

F14. An aircraft is flying at speed  $V_\infty$ , in an atmosphere with  $p_\infty$ , and  $\rho_\infty$ .

- a) What is the flight Mach number  $M_\infty$ ? Give in terms of the quantities above.
- b) Determine the stagnation pressure  $p_o$  at the nose of the aircraft in two ways:
  - i) The exact full compressible equation.
  - ii) The incompressible Bernoulli equation, pretending  $\rho = \rho_\infty$  is constant.

Plot  $p_o/p_\infty$  versus  $M_\infty$  for the two equations. Also plot the “Bernoulli error”

$$(p_o/p_\infty)_{\text{exact}} - (p_o/p_\infty)_{\text{Bernoulli}}$$

versus  $M_\infty$ . What would you judge to be a reasonable upper Mach limit on the validity of the Bernoulli equation?