0.41236E-06	0.12505E-05	0.55198E-07	0.45596E-07	0.13960E-04	0.40680E-04	0.37778E-05	0.27207E-05			
6	0.47202E-08	0.14617E-07	0.46981E-09	0.40318E-09	0.33420E-06	0.91914E-06	0.61606E-07	0.47460E-07			
x = 1.35						x = 1.85					
1	0.49155E-00	0.22851E-00	0.25825E-00	-0.39782E-01	0.59473E-00	0.16097E-00	0.45186E-00	-0.21302E-00			
2	0.34586E-01	0.76781E-01	0.16739E-01	0.72023E-02	0.27908E-00	0.19102E-00	0.12729E-00	-0.15481E-01			
3	0.14301E-02	0.37693E-02	0.42104E-03	0.28248E-03	0.13126E-01	0.30452E-01	0.76857E-02	0.29301E-02			
4	0.35818E-04	0.10810E-03	0.72780E-05	0.39836E-05	0.59829E-03	0.15952E-02	0.23868E-03	0.14348E-02			
5	0.62138E-06	0.18781E-05	0.90101E-07	0.79659E-07	0.18762E-04	0.34370E-04	0.33925E-05	0.38128E-05			
6	0.76646E-08	0.23691E-07	0.82369E-09	0.70582E-09	0.49126E-06	0.12988E-05	0.91910E-07	0.70576E-07			
x = 1.40						x = 1.90					
1	0.51243E-00	0.22128E-00	0.28937E-00	-0.59786E-01	0.59409E-00	0.15641E-00	0.46821E-00	-0.22190E-00			
2	0.36914E-01	0.69655E-01	0.18184E-01	0.83659E-02	0.30791E-00	0.19122E-00	0.14334E-00	-0.27213E-01			
3	0.18580E-02	0.48181E-02	0.58823E-03	0.38148E-03	0.18774E-01	0.36071E-01	0.97992E-02	0.33624E-02			
4	0.49907E-04	0.14301E-03	0.10879E-04	0.62007E-05	0.18148E-03	0.20048E-02	0.32095E-03	0.19617E-03			
5	0.92130E-06	0.27770E-05	0.14448E-06	0.11860E-06	0.25017E-04	0.72044E-04	0.76247E-05	0.52872E-05			
6	0.12224E-07	0.37798E-07	0.14224E-08	0.12036E-08	0.40956E-06	0.18174E-05	0.15683E-06	0.10375E-06			
x = 1.45						x = 1.95					
1	0.52954E-00	0.21360E-00	0.30652E-00	-0.80408E-01	0.59785E-00	0.15218E-00	0.48454E-00	-0.22888E-00			
2	0.70569E-01	0.10343E-00	0.28088E-01	0.93844E-07	0.33896E-00	0.18831E-00	0.15914E-00	-0.39602E-01			
3	0.23957E-02	0.61015E-02	0.81269E-03	0.50777E-03	0.23107E-01	0.42432E-01	0.12388E-01	0.37565E-02			
4	0.57663E-04	0.19433E-03	0.16036E-04	0.11864E-04	0.96403E-03	0.25017E-02	0.42827E-03	0.23900E-03			
5	0.13883E-05	0.46494E-05	0.22790E-06	0.18205E-06	0.35108E-04	0.94767E-04	0.10684E-04	0.72577E-05			
6	0.19175E-07	0.59020E-07	0.24102E-08	0.21175E-08	0.84262E-06	0.25197E-05	0.20160E-06	0.19084E-06			
x = 1.50						x = 2.00					
1	0.54327E-00	0.20579E-00	0.32806E-00	-0.10148E-00	0.52724E-00	0.14820E-00	0.50083E-00	-0.23395E-00			
2	0.86836E-01	0.11782E-00	0.35713E-01	0.10078E-01	0.38860E-00	0.18268E-00	0.17445E-00	-0.33350E-01			
3	0.30684E-02	0.76598E-02	0.11110E-02	0.66633E-02	0.28431E-01	0.49558E-01	0.15525E-01	0.40602E-02			
4	0.91516E-04	0.26107E-03	0.23335E-04	0.16920E-04	0.12144E-02	0.31022E-02	0.56729E-03	0.30396E-03			
5	0.19463E-05	0.58251E-05	0.35934E-06	0.27922E-06	0.43908E-04	0.12189E-03	0.14884E-04	0.98633E-05			
6	0.29610E-07	0.90930E-07	0.44004E-08	0.33168E-08	0.11624E-05	0.34626E-05	0.29498E-06	0.21701E-06			

m = 2.00-0.60 :

x = 0.05				x = 0.55				
n	a _n	a ₁ ⁿ	b _n ⁿ	b ₁ ⁿ	a _n ⁿ	a ₁ ⁿ	b _n ⁿ	b ₁ ⁿ
1	0.119999E-04	0.47623E-04	0.16180E-07	0.1124E-07	0.28669E-01	0.6042E-01	0.30384E-02	0.28185E-02
2	0.19096E-08	0.61201E-07	-0.68691E-10	-0.10162E-09	0.31868E-03	0.38944E-03	0.24146E-04	0.26772E-04
3	-0.23117E-12	0.47047E-12	-0.67212E-12	-0.28823E-10	0.23433E-05	0.78016E-05	0.11312E-05	0.11959E-06
4					0.10411E-07	0.35728E-07	0.33411E-09	0.37459E-09
5					0.30408E-10	0.10835E-09	0.19807E-11	0.39342E-11
6					-0.48047E-13	0.38137E-12	-0.15400E-12	0.72225E-12
x = 0.10				x = 0.60				
1	0.12879E-03	0.36701E-03	0.53430E-06	0.58640E-06	0.39649E-01	0.7736E-01	0.44818E-02	0.42816E-02
2	0.82602E-07	0.19999E-05	-0.72522E-10	0.10499E-09	0.49536E-03	0.15248E-02	0.44764E-04	0.45265E-04
3	-0.25197E-10	0.74763E-10	-0.45119E-10	-0.40314E-10	0.43020E-05	0.14284E-04	0.24829E-05	0.26032E-05
4					0.22725E-07	0.77863E-07	0.32243E-07	0.96755E-09
5					0.79414E-10	0.28868E-09	0.54939E-11	0.94901E-11
6					-0.99583E-13	0.11432E-11	-0.22941E-12	0.17635E-11
x = 0.15				x = 0.65				
1	0.43916E-03	0.12407E-02	0.40830E-05	0.44443E-05	0.53368E-01	0.96514E-01	0.73975E-02	0.52603E-02
2	0.47233E-06	0.15181E-05	0.26123E-08	0.27084E-08	0.74471E-03	0.22678E-02	0.79110E-04	0.78709E-04
3	0.42870E-09	0.87799E-09	0.70160E-10	-0.27285E-10	0.75217E-05	0.24898E-04	0.51179E-06	0.53223E-06
4					0.44593E-07	0.15929E-06	0.21644E-08	0.23026E-08
5					0.18704E-09	0.66421E-09	0.61562E-11	0.12191E-10
6					0.32753E-13	0.23234E-11	-0.68961E-12	0.98479E-12
x = 0.20				x = 0.70				
1	0.10576E-02	0.29466E-02	0.17319E-04	0.14464E-04	0.70487E-01	0.11744E-00	0.11851E-01	0.88291E-02
2	0.40913E-05	0.51904E-05	0.19443E-07	0.27130E-07	0.10887E-02	0.32734E-02	0.13426E-03	0.13117E-03
3	0.19795E-09	0.66685E-09	-0.16970E-10	-0.80023E-11	0.12617E-04	0.41620E-04	0.40007E-05	0.10308E-05
4	-0.32715E-11	0.21378E-11	-0.28924E-11	-0.78223E-11	0.90399E-07	0.30886E-06	0.48902E-08	0.53500E-08
5	-0.56322E-15	0.34392E-14	-0.28551E-11	0.38433E-13	0.42633E-09	0.14910E-08	0.18990E-10	0.23768E-10
6	-0.23736E-18	0.93871E-18	-0.39180E-15	0.47955E-15	0.88881E-12	0.57218E-11	-0.35671E-12	0.14396E-11
x = 0.25				x = 0.75				
1	0.21107E-02	0.47657E-02	0.53304E-04	0.56011E-04	0.91392E-01	0.13959E-00	0.16119E-01	0.12034E-01
2	0.60827E-05	0.19476E-04	0.93775E-07	0.10169E-05	0.15545E-02	0.60503E-02	0.22006E-03	0.21068E-03
3	0.49475E-08	0.31554E-07	0.10780E-09	0.99554E-10	0.20421E-04	0.67104E-04	0.18693E-05	0.19056E-05
4	0.99977E-11	0.31517E-10	0.23787E-11	0.12160E-11	0.16765E-06	0.57171E-06	0.10430E-07	0.10911E-07
5	-0.84733E-14	0.39596E-13	0.26438E-12	0.51802E-12	0.99901E-09	0.21633E-09	0.43816E-10	0.44669E-10
6	-0.43078E-17	0.17036E-16	-0.42772E-14	0.49148E-14	0.37685E-11	0.12938E-10	0.24516E-11	0.17367E-11
x = 0.30				x = 0.80				
1	0.37495E-02	0.99775E-02	0.13407E-03	0.14114E-03	0.11632E-00	0.16220E-00	0.23014E-01	0.15861E-01
2	0.11154E-04	0.48380E-04	0.13738E-04	0.16338E-04	0.21754E-02	0.83335E-02	0.35901E-03	0.32759E-03
3	0.33945E-07	0.11392E-06	0.65819E-09	0.43148E-06	0.32041E-04	0.10484E-04	0.33562E-05	0.33827E-05
4	0.50724E-10	0.16698E-09	0.14117E-10	0.12971E-10	0.29867E-06	0.10164E-05	0.21237E-07	0.22077E-07
5	-0.64640E-13	0.29074E-12	0.7573E-12	0.19444E-11	0.18397E-08	0.64021E-08	0.97789E-10	0.10849E-09
6	-0.45979E-16	0.18177E-15	-0.21413E-13	0.23694E-13	0.71821E-11	0.29399E-10	-0.17867E-11	0.27079E-11
x = 0.35				x = 0.85				
1	0.51594E-02	0.15835E-01	0.29344E-03	0.30377E-03	0.14429E-00	0.18416E-00	0.32711E-01	0.20197E-01
2	0.32907E-04	0.10436E-03	0.29573E-05	0.20460E-05	0.29929E-02	0.85395E-02	0.54229E-03	0.49688E-03
3	0.99869E-07	0.37470E-06	0.19346E-08	0.20335E-08	0.48926E-04	0.15932E-03	0.58195E-05	0.59711E-05
4	0.18719E-09	0.1170E-09	0.11027E-10	-0.11712E-11	0.51358E-06	0.17438E-05	0.41383E-07	0.42712E-07
5	0.20647E-12	0.17886E-11	0.24140E-11	-0.87418E-14	0.35695E-08	0.12396E-07	0.20872E-09	0.22223E-09
6	-0.13121E-15	0.13449E-14	-0.65484E-13	0.25180E-12	0.17040E-10	0.62288E-10	0.54755E-12	0.20305E-11
x = 0.40				x = 0.90				
1	0.95553E-02	0.13644E-01	0.58113E-03	0.58899E-03	0.17602E-00	0.20507E-00	0.44219E-01	0.24773E-01
2	0.41945E-04	0.20303E-03	0.25487E-05	0.27049E-05	0.40577E-02	0.11312E-01	0.82105E-03	0.72843E-03
3	0.25336E-06	0.44870E-06	0.65040E-08	0.58916E-08	0.72938E-04	0.23624E-03	0.97854E-05	0.96100E-05
4	0.60703E-09	0.20704E-09	0.31420E-10	0.27091E-10	0.85959E-06	0.28990E-05	0.77751E-07	0.75972E-07
5	0.21391E-12	0.54482E-11	0.19366E-11	0.56941E-11	0.66873E-08	0.23119E-07	0.44130E-09	0.46632E-09
6	-0.19080E-14	0.75788E-14	-0.32289E-12	0.56437E-12	0.35673E-10	0.13074E-09	0.15749E-11	0.50752E-11
x = 0.45				x = 0.95				
1	0.14250E-01	0.33576E-01	0.10662E-02	0.10539E-02	0.21999E-00	0.22939E-00	0.59525E-01	0.29111E-01
2	0.11839E-03	0.36497E-03	0.58452E-05	0.61434E-05	0.54331E-02	0.14945E-01	0.12180E-02	0.10470E-02
3	0.97591E-05	0.15293E-05	0.18550E-07	0.19790E-07	0.19844E-03	0.34271E-03	0.16009E-04	0.15093E-04
4	0.17267E-09	0.59197E-09	0.52425E-10	0.46305E-10	0.14872E-05	0.46854E-05	0.14113E-06	0.14191E-06
5	0.37227E-11	0.14064E-10	0.21294E-11	0.30192E-11	0.12031E-07	0.41647E-07	0.88305E-09	0.92232E-09
6	-0.31651E-14	0.34450E-13	-0.68565E-13	0.71379E-12	0.72790E-10	0.26039E-09	0.38744E-11	0.70624E-11
x = 0.50				x = 1.00				
1	0.20552E-01	0.49808E-01	0.18432E-02	0.17685E-02	0.25214E-00	0.23852E-00	0.78500E-01	0.12590E-01
2	0.19693E-03	0.61644E-03	0.17000E-04	0.17937E-04	0.71968E-02	0.18948E-01	0.17743E-02	0.14733E-02
3	0.17943E-06	0.49192E-06	0.47806E-07	0.50916E-07	0.15242E-03	0.48747E-03	0.25558E-04	0.24344E-04
4	0.44236E-09	0.15203E-07	0.11884E-09	0.12624E-09	0.15292E-05	0.73843E-05	0.24893E-06	0.24982E-06
5	0.10991E-10	0.35897E-10	0.58694E-12	-0.39375E-12	0.21955E-07	0.72752E-07	0.17093E-09	0.17679E-09
6	0.84195E-13	0.20193E-12	0.11380E-12	-0.94849E-13	0.14245E-09	0.50146E-09	0.34249E-11	0.40041E-11

m = 2.00-0.60 i

x = 1.05				x = 1.55				
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ
1	0.29158E-00	0.74992E-00	0.10127E-00	0.34272E-01	0.58197E-00	0.20760E-00	0.43719E-00	-0.12291E-00
2	0.94455E-02	0.74025E-01	0.25429E-02	0.20281E-02	0.10010E-00	0.13785E-00	0.44763E-01	0.14952E-01
3	0.21455E-03	0.68115E-03	0.39914E-04	0.37366E-04	0.34925E-02	0.95604E-02	0.14651E-02	0.10346E-02
4	0.33883E-05	0.11374E-04	0.42603E-06	0.42388E-06	0.10889E-03	0.34703E-03	0.31964E-04	0.27399E-04
5	0.37843E-07	0.12362E-06	0.32263E-08	0.31795E-08	0.24632E-05	0.82613E-05	0.51136E-06	0.47171E-06
6	0.26675E-09	0.74093E-09	0.17617E-10	0.22055E-10	0.39984E-07	0.13773E-06	0.61443E-08	0.60121E-08
x = 1.10				x = 1.60				
1	0.33108E-00	0.25736E-00	0.12761E-00	0.33199E-01	0.58929E-00	0.19739E-00	0.39024E-00	-0.14386E-00
2	0.12298E-01	0.30080E-01	0.35912E-02	0.27391E-02	0.12199E-00	0.15330E-00	0.58488E-01	0.15003E-01
3	0.29733E-03	0.49657E-03	0.61105E-04	0.56143E-04	0.44302E-02	0.11848E-01	0.19747E-02	0.13331E-02
4	0.51249E-05	0.17161E-04	0.71232E-06	0.70104E-06	0.14460E-03	0.45713E-03	0.43544E-04	0.38227E-04
5	0.59503E-07	0.20481E-06	0.59027E-08	0.60179E-08	0.34726E-05	0.11600E-04	0.45544E-06	0.41249E-06
6	0.48729E-09	0.17101E-08	0.36210E-10	0.40344E-10	0.60021E-07	0.20524E-06	0.98873E-08	0.45816E-08
x = 1.15				x = 1.65				
1	0.36751E-00	0.24090E-00	0.15683E-00	0.28449E-01	0.57930E-00	0.18872E-00	0.40731E-00	-0.16305E-00
2	0.15877E-01	0.37274E-01	0.45003E-02	0.36287E-02	0.18712E-00	0.14545E-01	0.26390E-02	0.16952E-02
3	0.40692E-03	0.12690E-02	0.91870E-04	0.82713E-04	0.55943E-02	0.14904E-03	0.64220E-04	0.52703E-04
4	0.76233E-05	0.25406E-04	0.11644E-05	0.11340E-05	0.19041E-03	0.48843E-03	0.15105E-04	0.10498E-04
5	0.36541E-07	0.33158E-06	0.10514E-07	0.10633E-07	0.48843E-05	0.16101E-04	0.11551E-05	0.10498E-05
6	0.26475E-09	0.10201E-08	0.70647E-10	0.74388E-10	0.86946E-07	0.30484E-06	0.15670E-07	0.15048E-07
x = 1.20				x = 1.70				
1	0.40586E-00	0.26090E-00	0.18788E-00	0.19484E-01	0.57422E-00	0.17992E-00	0.42356E-00	-0.18030E-00
2	0.20426E-01	0.45592E-01	0.68857E-02	0.47162E-02	0.17536E-00	0.18138E-00	0.87252E-01	0.10849E-01
3	0.54969E-03	0.18963E-02	0.13987E-03	0.11906E-03	0.70363E-02	0.17731E-01	0.34983E-02	0.21261E-02
4	0.11138E-04	0.36966E-04	0.18649E-05	0.17917E-05	0.24882E-03	0.77241E-03	0.89669E-04	0.71835E-04
5	0.15331E-06	0.52562E-06	0.38285E-07	0.18385E-07	0.66874E-05	0.22143E-04	0.17049E-05	0.15276E-05
6	0.14947E-08	0.52273E-08	0.13216E-09	0.14160E-09	0.13023E-06	0.44432E-06	0.24500E-07	0.23309E-07
x = 1.25				x = 1.75				
1	0.43935E-00	0.25785E-00	0.21944E-00	0.61232E-02	0.57232E-00	0.17166E-00	0.43930E-00	-0.19549E-00
2	0.20426E-01	0.45592E-01	0.68857E-02	0.47162E-02	0.17536E-00	0.18138E-00	0.87252E-01	0.10849E-01
3	0.73433E-03	0.22397E-02	0.18794E-03	0.17020E-03	0.68130E-02	0.21466E-01	0.44611E-02	0.26285E-02
4	0.16021E-04	0.52936E-04	0.29305E-05	0.27784E-05	0.32283E-03	0.99179E-03	0.12405E-03	0.96844E-04
5	0.23905E-06	0.31716E-06	0.31087E-07	0.30731E-07	0.71465E-05	0.30137E-04	0.24804E-05	0.21963E-05
6	0.25281E-08	0.88214E-08	0.24293E-09	0.25382E-09	0.18653E-06	0.64251E-06	0.37808E-07	0.35605E-07
x = 1.30				x = 1.80				
1	0.46943E-00	0.25237E-00	0.25026E-00	-0.11197E-01	0.56784E-00	0.16399E-00	0.45474E-00	-0.20858E-00
2	0.33144E-01	0.66146E-01	0.12547E-01	0.75145E-01	0.23934E-00	0.20020E-00	0.12136E-00	-0.14617E-02
3	0.97121E-03	0.29235E-02	0.28442E-03	0.23827E-03	0.11019E-01	0.25824E-01	0.60051E-02	0.31997E-02
4	0.22717E-04	0.77000E-04	0.51600E-05	0.23055E-05	0.41609E-03	0.12639E-02	0.17014E-03	0.12918E-03
5	0.36604E-06	0.12479E-05	0.51708E-07	0.41056E-07	0.12399E-04	0.40640E-04	0.35943E-05	0.31223E-05
6	0.18050E-08	0.11583E-07	0.37432E-09	0.45462E-09	0.27001E-06	0.91738E-06	0.57639E-07	0.53705E-07
x = 1.35				x = 1.85				
1	0.49573E-00	0.24505E-00	0.27733E-00	-0.31612E-01	0.56106E-00	0.15691E-00	0.47002E-00	-0.21958E-00
2	0.41872E-01	0.78977E-01	0.61675E-01	0.71541E-02	0.27359E-00	0.20457E-00	0.13928E-00	-0.11180E-01
3	0.12730E-02	0.37958E-02	0.40350E-03	0.32859E-03	0.13730E-01	0.30860E-01	0.77775E-02	0.38296E-02
4	0.31791E-04	0.10399E-03	0.68796E-05	0.63332E-05	0.53301E-03	0.15991E-02	0.23143E-03	0.17054E-03
5	0.55135E-06	0.18743E-05	0.28467E-07	0.28467E-07	0.12399E-04	0.40640E-04	0.35943E-05	0.31223E-05
6	0.68000E-08	0.23634E-07	0.77391E-09	0.73899E-09	0.38283E-06	0.12984E-05	0.38888E-07	0.80038E-07
x = 1.40				x = 1.90				
1	0.51812E-00	0.23647E-00	0.30867E-00	-0.54043E-01	0.55227E-00	0.15041E-00	0.48521E-00	-0.22850E-00
2	0.52597E-01	0.91894E-01	0.22049E-01	0.10292E-01	0.10791E-00	0.20517E-00	0.13708E-00	-0.23182E-01
3	0.16550E-02	0.44828E-02	0.36576E-03	0.44670E-03	0.70483E-01	0.34637E-01	0.49951E-02	0.44968E-02
4	0.43950E-04	0.14294E-03	0.10301E-04	0.93316E-05	0.47842E-03	0.20094E-02	0.31235E-03	0.22888E-03
5	0.60779E-06	0.17722E-05	0.13566E-06	0.13123E-06	0.22229E-04	0.72021E-04	0.72832E-05	0.51112E-05
6	0.10843E-07	0.17619E-07	0.13325E-08	0.13447E-08	0.53741E-05	0.18143E-05	0.11949E-05	0.11793E-05
x = 1.45				x = 1.95				
1	0.53655E-00	0.22712E-00	0.31029E-00	-0.77352E-01	0.54174E-00	0.14445E-00	0.50040E-00	-0.23337E-00
2	0.45665E-01	0.10547E-00	0.28662E-01	0.12583E-01	0.34134E-00	0.20209E-00	0.17428E-00	-0.37163E-01
3	0.21351E-02	0.51192E-02	0.78667E-03	0.59895E-03	0.21153E-01	0.43209E-01	0.12743E-01	0.51657E-01
4	0.60079E-04	0.19418E-03	0.15214E-04	0.13547E-04	0.66029E-02	0.25089E-02	0.41846E-03	0.28838E-03
5	0.11938E-05	0.40419E-05	0.21453E-06	0.20497E-06	0.29428E-04	0.94730E-04	0.10228E-04	0.84219E-04
6	0.17016E-07	0.58879E-07	0.22638E-08	0.22526E-08	0.74817E-06	0.25156E-05	0.19105E-06	0.17189E-06
x = 1.50				x = 2.00				
1	0.55112E-00	0.21739E-00	0.35215E-00	-0.10036E-00	0.52777E-00	0.13895E-00	0.51554E-00	-0.26022E-00
2	0.81394E-01	0.12186E-00	0.36862E-01	0.14023E-01	0.37287E-00	0.19571E-00	0.19057E-00	-0.52694E-01
3	0.27392E-02	0.76878E-02	0.10773E-02	0.79239E-03	0.26159E-01	0.50611E-01	0.16111E-01	0.57790E-02
4	0.81276E-04	0.26075E-03	0.22184E-04	0.19399E-04	0.10849E-02	0.31131E-02	0.55666E-03	0.36942E-03
5	0.17273E-05	0.58146E-05	0.33360E-06	0.11509E-06	0.36849E-04	0.12137E-04	0.14243E-04	0.11496E-04
6	0.26275E-07	0.90718E-07	0.37604E-08	0.37116E-08	0.10323E-05	0.34574E-05	0.27911E-06	0.24791E-06

m = 2.00-0.80 :

x = 0.05										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.20567E-04	0.48969E-04	0.20568E-07	0.17626E-07	0.36743E-01	0.63398E-01	0.39437E-02	0.22785E-02		
2	0.21241E-08	0.65013E-08	-0.44443E-09	-0.52675E-10	0.40527E-03	0.10568E-02	0.31902E-04	0.21330E-04		
3	-0.23811E-12	0.83273E-12	-0.65279E-10	-0.70071E-10	0.29573E-05	0.83218E-05	0.15006E-04	0.10417E-06		
4					0.13072E-07	0.38091E-07	0.45113E-09	0.36978E-09		
5					0.34496E-10	0.34496E-10	-0.28865E-11	0.35828E-11		
6					-0.19067E-12	0.33747E-12	-0.99722E-12	-0.10857E-12		

