

**NCERT SOLUTIONS**  
**CLASS-XI CHEMISTRY**  
**CHAPTER-1**  
**BASIC CONCEPTS OF CHEMISTRY**

**Exercise**

**Q1. Find out the value of molecular weight of the given compounds:**

(i)  $CH_4$     (ii)  $H_2O$     (iii)  $CO_2$

**Ans.**

(i)  $CH_4$  :

Molecular weight of methane,  $CH_4$

= (1 x Atomic weight of carbon) + (4 x Atomic weight of hydrogen)

= [1(12.011 u) + 4 (1.008u)]

= 12.011u + 4.032 u

= 16.043 u

(ii)  $H_2O$  :

Molecular weight of water,  $H_2O$

= (2 x Atomic weight of hydrogen) + (1 x Atomic weight of oxygen)

= [2(1.0084) + 1(16.00 u)]

= 2.016 u + 16.00 u

= 18.016u

So approximately

= 18.02 u

(iii)  $CO_2$  :

= Molecular weight of carbon dioxide,  $CO_2$

= (1 x Atomic weight of carbon) + (2 x Atomic weight of oxygen)

= [1(12.011 u) + 2(16.00 u)]

= 12.011 u + 32.00 u

= 44.011 u

So approximately

= 44.01u

**Q2. Sodium Sulphate ( $Na_2SO_4$ ) has various elements, find out the mass percentage of each element.**

**Ans.**

Now for  $Na_2SO_4$ .

Molar mass of  $\text{Na}_2\text{SO}_4$

$$= [(2 \times 23.0) + (32.066) + 4(16.00)]$$

$$= 142.066 \text{ g}$$

Formula to calculate mass percent of an element =

$$\frac{\text{Mass of that element in the compound}}{\text{Molar mass of the compound}} \times 100$$

Therefore, Mass percent of the sodium element:

$$= \frac{46.0 \text{ g}}{142.066 \text{ g}} \times 100$$

$$= 32.379$$

$$= 32.4\%$$

Mass percent of the sulphur element:

$$= \frac{32.066 \text{ g}}{142.066 \text{ g}} \times 100$$

$$= 22.57$$

$$= 22.6\%$$

Mass percent of the oxygen element:

$$= \frac{64.0 \text{ g}}{142.066 \text{ g}} \times 100$$

$$= 45.049$$

$$= 45.05\%$$

**Q3. Find out the empirical formula of an oxide of iron having 69.9% Fe and 30.1%  $\text{O}_2$  by mass.**

**Ans.**

Percent of Fe by mass = 69.9 % [As given above]

Percent of  $\text{O}_2$  by mass = 30.1 % [As given above]

Relative moles of Fe in iron oxide:

$$= \frac{\text{percent of iron by mass}}{\text{Atomic mass of iron}}$$

$$= \frac{69.9}{55.85}$$

$$= 1.25$$

Relative moles of O in iron oxide:

$$= \frac{\text{percent of oxygen by mass}}{\text{Atomic mass of oxygen}}$$

$$= \frac{30.1}{16.00}$$

$$= 1.88$$

Simplest molar ratio of Fe to O:

$$= 1.25: 1.88$$

= 1: 1.5

≈ 2: 3

Therefore, empirical formula of iron oxide is  $Fe_2O_3$ .

**Q4. Find out the amount of  $CO_2$  that can be produced when**

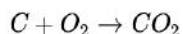
**(i) 1 mole carbon is burnt in air.**

**(ii) 1 mole carbon is burnt in 16 g of  $O_2$ .**

**(iii) 2 moles carbon are burnt in 16 g  $O_2$ .**

**Ans.**

(i) 1 mole of carbon is burnt in air.



1 mole of carbon reacts with 1 mole of  $O_2$  to form one mole of  $CO_2$ .

Amount of  $CO_2$  produced = 44 g

(ii) 1 mole of carbon is burnt in 16 g of  $O_2$ .

1 mole of carbon burnt in 32 grams of  $O_2$  it forms 44 grams of  $CO_2$ .

Therefore, 16 grams of  $O_2$  will form  $\frac{44 \times 16}{32}$

= 22 grams of  $CO_2$

(iii) 2 moles of carbon are burnt in 16 g of  $O_2$ .

