Chemistry 1a – 2011. Unit 2, Homework No. 1: Gases

Date issued: Monday, October 4, 2011. This homework is due on or before October 7, 5:00 pm. Late homework assignments will not be graded. Solutions will be available one day after the due date.

1. An ideal gas at 7^oC is in a spherical flexible container having a radius of 1.00 cm. The gas is heated at constant pressure to 88^oC. Determine the radius of the spherical container after the gas is heated. (Hint: volume of a sphere = $(4/3)\pi r^3$).

2. A sample of methane (CH_4) gas contains a small amount of helium. Calculate the volume percentage of helium if the density of the sample is 0.70902 g/L at STP.

3. Air bags are activated when a severe impact causes a steel ball to compress a spring and electrically ignite a detonator cap. This action causes sodium azide (NaN_3) to decompose explosively according to the following reaction:

   $$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$$

   What mass of $NaN_3(s)$ must be reacted to inflate an airbag to 70.0 L at STP?

4. Use the data in Table 5.4 in your textbook to calculate the partial pressure of He in dry air assuming that the total pressure is 1.0 atm. Assuming a temperature of 25^oC, calculate the number of He atoms per cubic centimeter.

5. (a) Calculate the work involved when one mole of an ideal gas is compressed irreversibly from 1.00 bar to 5.00 bar at a constant temperature of 300 K. (b) Calculate the work involved when one mole of in ideal gas is expanded irreversibly from 20.0 dm^3 to 40.0 dm^3 at a constant temperature of 300 K.

6. Consider an ideal gas that occupies 2.25 L at 1.33 bar. Calculate the work required to compress the gas isothermally to a volume of 1.50 L at a constant pressure of 2.00 bar followed by another isothermal compression to 0.800 L at a constant pressure of 2.50 bar. Compare this value to the one obtained when the gas is compressed in a single step from 2.25 L to 0.800 L. Comment on the difference.