Assignment 6

1. Ideal Gas
   a) Find the number density of an ideal gas at STP.
   b) In vacuum technology, the gas pressure is measured in torr. (1 atm = 760 torr).
      i. Find the number density at 1 torr.
      ii. Find the number density at 10^{-7} torr, a typical laboratory pressure.

2. Steam in a pipe is at a high pressure of 100 atm such that its molar volume is only 0.3 liters. The van der Waals constants for steam are a = 5.5 liters^2 mole^{-2} atm and b = 0.030 liter/mole. Evaluate $c_p - c_v$ and compare this to R.

3. The molar heat capacity at constant volume for a gas is measured to be $c_v = 33.3$ J mole^{-1} °C^{-1}
   a) Does the gas consist of monatomic or polyatomic molecules?
   b) How many degrees of freedom does one molecule have?

4. Estimate the sea level rise using the diagram below due to an increase in the ocean temperature by 2 °C assuming the average ocean temperature is a) 6 °C and b) 10 °C.

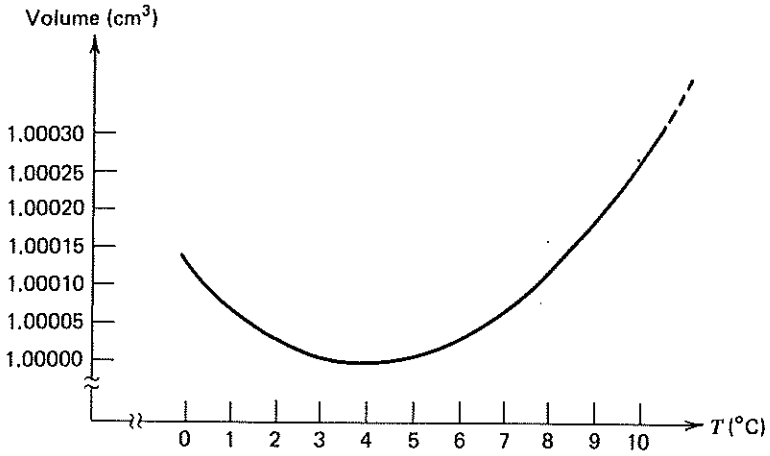

Figure 10.4 Plot of the volume of one gram of water versus temperature. Its volume decreases with increased temperature between 0 and 4°C, and then increases after that.

5. A certain solid is not isotropic. Calculate the coefficient of volume expansion if the linear expansion coefficients are as follows.

   $\alpha_x = 0.5 \times 10^{-6}$ °C^{-1} $\quad \alpha_y = 1.5 \times 10^{-6}$ °C^{-1} $\quad \alpha_z = 2 \times 10^{-6}$ °C^{-1}

6. Suppose the equation of state for some system was $p^2\, T^{-1/3}\, e^{aV} = b$ where a and b are constants.
   a) Write this in differential form, expressing dV in terms of dT and dP.
   b) Express the isothermal compressibility in terms of T, V and P.
   c) Express the coefficient of volume expansion in terms of T, V and P.