If 1 mole of carbon are burnt in 16grams of  $O_2$  it forms 22 grams of  $CO_2$

Therefore, if 2 moles of carbon are burnt it will form

$$= \frac{2 \times 22}{1}$$

= 44g of  $CO_2$

**Q5. Find out the mass of  $CH_3COONa$  (sodium acetate) required to make 500 mL of 0.375 molar aqueous solution. Molar mass of  $CH_3COONa$  is  $82.0245 \text{ g mol}^{-1}$**

**Ans.**

0.375 Maqueous solution of  $CH_3COONa$

= 1000 mL of solution containing 0.375 moles of  $CH_3COONa$

Therefore, no. of moles of  $CH_3COONa$  in 500 mL

$$= \frac{0.375}{1000} \times 1000$$

= 0.1875 mole

Molar mass of sodium acetate =  $82.0245 \text{ g mol}^{-1}$

Therefore, mass that is required of  $CH_3COONa$

$$= (82.0245 \text{ g mol}^{-1})(0.1875 \text{ mole})$$

$$= 15.38 \text{ gram}$$

**Q6. A sample of  $\text{HNO}_3$  has a density of  $1.41 \text{ g mL}^{-1}$  find the concentration of  $\text{HNO}_3$  in moles per litre and the mass percent of  $\text{HNO}_3$  in it is 69%.**

**Ans.**

Mass percent of  $\text{HNO}_3$  in sample is 69 %

Thus, 100 g of  $\text{HNO}_3$  contains 69 g of  $\text{HNO}_3$  by mass.

Molar mass of  $\text{HNO}_3$

$$= \{ 1 + 14 + 3(16) \} \text{ g mol}^{-1}$$

$$= 1 + 14 + 48$$

$$= 63 \text{ g mol}^{-1}$$

Now, No. of moles in 69 g of  $\text{HNO}_3$ :

$$= \frac{69 \text{ g}}{63 \text{ g mol}^{-1}}$$

$$= 1.095 \text{ mol}$$

Volume of 100g  $\text{HNO}_3$  solution

$$= \frac{\text{Mass of solution}}{\text{density of solution}}$$

$$= \frac{100\text{g}}{1.41\text{g mL}^{-1}}$$

$$= 70.92\text{mL}$$

$$= 70.92 \times 10^{-3} \text{ L}$$

Concentration of  $\text{HNO}_3$

$$= \frac{1.095 \text{ mole}}{70.92 \times 10^{-3} \text{ L}}$$

$$= 15.44 \text{ mol/L}$$

Therefore, Concentration of  $\text{HNO}_3 = 15.44 \text{ mol/L}$

**Q7. How much Cu (Copper) can be obtained from 100 gram of  $\text{CuSO}_4$  (copper sulphate)?**

**Ans.**

1 mole of  $\text{CuSO}_4$  contains 1 mole of Cu.

Molar mass of  $\text{CuSO}_4$

$$= (63.5) + (32.00) + 4(16.00)$$

$$= 63.5 + 32.00 + 64.00$$

$$= 159.5 \text{ gram}$$

159.5 gram of  $CuSO_4$  contains 63.5 gram of Cu.

Therefore, 100 gram of  $CuSO_4$  will contain  $\frac{63.5 \times 100g}{159.5}$  of Cu.

$$= \frac{63.5 \times 100}{159.5}$$

= 39.81 gram

**Q8. The mass percent of iron and oxygen in an oxide of iron is 69.9 and 30.1 calculate the molecular formula of the oxide of iron.  $159.69 \text{ g mol}^{-1}$  is the given molar mass of an oxide.**

**Ans.**

**Here,**

Mass percent of Fe = 69.9%

Mass percent of O = 30.1%

No. of moles of Fe present in oxide

$$= \frac{69.90}{55.85}$$

= 1.25

No. of moles of O present in oxide

$$= \frac{30.1}{16.0}$$

= 1.88

Ratio of Fe to O in oxide,

= 1.25 : 1.88

$$= \frac{1.25}{1.25} : \frac{1.88}{1.25}$$

= 1 : 1.5

= 2 : 3

Therefore, the empirical formula of oxide is  $Fe_2O_3$

Empirical formula mass of  $Fe_2O_3$

=  $[2(55.85) + 3(16.00)]$  gr

= 159.69 g

$$\text{Therefore } n = \frac{\text{Molar mass}}{\text{Empirical formula mass}} = \frac{159.69 \text{ g}}{159.7 \text{ g}}$$

= 0.999

= 1 (approx)

The molecular formula of a compound can be obtained by multiplying n and the

empirical formula.

Thus, the empirical of the given oxide is  $Fe_2O_3$  and n is 1.

