



## CHEMISTRY OF CLASS XI

### CHAPTER – 1 SOME BASIC CONCEPTS OF CHEMISTRY

**Q.1. In the combustion of methane, what is the limiting reactant and why?**

**Ans.** Methane is the limiting reactant because the other reactant is oxygen of the air which is always present in excess. Thus, the amounts of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  formed will depend upon the amount of  $\text{CH}_4$  burnt.

**Q.2. Volume of a solution changes with change in temperature, then, will molality of the solution be affected by temperature? Give reason for your answer.**

**Ans.** No, molality of solution does not change with temperature since mass remains unaffected with temperature.

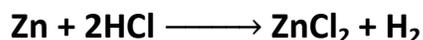
**Q.3. What do you understand by stoichiometric coefficients in a chemical equation?**

**Ans.** The coefficients of reactants and products involved in a chemical equation represented by the balanced form, are known as stoichiometric coefficients.

e.g.,  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$

The stoichiometric coefficients are 1,3 and 2 respectively.

**Q.4. Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated zinc. Following reaction takes place.**



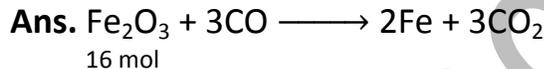
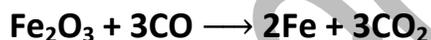


Calculate the volume of hydrogen gas liberated at STP when 32.65 g of zinc reacts with HCl. 1 mole of a gas occupies 22.7 L volume at STP ; atomic mass of Zn = 65.3 u.

**Ans.** From the equation, 65.3 g of zinc liberates 22.7 L of hydrogen.

$$\begin{aligned}\text{So, 32.65 g of zinc will liberate H}_2 &= 32.65 \text{ g} \times \frac{22.7\text{L}}{65.3 \text{ g}} \\ &= \frac{22.7}{2} \text{ L} \\ &= 11.35 \text{ L}\end{aligned}$$

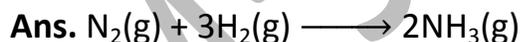
**Q.5.** How many moles of iron can be made  $\text{Fe}_2\text{O}_3$  by the use of 16 moles of carbon monoxide in the following reaction?



3 moles of CO are used to make 2 mole of Fe.

$$\therefore 16 \text{ moles of CO are used to make } \frac{2}{3} \times 16 = 10.67 \text{ mol}$$

**Q.6.** If 2 L of  $\text{N}_2$  is mixed with 2 L of  $\text{H}_2$  at a constant temperature and pressure, then what will be the volume of  $\text{NH}_3$  formed ?



1 L of  $\text{N}_2$  reacts with 3 L of  $\text{H}_2$ .

$\therefore$  2 L of  $\text{N}_2$  will react with 6 L of  $\text{H}_2$  but we have only 2 L of  $\text{H}_2$ , therefore,  $\text{H}_2$  is the limiting reactant.

3 L of  $\text{H}_2$  gives 2 L of  $\text{NH}_3$ .

$$\therefore 2 \text{ L of H}_2 \text{ gives } = \frac{2}{3} \times 2 = \frac{2}{3} \times 2 = \frac{4}{3} = 1.33 \text{ L of NH}_3$$



**Q.7. How much copper can be obtained from 100 g of copper sulphate ( $\text{CuSO}_4$ ) ?**

**Ans.** Molar mass of  $\text{CuSO}_4 = 63.54 + 32.06 + (4 \times 16)$

$$= 159.6 \text{ g mol}^{-1}$$

159.6 g  $\text{CuSO}_4$  contains 63.54 g Cu

$$1 \text{ g CuSO}_4 \text{ will contain } \frac{63.54}{159.6} \text{ g Cu}$$

$$\therefore 100 \text{ g CuSO}_4 \text{ will contain } \frac{63.54 \times 100}{159.6} = 39.81 \text{ g Cu}$$

**Q.8. What is the concentration of sugar ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) in  $\text{mol L}^{-1}$  if its 20 g are dissolved in enough water to make a final volume up to 2 L?**

**Ans.** Molar mass of the sugar,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$

$$m = (12 \times 12.01) + (22 \times 1.0079) + (11 \times 16.00)$$

$$= 342.2938 \text{ g mol}^{-1} = 342$$

Given,  $w = 20 \text{ g}$ ,  $V = 2 \text{ L}$

$$\text{Molarity} = \frac{w}{m \times V(L)} = \frac{20}{342 \times 2}$$

$$= 0.0292 \text{ mol L}^{-1}$$

$$= 0.0292 \text{ M}$$

**Q.9. How are 0.50 mole  $\text{Na}_2\text{CO}_3$  and 0.50 M  $\text{Na}_2\text{CO}_3$  different?**

**Ans.** Molar mass of  $\text{Na}_2\text{CO}_3 = (2 \times 22.99) + 12.01 + (3 \times 16)$

$$= 105.99 \approx 106 \text{ g mol}^{-1}$$

0.50 mole  $\text{Na}_2\text{CO}_3 = 0.50 \times 106 = 53 \text{ g Na}_2\text{CO}_3$