x = 0.10										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.16598E-03	0.39218E-03	0.71412E-06	0.92144E-06	0.90191E-01	0.80651E-01	0.62021E-02	0.33719E-02		
2	0.79075E-07	0.21367E-06	0.54773E-09	0.10524E-09	0.63035E-03	0.16277E-02	0.59016E-04	0.18849E-04		
3	0.16920E-10	0.95540E-10	0.60162E-10	0.44440E-10	0.54309E-05	0.15236E-04	0.32899E-06	0.22704E-06		
4					0.28550E-07	0.83006E-07	0.11906E-08	0.86859E-09		
5					0.94794E-10	0.29549E-09	-0.30509E-12	0.76874E-11		
6					-0.26952E-12	0.87734E-12	-0.13913E-11	0.33379E-12		

x = 0.15										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.56498E-03	0.13256E-02	0.54381E-05	0.39516E-05	0.67092E-01	0.99739E-01	0.94237E-02	0.47645E-02		
2	0.59877E-06	0.16207E-05	0.36344E-08	0.25072E-08	0.94827E-03	0.24204E-02	0.10404E-03	0.66540E-04		
3	0.34981E-09	0.97599E-09	0.31461E-10	0.17591E-10	0.94990E-05	0.26559E-04	0.67747E-06	0.46184E-06		
4					0.58527E-07	0.16982E-06	0.24867E-08	0.20327E-08		
5					0.23377E-09	0.70708E-09	0.56044E-11	0.12246E-10		
6					-0.10324E-12	0.21486E-11	-0.13309E-11	0.54297E-12		

x = 0.20										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.13611E-02	0.31470E-02	0.23040E-04	0.16552E-04	0.87897E-01	0.12011E-00	0.13896E-01	0.64385E-02		
2	0.25246E-05	0.68219E-05	0.26028E-07	0.18926E-07	0.13872E-02	0.34933E-02	0.17604E-03	0.10970E-03		
3	0.25130E-08	0.71177E-08	0.18812E-10	-0.15379E-10	0.13940E-04	0.44398E-04	0.13229E-05	0.88944E-06		
4	0.83462E-11	0.99338E-11	0.44626E-11	-0.34288E-11	0.11373E-06	0.32927E-06	0.64745E-08	0.48124E-08		
5	-0.49219E-15	0.31751E-14	0.59100E-12	0.18481E-11	0.53252E-09	0.15478E-08	0.22138E-10	0.22101E-10		
6	-0.25482E-18	0.86559E-18	-0.41964E-15	0.30928E-15	0.92658E-12	0.35439E-11	-0.10476E-11	0.89576E-12		

x = 0.25										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.27167E-02	0.61538E-02	0.70816E-04	0.50091E-04	0.11274E-00	0.14101E-00	0.19946E-01	0.83161E-02		
2	0.77137E-05	0.20790E-04	0.44883E-06	0.90297E-07	0.19819E-02	0.49125E-02	0.28755E-03	0.17397E-03		
3	0.11949E-07	0.34013E-07	0.16961E-09	0.12989E-09	0.25810E-04	0.71589E-04	0.24673E-05	0.16349E-05		
4	0.74370E-11	0.38860E-10	0.65319E-12	0.12518E-10	0.11373E-06	0.32927E-06	0.13800E-07	0.95170E-08		
5	-0.10615E-13	0.36534E-13	-0.14587E-11	0.15148E-11	0.21094E-06	0.60950E-06	0.33691E-08	0.11238E-08		
6	-0.44829E-17	0.15709E-16	-0.48541E-14	0.39149E-14	0.11374E-08	0.38023E-11	0.52417E-10	0.44047E-12		

x = 0.30										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.48251E-02	0.10638E-01	0.17777E-03	0.12330E-03	0.14177E-00	0.16152E-00	0.27927E-01	0.10233E-01		
2	0.19223E-04	0.51644E-04	0.44883E-06	0.32169E-06	0.27791E-02	0.67533E-02	0.45535E-03	0.26656E-03		
3	0.42759E-07	0.12154E-06	0.17975E-09	0.12592E-09	0.38197E-02	0.90996E-02	0.70247E-03	0.39591E-03		
4	0.51540E-10	0.66785E-09	0.42223E-11	0.11292E-10	0.40515E-04	0.11184E-03	0.44223E-05	0.28827E-05		
5	-0.74925E-13	0.26477E-12	-0.25512E-11	0.35019E-11	0.37889E-06	0.10838E-05	0.28063E-07	0.19159E-07		
6	-0.49374E-16	0.16760E-15	-0.35176E-13	0.24744E-13	0.23060E-08	0.68156E-08	0.12123E-09	0.90101E-10		

x = 0.35										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.79198E-02	0.16877E-01	0.38828E-03	0.26284E-03	0.17465E-00	0.18062E-00	0.38180E-01	0.11912E-01		
2	0.44163E-04	0.11142E-03	0.13235E-05	0.93974E-06	0.21791E-02	0.67533E-02	0.45535E-03	0.26656E-03		
3	0.12599E-06	0.35649E-06	0.25998E-08	0.18533E-08	0.38197E-02	0.90996E-02	0.70247E-03	0.39591E-03		
4	0.22642E-09	0.66785E-09	0.87273E-11	0.11292E-10	0.40515E-04	0.11184E-03	0.44223E-05	0.28827E-05		
5	-0.15245E-12	0.12409E-11	-0.48638E-12	0.21911E-11	0.37889E-06	0.10838E-05	0.28063E-07	0.19159E-07		
6	-0.36490E-15	0.12375E-14	-0.13203E-12	0.93564E-13	0.23060E-08	0.68156E-08	0.12123E-09	0.90101E-10		

x = 0.40										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.12286E-01	0.25119E-01	0.76632E-03	0.50370E-03	0.21075E-00	0.19799E-00	0.50989E-01	0.12954E-01		
2	0.81386E-04	0.21875E-03	0.33830E-05	0.23737E-05	0.51804E-02	0.15201E-03	0.10577E-02	0.57139E-03		
3	0.31941E-06	0.90922E-06	0.85355E-08	0.61266E-08	0.92323E-04	0.25201E-03	0.12841E-04	0.80427E-05		
4	0.74601E-09	0.21970E-08	0.14041E-10	0.70949E-10	0.68456E-06	0.18591E-05	0.54711E-07	0.36997E-07		
5	0.54741E-13	0.40061E-11	-0.19710E-11	0.17531E-11	0.83675E-08	0.24633E-07	0.57549E-09	0.19834E-09		
6	-0.20889E-14	0.69511E-14	-0.34927E-12	0.48997E-13	0.44412E-10	0.13746E-09	0.87774E-12	0.32996E-11		

x = 0.45										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.18266E-01	0.35560E-01	0.14002E-02	0.88819E-03	0.24911E-00	0.21093E-00	0.66513E-01	0.12840E-01		
2	0.14716E-03	0.38969E-03	0.77491E-05	0.53618E-05	0.69971E-02	0.15682E-01	0.15990E-02	0.80272E-03		
3	0.72764E-06	0.20579E-05	0.24402E-07	0.17489E-07	0.13881E-03	0.36557E-03	0.20958E-04	0.12880E-04		
4	0.21579E-08	0.63077E-08	0.52649E-10	0.44482E-10	0.17474E-05	0.49956E-05	0.18610E-06	0.12239E-06		
5	0.31455E-11	0.13280E-10	-0.84711E-12	0.18093E-11	0.15103E-07	0.44379E-07	0.11551E-08	0.80136E-09		
6	-0.96231E-14	0.30812E-13	-0.36048E-12	0.13174E-12	0.90602E-10	0.27521E-09	0.30727E-11	0.44800E-11		

x = 0.50										
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		
1	0.28265E-01	0.44318E-01	0.24081E-02	0.14438E-02	0.28964E-00	0.22085E-00	0.84719E-01	0.10880E-01		
2	0.25029E-03	0.69812E-03	0.16281E-04	0.11046E-04	0.91879E-02	0.20120E-01	0.22540E-02	0.10989E-02		
3	0.15194E-05	0.42871E-05	0.63521E-07	0.44769E-07	0.19316E-03	0.51995E-03	0.33367E-04	0.20035E-04		
4	0.55610E-08	0.16212E-07	0.16110E-09	0.11792E-09	0.27429E-05	0.78729E-05	0.32735E-06	0.21298E-06		
5	0.12897E-10	0.40177E-10	-0.19219E-13	0.10711E-11	0.26446E-07	0.77346E-07	0.22557E-08	0.15337E-08		
6	-0.27057E-13	0.94202E-13	-0.17195E-12	0.68834E-13	0.17773E-09	0.53365E-09	0.99880E-11	0.87839E-11		

m = 2.00-0.80 i

x = 1.05						x = 1.55					
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ			
1	0.32804E+00	0.22695E-00	0.10533E-00	0.67973E-02	0.55896E 00	0.18001E-00	0.32222E-00	-0.15146E-00			
2	0.12053E-01	0.25461E-01	0.52020E-02	0.14687E-02	0.12088E-00	0.13522E-00	0.47975E-01	0.15944E-02			
3	0.27210E-03	0.72647E-03	0.51949E-04	0.30404E-04	0.44818E-02	0.10159E-01	0.17921E-02	0.66978E-03			
4	0.42711E-05	0.12127E-04	0.56019E-06	0.35849E-06	0.13791E-03	0.36944E-03	0.40380E-04	0.20946E-04			
5	0.45029E-07	0.13175E-06	0.42498E-08	0.28614E-08	0.31041E-05	0.88025E-05	0.66498E-06	0.38741E-06			
6	0.33963E-09	0.10003E-08	0.21074E-10	0.17934E-10	0.50241E-07	0.14673E-06	0.80535E-08	0.50237E-08			
x = 1.10						x = 1.60					
1	0.36615E-00	0.22939E-00	0.12784E-00	-0.16116E-03	0.56296E 00	0.17499E-00	0.33979E-00	-0.16869E-00			
2	0.15677E-01	0.31807E-01	0.44753E-02	0.19081E-02	0.14491E-00	0.14831E-00	0.58079E-01	-0.12592E-02			
3	0.37752E-03	0.99874E-03	0.79254E-04	0.45111E-04	0.56462E-02	0.12543E-01	0.23885E-02	0.82554E-03			
4	0.64688E-05	0.18296E-04	0.93499E-06	0.58895E-06	0.18322E-03	0.44888E-03	0.57988E-04	0.24759E-04			
5	0.78776E-07	0.21825E-06	0.77753E-08	0.51614E-08	0.43778E-05	0.12359E-04	0.10033E-05	0.57354E-06			
6	0.61043E-09	0.18196E-08	0.45847E-10	0.39023E-10	0.75433E-07	0.21971E-06	0.12937E-07	0.79706E-08			
x = 1.15						x = 1.65					
1	0.40195E-00	0.22864E-00	0.15155E-00	-0.10121E-01	0.56422E 00	0.17078E-00	0.35708E-00	-0.14446E-00			
2	0.20237E-01	0.39247E-01	0.61607E-02	0.24171E-02	0.17188E-00	0.15949E-00	0.69218E-01	-0.53485E-02			
3	0.51868E-03	0.13529E-02	0.11810E-03	0.65933E-04	0.71286E-02	0.15349E-01	0.31522E-02	0.99501E-03			
4	0.96170E-05	0.27084E-04	0.15256E-05	0.94481E-06	0.24341E-03	0.63530E-03	0.81363E-04	0.38955E-04			
5	0.12135E-06	0.35338E-06	0.13849E-07	0.90918E-08	0.61081E-05	0.14949E-04	0.81474E-05	0.38730E-06			
6	0.10828E-08	0.32227E-08	0.89752E-10	0.64638E-10	0.11182E-06	0.32475E-06	0.20479E-07	0.12447E-07			
x = 1.20						x = 1.70					
1	0.43462E-00	0.22930E-00	0.17570E-00	-0.23818E-01	0.56900E 00	0.16794E-00	0.37424E-00	-0.19879E-00			
2	0.25940E-01	0.47852E-01	0.83594E-02	0.29754E-02	0.20116E-00	0.18497E-00	0.81209E-01	-0.10894E-01			
3	0.59841E-03	0.18081E-02	0.17478E-03	0.93128E-04	0.49959E-02	0.18692E-01	0.41204E-02	-0.11728E-02			
4	0.14056E-04	0.39409E-04	0.24380E-05	0.14426E-05	0.13543E-03	0.82200E-03	0.11299E-03	0.52049E-04			
5	0.19287E-06	0.56018E-06	0.24060E-07	0.16822E-07	0.84349E-05	0.23578E-04	0.21999E-05	0.24752E-05			
6	0.18758E-08	0.55659E-08	0.17900E-09	0.11862E-09	0.16376E-06	0.47418E-06	0.31964E-07	0.19159E-07			
x = 1.25						x = 1.75					
1	0.46383E-00	0.22006E-00	0.19961E-00	-0.38502E-01	0.59956E 00	0.16461E-00	0.39142E-00	-0.21153E-00			
2	0.33030E-01	0.57659E-01	0.11186E-01	0.39447E-02	0.23211E-00	0.17555E-00	0.93823E-01	-0.17944E-01			
3	0.93562E-03	0.23864E-02	0.25338E-03	0.13043E-03	0.11210E-01	0.22589E-01	0.53511E-02	0.19433E-02			
4	0.20228E-04	0.58432E-04	0.38233E-05	0.22796E-05	0.40972E-03	0.10550E-02	0.15539E-03	0.68693E-04			
5	0.30067E-06	0.87087E-06	0.40885E-07	0.26147E-07	0.11544E-04	0.32099E-04	0.32013E-05	0.17157E-05			
6	0.31730E-08	0.93962E-08	0.32026E-09	0.21608E-09	0.23713E-06	0.68442E-06	0.49244E-07	0.29080E-07			
x = 1.30						x = 1.80					
1	0.48913E-00	0.21359E-00	0.22273E-00	-0.56012E-01	0.59413E 00	0.16249E-00	0.40871E-00	-0.22259E-00			
2	0.41782E-01	0.68655E-01	0.14785E-01	0.40710E-02	0.26393E-00	0.17899E-00	0.10481E-00	-0.26563E-01			
3	0.12354E-02	0.31137E-02	0.36207E-03	0.17901E-03	0.13979E-01	0.27054E-01	0.68432E-02	0.14870E-02			
4	0.28694E-04	0.79627E-04	0.59882E-05	0.34387E-05	0.52832E-03	0.13437E-02	0.21132E-03	0.98405E-04			
5	0.46052E-06	0.13299E-05	0.57982E-07	0.42911E-07	0.15635E-04	0.43279E-04	0.44609E-05	0.52409E-05			
6	0.52598E-08	0.15532E-07	0.57865E-09	0.34951E-09	0.33972E-06	0.97718E-06	0.74927E-07	0.49555E-07			
x = 1.35						x = 1.85					
1	0.51048E 00	0.20650E-00	0.24477E-00	-0.74807E-01	0.56495E 00	0.16088E-00	0.42615E-00	-0.29199E-00			
2	0.52495E-01	0.60740E-01	0.19224E-01	0.44581E-02	0.29571E-00	0.17954E-00	0.11993E-00	-0.36806E-01			
3	0.16204E-02	0.40193E-02	0.51048E-03	0.24139E-03	0.17371E-01	0.32149E-01	0.86944E-02	0.15759E-02			
4	0.40177E-04	0.11084E-03	0.69241E-05	0.50957E-05	0.67706E-03	0.16990E-02	0.25592E-03	0.11496E-03			
5	0.69387E-06	0.19974E-05	0.11091E-06	0.69015E-07	0.21054E-04	0.57843E-04	0.65801E-05	0.33481E-05			
6	0.85384E-08	0.25178E-07	0.10196E-08	0.66816E-09	0.48181E-06	0.13808E-05	0.11269E-06	0.64434E-07			
x = 1.40						x = 1.90					
1	0.52796E 00	0.19927E-00	0.26562E-00	-0.94411E-01	0.53825E 00	0.15962E-00	0.44437E-00	-0.23995E-00			
2	0.65478E-01	0.93805E-01	0.24692E-01	0.45826E-02	0.32659E-00	0.17724E-00	0.13299E-00	-0.47931E-01			
3	0.21079E-02	0.51368E-02	0.71077E-03	0.31991E-03	0.21512E-01	0.38043E-01	0.10924E-01	0.15489E-02			
4	0.55571E-04	0.15234E-03	0.13322E-04	0.74254E-05	0.86270E-03	0.21335E-02	0.38286E-03	0.14877E-03			
5	0.10297E-05	0.29542E-05	0.17775E-06	0.10896E-06	0.28091E-04	0.76648E-04	0.92702E-05	0.45899E-05			
6	0.13621E-07	0.44077E-07	0.17571E-08	0.11398E-08	0.67682E-06	0.19323E-05	0.16762E-06	0.94178E-07			
x = 1.45						x = 1.95					
1	0.54817E 00	0.19228E-00	0.28536E-00	-0.11401E-00	0.52824E 00	0.15857E-00	0.46154E-00	-0.24537E-00			
2	0.81025E-01	0.10751E-00	0.31268E-01	0.42819E-02	0.35579E-00	0.17242E-00	0.14984E-00	-0.60331E-01			
3	0.27218E-02	0.65039E-02	0.97405E-03	0.41869E-03	0.28546E-01	0.44409E-01	0.13637E-01	0.14174E-02			
4	0.76005E-04	0.20692E-03	0.19810E-04	0.10649E-04	0.10934E-02	0.26415E-02	0.50849E-03	0.19230E-03			
5	0.15067E-05	0.43071E-05	0.28016E-06	0.16901E-06	0.37203E-04	0.10082E-03	0.12964E-04	0.62423E-05			
6	0.21371E-07	0.62728E-07	0.29729E-08	0.19017E-08	0.94219E-06	0.26789E-05	0.24669E-06	0.13611E-06			
x = 1.50						x = 2.00					
1	0.55197E 00	0.18581E-00	0.30415E-00	-0.13314E-00	0.51713E 00	0.15757E-00	0.47944E-00	-0.24940E-00			
2	0.99377E-01	0.12144E-00	0.39023E-01	0.33594E-02	0.38272E-00	0.16867E-00	0.15840E-00	-0.73594E-01			
3	0.34913E-02	0.81625E-02	0.13309E-02	0.53324E-03	0.32640E-01	0.51900E-01	0.16825E-01	0.10578E-02			
4	0.10288E-03	0.27803E-03	0.28689E-04	0.15044E-04	0.13791E-02	0.32992E-02	0.67002E-03	0.22449E-03			
5	0.21760E-05	0.61941E-05	0.43479E-06	0.25787E-06	0.48924E-04	0.13158E-03	0.17973E-04	0.83855E-05			
6	0.33008E-07	0.96650E-07	0.49377E-08	0.31205E-08	0.13004E-05	0.36815E-05	0.35949E-06	0.19454E-06			

m = 2.00-1.00 1

x = 0.05										x = 0.55			
n	a _n	a _n	a _n	b _n	b _n	a _n	a _n	b _n	b _n				
1	0.274441E-04												
2	0.278757E-08												
3	-0.271746E-12	0.528649E-04		0.265411E-07		0.44019E-01	0.67488E-01	0.47712E-02	0.18211E-02				
4		0.54040E-08		-0.19670E-09		0.47541E-03	0.11377E-02	0.39815E-04	0.14943E-04				
5			0.77959E-17		-0.15040E-09	0.34361E-05	0.89388E-05	0.18637E-06	0.85746E-07				
6					-0.10359E-11	-0.41790E-10	0.40837E-07	0.56021E-09	0.28933E-09				
						-0.17491E-12	0.12035E-09	-0.18984E-11	0.14382E-11				
							0.25324E-12	-0.44982E-12	-0.38239E-12				
x = 0.10										x = 0.60			
1	0.19686E-03												
2	0.92053E-07												
3	0.23133E-10	0.42347E-03		0.89116E-06		0.60038E-01	0.45330E-01	0.74328E-02	0.22751E-02				
4		0.22977E-04		0.31461E-09		0.74017E-03	0.17529E-02	0.72719E-04	0.30289E-04				
5		0.68863E-10		0.81908E-11		0.63127E-05	0.16387E-04	0.40794E-06	0.18456E-06				
6						0.39027E-07	0.48034E-07	0.14612E-08	0.70549E-09				
						0.11185E-09	0.31258E-09	-0.31794E-13	0.16889E-11				
						-0.12255E-12	0.27811E-12	-0.41619E-12	-0.40016E-12				
x = 0.15										x = 0.65			
1	0.67227E-03												
2	0.49920E-06												
3	0.38340E-09	0.14312E-02		0.67866E-05		0.80024E-01	0.10470E-00	0.11804E-01	0.25986E-02				
4		0.17434E-05		0.44165E-03		0.11147E-02	0.20062E-02	0.12779E-03	0.51279E-04				
5		0.10354E-08		0.44781E-11		0.11048E-04	0.28553E-04	0.83845E-06	0.37230E-04				
6						0.67722E-07	0.18218E-06	0.33349E-08	0.16597E-08				
						0.27207E-09	0.75269E-09	0.63994E-11	0.49739E-11				
						0.72679E-12	0.15092E-11	-0.35860E-12	-0.71471E-12				
x = 0.20										x = 0.70			
1	0.15712E-02												
2	0.28445E-07												
3	0.29110E-04	0.33473E-02		0.45717E-04		0.10432E-00	0.12489E-00	0.18232E-01	0.34891E-02				
4	0.17902E-11	0.76818E-09		0.12720E-07		0.18326E-02	0.37811E-02	0.21944E-03	0.82849E-04				
5	-0.11177E-15	0.31203E-11		0.16597E-10		0.18548E-04	0.47702E-04	0.16356E-05	0.71091E-04				
6	-0.15179E-19	0.77411E-14		0.44403E-10		0.13161E-06	0.35329E-06	0.88071E-08	0.36943E-08				
		0.60331E-18		-0.44481E-15		0.61348E-09	0.16970E-08	0.21744E-10	0.14979E-10				
						0.16374E-11	0.49582E-11	-0.91122E-12	-0.62260E-12				
x = 0.25										x = 0.75			
1	0.32400E-02												
2	0.90141E-05												
3	0.19840E-07	0.59412E-02		0.88104E-04		0.13904E-00	0.14488E-00	0.22914E-01	0.41795E-02				
4	0.01074E-11	0.22588E-04		0.12240E-06		0.23954E-02	0.52888E-02	0.35044E-03	0.12894E-03				
5	-0.10700E-13	0.36500E-07		0.16224E-09		0.30049E-04	0.74917E-04	0.30488E-05	0.12920E-05				
6	-0.44971E-17	0.33625E-13		-0.10412E-11		0.24624E-06	0.65408E-06	0.17390E-07	0.77298E-08				
		0.14093E-16		-0.44840E-14		0.19134E-08	0.36081E-08	0.62833E-10	0.30256E-10				
						0.31147E-11	0.13944E-10	-0.12788E-12	-0.67197E-12				
x = 0.30										x = 0.80			
1	1.07621E-07												
2	0.21474E-04												
3	0.40943E-07	0.11174E-01		0.42097E-03		0.18596E-00	0.16361E-00	0.31460E-01	0.41999E-02				
4	0.15619E-10	0.55977E-06		0.27704E-09		0.32746E-02	0.72889E-02	0.55244E-03	0.19131E-03				
5	-0.18151E-13	0.13946E-04		0.30700E-09		0.47188E-04	0.12018E-03	0.54657E-05	0.22516E-05				
6	-0.44949E-16	0.17331E-11		-0.18951E-11		0.43985E-04	0.11828E-03	0.34760E-07	0.19466E-07				
		0.13061E-11		-0.15350E-11		0.26410E-08	0.73066E-08	0.14857E-09	0.75904E-10				
		0.15558E-12		-0.16374E-13		0.10921E-10	0.31261E-10	-0.88891E-12	-0.26679E-12				
x = 0.35										x = 0.85			
1	0.94705E-02												
2	0.48697E-04												
3	0.14572E-06	0.18189E-01		0.48047E-03		0.30344E-00	0.49134E-02	0.42059E-01	0.94170E-02				
4	0.29513E-09	0.38283E-06		0.32017E-08		0.97908E-02	0.19981E-02	0.84710E-03	0.27503E-03				
5	-0.29679E-12	0.71108E-09		0.32017E-08		0.72135E-04	0.18285E-03	0.94018E-05	0.37775E-05				
6	-0.36283E-15	0.96100E-12		-0.17374E-11		0.74910E-06	0.19991E-05	0.67642E-07	0.29536E-07				
		0.11494E-14		-0.16288E-12		0.51712E-08	0.14258E-07	0.39319E-09	0.15474E-09				
						0.26496E-10	0.69949E-10	0.19863E-12	-0.21518E-12				
x = 0.40										x = 0.90			
1	0.14708E-01												
2	0.95250E-04												
3	0.37078E-06	0.27019E-01		0.94440E-03		0.26153E-00	0.19941E-00	0.54790E-01	0.14340E-02				
4	0.89736E-09	0.23327E-03		0.42051E-05		0.81306E-02	0.12991E-01	0.12672E-02	0.38173E-03				
5	-0.19799E-12	0.97219E-06		0.10625E-07		0.10787E-03	0.27084E-03	0.15731E-04	0.61239E-05				
6	-0.20785E-14	0.23542E-08		0.11009E-10		0.12492E-05	0.33170E-05	0.12672E-06	0.94390E-07				
		0.35863E-11		-0.27927E-11		0.94819E-08	0.26405E-07	0.70287E-09	0.32947E-09				
		0.64794E-14		-0.40445E-12		0.52239E-10	0.14559E-09	0.10678E-11	0.30483E-12				
x = 0.45										x = 0.95			
1	0.21886E-01												
2	0.17294E-03												
3	0.84491E-06	0.38158E-01		0.17175E-02		0.28198E-00	0.20300E-00	0.69887E-01	-0.21748E-02				
4	0.24887E-08	0.41939E-03		0.96158E-05		0.82203E-02	0.16891E-01	0.18537E-02	0.51151E-03				
5	0.30337E-11	0.22102E-09		0.30622E-07		0.15799E-03	0.39290E-03	0.25597E-04	0.98219E-05				
6	-0.10147E-13	0.22542E-08		0.58107E-10		0.20240E-05	0.33616E-05	0.22942E-06	0.94615E-07				
		0.13076E-10		-0.23376E-11		0.17450E-07	0.47980E-07	0.14249E-08	0.64205E-09				
		0.29270E-13		-0.44871E-12		0.10583E-09	0.29398E-09	0.46253E-11	0.15899E-11				
x = 0.50										x = 1.00			
1	0.31481E-01												
2	0.29335E-03												
3	0.17649E-05	0.51673E-01		0.29358E-02		0.32242E-00	0.20869E-00	0.86219E-01	-0.77957E-02				
4	0.64278E-08	0.78843E-03		0.20163E-04		0.19202E-01	0.21599E-01	0.26570E-02	0.46607E-03				
5	0.14569E-10	0.46047E-05		0.78990E-07		0.22560E-03	0.55884E-03	0.40616E-04	0.14587E-04				
6	-0.56064E-13	0.17391E-07		0.19568E-09		0.32047E-05	0.86500E-05	0.40284E-06	0.16957E-06				
		0.42226E-10		-0.92658E-12		0.30569E-07	0.89138E-07	0.27891E-08	0.12248E-08				
		0.87577E-13		-0.19139E-12		-0.16856E-12	0.57132E-09	0.13417E-10	0.68096E-11				

