HW 16

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. 4 g of hydrogen (H_2) were mixed with 64 g of oxygen (O_2). The mixture exploded forming water (H_2O). Write down the equation of the chemical reaction. How many grams of water did form? How many grams of oxygen remained unreacted?
2. There are 180 g of water in a glass. How many molecules are there? How many moles?
3. The lesser is the density of a gas the better is the lifting force of a hot air balloon filled with it. What is the density of hydrogen (H_2) in (g/L)? What is the density of helium (He) in (g/L)? What gas is more advantageous to use for a hot air balloon?
4. A gas has a density of 3.17 g/L under normal conditions. What is its molar mass and molecular weight? What is the gas? Write down its formular using periodic table of elements. Hint: it has two identical atoms in a molecule.
5. Determine the molar mass of a gaseous compound of oxygen and nitrogen with a density of 1.34 g/L under normal conditions. What is its molecular formula?
6. A steel container with the volume of 40 L is filled with hydrogen under a pressure of 60 atm and at a temperature of 25^oC. How many moles of hydrogen are in the container? How many grams? What volume this hydrogen will take under normal conditions?