

LAST LOOK**Question (no. 4)****Problems****1- Calculate the volume of 0.1 of CO₂ gas at S.T.P.**

$$\text{Volume of CO}_2 \text{ gas at S.T.P} = 0.1 \times 22.4 = 2.24 \text{ liter}$$

2- Calculate the density of oxygen (O₂) at (STP) . [O=16]

$$\text{Molecular mass} = 2 \times 16 = 32 \text{ grams}$$

$$\text{The molecular mass} = \text{The density} \times \text{volume of one mole}$$

$$32 = \text{The density} \times 22.4$$

$$\text{The density} = 32 \div 22.4 = 1.43 \text{ grams / liter}$$

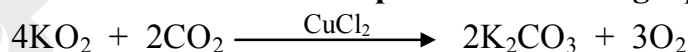
3- Calculate the volume of chlorine gas evolved at (S.T.P) during the electrolysis of sodium chloride (NaCl) solution by passing an electric current, its intensity is 10 amperes for 20 minutes. (Cl = 35.45)

$$\text{The equivalent mass of chlorine} = \frac{35.45}{1} = 35.45 \text{ gm}$$

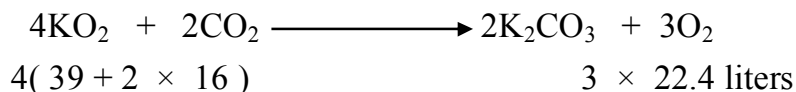
$$\text{The mass of chlorine} = \frac{10 \times 20 \times 60 \times 35.45}{96500} = 4.4 \text{ gm}$$

$$\text{The number of chlorine moles} = \frac{4.4}{70.9} = 0.062 \text{ moles}$$

$$\text{The volume of chlorine at S.T.P} = 0.062 \times 22.4 = 1.3888 \text{ liters}$$

4- Potassium super oxide KO₂ is a compound used to purify atmospheric air from carbon dioxide in a closed atmosphere as following equation .If 14.2 gm of KO₂ is used, calculate the volume of oxygen formed in liters

(K=39 , O=16)

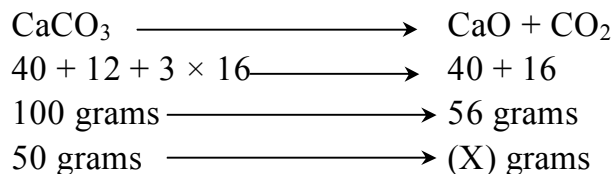


$$284 \text{ grams} \longrightarrow 67.2 \text{ liters}$$

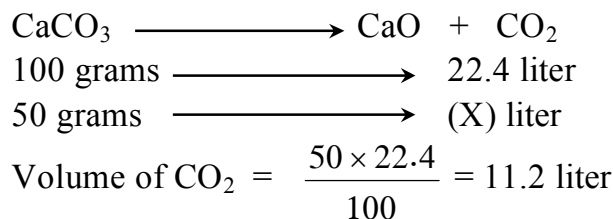
$$14.2 \text{ grams} \longrightarrow (X) \text{ liters}$$

$$\text{Volume of Oxygen} = \frac{14.2 \times 67.2}{284} = 3.36 \text{ liters}$$

5- Calculate the mass of calcium oxide produced from the thermal decomposition of 50 gram calcium carbonate, then calculate the volume of carbon dioxide gas evolve. (Ca = 40 , O = 16 , C = 12)



$$(\text{X}) \text{ Mass of calcium oxide} = \frac{50 \times 56}{100} = 28 \text{ grams}$$



6- Calculate the number of ions produce by dissolving 7.1 grams of sodium sulphate (Na₂SO₄) in water.



$$\text{Molecular mass of sodium sulphate} = (23 \times 2) + (32 \times 1) + (16 \times 4) = 142 \text{ grams}$$

$$\text{Number of moles of sodium sulphate} = \frac{7.1}{142} = 0.05 \text{ mole}$$

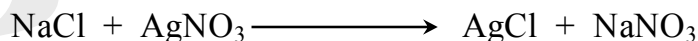
Each mole of sodium sulphate gives 3 moles of ions.

$$\text{Total number of moles of the produced ions} = 3 \times 0.05 = 0.15 \text{ mole}$$

$$\text{Total number of the produced ions} = 0.15 \times 6.02 \times 10^{23} = 0.9 \times 10^{23} \text{ ions}$$