m = 2.00-1.00 i

x = 1.05										x = 1.55									
n	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ		a _n ^r	a _n ⁱ	b _n ^r	b _n ⁱ	
1	0.36156E-00	0.21070E-00	0.10431E-00	-0.15629E-01	0.56488E-00	0.16632E-00	0.28994E-00	-0.17379E-00		0.56488E-00	0.16632E-00	0.28994E-00	-0.17379E-00		0.56488E-00	0.16632E-00	0.28994E-00	-0.17379E-00	
2	0.14317E-01	0.27286E-01	0.37970E-02	0.81991E-03	0.13914E-00	0.13998E-00	0.46672E-01	0.89412E-02		0.13914E-00	0.13998E-00	0.46672E-01	0.89412E-02		0.13914E-00	0.13998E-00	0.46672E-01	0.89412E-02	
3	0.31807E-03	0.78081E-03	0.62997E-04	0.21233E-04	0.52556E-02	0.10874E-01	0.20259E-02	0.27479E-03		0.52556E-02	0.10874E-01	0.20259E-02	0.27479E-03		0.52556E-02	0.10874E-01	0.20259E-02	0.27479E-03	
4	0.49560E-05	0.13017E-04	0.68799E-06	0.27624E-06	0.16096E-03	0.39667E-03	0.48535E-04	0.13279E-04		0.16096E-03	0.39667E-03	0.48535E-04	0.13279E-04		0.16096E-03	0.39667E-03	0.48535E-04	0.13279E-04	
5	0.32033E-07	0.14127E-06	0.52434E-08	0.27139E-08	0.36102E-05	0.94413E-05	0.80564E-04	0.27022E-04		0.36102E-05	0.94413E-05	0.80564E-04	0.27022E-04		0.36102E-05	0.94413E-05	0.80564E-04	0.27022E-04	
6	0.38666E-09	0.10703E-08	0.27278E-10	0.11912E-10	0.58084E-07	0.15790E-06	0.986310E-06	0.37463E-06		0.58084E-07	0.15790E-06	0.986310E-06	0.37463E-06		0.58084E-07	0.15790E-06	0.986310E-06	0.37463E-06	
x = 1.10										x = 1.60									
1	0.39829E-00	0.20959E-00	0.12398E-00	-0.23951E-01	0.56713E-00	0.16448E-00	0.30696E-00	-0.18927E-00		0.56713E-00	0.16448E-00	0.30696E-00	-0.18927E-00		0.56713E-00	0.16448E-00	0.30696E-00	-0.18927E-00	
2	0.18639E-01	0.34017E-01	0.51641E-02	0.97066E-03	0.16334E-00	0.14442E-00	0.45251E-01	-0.13405E-01		0.16334E-00	0.14442E-00	0.45251E-01	-0.13405E-01		0.16334E-00	0.14442E-00	0.45251E-01	-0.13405E-01	
3	0.44170E-05	0.10734E-02	0.95706E-04	0.31608E-04	0.46705E-02	0.13411E-01	0.26692E-02	0.21772E-03		0.46705E-02	0.13411E-01	0.26692E-02	0.21772E-03		0.46705E-02	0.13411E-01	0.26692E-02	0.21772E-03	
4	0.75097E-05	0.19439E-04	0.11459E-05	0.44847E-06	0.21400E-03	0.52250E-03	0.60514E-04	0.17615E-04		0.21400E-03	0.52250E-03	0.60514E-04	0.17615E-04		0.21400E-03	0.52250E-03	0.60514E-04	0.17615E-04	
5	0.86442E-07	0.23607E-06	0.95876E-08	0.40765E-08	0.50887E-05	0.13256E-04	0.12121E-05	0.40348E-06		0.50887E-05	0.13256E-04	0.12121E-05	0.40348E-06		0.50887E-05	0.13256E-04	0.12121E-05	0.40348E-06	
6	0.70536E-09	0.19489E-08	0.57002E-10	0.24779E-10	0.87231E-07	0.23553E-06	0.15806E-07	0.59636E-08		0.87231E-07	0.23553E-06	0.15806E-07	0.59636E-08		0.87231E-07	0.23553E-06	0.15806E-07	0.59636E-08	
x = 1.15										x = 1.65									
1	0.43182E-00	0.20597E-00	0.14294E-00	-0.38481E-01	0.56702E-00	0.16439E-00	0.32458E-00	-0.20346E-00		0.56702E-00	0.16439E-00	0.32458E-00	-0.20346E-00		0.56702E-00	0.16439E-00	0.32458E-00	-0.20346E-00	
2	0.24373E-01	0.41865E-01	0.70177E-02	0.10834E-02	0.19380E-00	0.15932E-00	0.64475E-01	-0.18989E-01		0.19380E-00	0.15932E-00	0.64475E-01	-0.18989E-01		0.19380E-00	0.15932E-00	0.64475E-01	-0.18989E-01	
3	0.60010E-03	0.14540E-02	0.14267E-02	0.44671E-04	0.64623E-02	0.16447E-01	0.34785E-02	0.27331E-03		0.64623E-02	0.16447E-01	0.34785E-02	0.27331E-03		0.64623E-02	0.16447E-01	0.34785E-02	0.27331E-03	
4	0.11170E-04	0.29075E-04	0.18652E-05	0.71009E-06	0.28175E-03	0.48147E-03	0.95589E-04	0.22961E-04		0.28175E-03	0.48147E-03	0.95589E-04	0.22961E-04		0.28175E-03	0.48147E-03	0.95589E-04	0.22961E-04	
5	0.14036E-06	0.37897E-06	0.17055E-07	0.71192E-08	0.70922E-04	0.80190E-03	0.13193E-03	0.29508E-04		0.70922E-04	0.80190E-03	0.13193E-03	0.29508E-04		0.70922E-04	0.80190E-03	0.13193E-03	0.29508E-04	
6	0.12516E-08	0.34522E-08	0.11257E-09	0.48775E-10	0.12934E-06	0.34814E-06	0.24969E-07	0.92164E-08		0.12934E-06	0.34814E-06	0.24969E-07	0.92164E-08		0.12934E-06	0.34814E-06	0.24969E-07	0.92164E-08	
x = 1.20										x = 1.70									
1	0.44181E-00	0.20075E-00	0.16257E-00	-0.52999E-01	0.56479E-00	0.16470E-00	0.34248E-00	-0.21678E-00		0.56479E-00	0.16470E-00	0.34248E-00	-0.21678E-00		0.56479E-00	0.16470E-00	0.34248E-00	-0.21678E-00	
2	0.30856E-01	0.50647E-01	0.93849E-02	0.11127E-02	0.22321E-00	0.11818E-00	0.44592E-01	-0.25727E-01		0.22321E-00	0.11818E-00	0.44592E-01	-0.25727E-01		0.22321E-00	0.11818E-00	0.44592E-01	-0.25727E-01	
3	0.81871E-03	0.19429E-02	0.20899E-03	0.61439E-04	0.10588E-01	0.19917E-01	0.44859E-02	0.21498E-03		0.10588E-01	0.19917E-01	0.44859E-02	0.21498E-03		0.10588E-01	0.19917E-01	0.44859E-02	0.21498E-03	
4	0.16334E-04	0.42304E-04	0.29728E-05	0.10984E-05	0.36919E-03	0.88190E-03	0.13193E-03	0.29508E-04		0.36919E-03	0.88190E-03	0.13193E-03	0.29508E-04		0.36919E-03	0.88190E-03	0.13193E-03	0.29508E-04	
5	0.22315E-06	0.60074E-06	0.29595E-07	0.12111E-07	0.98009E-05	0.25295E-04	0.26405E-05	0.81173E-06		0.98009E-05	0.25295E-04	0.26405E-05	0.81173E-06		0.98009E-05	0.25295E-04	0.26405E-05	0.81173E-06	
6	0.21667E-08	0.59649E-08	0.21584E-09	0.92601E-10	0.18949E-06	0.58831E-06	0.38885E-07	0.14027E-07		0.18949E-06	0.58831E-06	0.38885E-07	0.14027E-07		0.18949E-06	0.58831E-06	0.38885E-07	0.14027E-07	
x = 1.25										x = 1.75									
1	0.48743E-00	0.19644E-00	0.18193E-00	-0.49098E-01	0.56063E-00	0.16567E-00	0.36873E-00	-0.22833E-00		0.56063E-00	0.16567E-00	0.36873E-00	-0.22833E-00		0.56063E-00	0.16567E-00	0.36873E-00	-0.22833E-00	
2	0.39280E-01	0.61025E-01	0.12355E-01	0.99676E-03	0.25492E-00	0.16560E-00	0.49339E-01	-0.35627E-01		0.25492E-00	0.16560E-00	0.49339E-01	-0.35627E-01		0.25492E-00	0.16560E-00	0.49339E-01	-0.35627E-01	
3	0.10950E-02	0.25439E-02	0.35846E-03	0.45447E-05	0.13291E-01	0.23999E-01	0.57226E-02	0.90712E-04		0.13291E-01	0.23999E-01	0.57226E-02	0.90712E-04		0.13291E-01	0.23999E-01	0.57226E-02	0.90712E-04	
4	0.23519E-04	0.60578E-04	0.46057E-05	0.16821E-05	0.47959E-03	0.11310E-02	0.18024E-03	0.36681E-04		0.47959E-03	0.11310E-02	0.18024E-03	0.36681E-04		0.47959E-03	0.11310E-02	0.18024E-03	0.36681E-04	
5	0.34800E-06	0.93402E-06	0.50188E-07	0.20122E-07	0.36919E-03	0.34421E-04	0.38287E-05	0.11379E-05		0.36919E-03	0.34421E-04	0.38287E-05	0.11379E-05		0.36919E-03	0.34421E-04	0.38287E-05	0.11379E-05	
6	0.36654E-08	0.10071E-07	0.39909E-09	0.16947E-09	0.27460E-06	0.73368E-06	0.59778E-07	0.21024E-07		0.27460E-06	0.73368E-06	0.59778E-07	0.21024E-07		0.27460E-06	0.73368E-06	0.59778E-07	0.21024E-07	
x = 1.30										x = 1.80									
1	0.50926E-00	0.18830E-00	0.20085E-00	-0.84304E-01	0.55476E-00	0.16712E-00	0.37936E-00	-0.23881E-00		0.55476E-00	0.16712E-00	0.37936E-00	-0.23881E-00		0.55476E-00	0.16712E-00	0.37936E-00	-0.23881E-00	
2	0.44950E-01	0.72247E-01	0.16817E-01	0.64435E-03	0.28600E-00	0.16865E-00	0.94723E-01	-0.42631E-01		0.28600E-00	0.16865E-00	0.94723E-01	-0.42631E-01		0.28600E-00	0.16865E-00	0.94723E-01	-0.42631E-01	
3	0.14514E-02	0.35443E-02	0.42768E-03	0.0921E-03	0.16514E-01	0.28642E-01	0.72255E-02	0.12774E-03		0.16514E-01	0.28642E-01	0.72255E-02	0.12774E-03		0.16514E-01	0.28642E-01	0.72255E-02	0.12774E-03	
4	0.33984E-04	0.85478E-04	0.71372E-05	0.24639E-05	0.61884E-03	0.14400E-02	0.24381E-03	0.44887E-04		0.61884E-03	0.14400E-02	0.24381E-03	0.44887E-04		0.61884E-03	0.14400E-02	0.24381E-03	0.44887E-04	
5	0.53917E-06	0.14264E-05	0.83317E-07	0.32698E-07	0.18204E-04	0.46406E-04	0.54905E-05	0.16135E-05		0.18204E-04	0.46406E-04	0.54905E-05	0.16135E-05		0.18204E-04	0.46406E-04	0.54905E-05	0.16135E-05	
6	0.60717E-08	0.16647E-07	0.71636E-09	0.29877E-09	0.39336E-06	0.10475E-05	0.90735E-07	0.31091E-07		0.39336E-06	0.10475E-05	0.90735E-07	0.31091E-07		0.39336E-06	0.10475E-05	0.90735E-07	0.31091E-07	
x = 1.35										x = 1.85									
1	0.52719E-00	0.18223E-00	0.21926E-00	-0.10413E-00	0.56733E-00	0.16888E-00	0.39837E-00	-0.24757E-00		0.56733E-00	0.16888E-00	0.39837E-00	-0.24757E-00		0.56733E-00	0.16888E-00	0.39837E-00	-0.24757E-00	
2	0.62118E-01	0.64439E-01	0.20490E-01	0.44069E-04	0.31639E-00	0.16932E-00	0.10924E-00	-0.32644E-01		0.31639E-00	0.16932E-00	0.10924E-00	-0.32644E-01		0.31639E-00	0.16932E-00	0.10924E-00	-0.32644E-01	
3	0.19058E-02	0.43155E-02	0.59872E-03	0.14002E-03	0.20498E-01	0.34824E-01	0.90287E-02	0.41947E-03		0.20498E-01	0.34824E-01	0.90287E-02	0.41947E-03		0.20498E-01	0.34824E-01	0.90287E-02	0.41947E-03	
4	0.46768E-04	0.11898E-03	0.10780E-04	0.35810E-05	0.79399E-03	0.21819E-02	0.32672E-03	0.53949E-04		0.79399E-03	0.21819E-02	0.32672E-03	0.53949E-04		0.79399E-03	0.21819E-02	0.32672E-03	0.53949E-04	
5	0.80369E-06	0.21824E-05	0.13947E-06	0.52035E-07	0.26495E-04	0.62015E-04	0.77927E-05	0.21124E-05		0.26495E-04	0.62015E-04	0.77927E-05	0.21124E-05		0.26495E-04	0.62015E-04	0.77927E-05	0.21124E-05	
6	0.98619E-08	0.24995E-07	0.12969E-08	0.51794E-09	0.55808E-06	0.14801E-05	0.13611E-06	0.45341E-07		0.55808E-06	0.14801E-05	0.13611E-06	0.45341E-07		0.55808E-06	0.14801E-05	0.13611E-06	0.45341E-07	
x = 1.40										x = 1									

m = 2.98-1.74

x = 0.05										x = 0.55									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.14971E-04	0.71811E-04	0.11942E-07	0.33921E-07															
2	0.14478E-09	0.11482E-09	-0.1176E-10	-0.19124E-10	0.39676E-01	0.10108E-00	0.13222E-01	0.86906E-03											
3	-0.11134E-12	0.71151E-12	0.4492E-12	-0.49514E-11	0.28598E-03	0.14832E-02	0.10868E-03	0.31642E-04											
4					0.19665E-05	0.11332E-04	0.50281E-06	0.18420E-06											
5					0.69022E-08	0.31182E-07	0.15076E-08	0.60572E-09											
6					0.24406E-10	0.15069E-09	0.31321E-11	0.13405E-11											
					0.49599E-13	0.31015E-12	0.43122E-14	0.77922E-15											
x = 0.10										x = 0.60									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.17415E-03	0.57633E-03	0.27329E-05	0.19885E-05	0.98152E-01	0.12978E-00	0.20149E-01	-0.32406E-03											
2	0.13578E-07	0.27079E-05	0.67041E-09	0.32177E-09	0.45012E-03	0.22922E-02	0.20194E-03	0.51995E-04											
3	0.17310E-10	0.76409E-10	0.12302E-12	0.29029E-11	0.36232E-05	0.20771E-04	0.11079E-05	0.38982E-05											
4					0.18587E-07	0.11161E-06	0.39423E-08	0.15334E-08											
5					0.63442E-10	0.39111E-09	0.97293E-11	0.40515E-11											
6					0.15398E-12	0.95951E-12	0.14364E-13	0.24405E-14											
x = 0.15										x = 0.65									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.2850E-04	0.19990E-07	0.17806E-04	0.74456E-05	0.83251E-01	0.16126E-00	0.29099E-01	-0.30596E-07											
2	0.40713E-05	0.26292E-05	0.11319E-07	0.71492E-09	0.68719E-03	0.34215E-02	0.35686E-03	0.77543E-04											
3	0.22079E-09	0.12921E-08	0.42455E-11	0.63394E-12	0.55420E-05	0.36292E-04	0.22928E-05	0.35978E-08											
4					0.38167E-07	0.22850E-06	0.95502E-08	0.74473E-06											
5					0.15276E-09	0.93997E-09	0.27767E-10	0.35789E-08											
6					0.49366E-12	0.27086E-11	0.57407E-13	0.11199E-10											
								0.20555E-11											
x = 0.20										x = 0.70									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.10491E-02	0.46652E-02	0.76018E-04	0.31853E-04	0.11608E-00	0.19371E-00	0.39891E-01	-0.79966E-02											
2	0.17194E-05	0.94464E-05	0.85349E-07	0.37972E-07	0.10234E-02	0.49587E-02	0.50356E-04	0.10556E-02											
3	0.16475E-05	0.46718E-08	0.55099E-10	0.23962E-10	0.10725E-04	0.60682E-04	0.44871E-05	0.13544E-02											
4	0.95391E-12	0.58270E-11	0.11770E-12	0.76021E-13	0.7309E-07	0.44338E-06	0.21674E-07	0.77907E-08											
5	-0.22096E-15	0.25883E-14	-0.11083E-14	0.99788E-14	0.34825E-09	0.21157E-08	0.73054E-10	0.28621E-08											
6	-0.99564E-19	0.72404E-18	-0.13466E-15	0.61269E-16	0.11328E-11	0.70750E-11	0.17998E-12	0.69418E-13											
x = 0.25										x = 0.75									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.21442E-02	0.91846E-02	0.23575E-03	0.92134E-04	0.15732E-00	0.22462E-00	0.52036E-01	-0.15640E-02											
2	0.52635E-05	0.26818E-05	0.40977E-06	0.17273E-06	0.14930E-02	0.70059E-02	0.98156E-03	0.12639E-02											
3	0.78547E-08	0.46036E-07	0.40331E-09	0.18272E-09	0.17462E-04	0.97985E-04	0.84198E-05	0.23201E-05											
4	0.71287E-11	0.43069E-10	0.41392E-12	0.90775E-13	0.13820E-06	0.82138E-06	0.46496E-07	0.15945E-07											
5	0.24643E-14	0.29225E-13	0.82918E-14	0.10915E-13	0.13820E-06	0.82138E-06	0.46496E-07	0.15945E-07											
6	-0.17783E-17	0.13115E-16	-0.48458E-15	0.61490E-15	0.73445E-09	0.45001E-08	0.17998E-09	0.68303E-10											
					0.27682E-11	0.17284E-10	0.51315E-12	0.20610E-12											
x = 0.30										x = 0.80									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.39923E-02	0.14011E-01	0.59752E-03	0.21254E-03	0.20510E-00	0.25101E-00	0.64850E-01	-0.24619E-01											
2	0.19152E-04	0.71482E-04	0.14864E-05	0.61698E-06	0.21456E-02	0.76405E-02	0.134C1E-02	0.12113E-03											
3	0.28143E-07	0.16477E-06	0.20889E-08	0.91947E-09	0.27591E-04	0.15333E-03	0.15133E-04	0.37520E-05											
4	0.36452E-10	0.22169E-09	0.18902E-11	0.10732E-11	0.24697E-06	0.14614E-05	0.94964E-07	0.30881E-07											
5	0.25024E-13	0.19200E-12	-0.15444E-13	0.10005E-13	0.14908E-08	0.91114E-08	0.41715E-09	0.15335E-09											
6	-0.21840E-16	0.13790E-15	-0.13411E-14	-0.68435E-15	0.63887E-11	0.39831E-10	0.13523E-11	0.53222E-12											
x = 0.35										x = 0.85									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.67240E-02	0.25654E-01	0.13171E-02	0.41266E-03	0.25889E-00	0.27025E-00	0.77470E-01	-0.39379E-01											
2	0.28584E-05	0.15488E-03	0.43942E-05	0.17495E-05	0.39421E-02	0.13116E-01	0.23371E-02	0.27667E-04											
3	0.82812E-07	0.46381E-05	0.33977E-08	0.15903E-08	0.42473E-04	0.23341E-03	0.26230E-04	0.57248E-05											
4	0.14890E-09	0.88571E-09	0.10198E-10	0.48231E-11	0.42624E-06	0.25095E-05	0.18573E-06	0.56860E-07											
5	0.16379E-12	0.10494E-11	-0.15561E-13	0.71380E-13	0.28986E-08	0.17866E-08	0.91978E-09	0.32594E-09											
6	-0.28649E-15	0.91282E-15	-0.12258E-14	-0.16177E-14	0.14015E-10	0.87219E-10	0.33648E-11	0.12847E-11											
x = 0.40										x = 0.90									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.10962E-01	0.38614E-01	0.26175E-02	0.69945E-02	0.31381E-00	0.28081E-00	0.90035E-01	-0.54772E-01											
2	0.58131E-04	0.30187E-03	0.11311E-04	0.42543E-05	0.42403E-02	0.7459E-01	0.34355E-02	-0.11415E-03											
3	0.21097E-06	0.12294E-05	0.28076E-07	0.11646E-07	0.69919E-04	0.34674E-03	0.44000E-04	0.82063E-05											
4	0.48944E-09	0.29590E-08	0.44895E-10	0.19446E-10	0.71333E-06	0.41758E-05	0.34955E-06	0.99929E-07											
5	0.79904E-12	0.45724E-11	0.44866E-13	0.18985E-13	0.54254E-08	0.32961E-07	0.19386E-08	0.65926E-09											
6	0.10710E-14	0.44907E-14	0.21945E-15	-0.54954E-15	0.29887E-10	0.18249E-09	0.74466E-11	0.29498E-11											
x = 0.45										x = 0.95									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.17266E-01	0.58318E-01	0.47949E-02	0.98575E-03	0.38649E-00	0.28279E-00	0.10177E-00	-0.71729E-01											
2	0.10209E-03	0.54386E-03	0.54392E-05	0.91517E-05	0.59379E-02	0.22870E-01	0.48973E-02	-0.44530E-02											
3	0.48148E-06	0.27970E-05	0.61534E-07	0.32649E-07	0.94291E-04	0.50397E-03	0.71644E-04	0.10936E-04											
4	0.13998E-08	0.84612E-08	0.16444E-09	0.69962E-10	0.11616E-05	0.6559E-05	0.63551E-06	0.18795E-06											
5	0.26892E-11	0.15667E-10	0.21067E-12	0.10354E-11	0.98166E-08	0.59426E-07	0.39247E-08	0.12757E-08											
6	0.38268E-14	0.22943E-13	-0.74363E-15	-0.13112E-14	0.59174E-10	0.36671E-09	0.17907E-10	0.64848E-11											
x = 0.50										x = 1.00									
n	a _n	i _n	b _n	bl _n	a _n	i _n	b _n	bl _n											
1	0.26477E-01	0.78140E-01	0.82055E-02	0.11463E-02	0.41494E-00	0.27781E-00	0.11296E-00	-0.89655E-01											
2	0.17495E-03	0.92044E-03	0.55150E-04	0.17803E-04	0.82019E-02	0.29515E-01	0.67756E-02	-0.1879E-02											
3	0.10077E-05	0.58322E-05	0.21161E-06	0.81393E-07	0.13670E-03	0.71828E-03	0.11390E-03	0.13240E-04											
4	0.36964E-08	0.21776E-07	0.52653E-09	0.21733E-09	0.18459E-05	0.10658E-04	0.11199E-05	0.27030E-06											
5	0.85734E-11	0.52988E-10	0.93092E-12	0.40144E-12	0.71230E-07	0.10389E-06	0.76613E-08	0.23489E-08											
6	0.13902E-13	0.90485E-13	0.11460E-14	0.23695E-14	0.11495E-09	0.71067E-09	0.38677E-10	0.13554E-10											

