The Mole and Related Calculations

1. What is a mole?

   A mole is a convenient way of describing a very large quantity.

   1 mole = 6.022×10^{23} particles
   (6.022×10^{23} is known as Avogadros'number)

2. How does the molecular formula relate to the number of moles?

   The molecular formula indicates the number of individual atoms of a particular element in a given molecule. This value is directly equal to the number of moles of a given element within a mole of a molecule.

   For example, in C_6H_6, there are 6 carbon atoms in every one molecule of C_6H_6. This can also be understood as 6 moles of carbon for every mole of C_6H_6.

3. What is the molar mass of a compound?

   It is the $\frac{number\ of\ grams}{mole}$ of a given substance.

   Molar mass = (Number of moles of element 1 in compound)(atomic mass of element 1) + (number of moles of element 2 in compound)(atomic mass of element 2)+….

   Atomic mass of each element is obtained from the periodic table.

a. Calculate the molar mass of C_6H_6.

$$(6 \text{ moles of Carbon})\frac{(12.01g)}{(\text{mole})} + (6 \text{ moles of hydrogen})\frac{(1.01g)}{(\text{mol})} = 78.12 \text{ g/mole}$$

4. In 3.35×10^{22} total atoms of CH_3OH there are how many

a. Molecules

$$(3.35 \times 10^{22} \text{ total atoms})\frac{(1 \text{ molecule})}{(6 \text{ total atoms})} = 5.58 \times 10^{21} \text{ molecules of } CH_3OH$$

b. Moles

$$5.58 \times 10^{21} \text{ molecules } CH_3OH \quad \frac{1 \text{ mole } CH_3OH}{6.022 \times 10^{23} \text{ molecules } CH_3OH} = \boxed{0.00927 \text{ moles } CH_3OH}$$

c. Grams

$$0.00927 \text{ mol } CH_3OH \quad \frac{32.05 \text{ g } CH_3OH}{\text{mole } CH_3OH} = \boxed{0.297 \text{ g } CH_3OH}$$

For this problem you needed to solve for the molar mass of the CH_3OH first – using techniques already discussed.

5. How many grams of $FeCl_3$ contain the same the number of total ions as 5.85g of Al_2SO_4?

$$5.85 \text{ g } Al_2SO_4 \quad \frac{1 \text{ mol } Al_2SO_4}{150.03 \text{ g } Al_2SO_4} \quad \frac{3 \text{ mol ions}}{1 \text{ mol } Al_2SO_4} \quad \frac{1 \text{ mol } FeCl_3}{4 \text{ mol ions}} \quad \frac{162.2 \text{ g } FeCl_3}{1 \text{ mol } FeCl_3} = 4.74 \text{ g } FeCl_3$$

6. How many atoms of oxygen are contained 14.82 g of $C_6H_{12}O_6$?

$$14.82 \text{ g } C_6H_{12}O_6 \times \frac{1 \text{ mol } C_6H_{12}O_6}{180.18 \text{ g } C_6H_{12}O_6} \times \frac{6 \text{ mol O}}{1 \text{ mol } C_6H_{12}O_6} \times \frac{6.022 \times 10^{23} \text{ atoms O}}{1 \text{ mol O}} = 2.972 \times 10^{23} \text{ atoms O}$$