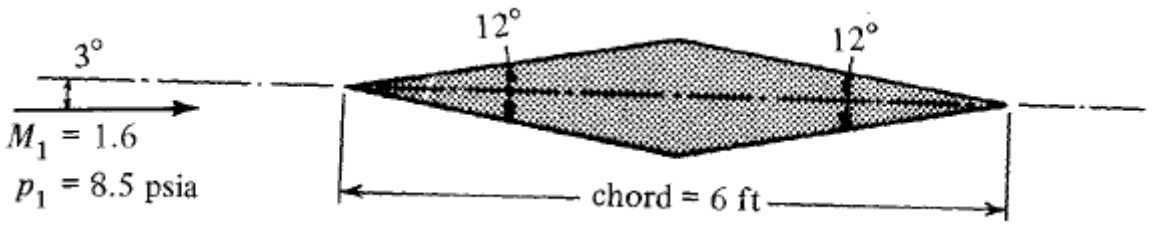
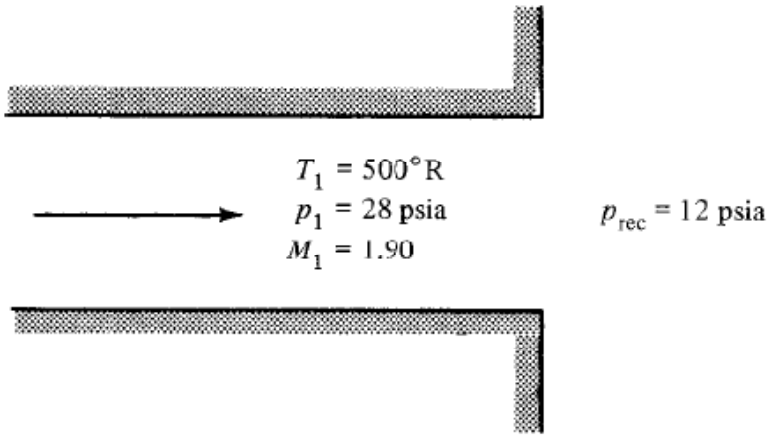
Gas Dynamics

HW Ch#4
Due Date: Final Exam Day

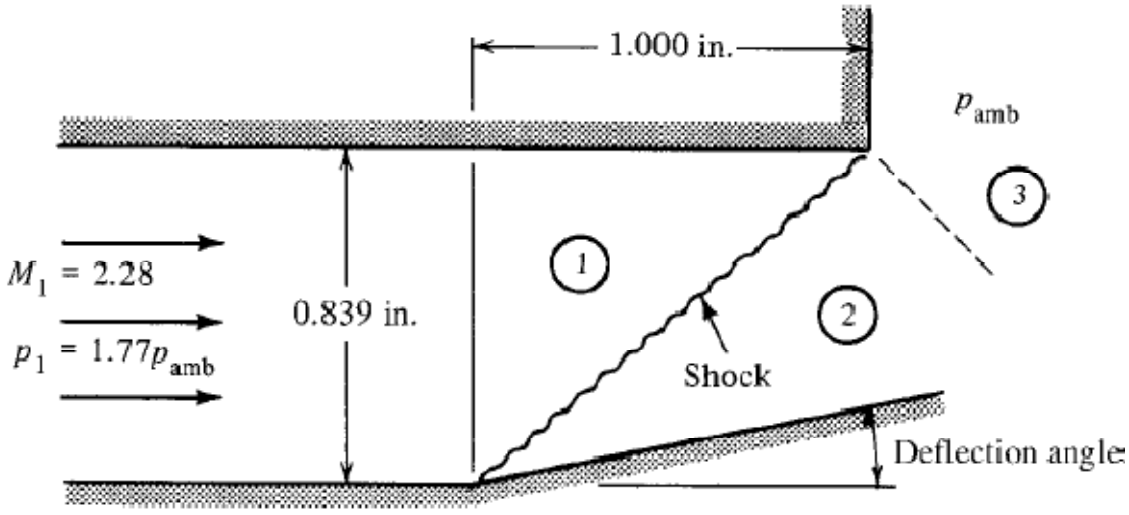
1- The symmetrical diamond-shaped airfoil shown in figure below is operating at a 3° angle of attack. The flight speed is $M = 1.8$ and the air pressure equals 8.5 psia.
(a) Compute the pressure on each surface.
(b) Calculate the lift and drag forces.
(c) Repeat the problem with a 10° angle of attack.



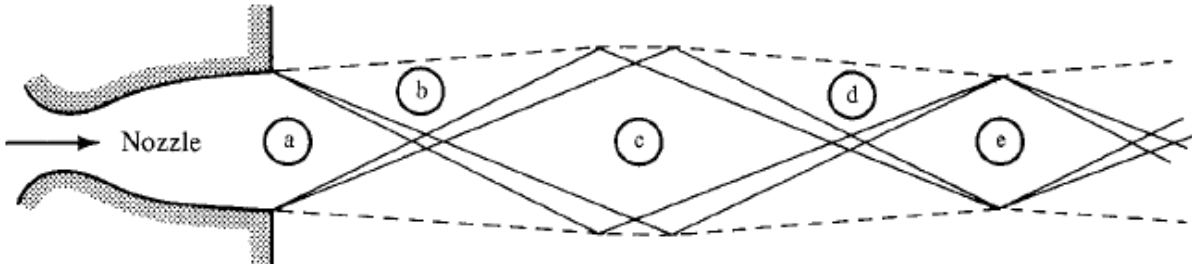
2- Properties of the flow are given at the exit plane of the two-dimensional duct shown in figure below. The receiver pressure is 12 psia.
(a) Determine the Mach number and temperature just past the exit (after the flow has passed through the first wave formation). Assume that $\gamma = 1.4$.
(b) Make a sketch showing the flow direction, wave angles, and so on.



3- Air flows in a two-dimensional channel and exhausts to the atmosphere as shown in figure below. Note that the oblique shock just touches the upper corner.
(a) Find the deflection angle.
(b) Determine M_2 and p_2 (in terms of p_{amb}).
(c) What is the nature of the wave form emanating from the upper corner and dividing regions 2 and 3?
(d) Compute M_3, p_3, and T_3 (in terms of T_1). Show the flow direction in region 3.



4- Figure below is a representation of a Schlieren photo showing a converging–diverging nozzle in operation. Indicate whether the pressures in regions a, b, c, d, and e are equal to, greater than, or less than the receiver pressure.



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The figure indicates a two-dimensional diffuser that produces no net turning of the flow. For the geometry shown, calculate the overall stagnation pressure ratio for a flight Mach number of 3.0. Neglect all losses except those occurring in the shocks. Would this diffuser be easy to start?