m = 2.98-1.74 j

x = 1.05				x = 1.55			
n	a _n ⁱ	a _n ^j	b _n ^j	a _n ⁱ	a _n ^j	b _n ^j	b _n ⁱ
1	0.45595E-00	0.26834E-00	0.12382E-00	-0.10807E-00	0.56924E-00	0.22843E-00	0.27494E-00
2	0.11257E-01	0.37562E-01	0.91055E-02	-0.20913E-07	0.15748E-00	0.14802E-00	0.50484E-01
3	0.19514E-03	0.10058E-02	0.17528E-03	0.13761E-04	0.40283E-02	0.18332E-01	0.51202E-00
4	0.28700E-05	0.16434E-04	0.19182E-05	0.41644E-06	0.10311E-03	0.30671E-03	0.41860E-02
5	0.29428E-07	0.17665E-06	0.14472E-07	0.42301E-0F	0.21477E-05	0.11894E-04	0.12689E-03
6	0.21616E-09	0.13328E-08	0.80519E-10	0.27206E-1C	0.35438E-07	0.19656E-06	0.22305E-05
x = 1.10				x = 1.60			
1	0.48937E-00	0.25695E-00	0.13467E-00	-0.12663E-00	0.56459E-00	0.23293E-00	0.28558E-00
2	0.15356E-01	0.47155E-01	0.11897E-01	-0.35931E-02	0.18804E-00	0.19878E-00	0.55641E-01
3	0.27498E-03	0.13858E-02	0.26426E-03	0.10098E-04	0.52611E-02	0.17699E-01	0.59681E-01
4	0.43790E-05	0.24822E-04	0.32008E-05	0.51297E-06	0.13921E-03	0.66787E-03	0.24557E-02
5	0.49032E-07	0.29286E-06	0.26593E-07	0.72831E-0C	0.30564E-05	0.16719E-04	0.24171E-04
6	0.39868E-09	0.24261E-08	0.16200E-09	0.52602E-1C	0.50475E-07	0.29450E-06	0.33363E-05
x = 1.15				x = 1.65			
1	0.51559E-00	0.24569E-00	0.14581E-00	-0.14508E-00	0.55818E-00	0.23781E-00	0.29914E-00
2	0.20811E-01	0.58040E-01	0.15131E-01	-0.57078E-02	0.22022E-00	0.20893E-00	0.69319E-01
3	0.46551E-03	0.18816E-02	0.38942E-03	-0.16484E-05	0.68950E-02	0.87220E-03	0.33822E-02
4	0.79879E-05	0.36799E-04	0.52140E-05	0.47328E-07	0.18655E-03	0.87220E-03	0.63668E-02
5	0.70152E-09	0.42979E-03	0.31576E-09	0.92115E-10	0.43042E-05	0.23225E-04	0.29850E-03
6	0.59591E-00	0.23596E-00	0.15750E-00	-0.16326E-00	0.55009E-00	0.24279E-00	0.31025E-00
2	0.27995E-01	0.7159E-01	0.18765E-01	-0.48320E-02	0.29312E-00	0.21401E-00	0.33246E-00
3	0.52749E-03	0.25298E-02	0.56145E-03	-0.27400E-04	0.888327E-02	0.26330E-01	0.68399E-01
4	0.96549E-05	0.53591E-04	0.83949E-05	0.11314E-05	0.24825E-03	0.11291E-02	0.75891E-02
5	0.12749E-06	0.75270E-06	0.30310E-07	0.19442E-07	0.42802E-05	0.31999E-04	0.45436E-02
6	0.12167E-08	0.74271E-08	0.59811E-09	0.17742E-09	0.11092E-06	0.63633E-06	0.69890E-04
x = 1.20				x = 1.70			
1	0.55018E-00	0.22049E-00	0.16998E-00	-0.18103E-00	0.54043E-00	0.24759E-00	0.35662E-00
2	0.17332E-01	0.85939E-01	0.22740E-01	-0.12137E-01	0.24888E-00	0.22040E-00	0.74807E-01
3	0.42016E-03	0.33343E-02	0.79259E-03	-0.75650E-04	0.21352E-01	0.31727E-01	0.81650E-01
4	0.14021E-04	0.76832E-04	0.12453E-04	0.13802E-05	0.33220E-03	0.14698E-02	0.91709E-02
5	0.19971E-06	0.11711E-05	0.13988E-06	0.30157E-07	0.83151E-05	0.43842E-04	0.42328E-03
6	0.20634E-08	0.12545E-07	0.11036E-08	0.31075E-09	0.16170E-06	0.91899E-06	0.10241E-04
x = 1.25				x = 1.75			
1	0.55018E-00	0.22049E-00	0.16998E-00	-0.18103E-00	0.54043E-00	0.24759E-00	0.35662E-00
2	0.17332E-01	0.85939E-01	0.22740E-01	-0.12137E-01	0.24888E-00	0.22040E-00	0.74807E-01
3	0.42016E-03	0.33343E-02	0.79259E-03	-0.75650E-04	0.21352E-01	0.31727E-01	0.81650E-01
4	0.14021E-04	0.76832E-04	0.12453E-04	0.13802E-05	0.33220E-03	0.14698E-02	0.91709E-02
5	0.19971E-06	0.11711E-05	0.13988E-06	0.30157E-07	0.83151E-05	0.43842E-04	0.42328E-03
6	0.20634E-08	0.12545E-07	0.11036E-08	0.31075E-09	0.16170E-06	0.91899E-06	0.10241E-04
x = 1.30				x = 1.80			
1	0.56055E-00	0.22351E-00	0.18341E-00	-0.19838E-00	0.52927E-00	0.25198E-00	0.38111E-00
2	0.49252E-01	0.10197E-00	0.26995E-01	-0.18562E-01	0.31767E-00	0.22227E-00	0.81650E-01
3	0.97522E-03	0.43601E-02	0.10943E-02	-0.15801E-03	0.14307E-01	0.37924E-01	0.19815E-01
4	0.20092E-04	0.10854E-03	0.19807E-04	0.14959E-05	0.33220E-03	0.14698E-02	0.15254E-03
5	0.30751E-06	0.17898E-05	0.23257E-06	0.45137E-07	0.83151E-05	0.43842E-04	0.14687E-04
6	0.14276E-08	0.20746E-07	0.19870E-08	0.27988E-0C	0.23335E-06	0.58672E-04	0.25064E-06
x = 1.35				x = 1.85			
1	0.56741E-00	0.22093E-00	0.19793E-00	-0.21544E-00	0.51673E-00	0.25574E-00	0.40633E-00
2	0.49420E-01	0.11989E-00	0.31475E-01	-0.21817E-01	0.34792E-00	0.22208E-00	0.88975E-01
3	0.13110E-02	0.58400E-02	0.14868E-02	-0.28955E-02	0.18429E-01	0.44969E-01	0.12625E-01
4	0.23443E-04	0.15127E-03	0.33812E-04	0.12826E-05	0.58318E-03	0.23342E-02	0.71225E-03
5	0.46606E-06	0.26901E-05	0.37894E-06	0.65029E-07	0.11409E-04	0.78450E-04	0.20234E-04
6	0.55861E-08	0.33647E-07	0.34972E-08	0.87148E-09	0.33352E-06	0.18561E-05	0.37410E-06
x = 1.40				x = 1.90			
1	0.57135E-00	0.22050E-00	0.21362E-00	-0.23124E-00	0.50292E-00	0.25987E-00	0.43214E-00
2	0.82466E-01	0.13677E-00	0.36143E-01	-0.27889E-01	0.37617E-00	0.22052E-00	0.94824E-01
3	0.17999E-02	0.72216E-02	0.19782E-02	-0.48900E-03	0.23266E-01	0.52890E-01	0.14601E-01
4	0.34820E-04	0.20815E-03	0.43812E-04	0.41288E-06	0.78140E-03	0.29294E-02	0.90694E-03
5	0.69612E-06	0.39822E-05	0.60578E-06	0.89770E-07	0.20992E-04	0.10401E-03	0.27915E-04
6	0.89447E-08	0.53991E-07	0.60265E-08	0.13985E-08	0.47298E-06	0.25986E-05	0.55129E-06
x = 1.45				x = 1.95			
1	0.57279E-00	0.22185E-00	0.23051E-00	-0.24667E-00	0.48797E-00	0.26070E-00	0.45839E-00
2	0.10420E-00	0.15432E-00	0.40941E-01	-0.34789E-01	0.40211E-00	0.21771E-00	0.98245E-01
3	0.23244E-02	0.91580E-02	0.25941E-02	-0.77868E-03	0.29182E-01	0.61693E-01	0.10526E-01
4	0.53182E-04	0.29306E-03	0.63475E-04	0.16210E-05	0.94470E-03	0.36315E-02	0.6753E-01
5	0.10258E-05	0.54105E-05	0.95119E-06	0.11778E-06	0.28173E-04	0.13680E-03	0.11416E-02
6	0.14090E-07	0.83929E-07	0.10182E-07	0.21805E-08	0.68335E-06	0.36044E-05	0.40264E-05
x = 1.50				x = 2.00			
1	0.57202E-00	0.22442E-00	0.24867E-00	-0.26126E-00	0.47201E-00	0.26135E-00	0.48493E-00
2	0.12933E-00	0.17099E-00	0.45994E-01	-0.42360E-01	0.42580E-00	0.21411E-00	0.11431E-00
3	0.30482E-02	0.11507E-01	0.33146E-02	-0.11841E-02	0.13331E-01	0.71354E-01	0.19080E-01
4	0.77536E-04	0.38070E-03	0.90463E-04	0.59900E-05	0.2138E-02	0.45211E-02	0.14212E-02
5	0.14929E-05	0.83656E-05	0.14684E-05	0.14468E-06	0.17855E-03	0.17855E-03	0.51266E-04
6	0.21667E-07	0.12939E-06	0.16885E-07	0.33019E-08	0.42400E-06	0.49559E-05	0.11550E-05

Calculation of Light-Scattering Functions for
a Normal Distribution of Sizes

The density function for a normal distribution is given by equation 7.1. Figure E.1 is a plot of $f(x)$ against x for given values of the mean μ and the standard deviation σ . It is seen from this figure that μ is the number mean about which x is distributed while the standard deviation σ determines the extent of the distribution. Small values of σ give steep or narrow distributions, while large values of σ give broad distributions.

The calculation of \bar{i}_1 and \bar{i}_2 defined by equations 7.2 and 7.3 involves first, the calculation of i_1 and i_2 for a given value of m for a range of x at different values of θ . At a given angle θ , each of these values of i_1 and i_2 which correspond to a particular value of x is multiplied by the appropriate value of $f(x)$ to obtain the integrands, $i_1f(x)$ and $i_2f(x)$ for various values of x . The numerical value of the integrals can then be evaluated by a numerical method. Simpson's rule was used to evaluate these integrals.

Simpson's rule can be written as

$$\int_{x_0}^{x_n} y dx = h/3 [y_0 + y_n + 4(y_1 + y_3 + \dots + y_{n-1}) + 2(y_2 + y_4 + \dots + y_{n-2})]$$

E.1

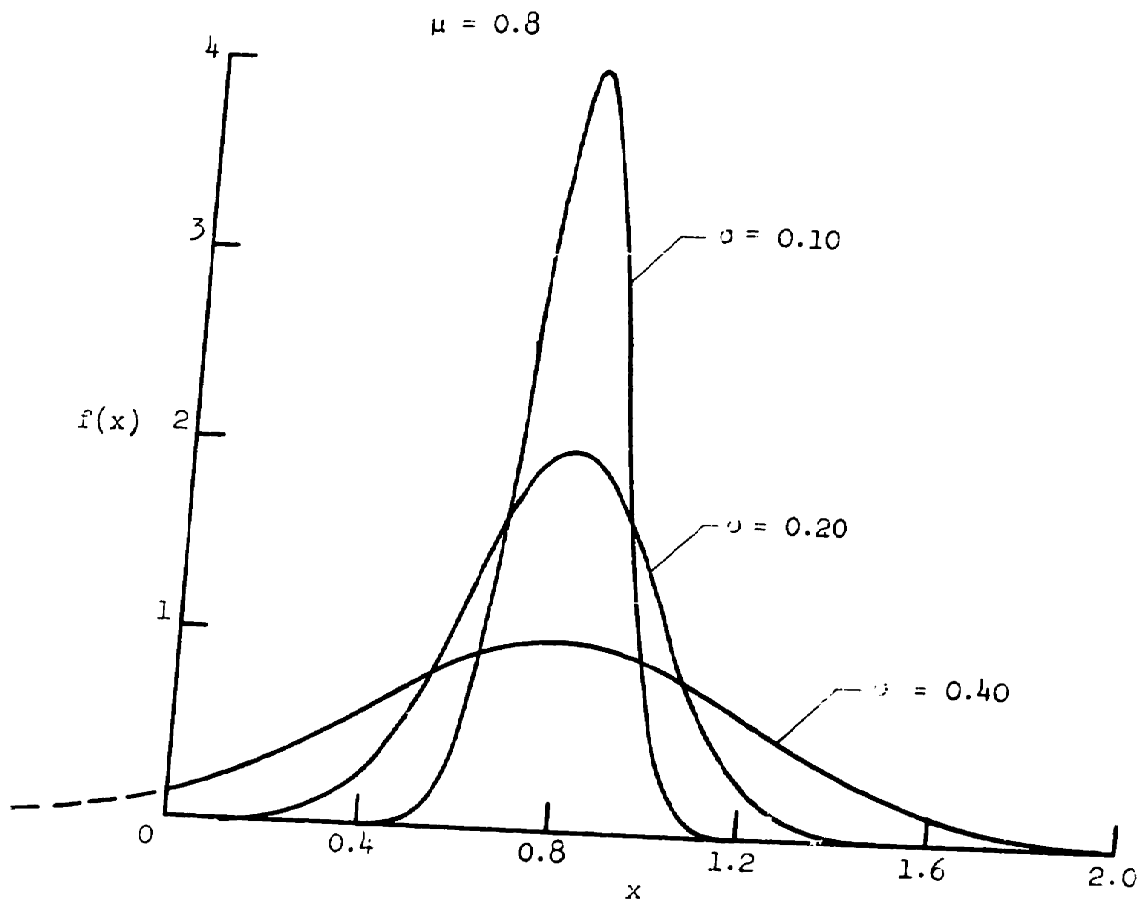


Figure E.1.- Density function, $f(x)$, for a normal distribution plotted against x for $\mu = 0.8$ at various values of the standard deviation.

where h is the difference between successive values of x , y_0 is the first value of the integrand which corresponds to x_0 , and y_n is the last value of the integrand which corresponds to x_n . The value of h was taken as 0.05 to correspond to the available data cards used in the program already presented in appendix C. In those calculations, x was taken in increments of 0.05.

The modified Fortran program which was used to calculate \bar{i}_1 and \bar{i}_2 for various combinations of μ , σ , and θ follows.

For the purpose of calculation, m was set equal to $1.71 - 0.76 i$ and the functions \bar{i}_1 and \bar{i}_2 were calculated for $\theta = 0^\circ(5^\circ) 180^\circ$ for $\mu = 0.80$ and $\sigma = 0.10, 0.20, \text{ and } 0.40$. The results of these calculations are plotted in Figure E.2 along with the monodispersed functions i_1 and i_2 for $x = 0.80$ (i.e., $\mu = 0.80$ and $\sigma = 0$). It is seen from Figure E.2 that the effect of increasing the value of σ at a given value of μ is to increase the apparent diameter as determined by light scattering.

A listing of the modified Fortran program for a normal distribution of sizes follows:

```

DIMENSION PI(10,75), TAU(10,75), C(10), S(10), GREAL(10), GIMAG(10),
      L(10), P(10), AREAL(10), AIMAG(10), BREAL(10), BIMAG(10), ANGLE(75),
      PRI(50,40), PLI(50,40), Z(10), DENS(50), YPRI(50,40), YPLI(50,40),
      PRIA(40), PLIA(40)
10 FORMAT(2I6, F6.2)
20 FORMAT(6E12.5)
30 FORMAT(5E14.8)
40 FORMAT(2F10.3)
50 FORMAT(I1)
READ10, NFINAL, MFINAL, ANGSIZ
READ20, ((PI(N,M), N=2,7), M=1, MFINAL), ((TAU(N,M), N=2,7) M=1,
      MFINAL)

```

```

GOTO900
60 READ30, ALPHA, (C(N), N=1,7), (S(N), N=1,7)
   GOTO(70,80,70,1000), IND
70 READ40,U,V
   J=0
80 DCONS=U**2+V**2
   J=J+1
   DREAL=U/DCONS
   DIMAG=V/DCONS
   SINH=(EXPF(2.*ALPHA*V)-EXPF(-2.*ALPHA*V))/2.
   COSH=(EXPF(2.*ALPHA*V)+EXPF(-2.*ALPHA*V))/2.
   GCONS=COSH-COSF(2.*ALPHA*U)
   GREAL(1)=SINF(2.*ALPHA*U)/GCONS
   GIMAG(1)=SINH/GCONS
   DO9ON=2, NFINAL
   P(N)=N-1
   L(N)=N-1
   EREAL=(2.*P(N)-1.)*DREAL/ALPHA-GREAL(N-1)
   EIMAG=(2.*P(N)-1.)*DIMAG/ALPHA-GIMAG(N-1)
   GCONS=EREAL**2+EIMAG**2
   GREAL(N)=EREAL/GCONS
   GIMAG(N)=-EIMAG/GCONS
   HREAL=U*GREAL(N)+V*GIMAG(N)
   HIMAG=U*GIMAG(N)-V*GREAL(N)
   QREAL=HREAL*C(N)-C(N-1)
   QIMAG=HIMAG*C(N)
   RREAL=HREAL*S(N)-S(N-1)
   RIMAG=HIMAG*S(N)
   SCONS=RREAL**2+RIMAG**2
   SREAL=(QREAL*RREAL+QIMAG*RIMAG)/SCONS
   SIMAG=(QIMAG*RREAL-QREAL*RIMAG)/SCONS
   BCONS=(1.-SIMAG)**2+SREAL**2
   BREAL(N)=(1.-SIMAG)/BCONS
   BIMAG(N)=-SREAL/BCONS
   TREAL=DREAL*GREAL(N)-DIMAG*GIMAG(N)
   TIMAG=DIMAG*GREAL(N)+DREAL*GIMAG(N)
   UREAL=P(N)*(1.-DREAL**2+DIMAG**2)/ALPHA
   UIMAG=-2.*P(N)*DREAL*DIMAG/ALPHA
   VREAL=TREAL+UREAL
   VIMAG=TIMAG+UIMAG
   WREAL=VREAL*C(N)-C(N-1)
   WIMAG=VIMAG*C(N)
   XREAL=VREAL*S(N)-S(N-1)
   XIMAG=VIMAG*S(N)
   YCONS=XREAL**2+XIMAG**2
   YREAL=(WREAL*XREAL+WIMAG*XIMAG)/YCONS
   YIMAG=(WIMAG*XREAL-WREAL*XIMAG)/YCONS
   ACONS=(1.-YIMAG)**2+YREAL**2

```

```

    AREAL(N)=(1.-YIMAG)/ACONS
    AIMAG(N)=-YREAL/ACONS
90 CONTINUE
    DOL4CM=1, MFINAL
    G=M-1
    ANGLE(M)=ANGSIZ*G
    SARP=0.0
    SART=0.0
    SBRP=0.0
    SBRT=0.0
    SAIP=0.0
    SAIT=0.0
    SBIP=0.0
    SBIT=0.0
    DOL3ON=2, NFINAL
    P(N)=N-1
    Z(N)=(2.*P(N)+1.)/(P(N)*(P(N)+1.))
    ARP=AREAL(N)*Z(N)*PI(N,M)
    SARP=SARP+ARP
    ART=AREAL(N)*Z(N)*TAU(N,M)
    SART=SART+ART
    BRP=BREAL(N)*Z(N)*PI(N,M)
    SBRP=SBRP+BRP
    BRT=BREAL(N)*Z(N)*TAU(N,M)
    SBRT=SBRT+BRT
    AIP=AIMAG(N)*Z(N)*PI(N,M)
    SAIP=SAIP+AIP
    AIT=AIMAG(N)*Z(N)*TAU(N,M)
    SAIT=SAIT+AIT
    BIP=BIMAG(N)*Z(N)*PI(N,M)
    SBIP=SBIP+BIP
    BIT=BIMAG(N)*Z(N)*TAU(N,M)
    SBIT=SBIT+BIT
130 CONTINUE
    PRI(J,M)=(SARP+SBRT)**2.+(SAIP+SBIT)**2.
    PLI(J,M)=(SART+SBRP)**2.+(SAIT+SBIP)**2.
140 CONTINUE
900 READ50, IND
    GOTO(60,60,70,1000), IND
1000 JFINAL=J
1030 READ1010, SIGMA, UM
    IF(SIGMA)1001,9999,1001
1001 DOL002J=2, JFINAL
    E=J-1
1002 DENS(J)=(.399/SIGMA)*EXPF(-.5((.05*E-UM)/SIGMA)**2)
    DOL005M=1, MFINAL
    SEPRI=0.0
    SOPRI=0.0

```

```

SEPLI=0.0
SOPLI=0.0
DO1003J=2, JFINAL
YPRI(J,M)=PRI(J,M)*DENS(J)
1003 YPLI(J,M)=PLI(J,M)*DENS(J)
DO1004J=2, JFINAL, 2
SEPRI=SEPRI+YPRI(J,M)
SOPRI=SOPRI+YPRI(J+1,M)
SEPLI=SEPLI+YPLI(J,M)
1004 SOPLI=SOPLI+YPLI(J+1,M)
PRIA(M)=.05/3.*(4.*SEPRI+2.*SOPRI-YPRI(JFINAL,M))
1005 PLIA(M)=.05/3.*(4.*SEPLI+2.*SOPLI-YPLI(JFINAL,M))
1010 FORMAT(2F10.3)
1015 FORMAT(7HLSIGMA=F5.3,6H MU=F5.3,6H U=F5.3,6H V=F5.3)
1020 FORMAT(50H ANGLE PERPENDICULAR PARALLEL)
1025 FORMAT(F8.1,2E21.5)
PRINT1015,SIGMA,UM,U,V
PRINT1020
PRINT1025,(ANGLE(M),PRIA(M),PLIA(M),M=1,MFINAL)
GOTO1030
9999 CALL EXIT
END

```

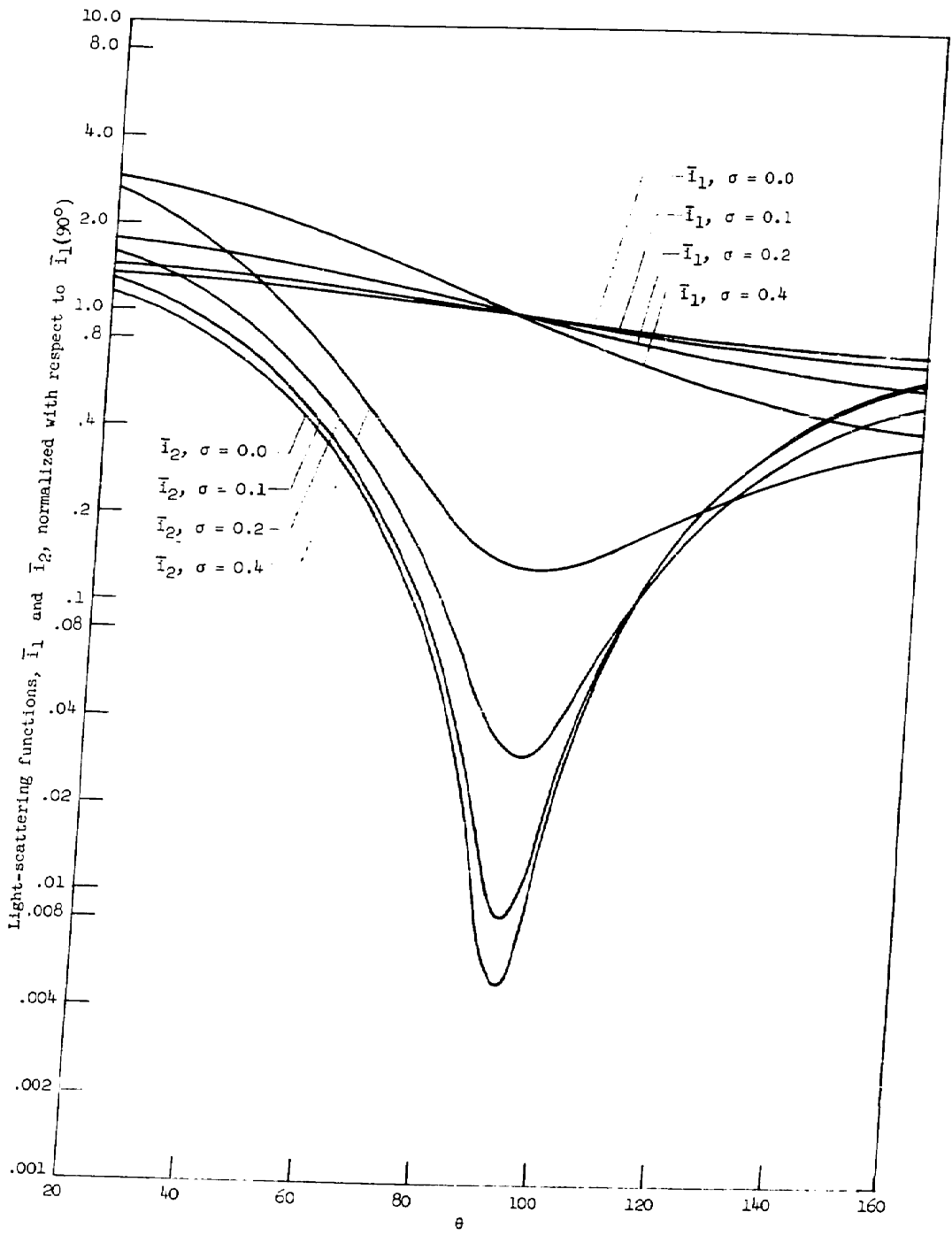


Figure E.2.- Light-scattering functions, \bar{i}_1 and \bar{i}_2 , normalized with respect to $\bar{i}_1(90^\circ)$ for $\mu = 0.8$ and various values of the standard deviation for $m = 1.71 - 0.76 i$.

