Physical Chemistry Worksheet – Chem1012 and friends

1. a) What is an ideal gas?
   b) When is it suitable to assume idea gas behaviour?

2. Write the following values in terms of Force (N) and length (m):

   1 Pa  1 Pa * m  1 Joule  1 kPa . L

   What values for pressure, temperature and volume do you use for calculations with the gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$?

   Which do you use for $R = 0.08206 \text{ L atm K}^{-1} \text{ mol}^{-1}$?

3. Wentworth Shire Council in New South Wales has started a solar tower energy project. Sunlight is captured in large greenhouse canopy in the ground, which heats the air inside the canopy and forces it to move upward through a tall thin tower that contains a turbine (see diagram below). The temperature in the canopy is 35° hotter than the outside air and moves through the tower/turbine at a velocity of approximately 15m/s.

   Compared to air at Room Temperature and Pressure (25° C and 1 atm), what is the increase in volume that results from heating in L/mol (neglect pressure changes)?

   What is the change in enthalpy for one mole of air if the specific heat of air is approximately 30 J/mol K?

   When the prototype is running at midday it produces 50 kW (1 Watt = 1 J/s) of electricity from the 378 kW of energy it receives from the sun’s rays. How much heat is lost to the atmosphere? Give it the appropriate sign (negative or positive) if the tower is the system.

   * If the air flows through the cylindrical tower at a rate of 76.29 kmol/minute, what is the radius of the tower?