0.50 M  $\text{Na}_2\text{CO}_3$  means 53 g  $\text{Na}_2\text{CO}_3$  is present in 1 L of the solution.

**Q.10. How many gram of  $\text{Na}_2\text{CO}_3$  should be dissolved to make  $100 \text{ cm}^3$  of 0.15 M  $\text{Na}_2\text{CO}_3$  solution?**



**Ans.**  $1000 \text{ cm}^3$  of  $0.15 \text{ M Na}_2\text{CO}_3$  contains  $\text{Na}_2\text{CO}_3 = 0.15 \text{ mol}$

$100 \text{ cm}^3$  of  $0.15 \text{ M Na}_2\text{CO}_3$  will contain  $\text{Na}_2\text{CO}_3 = \frac{0.15}{1000} \times 100 = 0.015 \text{ mol}$

(Molar mass of  $\text{Na}_2\text{CO}_3 = 106 \text{ g mol}^{-1}$ )

Mass of  $\text{Na}_2\text{CO}_3 = 0.015 \times 106 = 1.59 \text{ g}$

**Q.11. Commercially available concentrated hydrochloric acid contains 38% HCl by mass.**

**(i) What is the molarity of the solution (density of solution =  $1.19 \text{ g mL}^{-1}$ )?**

**Ans.** (i) 38% HCl by mass means 38 g of HCl is presented in 100 g of solution.

Volume of solution =  $\frac{\text{mass}}{\text{density}} = \frac{100}{1.19} = 84.03 \text{ mL}$

Moles of HCl =  $\frac{38}{36.5} = 1.04$

Molarity =  $\frac{1.04 \times 1000}{84.03} = 12.38 \text{ M}$

**Q.12. If the density of methanol is  $0.793 \text{ kg L}^{-1}$ , what is its volume needed for making 2.5 L of its 0.25 M solution?**

**Ans.** Given,  $d = 0.793 \text{ kg L}^{-1} = 0.793 \times 10^3 \text{ g L}^{-1}$

Final volume,  $V_2 = 2.5 \text{ L}$

Final molarity,  $M_2 = 0.25 \text{ M}$

Molarity of initial solution  $M_1 = ?$

Initial volume  $V_1 = ?$

Molar mass of methanol,

$\text{CH}_3\text{OH} = (1 \times 12.01) + (4 \times 1.0079) + 16.00$

$= 32.0416 = 32 \text{ g mol}^{-1}$



$$\text{Molarity} = \frac{0.793 \times 10^3 \text{ g L}^{-1}}{32 \text{ g mol}^{-1}} = 24.281 \text{ mol L}^{-1}$$

$$M_1 V_1 = M_2 V_2$$

$$24.781 \times V_1 = 0.25 \times 2.5$$

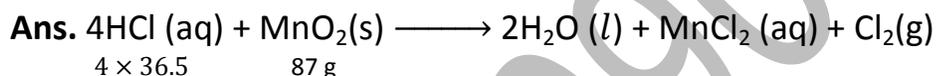
$$V_1 = \frac{0.25 \times 2.5}{24.781} = 0.02522 \text{ L}$$

$$= 25.22 \text{ ml}$$

**Q.13.** Chlorine is prepared in the laboratory by treating manganese dioxide ( $\text{MnO}_2$ ) with aqueous hydrochloric acid according to the reaction,



How many gram of HCl reacts with 5.0 g of manganese dioxide?



According to the balance chemical equation,

87 g of  $\text{MnO}_2$  reacts with  $4 \times 36.5$  g HCl

5 g of  $\text{MnO}_2$  will react with

$$\frac{4 \times 36.5 \times 5}{87} = 8.39 \text{ HCl}$$

**Q.14.** Ravi is the Mr. Sharma's grandson. He take him regularly for routine check up to doctor. One time doctor reporter that his blood sugar level is  $10 \text{ mmol L}^{-1}$ . Note that a person is declared as a diabetic if his blood sugar level exceeds 160 mg/dL when tested 2 hours after meals.

(i) Convert the blood sugar level of his grand father in mg/dL units.

(ii) Is his grandfather diabetic?

(iii) What cares should be taken in case of diabetes?