Further Description of the Light-Scattering Apparatus

A brief description of the light-scattering apparatus has already been given and a schematic drawing is shown in Figures 8.1 and 8.2.

A more detailed description of the various apparatus components than was given before is presented here. Since the selection of each of the various components must be based on consideration of other components, it is necessary to discuss the interdependent components together.

Let us begin with the light source and its interdependent components. A GE B-H6 high brightness mercury arc lamp was chosen for the light source for several reasons. First, the extremely high brightness of this lamp makes it possible to develop a scattered-light intensity which is quite easily measured with an inexpensive multiplier phototube. In addition, the radiation from this lamp is concentrated in relatively narrow spectral bands, characteristic of mercury. Thus, by using an appropriate optical interference filter, a suitably measurable scattered-light intensity, having a fairly narrow wavelength band width, is possible. Another reason for selecting this lamp was that it operates from a 60-cps source and therefore generates modulated light at 120 cps. This, with an appropriate electronic filter, permits easy separation of the scattered-light signal from the steady-flame signal.

The average spectral distribution of the radiation from several B-H6 lamps is given in reference 30. The radiation in watts per

steradian perpendicular to the axis of the lamp is tabulated for a large number of wavelength intervals. Figure F.1 is a histogram based on these data. This figure indicates that the various spectral bands are broadened and there is a slight continuum superimposed in the low pressure mercury spectrum. This broadening and superpositioning of a continuum is due to the high pressure at which this lamp operates. The internal operating pressure of this lamp is about 100 atm. A part of the apparent broadening shown in Figure F.1 is due to the relatively large interval size of the wavelength over which each measurement was made, so that the actual spectral distribution may show steeper and higher peaks. The highest peaks correspond approximately to the principle mercury lines of 3650 \AA , 4047 \AA , 4358 \AA , and 5461 \AA .

Since it is desirable to produce a strong high quality signal as a measure of the scattered-light intensity, the selection of the particular spectral band must include a consideration of the spectral sensitivity of the multiplier phototube. The RCA 931-A multiplier phototube which was chosen typically has a spectral sensitivity as shown in Figure F.2 which is based on data from reference 27. It is seen from Figure F.2 that the maximum sensitivity of this type of tube occurs at about 4000 \AA . Even though the sensitivity of the tube would be greater for 4047 \AA than for 4358 \AA , the band about 4358 \AA is stronger and more than compensates for the small difference in sensitivity. The band about 4358 \AA was selected. In order to define a narrow wavelength band about 4358 \AA , a relatively narrow band optical

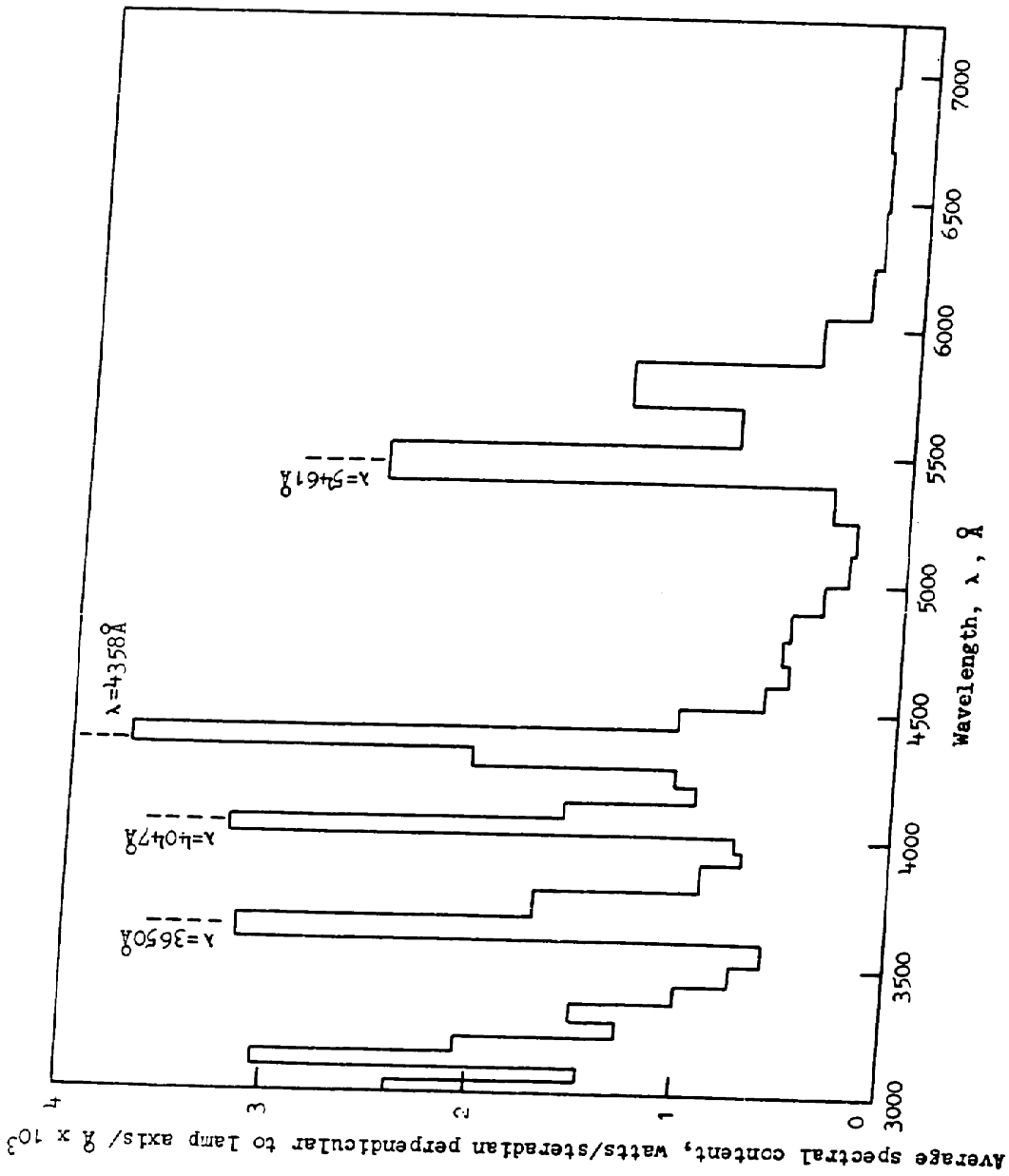


Figure F.1.- Average spectral distribution from a GE B-H6 mercury arc lamp.

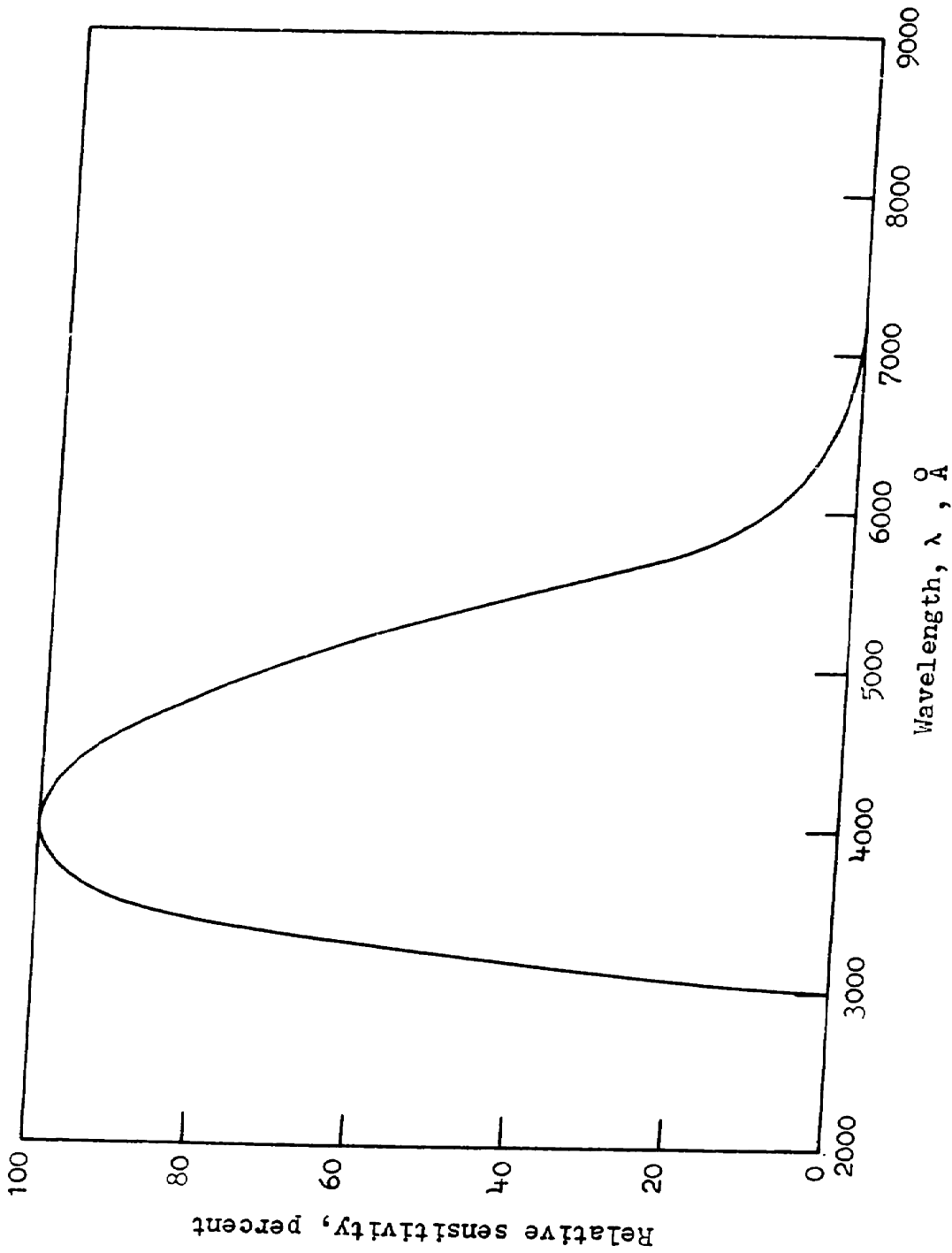


Figure F.2.- Spectral sensitivity characteristic of an RCA 931-A multiplier phototube for equal values of radiant flux at all wavelengths.

interference filter was used. The particular filter used was a type B-1 optical interference filter with a peak wavelength of 4358 \AA manufactured by Baird-Atomic, Inc. This filter has a bandwidth at half of the peak transmission of approximately 65 \AA and has a peak transmission of about 50 percent. This bandwidth corresponds to a range in λ about 4358 \AA of only ± 0.75 percent which is felt to be quite acceptable for this investigation. In addition to defining a relatively narrow wavelength band, this filter also reduces the steady flame light intensity, particularly wavelengths outside the band pass, when it is placed between the flame and the collection system for the scattered light.

Achromatic lenses of good quality were used to assure that the alignment and focal adjustment of the optical system (made by using easy-to-see unfiltered light from the light source) remained the same for the light-scattering measurements which were made by using roughly monochromatic light. The two short focal length lenses used, each had a length of 78 mm and the two long focal length lenses each had a focal length of 508 mm. It would be possible, of course, to replace both combinations of long and short focal length lenses in each collimation system by a single lens in each system.

The size of the circular aperture at the light source, along with the lenses of the collimation system for the incident light, determine the size of the circular cross section of the cylindrical scattering volume in the flame. As already mentioned, it is desirable to keep

this probe volume as small as possible but still large enough to produce a measurable quantity of scattered light. The square aperture between the multiplier phototube and polarization filter (see Fig. 8.1) defines a square-shaped cross-sectional view of the flame which is received by the scattered-light collection system. The intersection of this projected square with the cylindrical scattering volume determines the observation volume or probe volume in the flame.

Based on preliminary measurements with various aperture sizes and the above-mentioned lens system, it was decided to use a circular aperture at the light source which consists of a 0.0135-inch-diameter hole through 0.004-inch copper sheet. Provision is made for alining the aperture with the axis of the lamp. With the aperture alined with the lamp and the lenses of the incident light system properly focused, an image of the circular aperture is formed at the center line of the burner tube which was measured to be 0.078-inch diameter. This produces an approximately cylindrical scattering volume in the flame with a diameter of approximately 0.078 inch.

The square aperture located in front of the multiplier phototube is formed by the intersection of two narrow rectangular slits as shown in Figure F.3. Each slit is 0.015 inch wide and about 0.375 inch long, also made from 0.004-inch copper sheet. The vertical position of the horizontal slit is controlled by moving the stock containing this slit, denoted as H in Figure F.3, vertically up or down. The horizontal position of the vertical slit is likewise controlled by

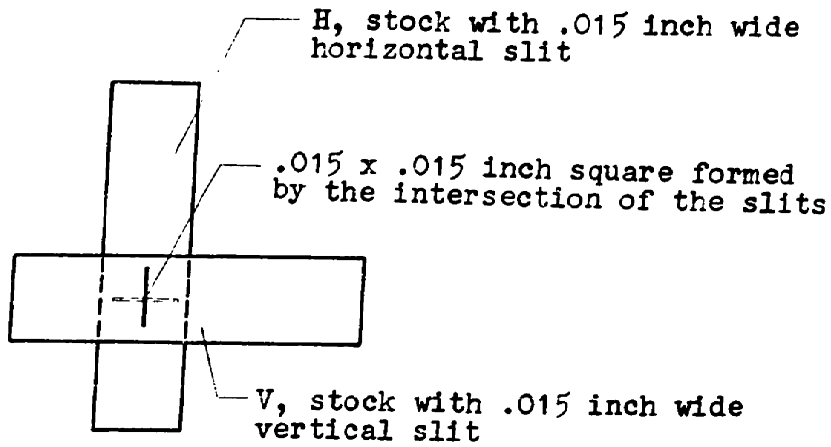


Figure F.3.- Schematic drawing of square aperture system.

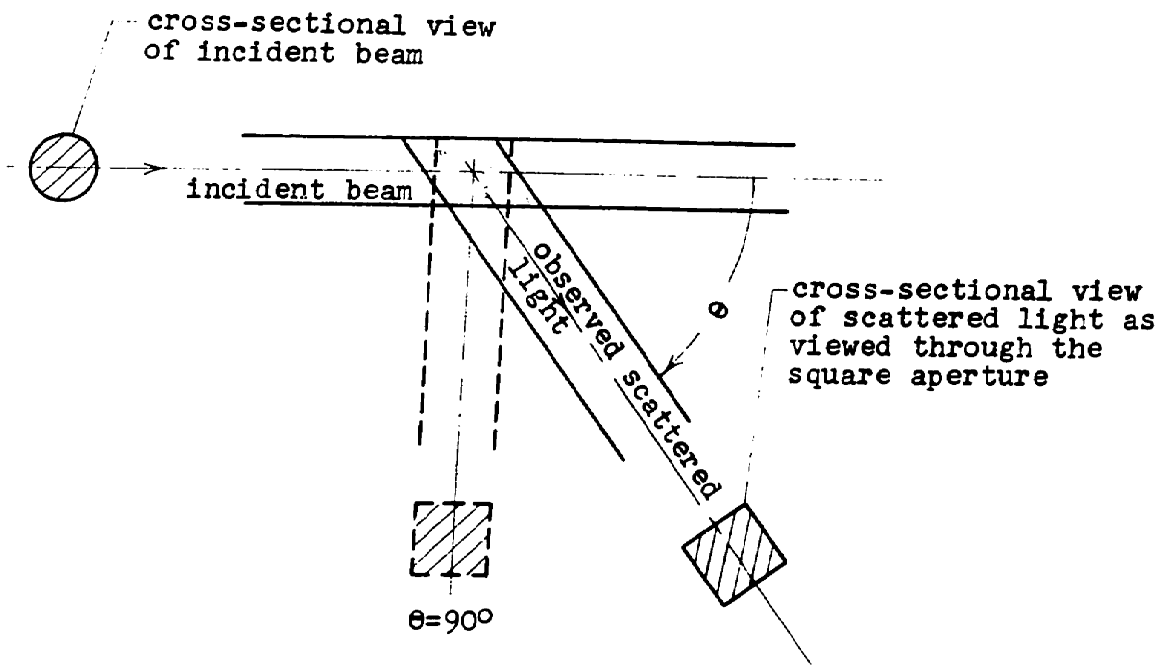


Figure F.4.- Schematic drawing of observed scattering volume at an arbitrary angle θ .

horizontal movement of V. The simultaneous movement of the two slits permits the square aperture to be properly positioned. The viewing area of the flame seen through this square aperture was measured by placing a lamp behind the aperture and observing the image formed at the center line of the burner tube. This image was found to be a 0.094-inch square so that when the scattered light is observed at right angles to the incident light, that is, $\theta = 90^\circ$, the observed scattering volume is a right-circular cylinder with a diameter of 0.078 inch and a length of 0.094 inch. It is noted that the square is larger than the diameter of the incident beam through the flame by 0.016 inch. This permits some freedom in the vertical alinement of the scattered-light collection system with respect to the incident beam. The observed scattering volume formed by the intersection of the cylinder and projected square is of course larger at any angle θ different than 90° . It is easily seen from Figure F.4 that the observed scattering volume at any angle θ is equal to the observed scattering volume at $\theta = 90^\circ$ multiplied by $1/\sin \theta$.

It is of course very important to have the optical system properly alined. The method of determining the soot particle size by comparing the shape of experimental and theoretical light-scattering patterns requires that the relation between the observed scattering volume and the angle θ be known. This volume is proportional to $1/\sin \theta$ only if the system is properly alined. See appendix G.

Figure F.5 shows the arrangement of the electronic equipment. The high voltage required to operate the RCA 931-A multiplier phototube is supplied by a regulated high-voltage supply, model RE-1602, Northeast Scientific Corp. The ten resistors which make up the voltage divider and the load resistor are each 20 K Ω . The signal from the multiplier phototube which is produced by that portion of the scattered light which strikes the photocathode is then passed through a sound analyzer, type 760-B, General Radio Co. This unit is turned to 120 cps to match the modulated light from the mercury lamp and has the measured filtration characteristics shown in Figure F.6. Included as an integral part of the analyzer is a variable amplifier which has a maximum amplification factor of 80. The filtered and amplified signal is then measured with a root-mean-square voltmeter, model 400c, Hewlet Packard. Shielded cables were used for all leads to reduce the pick-up of extraneous signals.

This arrangement was very effective in practically eliminating the steady signal due to the flame. A test was made in which the filtered signal was measured on an RMS voltmeter and the unfiltered steady signal was measured on a d-c voltmeter for both the perpendicular scattered light at $\theta = 30^\circ$, including of course the flame light, and for the flame light only, without scattering. The ratio of the signal from the flame light only to the signal from the scattered light and flame light was less than 0.1 percent for the filtered RMS signal, but was 8.4 percent for the unfiltered steady signal.

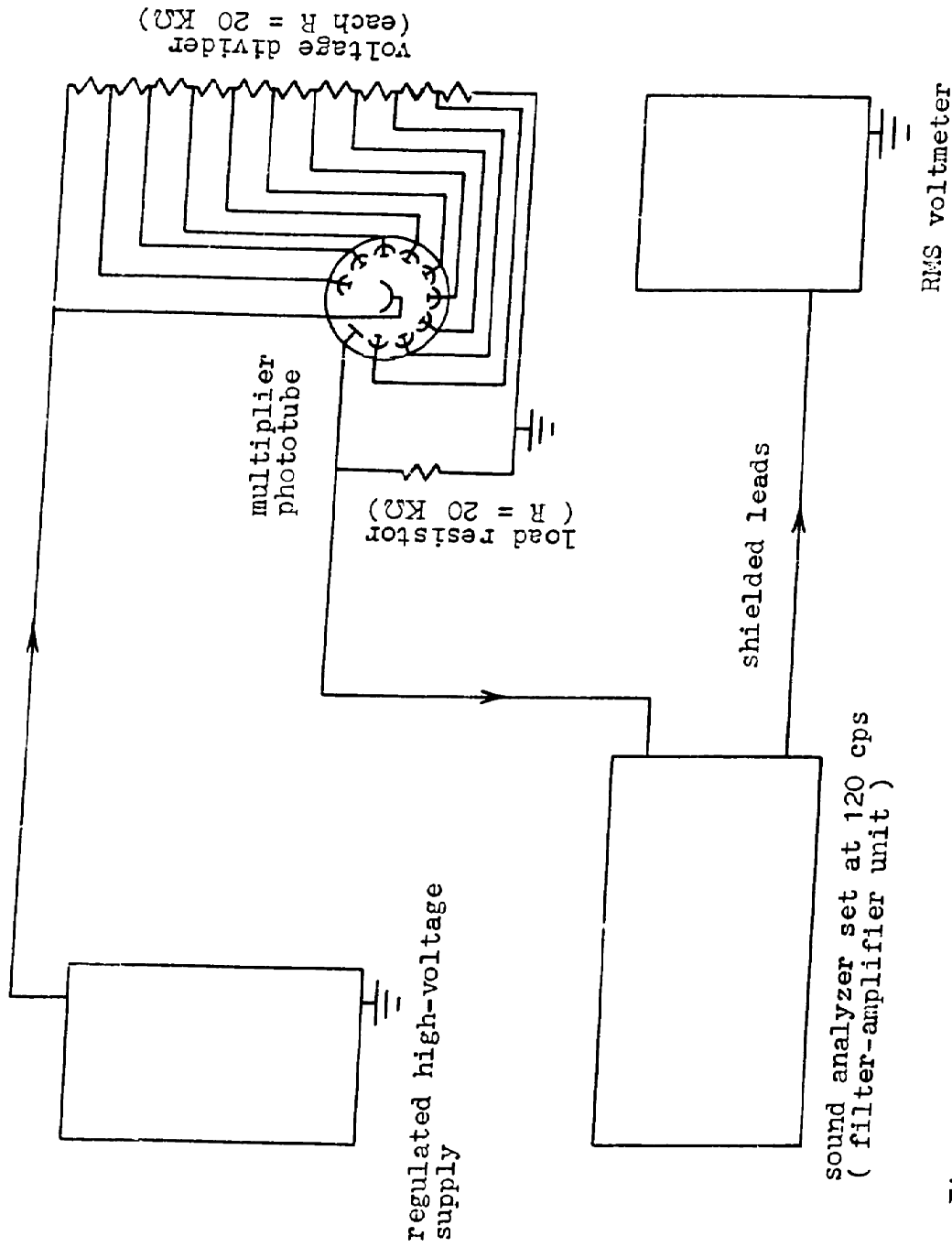


Figure F.5.- Arrangement of electronic equipment for light-scattering apparatus.

