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 CO_2 and H_2O formed will depend upon the amount of 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., $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

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.

$$\mathbf{Zn + 2HCl \longrightarrow ZnCl_2 + H_2}$$

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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.

So, 32.65 g of zinc will liberate H_2 = 32.65 g $\times \frac{22.7L}{65.3\ g}$

$= \frac{22.7}{2}$ L

= 11.35 L

Q.5. How many moles of iron can be made Fe_2O_3 by the use of 16 moles of carbon monoxide in the following reaction?

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

Ans. $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$
16 mol

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

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

Q.6. If 2 L of N_2 is mixed with 2 L of H_2 at a constant temperature and pressure, then what will be the volume of NH_3 formed ?

Ans. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

1 L of N_2 reacts with 3 L of H_2.

∵ 2 L of N_2 will react with 6 L of H_2 but we have only 2 L of H_2, therefore, H_2 is the limiting reactant.

3 L of H_2 gives 2 L of NH_3.

∴ 2 L of H_2 gives = $\frac{2}{3} \times 2 = \frac{2}{3} \times 2 = \frac{4}{3}$ = 1.33 L of NH_3

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Q.7. How much copper can be obtained from 100 g of copper sulphate ($CuSO_4$) ?

Ans. Molar mass of $CuSO_4$ = 63.54 + 32.06 + (4 × 16)

= 159.6 g mol^{-1}

159.6 g $CuSO_4$ contains 63.54 g Cu

1 g $CuSO_4$ will contain $\frac{63.54}{159.6}$ g Cu

∴ 100 g $CuSO_4$ will contain $\frac{63.54\times100}{159.6}$ = 39.81 g Cu

Q.8. What is the concentration of sugar ($C_{12}H_{22}0_{11}$) in 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, $C_{12}H_{22}O_{11}$

m = (12 × 12.01) + (22 × 1.0079) + (11 × 16.00)

= 342.2938 g mol^{-1} = 342

Given, w = 20 g, V = 2 L

$$\text{Molarity} = \frac{w}{m\times V(L)} = \frac{20}{342\times2}$$

= 0.0292 mol L^{-1}

= 0.0292 M

Q.9. How are 0.50 mole Na_2CO_3 and 0.50 M Na_2CO_3 different?

Ans. Molar mass of Na_2CO_3 = (2 × 22.99) + 12.01 + (3 × 16)

= 105.99 ≈ 106 g mol^{-1}

0.50 mole Na_2CO_3 = 0.50 × 106 = 53 g Na_2CO_3

0.50 M Na_2CO_3 means 53 g Na_2CO_3 is present in 1 L of the solution.

Q.10. How many gram of Na_2CO_3 should be dissolved to make 100 cm^3 of 0.15 M Na_2CO_3 solution?

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Ans. 1000 cm^3 of 0.15 M Na_2CO_3 contains Na_2CO_3 = 0.15 mol

100 cm^3 of 0.15 M Na_2CO_3 will contain $Na_2CO_3 = \frac{0.15}{1000} \times 100$ = 0.015 mol

(Molar mass of Na_2CO_3 = 106 g mol^{-1})

Mass of Na_2CO_3 = 0.015 × 106 = 1.59 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 g mL^{-1})?

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

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

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

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

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

Ans. Given, d = 0.793 kg L^{-1} = 0.793 × 10^3 g L^{-1}

Final volume, V_2 = 2.5 L

Final molarity, M_2 = 0.25 M

Molarity of initial solution M_1 = ?

Initial volume V_1 = ?

Molar mass of methanol,

CH_3OH = (1 × 12.01) + (4 × 1.0079) + 16.00

= 32.0416 = 32 g mol^{-1}

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Molarity = $\frac{0.793\times10^{3}gL^{-1}}{32g\ mol^{-1}}$ = 24.281 mol L^{-1}

$M_1V_1 = M_2V_2$

$24.781 \times V_1 = 0.25 \times 2.5$

$V_1 = \frac{0.25\times2.5}{24.781}$ = 0.02522 L

= 25.22 Ml

Q.13. Chlorine is prepared in the laboratory by treating manganese dioxide (MnO_2) with aqueous hydrochloric acid according to the reaction,

$4\ HCl(aq) + MnO_2(s) \longrightarrow 2H_2O(l) + MnCl_2(aq) + Cl_2(g)$

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

Ans. $\underset{4\times36.5}{4HCl\ (aq)} + \underset{87\ g}{MnO_2(s)} \longrightarrow 2H_2O\ (l) + MnCl_2\ (aq) + Cl_2(g)$

According to the balance chemical equation,

87 g of MnO_2 reacts with 4 × 36.5 g HCl

5 g of MnO_2 will react with

$\frac{4\times36.5\times5}{87}$ = 8.39 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 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 diabeties?

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(iv) What values are exhibited by Ravi?

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

i.e., 1 mol = 180 g

∴ 1 mmol = 180 mg or 1 mmol L^{-1} = 18 mg/ dL

∴ 10 mmol L^{-1} = 10 × 18 mg/dL

= 180 mg/dL

(ii) Since his blood sugar level is 180 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 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 ppm means 15 parts in one million $(10)^6$ parts.

Therefore, % by mass = $\frac{15\times100}{10^6}$ = 1.5×10^{-3}%

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

1.5×10^{-3}% means 1.5×10^{-3} g chloroform is present in 100 g sample.

Molarity, M = $\frac{w\times1000}{m\times volume\ of\ sample}$

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

M = $\frac{1.5\times10^{-3}\times1000}{119\times100}$ = 1.26×10^{-4} M

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Q.16. Calcium carbonate reacts with aqueous HCl to give $CaCl_2$ and CO_2 according to the reaction,

$CaCO_3$ (s) + 2 HCl(aq) ⟶ $CaCl_2$ (aq) + CO_2 (g) + H_2O (l)

What mass of $CaCO_3$ 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

$$\text{Molarity} = \frac{w \times 1000}{m \times vo1(mL)}$$

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

(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 $CaCO_3$ to react completely with 0.6844 g HCl.

$$\underset{100\text{ g}}{CaCO_3(s)} + \underset{2 \times 36.5 = 73\text{ g}}{2HCl\ (aq)} \longrightarrow CaCl_2\ (aq) + CO_2(g) + H_2O(l)$$

According to balanced chemical equation,

73 g HCl completely reacts with 100g $CaCO_3$

1 g HCl completely reacts with $\frac{100}{73}$ g $CaCO_3$

∴ 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 $CaCl_2$ and CO_2 according to the reaction given below

$CaCO_3$(s) + 2HCl (aq) ⟶ $CaCl_2$ (aq) + CO_2 (g) + H_2O (l)

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What mass of $CaCl_2$ will be formed when 250 Ml of 0.76 M HCl reacts with 1000 g of $CaCO_3$? Name the limiting reagent. Calculate the number of moles of $CaCl_2$ formed in the reaction.

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

Number of moles of $CaCO_3$ = $\frac{1000g}{100\ g\ mol^{-1}} = 10$ mol

For the 10 moles of $CaCO_3$ (s) number of moles of HCl required would be 10 × $\frac{2}{1}$ = 20 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 $CaCl_2$, therefore, 0.19 moles of HCl (aq) would give

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

Mass of $CaCl_2$ = 0.095 × 111 = 10.54 g

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