Chemistry 11

Calculations Involving Multiple Conversions and Introducing Molarity

Recall that the molar mass (M) of a substance is weight in grams of any compound per one mole value. The molar mass can be found by adding the atomic mass of all of the elements present in a compound. For example, the molar mass of of Hydrogen Peroxide (H_2O_2) is as follows:

Hydrogen Peroxide → H_2O_2

- Hydrogen has an atomic mass of 1.0, and in this specific compound, we have 2 hydrogen atoms
- Oxygen has an atomic mass of 16.0, and in this specific compound, we have 2 oxygen atoms
- Therefore, our total weight in grams is: (2 x 1.0) + (2 x 16.0) = 34.0
- The molar mass of hydrogen peroxide is 34.0 g/mol

That means that in 1 mole of hydrogen peroxide, we have a mass of 34 grams.

Conversion Factors

1. There are 22.4L of gas in 1 mole of any gas at STP

$$\frac{22.4L}{1\,mol}$$

2. There are 6.02 x 10^{23} particles in 1 mole of any substance

$$\frac{6.02\times10^{23}}{1\,mol}$$

3. Molar Mass corresponds to the specific weight per 1 mole of a substance

$$\frac{specific\ weight\ in\ grams}{1\,mol}$$

Practice.

1. Find the molar mass of copper (II) sulfate pentahydrate?

2. How many moles are in 132g of carbon dioxide?

3. How many atoms are in 216g of pure silver?

4. How many atoms are in 50g of N_2?

5. What is the mass of 200 molecules of methane?

Molarity

Molarity of a substance refers to the molar concentration. That is, the amount of a substance that is present in a given volume of solution. Solutions can be either concentrated (high molarity) or dilute (low molarity).

$$C = \frac{n}{V}$$

C = Molar concentration
n = number of moles
V = Volume in litres

C gives us an answer with units of mol/L, which is read as "Molar"
For example, a 0.1M solution contains 0.1 mol of a substance in 1L of solution.

Chemistry 11

Example 1.

0.1M of NaOH contains 0.1 mol in 1L which is exactly 4.0g of NaOH. We use square brackets to express "molar concentration of"

- 0.1M solution
- [NaOH] = 0.1 M
- The molarity of NaOH is 0.1 molar
- C = 0.1 M

These values are all different ways of stating the same information!!

Example 2.

Find the molar concentration of a solution that contains 12g of NaOH in 250 ml of solution.

Step 1. The molar mass of NaOH is 40g/mol

Step 2. Find the number of moles: 12g x $\frac{1\ mol}{40g}$ = 0.3 mol

Step 3. Find the amount of solution in litres: 250ml x $\frac{1L}{1000ml}$= 0.25L

Step 4. Solve for molar concentration:

$C = \frac{n}{V}$ $C = \frac{0.3\ mol}{0.25L}$ *C* = 1.2 mol/L

The solution is 1.2 molar

Example 2.

Find the mass of KOH in 500 ml of 0.3M solution.

$C = \frac{n}{V}$ $0.3M = \frac{n}{0.5L}$ n = 0.15 mol

The molar mass of KOH is 56.1 g

0.15 mol x $\frac{56.1\ g}{1\ mol}$ = 8.42 g

There are 8.42 grams in the solution.

Chemistry 11

Practice.

1. Find the molarity of a solution that is made by dissolving and diluting 30g of NaOH in 1L of solution.

2. Find the molarity of hydrochloric acid that has a density of 1.03g/ml.

3. What is the molarity of pure sulfuric acid, H_2SO_4, having a density of 1.839 g/ml?

HW page 88 # 35 – 40, page 98 #59