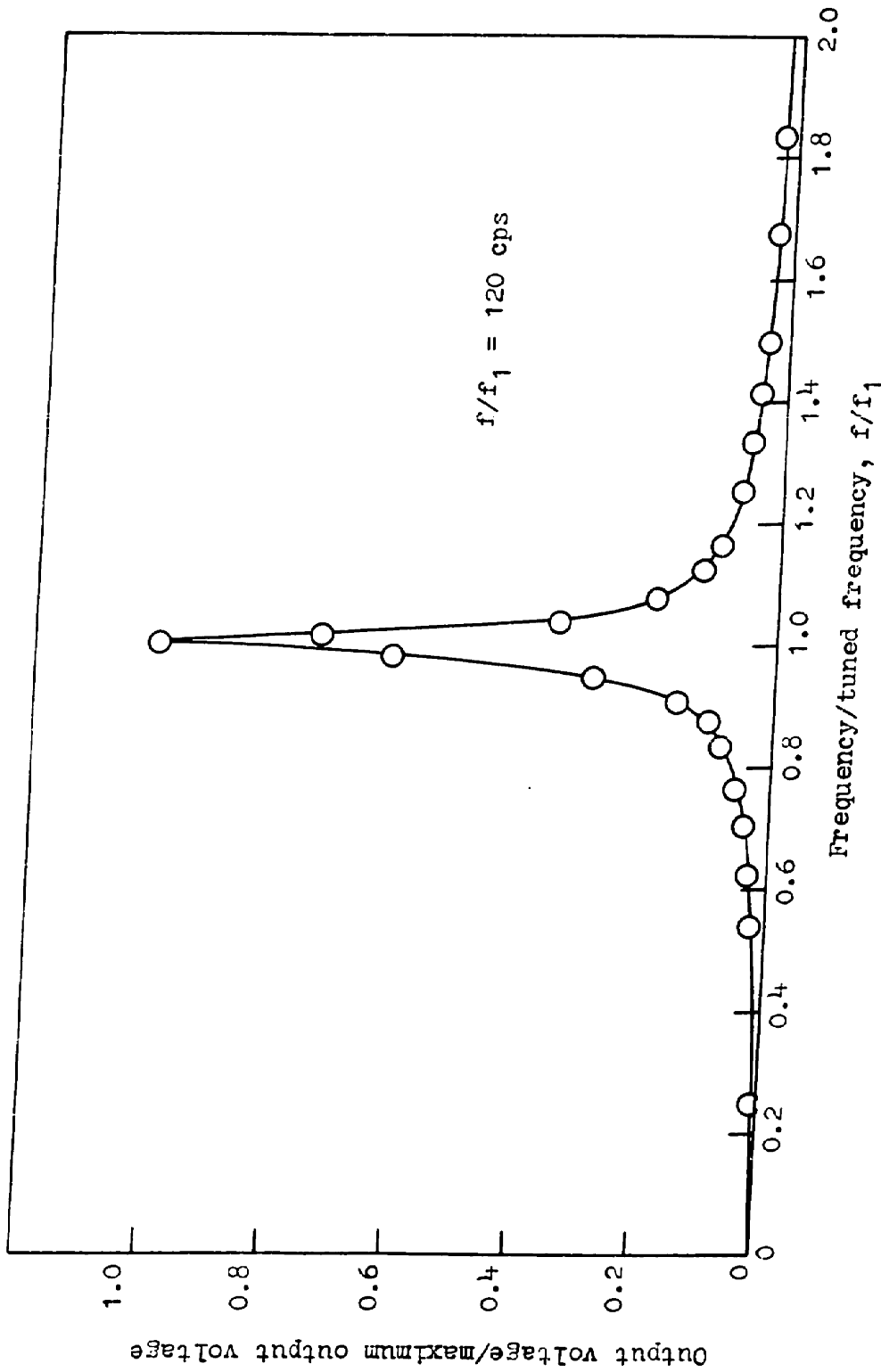


Figure F.6.-- Measured filtration characteristics of the sound analyzer tuned to 120 cps.

A 30-inch length of $\frac{3}{8}$ -inch copper tubing was used for the burner tube. The inside diameter of this tube was 0.317 inch. The corresponding length-to-diameter ratio was approximately 95.

A wind screen was placed concentric about the burner tube and consisted of a 4-inch-diameter by 18-inch-long cylinder constructed from perforated sheet metal around which one layer of 50-mesh copper screen was wrapped. The holes in the perforated sheet were $\frac{1}{8}$ -inch diameter on $\frac{3}{16}$ -inch centers. The top of the cylindrical wind screen was open and the bottom was covered with the perforated sheet and copper screen with an opening just large enough for the burner tube. A $\frac{5}{8}$ -inch slit was cut in the wind screen at 10- $\frac{1}{2}$ inches above its base to permit the incident and scattered light to enter and leave the flame. It was necessary to mask this slit down with paper to $\frac{3}{8}$ inch in order to stabilize the flame.

The benzene-air mixing system is shown in Figure F.7. The supply of benzene is contained in a cylindrical brass reservoir having a diameter of 2.5 inches and a depth of 2.5 inches. This gives a storage volume of approximately 200 cc. A needle valve is located directly below the benzene reservoir for crude adjustment of the flow and for shutting off the flow. Directly following this valve, the benzene flows through a length of capillary with its lower end drawn to a taper to give small drops of uniform size. The tip of this capillary on which the benzene drops form and drop from is visible through the glass tee which encloses the capillary. The benzene flow

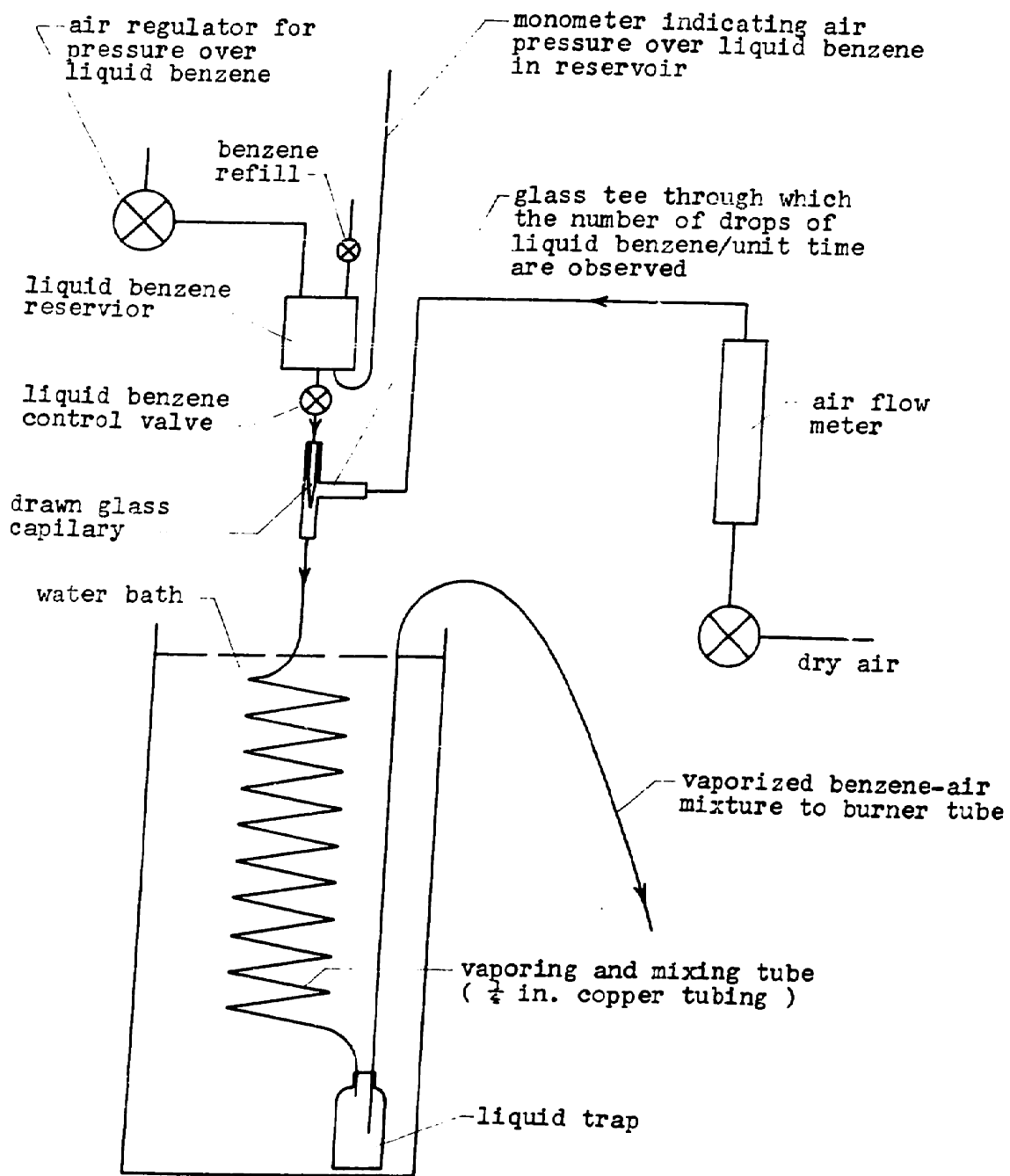


Figure F.7.- Benzene-air mixing system.

rate is determined by counting the drops per unit time and comparing with a previous calibration.

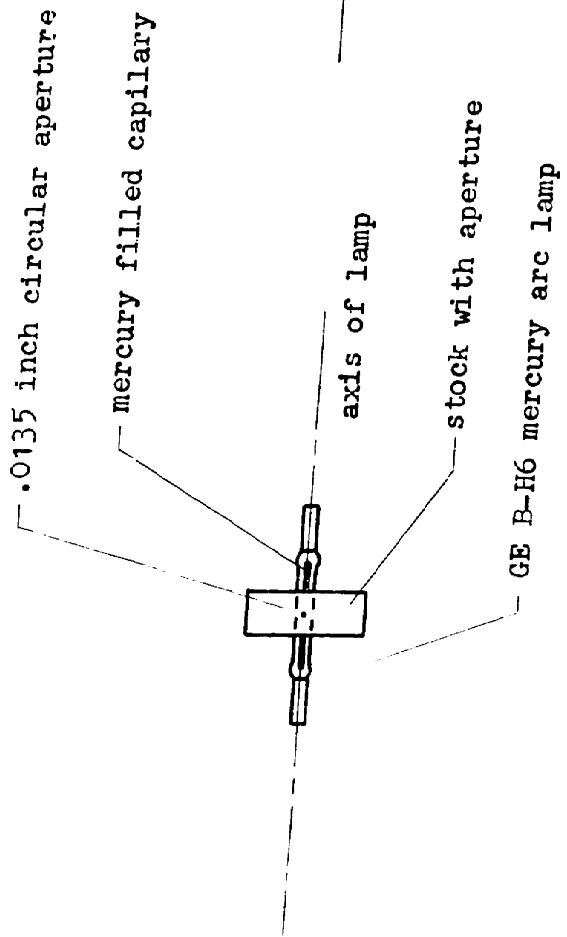
Fine adjustment of the benzene flow is facilitated by regulated air pressure over the benzene in the air-tight reservoir. The change in benzene flow rate with time due to the decrease in the level of benzene in the reservoir was made negligible by holding this applied pressure at about 25 cm of benzene. By taking into account the additional head due to the distance of 16 cm from the base of the reservoir to the tip of the capillary where the benzene exits, the rate of decrease of the total effective benzene head for the largest benzene flow used (0.3 cc/min.) is only about 1 percent per hour. Metered air enters the system at the glass mixing tee and flows in parallel with the liquid benzene into the mixing coil. This mixing coil is made from 14 feet of 1/4-inch copper tube wound with 14 turns and a diameter of 3.75 inches. The coil serves to vaporize all of the benzene and produce a well-mixed benzene-air stream of known composition. A liquid trap is located at the end of the mixing coil to remove any nonvolatile material from the benzene-air stream before it passes through the flexible tubing to the burner tube. A small wad of steel wool is placed between the burner tube and the flexible tubing to act as a flame trap. The benzene-air stream flows up the burner tube to be burned.

The incident light intensity is measured with the apparatus shown in Figure 8.2. The rotating arm is positioned at $\theta = 90^\circ$ with the

series of three black-glass mirrors alined as shown in Figure 8.2. Each of these mirrors is a 2-1/2-inch square of "Carrara" black-glass made by the Pittsburgh Plate Glass Co. The reflecting power of a single black-glass mirror was measured by replacing the mercury lamp with a 40-watt frosted bulb. For the vertical setting of the polarization filter, the reflecting power was 0.101 and for the horizontal setting, 0.0137. By using three of these mirrors in series, the incident light is attenuated to a fraction of $(0.101)^3$ or 1.03×10^{-3} for the vertical setting of the polarization filter and to $(0.0137)^3$ or 2.57×10^{-6} for the parallel setting of the polarization filter. As already mentioned, the scattered-light intensity is usually only about 10^{-6} times that of the incident light. Therefore, in order to measure the incident light intensity at a level comparable to the scattered-light intensity, either the parallel setting of the polarization filter must be used or three more additional black-glass mirrors in series must be used with the vertical setting. It was decided to use the horizontal setting to avoid using additional mirrors.

Procedure for Alining Optical System

The first step in the alinement procedure is to position the circular aperture in front of the mercury vapor lamp so that the center of the aperture coincides with the axis of the lamp and the aperture is filled with light as seen by the first lens L_1 as shown in Figure G.1. The axis of the lens tube which holds the lenses and stops for the collimating system for the incident light is then alined with the center of the aperture by using the two alinement jigs shown in Figure G.2. The first jig, J_1 , was accurately machined so as to fit snugly, but able to move freely, inside the lens tube, the inside of which was accurately bored. There is a 0.020-inch-diameter hole through the exact center of this jig. A second jig, J_2 , was likewise accurately machined to fit in the lens tube but has fitted to it a piece of translucent plastic material on which narrow reference lines at right angles are scribed through its exact center. With the two jigs in place as shown in Figure G.2, the combination of the small hole of J_1 and the intersection of the reference lines on J_2 determines the axis of the lens tube. The axis of this lens tube is alined with the center of the circular aperture by moving the lens tube system on the front surface of the mercury lamp enclosure until the small light spot on jig J_2 , formed by the narrow beam of light which passes through the centered hole in jig J_1 , coincides with the intersection of the two reference lines on J_2 . When this has been accomplished, the adjustment between the aperture and lens tube is secured.



FRONT VIEW

SIDE VIEW

Figure G.1.- Alinement of circular aperture with axis of mercury arc lamp.

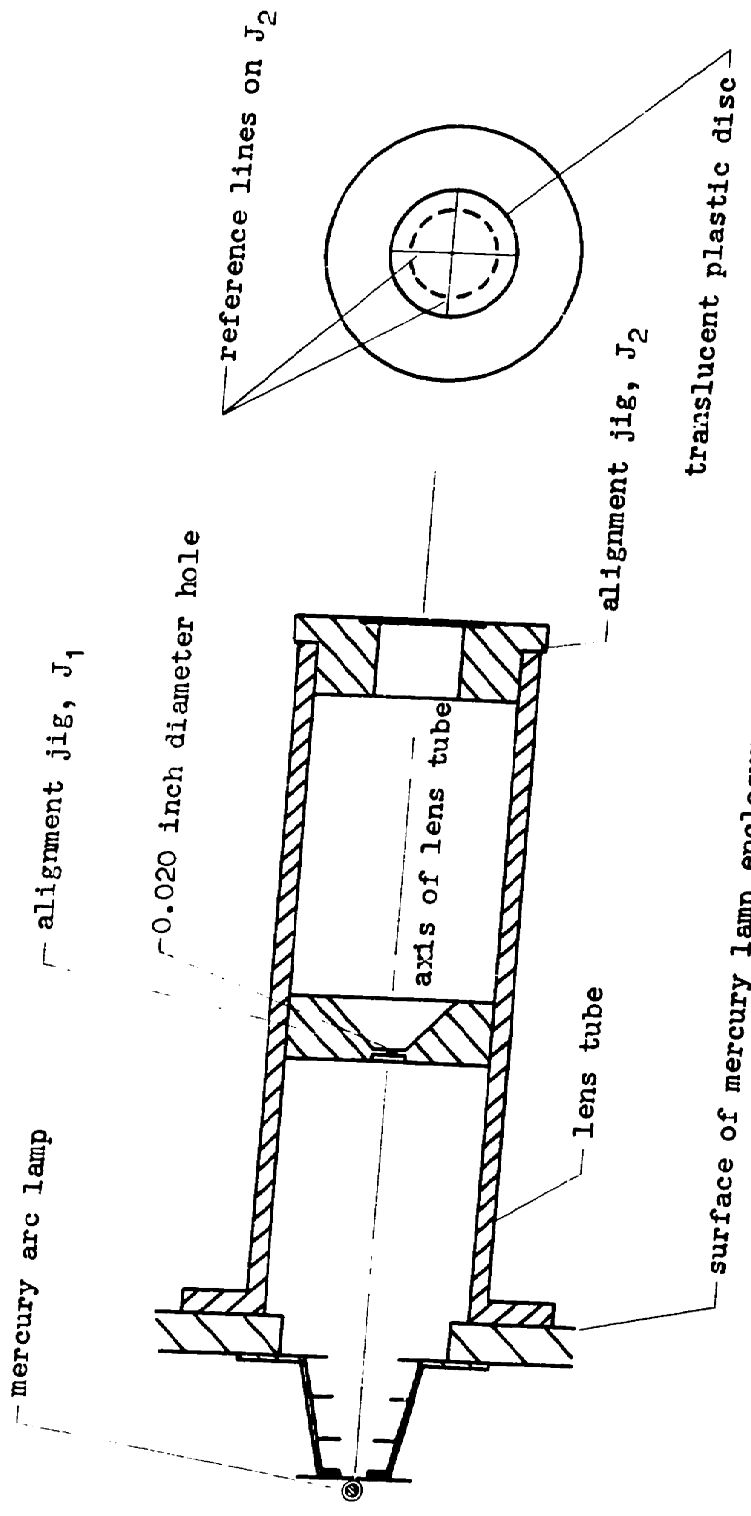


Figure G.2.- Arrangement of alignment jigs for alining lens tube for incident beam.

The two lenses, L_1 and L_2 , which form the incident light are then inserted into the lens tube. (See Fig. 8.1.) These lenses are centered in brass lens holders which have been machined to mate with the inside diameter of the lens tube. The axis of the aperture-lens-tube combination for the incident light is then made parallel to a plane which is generated by a point on the rotating arm system. (The plane in which the incident beam lies and which is also parallel to a plane generated by a point on the rotating arm system is called the plane of observation.) This is done by placing the jig J_2 shown in Figure G.2 into the lens tube for the collection system and alternately focusing the incident light on the translucent surface of J_2 when the arm is at $\theta = 0^\circ$ and then at $\theta = 180^\circ$. When the center of the image of the incident light falls at the same vertical position on J_2 , the axis of the incident beam is in the plane of observation.

The rotating arm is then positioned at $\theta = 0^\circ$. With the arm in this position, the lens tube for collecting the scattered light is mounted on the rotating arm with its axis made to coincide with the axis of the incident light beam. This was done by placing the alignment jig, J_2 , shown in Figure G.2, first in one end of the lens tube and simultaneously adjusting the vertical and horizontal position of the tube until the center of the focused image of the incident light was located at the intersection of the right-angle reference lines on J_2 and then repeated with the alignment jig in the other end of the tube. In general, the movement of the lens tube for the alignment of

one end of the tube will alter the alinement of the other so it is necessary to repeat this alinement procedure until both ends are simultaneously alined.

After this has been accomplished, a fixture, which serves to hold and aline the burner tube at the center of rotation of the rotating arm system, is mounted on the spindle about which the arm revolves as shown in Figure G.3. A drawing of the fixture alone is shown in Figure G.4. The outside diameter of the long cylindrical section and the $3/8$ -inch inside bore were machined in such a way to insure that the center line of the outside diameter coincides with that of the inside bore. The center line of this cylinder which is to hold the burner tube is made to coincide with the axis of rotation of the rotating arm system in the following way. A dial indicator gage is mounted on the rotating arm with its contact point touching the outside diameter of the cylinder at a point which is about an inch above the larger diameter base. The four horizontal set screws are simultaneously adjusted until the indicator gives a constant reading as the arm system is rotated through 360° . The contact point of the dial indicator gage is then made to touch the outside diameter of the cylinder at a point which is about an inch below its top. The indicator reading will be constant through a 360° rotation of the arm system for this location of the contact point only if the center line of this cylinder is perpendicular to the plane in which the arm rotates. In general, however, the center line of the cylinder will be tilted

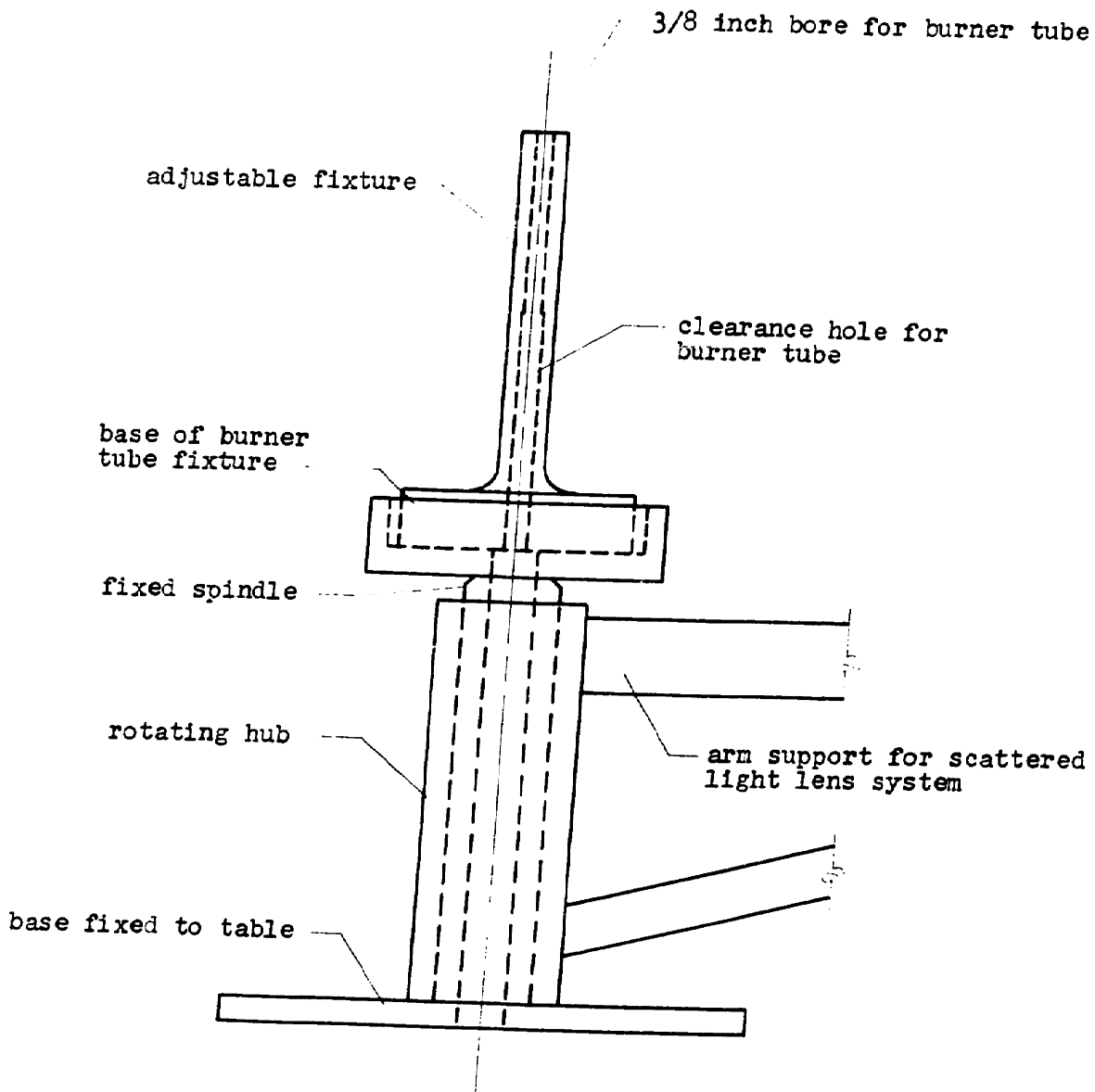


Figure G.3.- Burner tube fixture mounted on spindle of rotating arm system.

