

AE 3450 Thermodynamics and Compressible Flow

Sample Problems

(2nd Law of Thermodynamics, Isentropic Relations, Normal and Oblique Shocks)

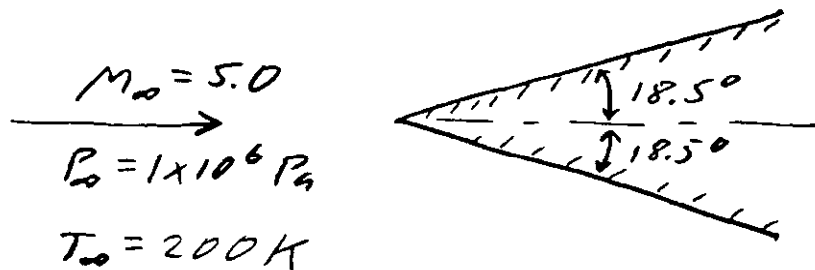
From the Black and Hartley textbook:

5.41

5.53

Problem 1

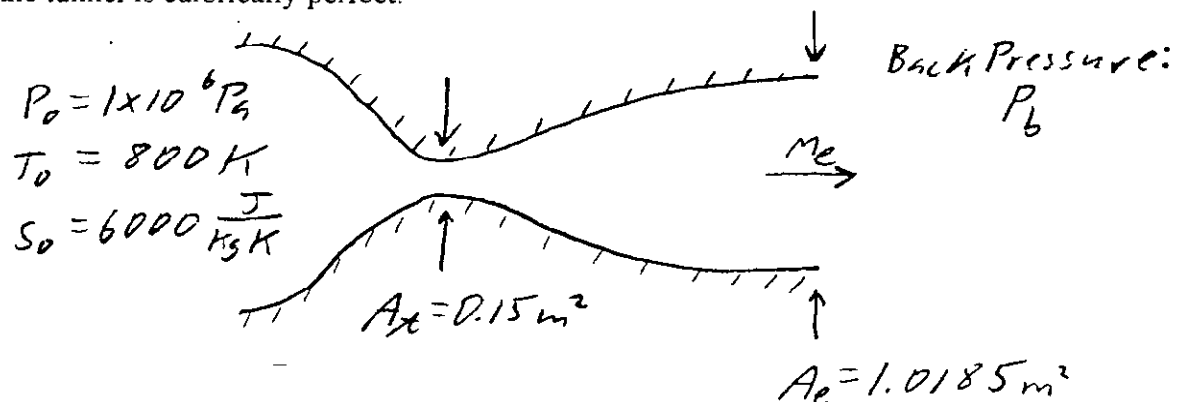
Consider calorically perfect air flowing around the wedge shown.



- Determine the pressure on the upper surface of the wedge. Note: This is the same as the pressure behind the shock wave.
- Determine the change in entropy per unit mass across the shock wave.
- Determine the range of freestream Mach number, M_∞ , for which a detached shock wave exists.
- Make a sketch of the wedge with a detached shock wave shown.
- Determine the pressure at the nose of the wedge if $M_\infty = 1.5$

Problem 2

Consider inviscid flow of air through the duct shown below. Assume that the steady air flow in the tunnel is calorically perfect.



- Find the range of back pressures, P_b , for which the flow is sonic at the throat.
- If $M_e = 3.5$, determine the density at the exit, ρ_e
- For the case described in part b, determine the mass flow rate through the throat.
- For the case described in part b, determine the entropy per unit mass at the nozzle exit.