7- A two gram of impure sodium chloride was dissolved in water, Excess of silver nitrate was added to precipitate 4.628 grams of silver chloride. Calculate the percentage of chlorine in the sample. Given that :

$$(O = 16 , N = 14 , Na = 23 , Cl = 35.5 , Ag = 108)$$



$$\text{Mole of AgCl} = (1 \times 108) + (1 \times 35.5) = 143.5 \text{ gram}$$

$$143.5 \text{ gram AgCl} \longrightarrow 35.5 \text{ gram chlorine}$$

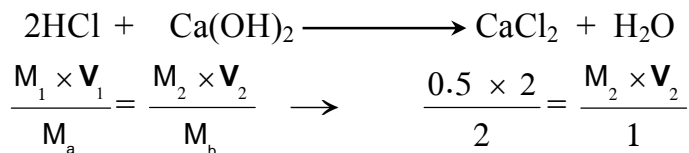
$$4.628 \text{ gram AgCl} \longrightarrow (\text{X}) \text{ gram chlorine}$$

Therefore mass of chlorine in silver chloride = mass of chlorine in sodium chloride

$$= \frac{4.628 \times 35.5}{143.5} = 1.145$$

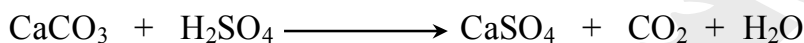
$$\frac{\text{Mass of chlorine the sample} \times 1}{\text{Mass of the sample}} = \frac{1.145 \times 100}{2} = 57.245 \%$$

8- 25 ml of 0.5 molar hydrochloric acid was neutralized with 20 ml of calcium hydroxide solution. Calculate the concentration of calcium hydroxide (mole/liter)



$$\text{Concentration of calcium hydroxide (M}_2\text{)} = \frac{0.5 \times 25}{40} = 0.3125 \text{ moles / liter}$$

9- 10 ml of 0.1 molar sulphuric acid added to 0.2 grams of impure sample of calcium carbonate until complete reaction takes place. Calculate the percent of calcium carbonate in The equation for the reaction is :



$$\text{The number of moles of H}_2\text{SO}_4 = \frac{10 \times 0.1}{1000} = 0.001 \text{ mole}$$

The balanced equation shows that :

The number of moles of CaCO_3 = the number of moles of H_2SO_4

The number of moles of CaCO_3 reacting with H_2SO_4 = 0.001 moles

One moles of CaCO_3 = $40 + 12 + (3 \times 16) = 100$ gm.

Mass of one CaCO_3 in the sample = $100 \times 0.001 = 0.1$ gm .

$$\% \text{ of CaCO}_3 \text{ in the impure sample} = \frac{0.1 \times 100}{0.2} = 50 \%$$

10- 0.2 gm of a mixture of solid substance containing sodium hydroxide and sodium chloride was titrated with 0.1 molar of hydrochloric. The complete reaction takes place by the consumption of 10 ml of the acid. Calculate the percentage of sodium hydroxide in the mixture. (Na = 23. O = 16. H = 1)

$$\text{Number of moles of HCl} = \frac{10 \times 0.1}{1000} = 0.001 \text{ mole}$$

Number of moles of $\text{NaOH} = 0.001$ mole

The mass of one mole of $\text{NaOH} = 23 + 16 + 1 = 40$ gm

The mass of NaOH in the mixture = $40 \times 0.001 = 0.04$ gm

$$\text{The percentage of NaOH the mixture} = \frac{0.04 \times 100}{0.2} = 20\%$$

11- Four grams of impure Sodium chloride was dissolved in water and an excess of silver nitrate solution was added to precipitate 9.256 gram of silver chloride. Calculate the percentage of sodium chloride in the sample.

$$(Na = 23, Cl = 35.5, Ag = 108)$$



The molecular mass in grams of AgCl = 108 + 35.5 = 143.5 gm

The molecular mass in grams of NaCl = 23 + 35.5 = 58.5 gm .

Each 58.5gm. of NaCl $\xrightarrow{\text{Produced}}$ 143.5gm.ofAgCl

(X) gm. of NaCl $\xrightarrow{\text{Produced}}$ 9.256gm.ofAgCl

$$\text{The mass of NaCl in the sample} = \frac{58.5 \times 9.256}{143.5} = 3.7733\text{gm.}$$

$$\% \text{ NaCl} = \frac{3.773}{4} \times 100 = 94.3325\%$$

12- A sample of 1.47grams of hydrated calcium chloride salt (CaCl₂. × H₂O). was heated several times till a constant mass of 1.11 grams., Find out the number of water molecules of crystallization in the molecule of hydrated calcium chloride.

$$(H = 1.O = 16.Ca = 40.Cl = 35.5)$$

The mass of water of crystallization in the sample = 1.47 – 1.11 = 0.36 gram.

