1. One mole of a monatomic perfect gas initially at temperature T_0 expands from volume V_0 to $2V_0$ (a) at constant temperature, (b) at constant pressure. Calculate the work of expansion and the heat absorbed by the gas in each case.

2. For a diatomic ideal gas near room temperature, what fraction. of the heat supplied is available for external work if the gas is expanded at constant pressure? At constant temperature?

3. For an ideal gas initially at $T_i = 0°C$, find the final temperature T_f (in $°C$) when the volume is expanded from V_0 to $10V_0$ reversibly and adiabatically.

4. An ideal gas with γ as the ratio of specific heats, is contained in a large jar of volume V_0. Fitted to the jar is a glass tube of cross-sectional area A in which a metal ball of mass m is fitted. The equilibrium pressure inside the jar is slightly large compared to the atmospheric pressure p_0. If the ball is displaced from its position, then it performs a simple harmonic motion. Determine the frequency of oscillation, assuming that the process is adiabatic.

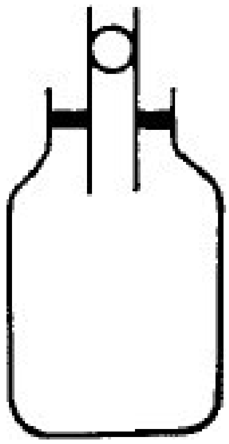

Figure 1: Schematic illustration for problem 4

5. 10 litres of gas at atmospheric pressure is compressed isothermally to a volume of 1litre and then allowed to expand adiabatically to 10 litres.
   a) Sketch the processes on a pV diagram for a monatomic gas.
   b) Make a similar sketch for a diatomic gas.
   c) Is a net work done on or by the system?
   d) Is it greater or less for the diatomic gas?

6. A Carnot engine has a cycle as shown in the figure below. If W and W' represent the work done by 1 mole of monoatomic and diatomic gas respectively, calculate the ratio W'/W.

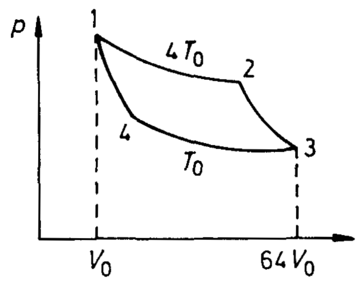

Figure 2: Schematic illustration for problem 6