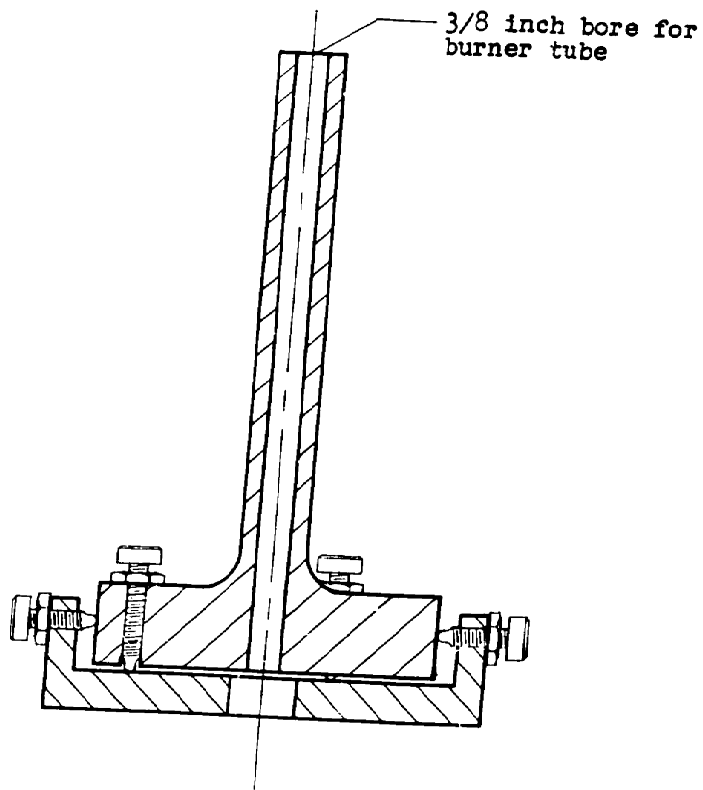
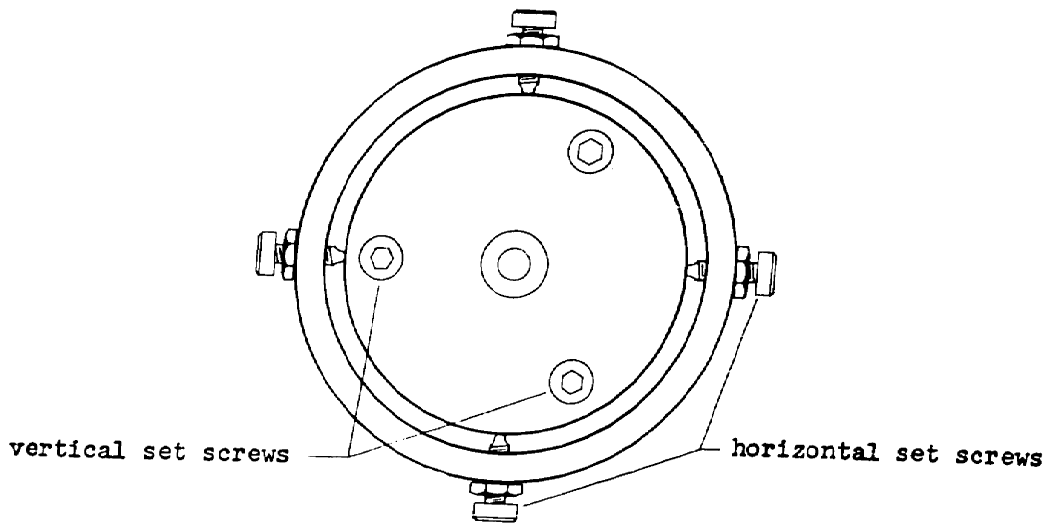


Figure G.4.- Detail view of burner tube fixture.

with respect to this plane so that the indicator readings will vary with angle. Then, depending on the values of these readings, the center line of the cylinder is made more nearly perpendicular to the plane of rotation of the arm by adjustment of the vertical set screws in the base indicated in Figure G.4. This movement will, of course, alter the initial adjustment so that it is necessary to repeat the alinement procedure for the contact point of the indicator in the lower position. The center line of the cylinder coincides with the axis of rotation of the rotating arm when the dial indicator readings remain constant with angular position at both the upper and lower locations of the contact point of the indicator. It was found necessary to repeat this process about three or four times in order to obtain indicator readings at both stations which remained constant to within 0.001 inch.

In order to fix the axis of the incident light beam through the center of rotation of the rotating arm system, the alinement jig shown in Figure G.5 was used. This jig was machined in such a manner that the two diameters have the same center line and the smaller diameter fits snugly into the 3/8-inch-diameter bored hole of the fixture shown in Figure G.4. Referring again to Figure G.5, the 3-inch slot in this jig was milled to a depth of half its diameter so that the center line of this jig lies in the plane of the surface of this slot, midway between the vertical edges. A narrow vertical reference line was carefully scribed on the surface of the slot to physically indicate

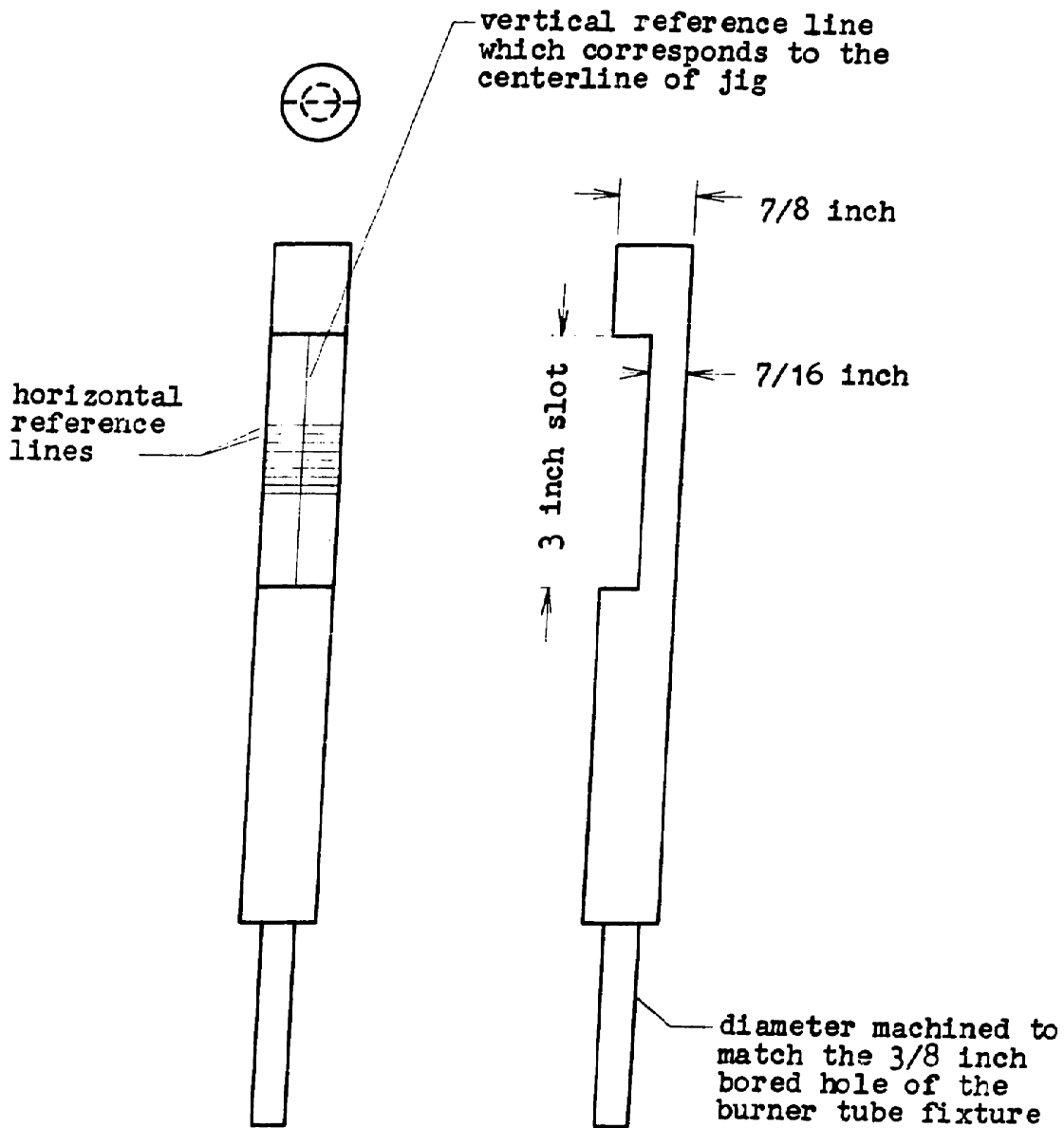


Figure G.5.- Slotted alignment jig for aligning the lens systems.

center line. Several horizontal lines were also scribed on this surface for reference. The small diameter section of this jig was fitted into the bored hole of the burner tube fixture and the plane of the surface of the slot was made perpendicular to the incident beam. The incident light system was then moved so as to position the center of the focused image of the incident light on the center line of this jig. During this movement, care was also taken to keep the incident beam in the plane of observation, defined above. Up to this point, then, the incident beam has been alined in the plane of observation and the center of the focused image of the incident light fixed on the axis about which the rotating arm turns.

At this point, the three black-glass mirrors which are used to measure the relative incident light intensity are alined as already shown in Figure 8.2. A more detailed drawing of this arrangement is shown in Figure G.6. Each mirror is mounted on a support system shown in Figure G.7 which permits the plane of the mirror to be rotated about three mutually perpendicular axes. Mirror A and its associated support system is fixed to the stationary optical bench with the approximate center of the mirror made to coincide with the center of the focused incident image and the plane of the mirror adjusted to make an angle of 45° with respect to the incident beam. This is done by setting the plane of the mirror at 45° with the end surface of the lens tube for the incident light by using a 45° square. Then with the other two mirrors not yet mounted, the alinement jig J_2 is placed

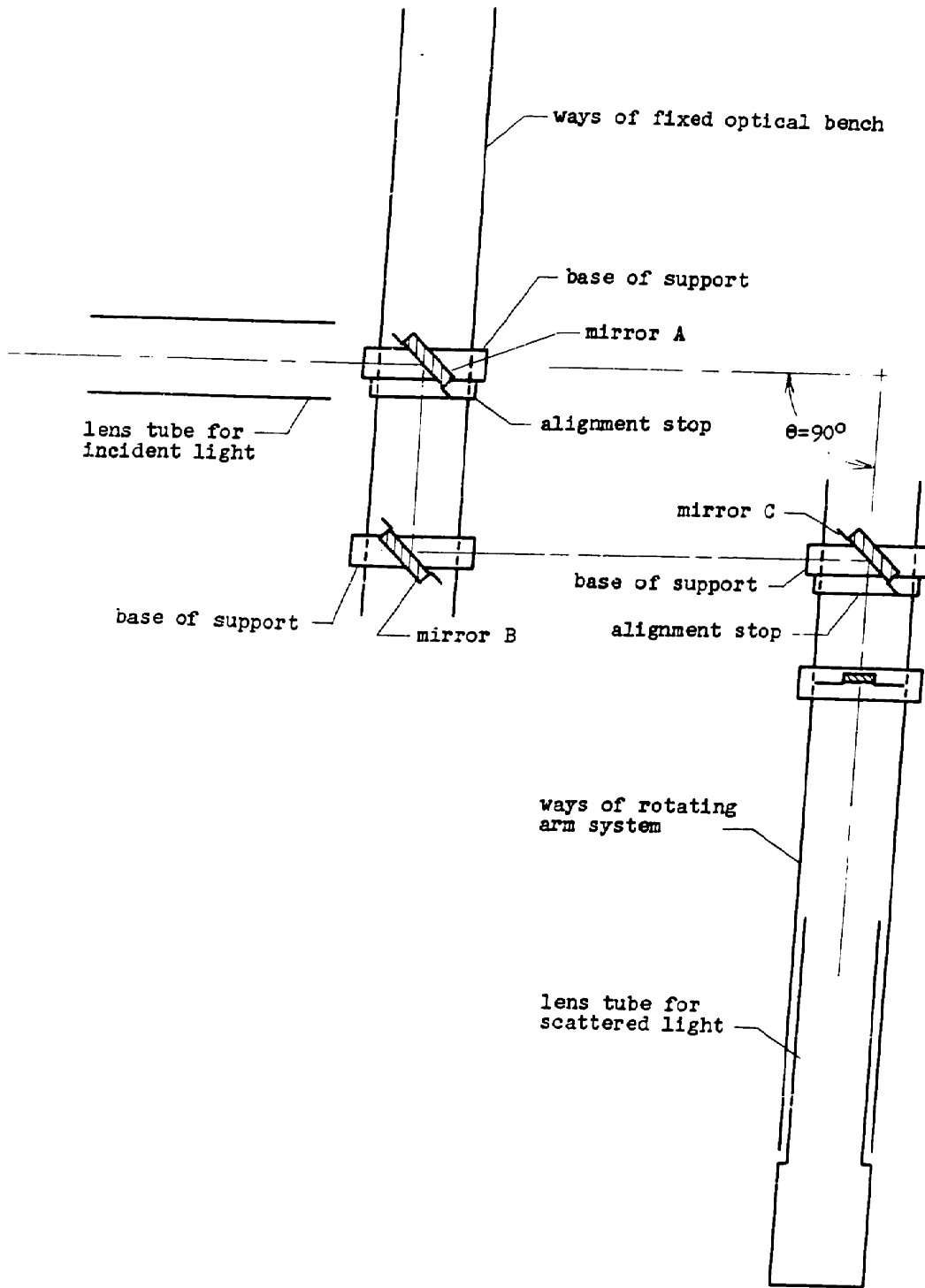


Figure G.6.- Alinement of the three-mirror system.

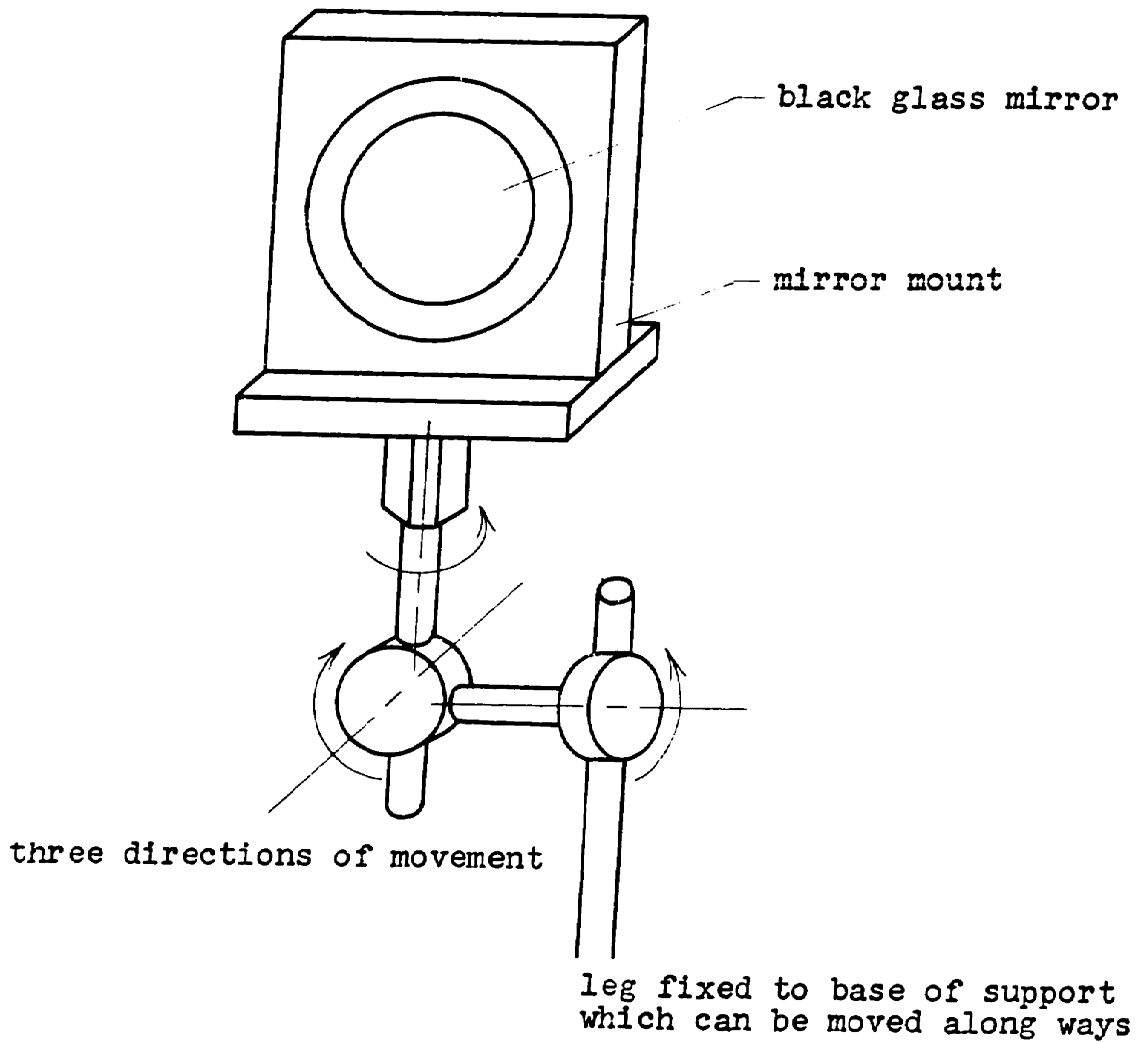


Figure G.7.- Mirror support system.

in the end of the collecting lens tube which is nearer the axis of rotation and the rotating arm system is swung to an angular position such that the focused image of the once reflected incident light strikes the translucent surface of J_2 . The support system holding mirror A is then adjusted to make the focused incident image coincide with the crossing reference lines on J_2 , while at the same time, the plane of the mirror is kept at an angle of 45° with respect to the end surface of the incident lens tube. As a result of this alinement of this mirror, the incident light beam is turned 90° from its initial direction while the direction of the reflected beam is kept in the plane of observation.

Mirror B and its associated support system is then also fixed to the stationary optical bench with the plane of the mirror made approximately parallel to the plane of mirror A. The horizontal axis of mirror B is accurately adjusted by swinging the rotating arm system, with the alinement jig J_2 still in place, to an angular position such that the focused image of the twice reflected incident light strikes the vertical reference line on the translucent surface of J_2 . The support system holding mirror B is then adjusted to make the center of the image coincide with the crossing reference lines on J_2 . Since the angular position of the rotating arm will in general not place the intersection of the reference lines on J_2 at the appropriate point for alining the vertical axis of mirror B, that is, turning the reflected light through 90° at mirror B, only partial alinement of

mirror B is possible at this point. The plane in which the twice-reflected beam travels was made to coincide with the plane of observation by simultaneously adjusting the support system for mirror B so that the center of the image of the twice-reflected beam coincides with the intersection of the reference lines on J_2 and moving the rotating arm system through a small range of angles which would bracket to position of the arm which would turn the light 90° at mirror B.

The alinement to this point causes the incident light to be reflected 90° by mirror A while keeping the direction of the reflected beam in the plane of observation. The partial alinement of mirror B insures that the direction of the twice-reflected beam remains in the plane of observation for a range of reflection angles.

Mirror C is placed on the rotating arm system and adjusted so that the plane of the mirror is 45° with respect to the end surface of the collection lens tube by using a 45° square. The rotating arm system is then positioned at approximately $\theta = 90^\circ$ and mirror C is moved along the ways of the rotating arm system so as to intercept and reflect the twice-reflected light beam. The direction of the resulting reflected light is made to lie in the plane of observation by moving the rotating arm system and adjusting the horizontal axis of mirror C until the center of the image of the reflected light coincides with the intersection of the reference lines on J_2 . This last adjustment may alter the angle between the surface of mirror C and

the end of the lens tube so the angle was checked and set at 45° again after which the previous alinement also checked. Mirror C and its support system is then secured to the rotating arm system as shown in Figure G.6.

The rotating arm system is positioned at $\theta = 90^\circ$ and the final alinement of mirror B is made by the simultaneous movement of the support system for mirror B along the stationary optical bench and slight rotation of the surface of mirror B only about its vertical axis. The center of the image of the thrice-reflected light is compared to the intersection of the reference lines of J_2 when J_2 is first placed at one end of the collecting lens tube and then at the other end. When the center of this image coincides with the intersection of the reference lines of J_2 for both positions of J_2 , the final alinement of mirror B has been made and the entire mirror system is alined.

Since mirror A and mirror C must be moved for the measurement of the scattered-light intensity at various angular positions, stops are fixed to the stationary optical bench and the ways of the rotating arm system at the base of the support systems for these two mirrors which allow them to be replaced to their proper alined positions.

The two lenses, L_3 and L_4 , and the polarization filter were then placed inside the lens tube. (See Fig. 8.1.) The long focal length lens, L_3 , which collects the scattered light, was then adjusted to a distance of 508 mm from the axis of the rotating arm. The square

aperture previously shown in figure F.) was then fixed to this lens tube system. Following this, the converging lens L_4 was adjusted so as to refocus the incident light at the plane of the square aperture. The square aperture was then adjusted to allow all of the incident light to pass through it.

The alinement of the collection system for the scattered light was then checked by a somewhat more sensitive technique in the following way. The alinement jig shown in Figure G.5 was placed in the burner tube fixture with the surface of its slot normal to the axis of the collection system. A lamp was placed behind the square aperture which in turn formed an image on the slot surface of the alinement jig. The horizontal alinement was checked by comparing the center of the image with the vertically scribed reference line on the slot surface which coincides the axis of rotation. In general, the center of the image was only very slightly misaligned with the vertical reference line of the jig and was more accurately alined by very slight adjustment of the vertical slit of the square aperture. This slight misalignment of the square aperture by the first technique is due to the refocused image of the incident light being slightly smaller than the aperture which allows some freedom in adjustment. The vertical alinement was checked by comparing the position of the focused incident image on the jig when the slot surface was normal to the axis of the incident beam with the position of the image of the square aperture when the slot surface was normal to the axis of the

collection system. In general, this too was only very slightly misaligned and was more accurately aligned by very slight adjustment of the horizontal slit of the square aperture. This check was then repeated at several different angles and it was found that once the system was accurately aligned at $\theta = 0^\circ$ by the second technique, no further adjustment was necessary.

With the alignment jig removed from the burner tube fixture and the rotating arm set at $\theta = 0^\circ$, the alignment was again checked to see that no part of the refocused image of the incident was cut off by the square aperture.

The optical interference filter and the multiplier phototube system were then mounted on the rotating arm. The multiplier phototube was mounted so that the photocathode surface was approximately $1/2$ inch from the plane of the square aperture and the light spot strikes the center of the photocathode surface.

Tabulation of Test Conditions for Light-Scattering

Measurements and Experimental Data

The original data and calibrations are on file at the MIT Fuels Research Laboratory. Table H.1 lists the test conditions for which light-scattering measurements were made. The runs numbered 1 through 4 were made for nearly identical flame conditions but at successively greater elevations above the burner tip. The runs numbered 5 and 6 were made for nearly identical flame conditions at the same elevation but for two different wavelengths. Runs 7 through 9 were also made for nearly identical flame conditions at successively greater elevations above the burner tip but with a lower fuel-air ratio and smaller elevation intervals. Run number 10 was made with a Hefner candle burning amyl acetate.

Table H.2 gives the experimental light-scattering data for each run. The measured voltage, which is proportional to the scattered-light intensity for the perpendicular component, $e_1(\theta)$, and for the parallel component, $e_2(\theta)$, is given for the various angular positions, θ . The measured voltage due to the thrice reflected incident light, $e'_{0,2}$, and the voltage due to the parallel component of the scattered-light intensity for $\theta = 60^\circ$, $e'_2(60)$, for the same apparatus adjustment, are also listed for each run.

TABLE H.1.1.- TEST CONDITIONS FOR LIGHT-SCATTERING MEASUREMENTS.

Run	Fuel	λ , Å	Benzene flow rate, gm-mole/min $\times 10^3$	Airflow rate, gm-mole/min $\times 10^2$	f/a times stoichiometric	Elevation of observed volume above burner, inches	Approximate flame height, inches	High voltage to multiplier phototube for scattering meas- urements, volts	Amplification of signal for scattering measurements	High voltage to multi- plier phototube for incident light meas- urements, volts	Amplification of signal for incident light measurements
1	Benzene	4358	3.16	4.70	2.39	1.25	3.15	1000	13	750	13
2	Benzene	4358	3.15	4.70	2.38	1.50	3.15	950	8	750	13
3	Benzene	4358	3.12	4.70	2.36	1.75	3.15	950	8	750	13
4	Benzene	4358	3.07	4.70	2.32	2.00	3.15	950	8	750	13
5	Benzene	4358	3.23	4.70	2.45	1.25	3.20	950	13	750	13
6	Benzene	5461	3.22	4.70	2.44	1.25	3.20	850	16	750	16
7	Benzene	4358	2.80	4.60	2.16	1.03	2.30	1000	16	750	16
8	Benzene	4358	2.80	4.60	2.16	1.10	2.30	1000	16	750	16
9	Benzene	4358	2.80	4.60	2.16	1.23	2.30	1000	16	750	16
10	Amyl acetate	4358			Diffu- sion flame	1.00	1.25	1000	16	750	16

TABLE H.2.- EXPERIMENTAL LIGHT-SCATTERING DATA

θ	Run 1		Run 2		Run 3		Run 4	
	$e_1(\theta)$	$e_2(\theta)$	$e_1(\theta)$	$e_2(\theta)$	$e_1(\theta)$	$e_2(\theta)$	$e_1(\theta)$	$e_2(\theta)$
30	681. mv	570. mv	560. mv	430. mv	605. mv	500. mv	580. mv	468. mv
40	575.	400.	455.	310.	475.	320.	450.	294.
45	524.	320.	401.	231.	425.	249.	388.	219.
50	480.	253.	360.	172.	375.	183.	345.	161.
60	400.	131.	293.	84.8	300.	88.	269.	75.
70	340.	57.5	231.	35.5	239.	36.	216.	30.2
80	298.	20.8	194.	12.2	199.	12.3	170.	10.3
90	266.	10.	166.	6.3	166.	6.3	141.	4.8
100	244.	17.	141.	10.2	142.	10.9	122.	8.3
110	230.	37.	129.	20.9	121.	20.8	109.	16.9
120	222.	66.8	124.	36.	118.	34.8	95.	28.5
130	219.	102.	119.	54.	107.	50.	88.	40.0
135	223.	122.	119.	64.	109.	59.5	87.	47.5
140	220.	147.	121.	74.	109.	69.	85.	53.
150	238.	196.	123.	97.	109.	86.	85.	65.
	$e'_{0,2} = 223.$ mv		$e'_{0,2} = 225.$ mv		$e'_{0,2} = 228.$ mv		$e'_{0,2} = 228.$ mv	
	$e'_2(60) = 18.7$ mv		$e'_2(60) = 27.5$ mv		$e'_2(60) = 28.8$ mv		$e'_2(60) = 25.0$ mv	

TABLE H.2.- EXPERIMENTAL LIGHT-SCATTERING DATA - Continued.

