HW 18

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^oC (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. A person needs about 1 mole of oxygen per hour to breath. Calculate how much Na_2O_2 will be needed for a 24-h trip in a single-person submarine using the following equation:

$$Na_2O_2 + CO_2 \rightarrow Na_2CO_3 + O_2$$

2. How many moles of oxygen are in an oxygen tank of 40 L if the oxygen is under a pressure of 150 atm at 20^oC? How much air (m^3) were used to obtain this oxygen? (Assume that oxygen makes up 21% by volume of air.)
3. There are 10 g of each: $KMnO_4$, $KClO_3$, KNO_3 in the lab. How many liters of oxygen can be obtained from each of these reagents? Use the following equations:

$$2KMnO_4 \text{ -> } K_2MnO_4 + MnO_2 + O_2$$

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

$$2KNO_3 \rightarrow 2KNO_2 + O_2$$