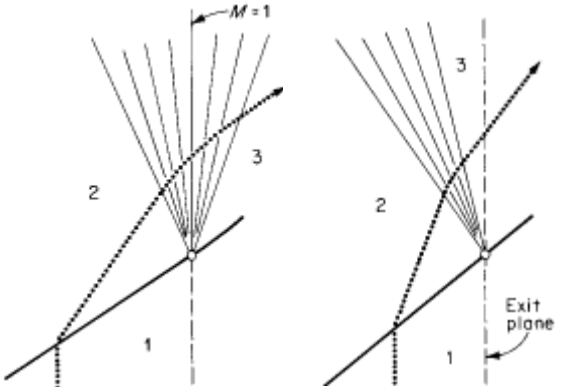
In the Name of GOD

GAS DYNAMICS

HW Chapter 7 Deadline: 25/2/1391

1- A shock travels in a tube and approaches the open end of the channel. Find the conditions within the tube after the shock reaches the exit plane, for 2 different Mach numbers:

a) M=1.25
b) M=1.5



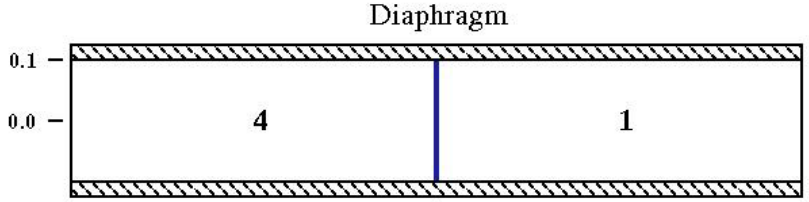
2- A piston is suddenly withdrawn with the displacement of $x=-0.5k\,t^2$, where k is a constant.

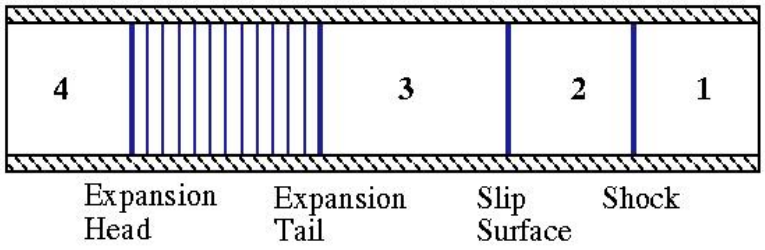
a) Plot the x-t diagram and determine simple and uniform regions.
b) Find velocity, temperature, and pressure on the piston over the time.

3- A shock with pressure ratio of $P_2/P_1=1.25$ is reflected from a rigid wall. Find the pressure behind the reflected shock;

a) From acoustic (linear) theory
b) From shock theory

4- Analysis of a Shock Tube: Consider the specific case of a 1-D shock tube. A membrane located at x = 0.5 separates two regions of air; the region to the right (region 1) is at atmospheric pressure (10^5 Pa) and T= 416.0 K, and the region at the left (region 4) is pressurized to 10^6 Pa and T= 520.0 K. At t = 0, the membrane is ruptured. (**40 pts**)





(a) Plot x-t diagram after rupture.

(b) What is pressure behind the moving shock?

(c) What is the shock speed (c_S) of the moving shock front?

(d) What is the induced velocity behind the moving shock?

(e) What is the speed of propagation of the leading edge of the expansion wave? the speed of the trailing edge?

(f) Plot the velocity distribution in the shock tube 0.5 seconds after the membrane has been ruptured.

(g) What is the temperature and density ratio across the shock and expansion fan?

(h) Coding: Code the solution of an arbitrary shock tube problem, using input parameters for regions 1 and 4 and provide all properties at regions 2 and 3. Plot distributions of properties with time.