**(iv) What values are exhibited by Ravi?**

**Ans.** (i) Molar mass of glucose ( $C_{16}H_{12}O_6$ ) =  $180 \text{ g mol}^{-1}$

i.e.,  $1 \text{ mol} = 180 \text{ g}$

$\therefore 1 \text{ mmol} = 180 \text{ mg}$  or  $1 \text{ mmol L}^{-1} = 18 \text{ mg/dL}$

$\therefore 10 \text{ mmol L}^{-1} = 10 \times 18 \text{ mg/dL}$

$= 180 \text{ mg/dL}$

(ii) Since his blood sugar level is  $180 \text{ mg/dL}$ , so he is diabetic.

(iii) Diabetic patient should take low calorie and low carbohydrate food. Food should be rich in fibres.

(iv) He is loving and careful about his grandfather's health.

**Q.15. (i) A sample of drinking water was found to be severely contaminated with chloroform,  $CHCl_3$ , supposed to be carcinogenic in nature. The level of contamination was  $15 \text{ ppm}$  (by mass).**

**(a) Express this in per cent by mass.**

**(b) Determine the molarity of chloroform in the water sample.**

**Ans.** (i) (a)  $15 \text{ ppm}$  means 15 parts in one million ( $10^6$ ) parts.

Therefore, % by mass =  $\frac{15 \times 100}{10^6} = 1.5 \times 10^{-3} \%$

(b) Molar mass of  $CHCl_3 = 119 \text{ g mol}^{-1}$

$1.5 \times 10^{-3} \%$  means  $1.5 \times 10^{-3} \text{ g}$  chloroform is present in  $100 \text{ g}$  sample.

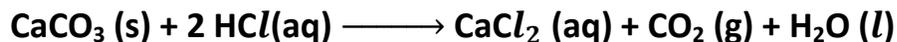
Molarity,  $M = \frac{w \times 1000}{m \times \text{volume of sample}}$

(For water, density =  $1 \text{ g cm}^{-3}$ , so mass = volume)

$M = \frac{1.5 \times 10^{-3} \times 1000}{119 \times 100} = 1.26 \times 10^{-4} \text{ M}$



**Q.16. Calcium carbonate reacts with aqueous HCl to give  $\text{CaCl}_2$  and  $\text{CO}_2$  according to the reaction,**



**What mass of  $\text{CaCO}_3$  is required to react completely with 25 mL of 0.75 M HCl?**

**Ans. (i) Calculation for mass of HCl in 25 mL of 0.75 M HCl**

$$\text{Molarity} = \frac{w \times 1000}{m \times \text{vol}(\text{mL})}$$

$$0.75 = \frac{w \times 1000}{36.5 \times 25}$$

(Molar mass of HCl = 1 + 35.5 g/mol)

$$w = 0.75 \times 36.5 \times \frac{25}{1000} = 0.6844 \text{ g}$$

(ii) Calculation for required mass of  $\text{CaCO}_3$  to react completely with 0.6844 g HCl.



According to balanced chemical equation,

73 g HCl completely reacts with 100g  $\text{CaCO}_3$

1 g HCl completely reacts with  $\frac{100}{73}$  g  $\text{CaCO}_3$

$\therefore$  0.6844 g HCl will completely reacts with

$$\frac{100 \times 0.6844}{73} = 0.9375 \text{ g}$$

**Q.17. Calcium carbonate reacts with aqueous HCl to give  $\text{CaCl}_2$  and  $\text{CO}_2$  according to the reaction given below**





What mass of  $\text{CaCl}_2$  will be formed when 250 mL of 0.76 M HCl reacts with 1000 g of  $\text{CaCO}_3$ ? Name the limiting reagent. Calculate the number of moles of  $\text{CaCl}_2$  formed in the reaction.

**Ans.** Number of moles of HCl =  $250 \text{ mL} \times \frac{0.76}{1000} = 0.19 \text{ mol}$ ;

Number of moles of  $\text{CaCO}_3 = \frac{1000 \text{ g}}{100 \text{ g mol}^{-1}} = 10 \text{ mol}$

For the 10 moles of  $\text{CaCO}_3$  (s) number of moles of HCl required would be 10

$$\times \frac{2}{1} = 20 \text{ mol HCl (aq)}$$

But we have only 0.19 mole HCl (aq), hence, HCl (aq) is the limiting reagent.

Since, 2 moles HCl (aq) forms 1 mole of  $\text{CaCl}_2$ , therefore, 0.19 moles of HCl (aq) would give

$$0.19 \times \frac{1}{2} = 0.095 \text{ mol}$$

$$\text{Mass of } \text{CaCl}_2 = 0.095 \times 111 = 10.54 \text{ g}$$