HW 17

The mole, molar gas volume, Clapeyron-Mendeleev equation

- To calculate masses of products and reactants using *balanced* chemical equations we use a unit called **mole**. One mole of a substance is the amount whose mass equals the molecular or atomic weight (in atomic mass units, amu) of the substance **expressed in grams**. This means that molecular weight of any substance in amu (from periodic table) is equal to molar weight in grams.
- *A mole of anything has 6.022 x 10^{23} particles*. This is called Avogadro's number, after Amedeo Avogadro, who first suggested that equal volumes of gas have equal numbers of molecules.
- 1 mole of any gas takes a volume of 22.4 liters at "normal conditions ". This is a molar gas volume under the normal conditions. Normal conditions are temperature of 0^{o}C (273 K) and pressure of 1 atm (101 325 Pa)
- For conditions that differ from normal we use Clapeyron-Mendeleev equation:
  pV = nRT
  n – gas mole number
  p – gas pressure (atm)
  V – gas volume (liters)
  T – temperature (K)
  R – gas constant (0.0821 l x atm/mole x K)

1. How much oxygen (in kg) does a car consumes between two fillings of its gas tank?

The equation for combustion is:

$2C_8H_{18} + 25\ O_2 = 16\ CO_2 + 18\ H_2O$

This means that the combustion of 2 molecules of gas requires 25 molecules of oxygen. An average tank of a car takes 40 L of gas. The density of gas is 0.7 kg/L.

2. Insert the missing equation coefficients:

? $Mg + O_2 = 2MgO$

? $Fe + 3\ Cl_2 = ?FeCl_3$

? $Al + ?\ S = Al_2S_3$

? $Cu + ?\ O_2 = ?CuO$

$P + N_2O = N_2 + P_2O_5$ (use the electron balance and show your work)

$NH_3 + O_2 = NO + H_2O$ (use electron balance and show your work)

3. What number of moles of Cr (52 amu) is in 20.8 g of this metal?
4. An explosion took place because of the following two reactions:

   $Na + H_2O = H_2 + NaOH$

   $2H_2 + O_2 = 2\ H_2O$ (explosion)

   Find equation coefficients for the first equation and calculate how much (by volume) hydrogen exploded if 2.3 g of Na reacted.