22.01 Introduction to Ionizing Radiation
Fall 2003
Problem Set #4

Due Date: Wednesday, October 8, 2003

Show all work. Provide units on all answers.

1. A narrow beam of 10^4 photons per second is normally incident on a 6 mm aluminum sheet. The beam consists of equal numbers of 200 keV photons and 2 MeV photons.

a) Calculate the number of photons per second of each energy that are transmitted without interaction through the sheet.
b) How much energy is absorbed in the sheet per second?
c) How thick would a sheet of lead be if it were to have the same thickness in g/cm^2?
d) How many photons per second of each energy are transmitted without interaction through the lead sheet?

2. A 1-MeV photon is Compton scattered at an angle of 55°. Calculate
(a) the energy of the scattered photon,
(b) the change in wavelength,
(c) the angle of recoil of the electron,
(d) the recoil energy of the electron.

3. A 4-MeV photon creates an electron-positron pair in the field of a nucleus. What is the total kinetic energy of the pair?

4. An experiment is carried out with monoenergetic photons in "good" geometry. The relative count rate of the detector is measured with different thicknesses *x* of tin used as absorber. The following data are measured:

x(cm)	0	0.50	1.0	1.5	2.0	3.0	5.0
Relative count rate	1.00	0.861	0.735	0.621	0.538	0.399	0.210

(a) What is the value of the linear attenuation coefficient?
(b) What is the value of the mass attenuation coefficient?
(c) What is the photon energy?

5. A sample containing 62 grams of ^{31}P (100% abundant) is exposed to 2 x 10^{11} thermal neutrons cm^{-2} sec^{-1}. If the thermal neutron absorption cross section is 0.19 barn, how much irradiation time is required to make a 1-Ci source of ^{32}P?