Exercise for Module - 3

Answer the following

1. With the help of the wave diagram explain the waves in the shock tube on rupture of its diaphragm.
2. Graphically show the variation of the ratios of temperature, pressure and density across the moving shock against the shock Mach number.
3. Derive an equation for the gas particle velocity behind the moving shock.
4. The gas particle velocity behind the moving shock increases with increasing shock speed, but the corresponding Mach number does not. Why?
5. What is the equation for the diaphragm pressure ratio in terms of the shock Mach number
6. For the given pressure ratio across the diaphragm of a shock tube, how can shocks of different strengths be generated?
7. What the feature of gas behind the reflected shock?
8. Sketch the boundary layer developed in the shock tube on diaphragm rupture.
9. What factors decide the observation time in a shock tube?
10. What is the effect of boundary layer on the observation time?
11. Unless special care is taken, the reflected shock does not pass through the contact surface without additional waves. Elucidate.
12. Why is shock velocity measurement very important in shock tube experiments? How is the velocity measured conventionally?

Work out the following numerical problem

1. In a shock tube experiment using air at $1\times10^5\,\mathrm{N/m^2}$ and 310K as the test gas, a pressure ratio of 29 across the wave was observed. Find the stagnation temperature and pressure behind the propagating shock wave.