**Q9. Find out the atomic mass (average) of chlorine using the following data:**

Percentage Natural Abundance		Molar Mass
$^{35}\text{Cl}$	75.77	34.9689
$^{37}\text{Cl}$	24.23	36.9659

**Ans.**

Average atomic mass of Cl.

$$= \left[ (\text{Fractional abundance of } ^{35}\text{Cl}) (\text{molar mass of } ^{35}\text{Cl}) + (\text{fractional abundance of } ^{37}\text{Cl}) (\text{Molar mass of } ^{37}\text{Cl}) \right]$$

$$= \left[ \left\{ \left( \frac{75.77}{100} \right) (34.9689u) \right\} + \left\{ \left( \frac{24.23}{100} \right) (36.9659u) \right\} \right]$$

$$= 26.4959 + 8.9568$$

$$= 35.4527 \text{ u}$$

Therefore, the average atomic mass of Cl = 35.4527 u

**Q10. In 3 moles of ethane ( $C_2H_6$ ), calculate the given below:**

(a) No. of moles of C- atoms

(b) No. of moles of H- atoms.

(c) No. of molecules of  $C_2H_6$ .

**Ans.**

(a) 1 mole  $C_2H_6$  contains two moles of C- atoms.

$\therefore$  No. of moles of C- atoms in 3 moles of  $C_2H_6$ .

$$= 2 * 3$$

$$= 6$$

(b) 1 mole  $C_2H_6$  contains six moles of H- atoms.

$\therefore$  No. of moles of C- atoms in 3 moles of  $C_2H_6$ .

$$= 3 * 6$$

$$= 18$$

(c) 1 mole  $C_2H_6$  contains six moles of H- atoms.

$\therefore$  No. of molecules in 3 moles of  $C_2H_6$ .

$$= 3 \times 6.023 \times 10^{23}$$

$$= 18.069 \times 10^{23}$$

**Q11. What is the concentration of sugar  $C_{12}H_{22}O_{11}$  in  $\text{mol L}^{-1}$  if its 20 gram are dissolved in enough  $H_2O$  to make a final volume up to 2 Litre?**

**Ans.**

Molarity (M) is as given by,

$$= \frac{\text{Number of moles of solute}}{\text{Volume of solution in Litres}}$$

$$= \frac{\text{Mass of sugar}}{\text{Molar mass of sugar} \times 2 \text{ L}}$$

$$= \frac{20 \text{ g}}{\frac{[(12 \times 12) + (1 \times 22) + (11 \times 16)] \text{ g}}{2 \text{ L}}}$$

$$= \frac{20 \text{ g}}{342 \text{ g}} \times 2 \text{ L}$$

$$= \frac{0.0585 \text{ mol}}{2 \text{ L}}$$

$$= 0.02925 \text{ mol L}^{-1}$$

Therefore, Molar concentration =  $0.02925 \text{ mol L}^{-1}$

**Q12. The density of  $CH_3OH$  (methanol) is  $0.793 \text{ kg L}^{-1}$ . For making 2.5 Litre of its 0.25 M solution what volume is needed?**

**Ans.)**

Molar mass of  $CH_3OH$

$$= (1 \times 12) + (4 \times 1) + (1 \times 16)$$

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

$$= 0.032 \text{ kg mol}^{-1}$$

Molarity of the solution

$$= \frac{0.793 \text{ kg L}^{-1}}{0.032 \text{ kg mol}^{-1}}$$

$$= 24.78 \text{ mol L}^{-1}$$

(From the definition of density)

$$M_1 V_1 = M_2 V_2$$

$$\therefore (24.78 \text{ mol L}^{-1}) V_1 = (2.5 \text{ L}) (0.25 \text{ mol L}^{-1})$$

$$V_1 = 0.0252 \text{ Litre}$$

$$V_1 = 25.22 \text{ Millilitre}$$

**Q13. Pressure is defined as force per unit area of the surface. Pascal, the SI unit of pressure is as given below:**

$$1 \text{ Pa} = 1 \text{ N m}^{-2}$$

**Assume that mass of air at the sea level is  $1034 \text{ g cm}^{-2}$ . Find out the pressure in Pascal.**

**Ans.**

As per definition, pressure is force per unit area of the surface.

$$\begin{aligned} P &= \frac{F}{A} \\ &= \frac{1034 \text{ g} \times 9.8 \text{ ms}^{-2}}{\text{cm}^2} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{(100)^2 \text{ cm}^2}{1 \text{ m}^2} \\ &= 1.01332 \times 10^5 \text{ kg m}^{-1} \text{ s}^{-2} \end{aligned}$$

Now,

$$1 \text{ N} = 1 \text{ kg ms}^{-2}$$

Then,

$$1 \text{ Pa} = 1 \text{ Nm}^{-2}$$

$$= 1 \text{ kgm}^{-2} \text{ s}^{-2}$$

$$\text{Pa} = 1 \text{ kgm}^{-1} \text{ s}^{-2}$$

$$\therefore \text{Pressure (P)} = 1.01332 \times 10^5 \text{ Pa}$$

**Q14. Write SI unit for mass. Also define mass.**

**Ans.**

Si Unit: Kilogram (kg)

Mass:

"The mass equal to the mass of the international prototype of kilogram is known as mass."

