



## II. Short Answer Type Questions

Question 1. Define molality. How does molality depend on temperature?

Answer: Molality is defined as the moles of solute per kilogram of solvent.

$$\text{Molality} = m = \frac{\text{Moles of solute}}{\text{Mass of solvent (in kg)}}$$

Molality of a solution does not depend on temperature.

Question 2. Convert 2.6 minutes in seconds.

Answer:

We know that, 1 min = 60 s

Conversion factor = 60 s/(1min)

2.6 min = 2.6 min  $\times$  conversion factor = 2.6  $\times$  60s/1min = 156 s.

Question 3. Express the following up to four significant figures.

(i) 6.5089                      (ii) 32.3928                      (iii)  $8.721 \times 10^4$                       (iv) 2000

Answer:

(i) 6.509                      (ii) 32.39                      (iii)  $8.721 \times 10^4$                       (iv)  $2.000 \times 10^3$

Question 4. Calculate the number of moles in each of the following.

Answer:

- (i) 392 g of sulphuric acid
- (ii) 44.8 litres of sulphur dioxide at N.T.P.
- (iii)  $6.022 \times 10^{22}$  molecules of oxygen
- (iv) 8g of calcium

(i) 392 g of sulphuric acid

Molar mass of  $\text{H}_2\text{SO}_4 = 2 \times 1 + 32 + 4 \times 16 = 98 \text{ g}$

98 g of sulphuric acid = 1 mol

392 g of sulphuric acid = 1 mol  $\times \frac{392 \text{ g}}{(98 \text{ g})} = 4 \text{ mol}$

(ii) 44.8 litres of sulphur dioxide at N.T.P.

22.4 litres of sulphur dioxide at N.T.P. = 1 mol

44.8 litres of sulphur dioxide at N.T.P. =  $\frac{1 \text{ mol}}{(22.4 \text{ L})} \times (44.8 \text{ L}) = 2.0 \text{ mol}$

(iii)  $6.022 \times 10^{22}$  molecules of oxygen

$6.022 \times 10^{23}$  molecules of oxygen = 1 mol

$6.022 \times 10^{22}$  molecules of oxygen = 1 mol  $\times \frac{6.022 \times 10^{22}}{6.022 \times 10^{23}} = 0.1 \text{ mol}$

(iv) 8g of calcium

Gram atomic mass of Ca = 40 g

40 g of calcium = 1 mol

8.0 g of calcium = 1 mol  $\times \frac{(8.0 \text{ g})}{(40 \text{ g})} = 0.2 \text{ mol}.$

Question 5. A compound on analysis was found to contain C =

34.6%, H = 3.85% and O = 61.55%. Calculate the empirical formula.

Answer: Step I. Calculation of simplest whole number ratios of the elements.

Element	Percentage	Atomic Mass	Gram atoms (Moles)	Atomic ratio (Molar ratio)	Simplest whole no. ratio
C	34.6	12	$\frac{34.6}{12} = 2.88$	$\frac{2.88}{2.88} = 1$	3
H	3.85	1	$\frac{3.85}{1} = 3.85$	$\frac{3.85}{2.88} = 1.337$ or $\frac{4}{3}$	4
O	61.55	16	$\frac{61.55}{16} = 3.85$	$\frac{3.85}{2.88} = 1.337$ or $\frac{4}{3}$	4

The simplest whole number ratios of the different elements are:

C:H:O::3:4:4

Step II. Writing the empirical formula of the compound.

The empirical formula of the compound =  $C_3H_4O_4$ .

Question 6. Calculate:

(a) Mass of 2.5 gram atoms of magnesium,

(b) Gram atom in 1.4 grams of nitrogen (Atomic mass Mg = 24, N = 14)

Answer:

(a) 1 gram atom of Mg = 24g

2.5 gram atoms of Mg =  $24 \times 2.5 = 60g$

(b) 1 gram atom of N = 14g;

14g of N = 1 gram atom

1.4g of N =  $\frac{1}{14} \times 1.4 = 0.1$  gram atom.

Question 7. The density of water at room temperature is 1.0 g/mL.

How many molecules are there in a drop of water if its volume is 0.05 mL?

Answer:

Volume of a drop of water = 0.05 mL

Mass of a drop of water = Volume  $\times$  density  
 $= (0.05 \text{ mL}) \times (1.0 \text{ g/mL}) = 0.05 \text{ g}$

Gram molecular mass of water ( $H_2O$ ) =  $2 \times 1 + 16 = 18 \text{ g}$   
 18 g of water = 1 mol

0.05 g of water =  $\frac{1 \text{ mol}}{18 \text{ g}} \times (0.05 \text{ g}) = 0.0028 \text{ mol}$

No. of molecules present

1 mole of water contain molecules =  $6.022 \times 10^{23}$

0.0028 mole of water contain molecules =  $6.022 \times 10^{23} \times 0.0028 = 1.68 \times 10^{21}$  molecules.

Question 8. What is the molecular mass of a substance each molecule of which contains 9 atoms of carbon, 13 atoms of hydrogen and  $2.33 \times 10^{-23} \text{ g}$  other component?

Answer:

Mass of 9 atoms of carbon =  $9 \times 12 \text{ amu} = 108 \text{ u}$ .

Mass of 13 atoms of hydrogen =  $13 \times 1 \text{ amu} = 13 \text{ u}$

Mass of  $2.33 \times 10^{-23} \text{ g}$  of other component =  $(1 \text{ u}) \times \frac{(2.33 \times 10^{-23} \text{ g})}{(1.66 \times 10^{-24} \text{ g})} = 14.04 \text{ u}$

Molecular mass of the substance =  $(108 + 13 + 14.04) \text{ u} = 135.04 \text{ u}$ .

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