Each 1.11 gram of anhydrous (CaCl₂) bind with 0.36 gram water of crystallization

The molecular mass of (CaCl₂) = (35.5 x2) + 40 = 111gram

1.11 gram CaCl₂ bind with \longrightarrow 0.36 gram water of crystallization

111 gram CaCl₂ bind with \longrightarrow (X) gram water of crystallization

X (mass of water of crystallization) = (111 x 0.36) ÷ 1.11 = 36 gram

The molecular mass of (H₂O)= 16 + (2x1) = 18 gram

The number of molecules of water of crystallization in the molecule of hydrate CaCl₂ = 36 ÷ 18

$$= 2 \text{ molecules}$$

13- Calculate the equilibrium constant (K_p) of the reaction :

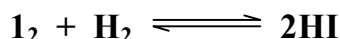


The pressures of gases are 2.3 atmosphere for N_2 , 7.1 atmosphere for H_2 and 0.6 atmosphere for NH_3 . Comment on the value of (K_p)

$$K_p = \frac{P_2[\text{NH}_3]}{P[\text{N}_2] \times P_3[\text{H}_2]} = \frac{(0.6)^2}{2.3 \times (7.1)^3} = 4.4 \times 10^{-4}$$

The small value of K_p indicating the small amount of resulting ammonia .

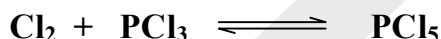
14- Calculate the equilibrium constant for the reaction :



Provided that concentrations of iodine , hydrogen and hydrogen iodide at equilibrium are 0.1105, 0.1105 and 0.7815 mole / liter respectively .

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{[0.781]^2}{[0.1105][0.1105]} = 50.018$$

15- If the equilibrium constant for the following reaction is 15.75



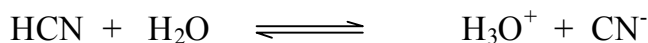
And the concentrations of chlorine and phosphorus trichloride were 0.3 and 0.84 mole / liter respectively. Calculate the concentration of phosphorus pentachloride.

$$\text{Equilibrium constant } K_c = \frac{[\text{PCl}_5]}{[\text{Cl}_2][\text{PCl}_3]} \rightarrow 15.75 = \frac{[\text{PCl}_5]}{[0.3][0.84]} \rightarrow 15.75 = \frac{[\text{PCl}_5]}{0.252}$$

The concentration of $\text{PCl}_5 = 15.75 \times 0.252 = 3.969$ mole / liter

16- Calculate the degree of dissociation in 0.1 molar hydrocyanic acid (HCN) solution at 25°C. Providing that the equilibrium constant of the acid

$$K_a = 7.20 \times 10^{-10}$$



Applying Ostwald law : $K_a = a^2 \times C$

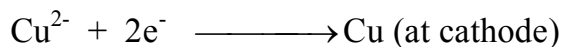
$$7.2 \times 10^{-10} = a^2 \times 0.1$$

$$a^2 = \frac{7.2 \times 10^{-10}}{0.1} = 72 \times 10^{-10}$$

$$a = \sqrt{72 \times 10^{-10}} = 8.5 \times 10^{-5}$$

The degree of dissociation of hydrogen ion = 8.5×10^{-5}

21- What is the number of faradays required to precipitate gram/atom of copper according to the following reaction :



2 Faradays

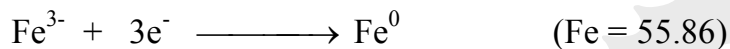
22- Calculate the electric current intensity required for passing 3.7 Faraday through an electrolyte for 40 minutes.

The quantity of electricity = current strength \times time

$$3.7 \times 96500 = I \times 40 \times 60$$

$$I = (3.7 \times 96500) \div (40 \times 60) = 148.7 \text{ ampere}$$

23- What is the quantity of electricity (coulomb) necessary to separate 5.6 grams of iron from solution of Iron (III) chloride ? Where the cathode reaction is :



$$\text{Equivalent mass of iron} = \frac{\text{Atomic mass}}{\text{Valence}} = \frac{55.86}{3} = 18.62 \text{ grams}$$

$$\begin{aligned} \text{Quantity of electricity (coulomb)} &= \frac{\text{Mass of deposited substance} \times 96500}{\text{Equivalent mass}} \\ &= \frac{5.6 \times 96500}{18.62} = 29022.5 \text{ coulomb} \end{aligned}$$

24- Aluminum metal is produced from electrolysis of molten aluminum oxide.

Calculate the number of aluminum moles produced when an electric current of intensity 9.6 amperes is passed for 5 minutes . the cathode reaction equation is : $\text{Al}^3 + 3\text{e}^{-} \longrightarrow \text{Al}^0$ (Al = 27)

Quantity of electricity = electric current intensity \times time

$$= 9.65 \times 5 \times 60 = 2895 \text{ coulombs}$$

Equivalent mass of Al = atomic mass / valency = 27 / 3 = 9 gram

$$96500 \text{ coulombs} \longrightarrow 9 \text{ grams Al}$$

$$285 \text{ coulombs} \longrightarrow (\text{X}) \text{ grams Al}$$

$$X = \frac{2895 \times 9}{96500} = 0.27 \text{ gram}$$

$$27 \text{ grams Al} \longrightarrow 1 \text{ mole Al}$$

$$0.27 \text{ gram Al} \longrightarrow (\text{X}) \text{ mole Al}$$

$$(\text{X}) \frac{0.27 \times 1}{27} = 0.01 \text{ mole Al}$$