**Q15. Match the prefixes with their multiples in the table given below:**

	<b>Prefixes</b>	<b>Multiples</b>
(a)	<i>femto</i>	$10$
(b)	<i>giga</i>	$10^{-15}$
(c)	<i>mega</i>	$10^{-6}$
(d)	<i>deca</i>	$10^9$
(e)	<i>micro</i>	$10^6$

**Ans.**



	Prefixes	Multiples
(a)	femto	$10^{-15}$
(b)	giga	$10^9$
(c)	mega	$10^6$
(d)	deca	10
(e)	micro	$10^{-6}$

**Q16. What are significant figures?**

**Ans.**

Significant figures are the meaningful digits which are known with certainty. Significant figures indicate uncertainty in experimented value.

e.g.: The result of the experiment is 15.6 mL in that case 15 is certain and 6 is uncertain. The total significant figures are 3.

Therefore, "the total number of digits in a number with the Last digit the shows the uncertainty of the result is known as significant figures."

**Q17. A sample of drinking water was found to be highly contaminated with  $CHCl_3$ , chloroform, which is carcinogenic. 15 ppm (by mass) was the level of contamination.**

**(a) Express in terms of percent by mass.**

**(b) Calculate the molality of chloroform in the given water sample.**

**Ans.**

(a) 1 ppm = 1 part out of 1 million parts.

Mass percent of 15 ppm chloroform in  $H_2O$

$$= \frac{15}{10^6} \times 100$$

$$= \approx 1.5 \times 10^{-3} \%$$

(b) 100 gram of the sample is having  $1.5 \times 10^{-3}g$  of  $CHCl_3$ .

1000 gram of the sample is having  $1.5 \times 10^{-2}g$  of  $CHCl_3$ .

$\therefore$  Molality of  $CHCl_3$  in water

$$= \frac{1.5 \times 10^{-2} g}{\text{Molar mass of } CHCl_3}$$

Molar mass ( $CHCl_3$ )

$$= 12 + 1 + 3 (35.5)$$

$$= 119.5 \text{ gram } mol^{-1}$$

Therefore, molality of  $CHCl_3$  | water

$$= 1.25 \times 10^{-4} \text{ m}$$

**Q18. Express the given number in scientific notation:**

(a) 0.0047

(b) 235,000

(c) 8009

(d) 700.0

(e) 5.0013

**Ans.**

(a)  $0.0047 = 4.7 \times 10^{-3}$

(b)  $235,000 = 2.35 \times 10^5$

(c)  $8009 = 8.009 \times 10^3$

(d)  $700.0 = 7.000 \times 10^2$

(e)  $5.0013 = 5.0013$

**Q19. Find the number of significant figures in the numbers given below.**

(a) 0.0027

(b) 209

(c) 6005

(d) 136,000

(e) 900.0

(f) 2.0035

**Ans.**

(i) 0.0027: 2 significant numbers.

(ii) 209: 3 significant numbers.

(iii) 6005: 4 significant numbers.

(iv) 136,000: 3 significant numbers.

(v) 900.0: 4 significant numbers.

(vi) 2.0035: 5 significant numbers.

**Q20. Round up the given numbers upto 3 significant numbers.**

(a) 35.217

(b) 11.4108

(c) 0.05577

(d) 2806

Ans.

- (a) The number after round up is: 35.2  
 (b) The number after round up is: 11.4  
 (c) The number after round up is: 0.0560  
 (d) The number after round up is: 2810

**Q21. When dioxygen and dinitrogen react together, they form various compounds. The information is given below:**

	Mass of dioxygen	Mass of dinitrogen
(i)	16 g	14 g
(ii)	32 g	14 g
(iii)	32 g	28 g
(iv)	80 g	28 g

(1) In the data given above, which chemical combination law is obeyed? Also give the statement of the law.

(2) Convert the following:

(a)  $1 \text{ km} = \text{---} \text{ mm} = \text{---} \text{ pm}$

(b)  $1 \text{ mg} = \text{---} \text{ kg} = \text{---} \text{ ng}$

(c)  $1 \text{ mL} = \text{---} \text{ L} = \text{---} \text{ dm}^3$

Ans.