θ	Run 5		Run 6	
	$e_1(\theta)$	$e_2(\theta)$	$e_1(\theta)$	$e_2(\theta)$
30	621. mv	505. mv	143. mv	108. mv
40	525.	350.	127.	76.5
45	478.	282.	116.	61.
50	435.	218.	109.	47.
60	362.	112.	93.5	25.8
70	308.	49.	81.	11.5
80	276.	17.5	71.8	4.
90	246.	8.4	64.3	2.
100	223.	15.1	60.	3.5
110	212.	32.5	58.	8.7
120	208.	59.5	59.	16.
130	210.	94.	61.	26.7
135	212.	111.	62.5	32.5
140	218.	132.	64.5	39.
150	224.	175.	69.	52.5
	$e'_{0,2} = 249. \text{ mv}$		$e'_{0,2} = 41. \text{ mv}$	
	$e'_2(60) = 21.7 \text{ mv}$		$e'_2(60) = 10.7 \text{ mv}$	

TABLE H.2.- EXPERIMENTAL LIGHT-SCATTERING DATA - Continued.

θ	Run 7		Run 8		Run 9	
	$e_1(\theta)$	$e_2(\theta)$	$e_1(\theta)$	$e_2(\theta)$	$e_1(\theta)$	$e_2(\theta)$
30	539. mv	442. mv	679. mv	564. mv	804. mv	664. mv
40	1.79.	324.	599.	409.	694.	474.
45	444.	271.	554.	336.	634.	384.
50	419.	209.	519.	269.	589.	301.
60	359.	113.	444.	144.	499.	162.
70	317.	50.	384.	62.	421.	70.
80	286.	17.	339.	21.	369.	23.
85	273.	10.	319.	11.	344.	13.
90	262.	7.5	299.	8.5	326.	9.5
95	251.	9.	294.	11.	306.	12.
100	247.	14.	288.	18.	299.	19.
105	237.	24.	279.	28.	292.	30.
115	231.	50.	267.	58.	276.	60.
120	231.	67.	262.	78.	271.	78.
130	232.	106.	262.	120.	266.	118.
135	237.	129.	262.	142.	260.	140.
140	240.	150.	266.	166.	261.	161.
150	251.	199.	272.	212.	262.	203.
	$e'_{0,2} = 220.$ mv		$e'_{0,2} = 218.$ mv		$e'_{0,2} = 218.$ mv	
	$e'_2(60) = 15.7$ mv		$e'_2(60) = 20.3$ mv		$e'_2(60) = 24.2$ mv	

TABLE H.2- EXPERIMENTAL LIGHT-SCATTERING DATA - Concluded

Run 10		
θ	$e_1(\theta)$	$e_2(\theta)$
30	575. mv	500. mv
40	530.	380.
45	500.	330.
50	450.	270.
60	428.	150.
70	400.	74.
80	360.	25.
90	325.	11.
100	295.	22.
110	270.	47.
120	255.	86.
130	245.	125.
135	230.	140.
140	220.	155.
150	210.	185.

A Sample Calculation Showing the Effect That a Large
Number of Small Particles Mixed With a Relatively
Small Number of Large Particles has on the
Light-Scattering Patterns for Two
Different Wavelengths

A comparison of the light-scattering data for run 5, which is for $\lambda = 4358 \text{ \AA}$, to run 6 which is for $\lambda = 5461 \text{ \AA}$, shows that the ratio of the apparent values of x for these respective runs is about 1.11 when the values of x are deduced by comparing the data with theory for uniform size particles. If the soot particles are nearly uniform in size, one would expect to have found the ratio of the two values of x equal to the inverse ratio of the respective wavelengths, that is, $5461/4358 = 1.25$, since the test conditions for these two runs are very nearly identical.

It is the object here to see if this apparent discrepancy between the data of run 5 and run 6 could be due to a soot particle system which consists of a relatively large number of small particles, say 250 \AA in diameter, and a relatively small number of large particles or agglomerates. The choice of a diameter of 250 \AA corresponds to the ultimate soot particle size shown in the electron micrograph, Figure 10.1.

The apparent value of x , deduced from the data of run 5 when $m = 1.71 - 0.76 i$, is 1.00. For the supposed particle system just mentioned, this value of $x = 1.00$ is expected to lie between the

corresponding value of x for the 250 Å particles and the equivalent value of x for the agglomerates. The value of x for the agglomerates was taken as 1.25 for this example when $\lambda = 4358 \text{ Å}$.

The apparent value of x deduced from the data of run 6 when $m = 1.79 - 0.79 i$ is 0.90. Since the size parameter x was already taken as 1.25 for the case when $\lambda = 4358 \text{ Å}$, the value of x for the agglomerates when $\lambda = 5461 \text{ Å}$ is necessarily 1.00 as determined by the inverse ratio of the respective wavelengths. The choice of these values of x is due in part to the fact that the scattering functions for these values are tabulated in appendix D, so no interpolation is necessary.

The corresponding values of x for the small particles which have a diameter of 250 Å are $x = 0.180$ for $\lambda = 4358 \text{ Å}$ and $x = 0.144$ for $\lambda = 5461 \text{ Å}$. Since it is the purpose here to show a rather gross effect, the values of the size parameter for the small particles were taken as $x = 0.20$ for $\lambda = 4358 \text{ Å}$ and $x = 0.15$ for $\lambda = 5461 \text{ Å}$, to avoid interpolation between the tabulated light-scattering functions.

Let β be defined as the number fraction of soot particles which are agglomerates and $(1 - \beta)$ the number fraction of ultimate soot particles. The effective light-scattering functions for this system of soot particles when $\lambda = 4358 \text{ Å}$ are

$$\bar{i}_1(\lambda = 4358, \theta) = i_1(x = 1.25, \theta)\beta + i_1(x = 0.20, \theta)(1 - \beta) \quad \text{I.1}$$

and

$$\bar{i}_2(\lambda = 4358, \theta) = i_2(x = 1.25, \theta)\beta + i_2(x = 0.20, \theta)(1 - \beta) \quad \text{I.2}$$

where $i_1(x = 1.25, \theta)$, for example, is the perpendicular light-scattering function for $x = 1.25$ at angle θ . The corresponding effective light-scattering functions for this system when $\lambda = 5461 \text{ \AA}$ are

$$\bar{i}_1(\lambda = 5461, \theta) = i_1(x = 1.00, \theta)\beta + i_1(x = 0.15, \theta)(1 - \beta) \quad \text{I.3}$$

and

$$\bar{i}_2(\lambda = 5461, \theta) = i_2(x = 1.00, \theta)\beta + i_2(x = 0.15, \theta)(1 - \beta) \quad \text{I.4}$$

The values of $i_1(x = 1.25, \theta)$ to be used in equation I.1, as tabulated in appendix D, range between about 1.0 and 0.15 and the values of $i_1(x = 0.20, \theta)$ are approximately 2.0×10^{-5} . Therefore, in order for the two different particles sizes to each significantly affect the light-scattering data, the value of β should be near the order of 10^{-4} or 10^{-5} . Larger values of β will cause the agglomerated particles to dominate the light-scattering results, which in turn would lead to different scattering patterns for each wavelength that correspond to two values of x , the ratio of which is equal to the reciprocal of the wavelengths. This is contrary to experiment. On the other hand, much smaller values of β would produce a nearly Rayleigh-type scattering pattern, which is also contrary to the data from run 5 and run 6. With this in mind, a value of $\beta = 5 \times 10^{-5}$ was chosen. The light-scattering functions used for the case where $\lambda = 4358 \text{ \AA}$ were taken from appendix D for $m = 1.71 - 0.76 i$. The

corresponding functions for the case where $\lambda = 5461 \text{ \AA}$ are based on $m = 1.79 - 0.79 i$.

Figure I.1 shows the results of these calculations based on equations I.1 and I.2 for the case of $\lambda = 4358 \text{ \AA}$. The symbols in this figure represent the calculated scattering pattern for the mixed particle system. This pattern was compared to the theoretical scattering curves for uniform size particles for various values of x at $m = 1.71 - 0.76 i$ to find the best fit for the perpendicular component. The best curve fit was found for x of about 0.95 and is drawn on the plot along with the symbols.

Figure I.2 presents the results based on equations I.3 and I.4 for the case of $\lambda = 5461 \text{ \AA}$, but the same supposed particle system as before. The resulting scattering pattern, again indicated with symbols, is compared to curves for various values of x for $m = 1.79 - 0.79 i$. The apparent value of x is about 0.90 or slightly less for this case.

For this supposed system of soot particles, the ratio of the size parameters for the case of $\lambda = 4358 \text{ \AA}$ to the case of $\lambda = 5461 \text{ \AA}$ is only slightly larger than $0.95/0.90 = 1.06$, rather than the inverse ratio of the two wavelengths, $5461/4358$ or 1.25. This shows the same effect as was indicated by the experimental data from run 5 and run 6 and therefore offers a possible reason for this seeming discrepancy. A different value of β or assumed value of the agglomerate size would certainly change the ratio of the values of x for the two wavelengths, so that the value of 1.11 for this ratio, as found in comparing run 5 and run 6, is not surprising.

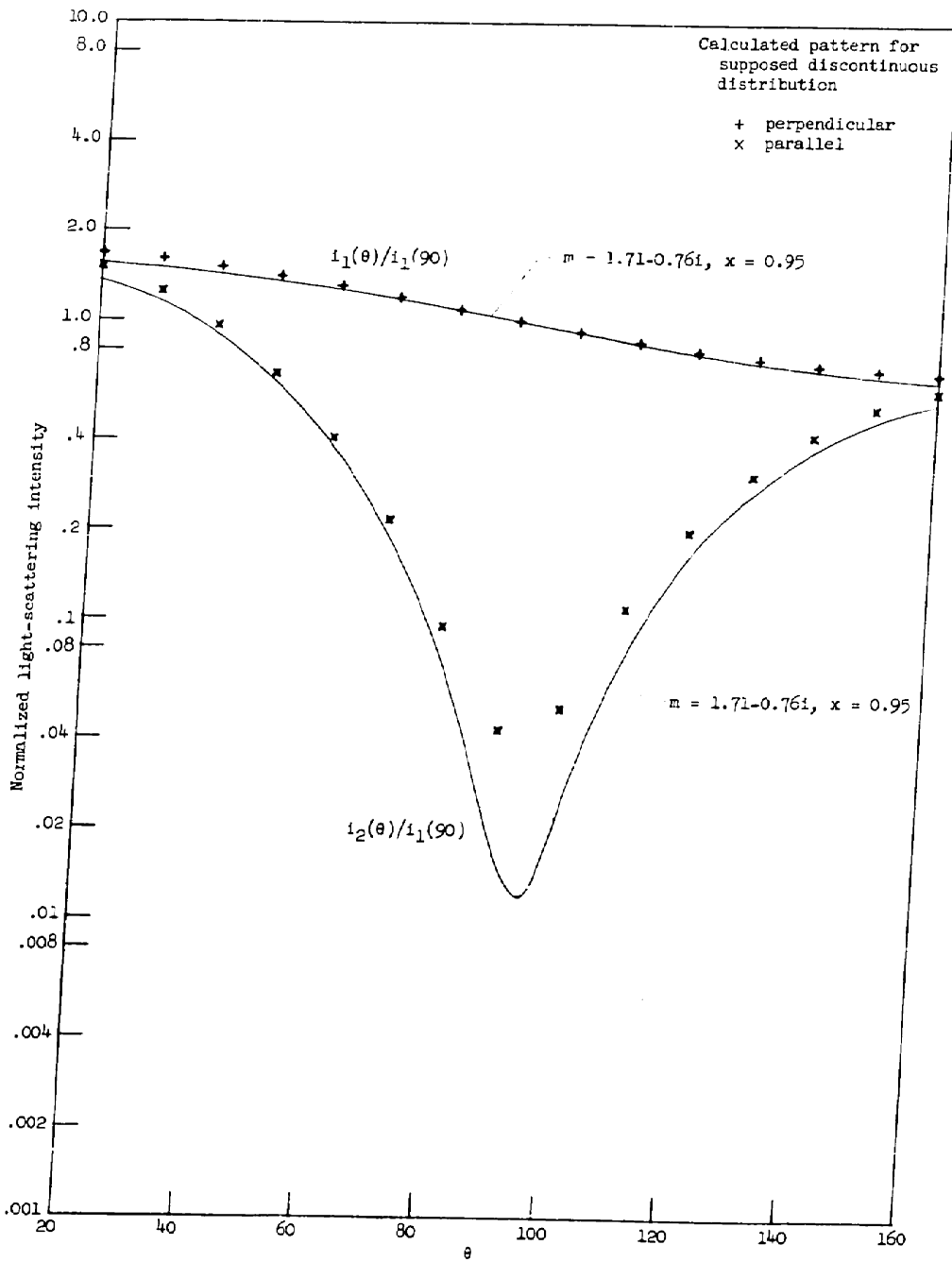


Figure I.1.- Comparison of the calculated light-scattering pattern for a supposed discontinuous particle distribution system, which contains a large fraction of small particles mixed with a small fraction of large particles, to the theoretical scattering pattern for a uniform particle size system where $\lambda = 4358 \text{ \AA}$ and $m = 1.71 - 0.76 i$.

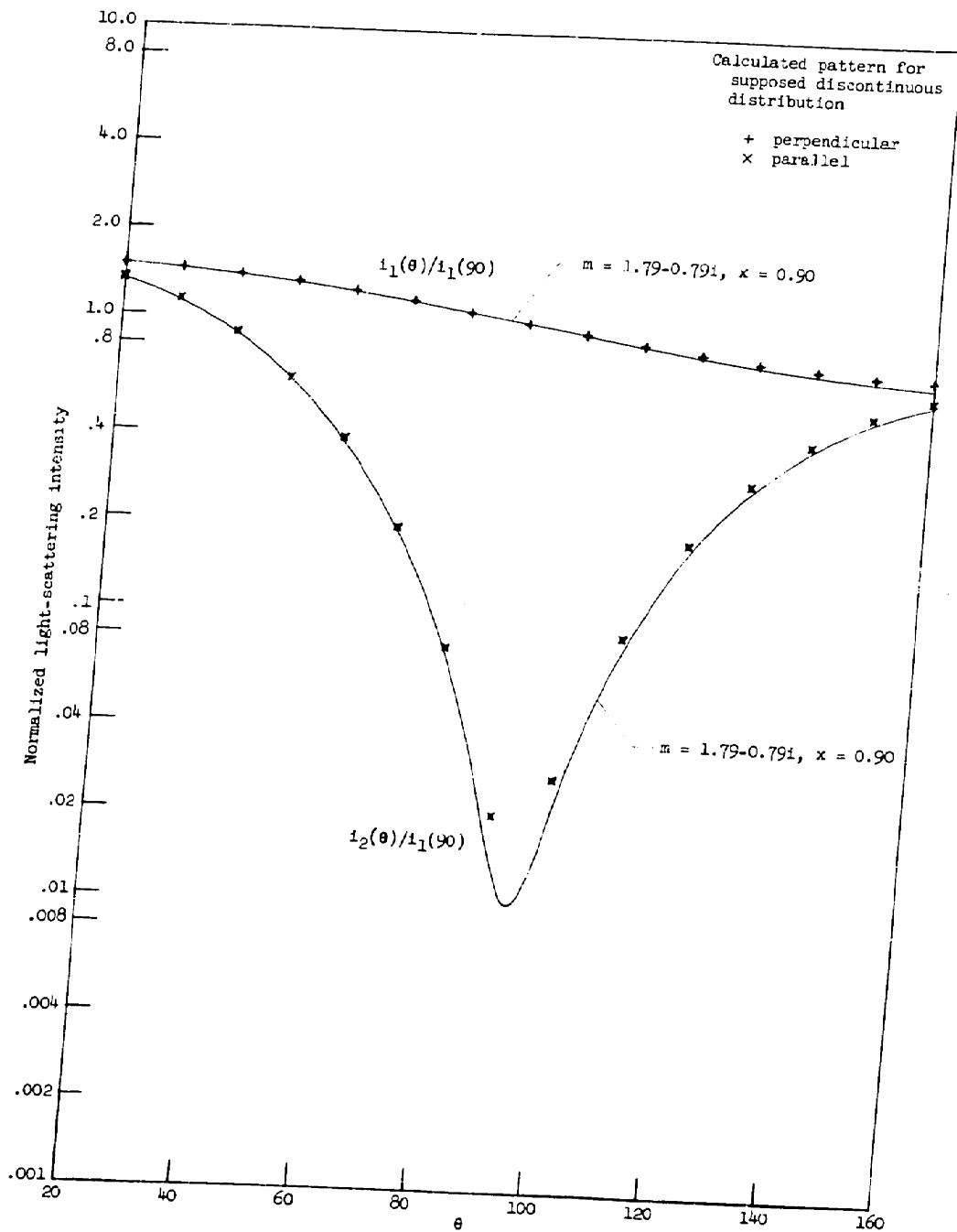


Figure I.2.- Comparison of the calculated light-scattering pattern for the same supposed discontinuous particle distribution as used for Figure I.1 to the theoretical scattering pattern for a uniform particle size system where $\lambda = 5461 \text{ \AA}$ and $m = 1.79 - 0.79 i$.

It should be noted that this supposed particle system is an oversimplified distribution which consists of a very large number of small particles, each of the same size, mixed with a relatively few larger particles, each of the same size. In the actual situation, one might expect to find a smooth distribution about a small mean particle size which corresponds to the ultimate soot particles and a second smooth distribution about a much larger mean particle size which corresponds to the agglomerates. It is felt that this consideration would not change the general effect already shown.

REFERENCES

1. Bone, W. A., and Towerd, D. T. A.: *Flames and Combustion in Gases*. Longmans, Green and Co., Ltd., London, 1927, p. 27.
2. Coward, H. F., and Woodhead, D. W.: *The Luminosities of the Flames of Some Individual Chemical Compounds, Alone and Mixed*. Third Symposium on Combustion and Flame and Explosion Phenomena. Baltimore, The Williams and Wilkins Co., 1949, pp. 518-522
3. Hunt, R. A.: *Relation of Smoke Point to Molecular Structure*. *Industrial and Engineering Chemistry*. Vol. 45, No. 3, 1953, pp. 602-606.
4. Schalla, R. L., Clark, T. P., and McDonald, G. E.: *Formation and Combustion of Smoke in Laminar Flames*. NACA Report 1186, 1954.
5. Fenimore, C. P., Jones, G. W., and Moore, G. E.: *Carbon Formation in Quenched Flat Flames at 1600° K*. Sixth Symposium (International) on Combustion, Reinhold Publishing Corp., New York, 1957, pp. 242-247.
6. Arthur, J. R., and Napier, D. H.: *Formation of Carbon and Related Materials in Diffusion Flames*. Fifth Symposium (International) on Combustion. Reinhold Publishing Corp. New York, 1955, pp. 303-316.
7. Stehling, F. C., Frazee, J. D., and Anderson, R. C.: *Carbon Formation From Acetylene*. Sixth Symposium (International) on Combustion. Reinhold Publishing Corp. New York, 1957, pp. 247-254.
8. Parker, W. G., and Wolfhard, H. G.: *Carbon Formation in Flames*. *Journal of the Chemical Society*, London, 1950, pp. 2038-2049.

9. Gaydon, A. G., and Wolfhard, H. G.: *Flames - Their Structure, Radiation, and Temperature*. Second Edition, Chapman and Hall Ltd., (London) 1960, pp. 175-209.
10. Tesner, F. A., Robinovitch, H. J., and Rafalkes, I. S.: *Formation of Dispersed Carbon in Hydrocarbon Diffusion Flames*. Eighth Symposium (Internation) on Combustion, 1961.
11. Senftleben, H., and Benedict, E.: "Über die Blugung des Lichtes an den Kohlensloffteilchen leuchtender Flammen. *Ann. d. Phys.*, Vol. 60, 1919, pp. 297-323.
12. Mie, G.: *Beiträge zur Optik trüber Medien, speziell kolloidaler Metallösungen*. *Ann. d. Phys.*, Vol. 25, No. 3, March 1908, pp. 377-445.
13. Durbin, Enoch J.: *Optical Methods Involving Light Scattering for Measuring Size and Concentration of Condensation Particles in Supercooled Hypersonic Flow*. NACA TN 2441, August 1951.
14. Kaskan, W. E.: *Light Scattering Measurements on Particles Condensed From Boron - Containing Flames*. *Combustion and Flame*, Vol. 5, No. 1, March 1961, pp. 93-98.
15. Sinclair, D., and LaMer, V. K.: *Light Scattering as a Measure of Particle Size in Aerosols*. *Chem. Rev.*, Vol. 44, No. 2, April 1949, pp. 245-267.
16. Van de Hulst, H. C.: *Light Scattering by Small Particles*. John Wiley and Sons, Inc., New York, 1957.
17. Senftleben, H., and Benedict, E.: "Über die optischen Konstanten und die Strahlungsgesetze der Kohle. *Ann. d. Phys.*, Vol. 54, 1918, pp. 65-78.

18. Stull, V. R., and Plass, G. N.: Emissivity of Dispersed Carbon Particles. J. Am. Opt. Soc., Vol. 50, No. 2, Feb. 1960, pp. 121-129.
19. Wartenberg, H. V., Optische Konstanten einiger Elemente. Verh. d. D. Physik. Ges., Vol. 12, 1910, pp. 105-120.
20. American Institute of Physics Handbook, McGraw Hill Book Company, Inc., 1957, Chapter 6, pp. 102-110.
21. Tool, A. Q.: A Method for Measuring Ellipticity and the Determination of Optical Constants of Metals. Vol. 31, No. 1, July 1910, pp. 1-25.
22. Warren, B. E.: X-Ray Diffraction Study of Carbon Black. J. Chem. Phys., Vol. 2, September 1934, pp. 551-555.
23. Gucker, F. T., and Cohn, S. H.: Numerical Evaluation of the Mie Scattering Functions; Table of the Angular Functions π_n and τ_n of Order 1 to 32, at 2.5° Intervals. Journ. Colloid. Sci., Vol. 8, No. 6, December 1953, pp. 550-574.
24. Stacey, K. A.: Light-Scattering in Physical Chemistry. Butterworths Scientific Publications, London, 1956.
25. Frazer, D. A. S.: Statistics; An Introduction. John Wiley and Sons, Inc., New York, 1958, pp. 68-70.
26. Pearson, E. S., and Hartley, H. O.: Biometrika Tables for Statisticians. Volume 1, Cambridge University Press, 1954.
27. Anon.: RCA 931-A Multiplier Phototube, Electron Tube Division, RCA, Harrison, New Jersey, 1958.
28. Tables of Spherical Bessel Functions, Vol. 1, NBS, 1946.
29. Reference Manual, 709/7090 Fortran Programming System, International Business Machines Corp., 1961.

30. Anon.: High Brightness Mercury Arc Lamps, Capillary Type A-H6 and B-H6, Application Data and Accessory Equipment. GET-1248G, Outdoor Lighting Department, General Electric Company, Hendersonville, North Carolina, 1959.

BIOGRAPHICAL NOTE

The author was born February 19, 1932 in Lansing, Michigan. He received his elementary and high school education in the public school system of Lansing and entered Michigan State College in March of 1950. He received the degree Bachelor of Science in Chemical Engineering in June of 1954 and the degree Master of Science in Chemical Engineering in the summer of 1955. In June of 1955, the author entered active duty with the United States Air Force and was assigned to work at the former National Advisory Committee for Aeronautics at Langley Field, Virginia. After completing the tour of duty in June of 1957, he entered the Graduate School of the Massachusetts Institute of Technology and received the degree Master of Science in Chemical Engineering Practice in June of 1958. The following month he returned to the National Advisory Committee for Aeronautics/National Aeronautics and Space Administration at the Langley Research Center, Langley Field, Virginia and has been employed there since. For intervals during the past few years, the author was granted graduate study leave to attend the Massachusetts Institute of Technology. He is presently engaged in hypersonic aerodynamic research at NASA, Langley Field, Virginia.

The author is a member of Tau Beta Pi, Sigma Xi, Pi Mu Epsilon, and Phi Kappa Phi. Former publications include:
Erickson, W. D.: Study of Pressure Distributions on Simple Sharp-Nosed Models at Mach Numbers From 16 to 18 in Helium Flow. NACA TN 4113. October 1957.

...more, n. s.: A Study of Equilibrium Real-Gas
Effects in Hypersonic Air Nozzles, Including Charts of Thermodynamic
Properties for Equilibrium Air. NASA TN D-231, April 1960.

Erickson, W. D.: Real-Gas Correction Factors for Hypersonic Flow Param-
eters in Helium. NASA TN D-462, September 1960.

Erickson, W. D.: Some Real-Gas Flow Parameters for Air. Readers'
Forum, Journal of the Aero/Space Sciences, Vol. 27, No. 9, pp. 716-717,
September 1960.