(1) If we fix the mass of  $\text{N}_2$  at 28 g, the masses of  $\text{N}_2$  that will combine with the fixed mass of  $\text{O}_2$  are 32 gram, 64 gram, 32 gram and 80 gram.

The mass of  $\text{O}_2$  bear whole no. ratio of 1: 2: 2: 5. Therefore, the given information obeys the law of multiple proportions.

The law of multiple proportions states, "If 2 elements combine to form more than 1 compound, then the masses of one element that combines with the fixed mass of another element are in the ratio of small whole numbers."

(2) Convert:

(a)  $1 \text{ km} = \text{---} \text{ mm} = \text{---} \text{ pm}$

$$1 \text{ km} = 1 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{10 \text{ mm}}{1 \text{ cm}}$$

$$\therefore 1 \text{ km} = 10^6 \text{ mm}$$

$$1 \text{ km} = 1 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ pm}}{10^{-12} \text{ m}}$$

$$\therefore 1 \text{ km} = 10^{15} \text{ pm}$$

$$\text{Therefore, } 1 \text{ km} = 10^6 \text{ mm} = 10^{15} \text{ pm}$$

$$(b) 1 \text{ mg} = \text{---} \text{ kg} = \text{---} \text{ ng}$$

$$1 \text{ mg} = 1 \text{ mg} * \frac{1 \text{ g}}{1000 \text{ mg}} * \frac{1 \text{ kg}}{1000 \text{ g}}$$

$$1 \text{ mg} = 10^{-6} \text{ kg}$$

$$1 \text{ mg} = 1 \text{ mg} * \frac{1 \text{ g}}{1000 \text{ mg}} * \frac{1 \text{ ng}}{10^{-9} \text{ g}}$$

$$1 \text{ mg} = 10^6 \text{ ng}$$

$$\text{Therefore, } 1 \text{ mg} = 10^{-6} \text{ kg} = 10^6 \text{ ng}$$

$$(c) 1 \text{ mL} = \text{---} \text{ L} = \text{---} \text{ dm}^3$$

$$1 \text{ mL} = 1 \text{ mL} * \frac{1 \text{ L}}{1000 \text{ mL}}$$

$$1 \text{ mL} = 10^{-3} \text{ L}$$

$$1 \text{ mL} = 1 \text{ cm}^3 = 1 * \frac{1 \text{ dm} \times 1 \text{ dm} \times 1 \text{ dm}}{10 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm}} \text{ cm}^3$$

$$1 \text{ mL} = 10^{-3} \text{ dm}^3$$

$$\text{Therefore, } 1 \text{ mL} = 10^{-3} \text{ L} = 10^{-3} \text{ dm}^3$$

**Q22. What is the distance covered by the light in 2 ns if the speed of light is  $3 \times 10^8 \text{ ms}^{-1}$**

**Ans.**

$$\text{Time taken} = 2 \text{ ns}$$

$$= 2 \times 10^{-9} \text{ s}$$

Now,

$$\text{Speed of light} = 3 \times 10^8 \text{ ms}^{-1}$$

So,

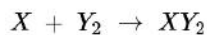
$$\text{Distance travelled in 2 ns} = \text{speed of light} * \text{time taken}$$

$$= (3 \times 10^8)(2 \times 10^{-9})$$

$$= 6 \times 10^{-1} \text{ m}$$

$$= 0.6 \text{ m}$$

**Q23. In the reaction given below:**



Find the limiting reagent if it is present in the reactions given below:

(a) 2 mol X + 3 mol Y

(b) 100 atoms of X + 100 molecules of Y

(c) 300 atoms of X + 200 molecules of Y

(d) 2.5 mol X + 5 mol Y

(e) 5 mol X + 2.5 mol Y

Ans.

Limiting reagent:

It determines the extent of a reaction. It is the first to get consumed during a reaction, thus causes the reaction to stop and limiting the amt. of products formed.

(a) 2 mol X + 3 mol Y

1 mole of X reacts with 1 mole of Y. Similarly, 2 moles of X reacts with 2 moles of Y, so 1 mole of Y is unused. Hence, X is limiting agent.

(b) 100 atoms of X + 100 molecules of Y

1 atom of X reacts with 1 molecule of Y. Similarly, 100 atoms of X reacts with 100 molecules of Y. Hence, it is a stoichiometric mixture where there is no limiting agent.

(c) 300 atoms of X + 200 molecules of Y

1 atom of X reacts with 1 molecule of Y. Similarly, 200 atoms of X reacts with 200 molecules of Y, so 100 atoms of X are unused. Hence, Y is limiting agent.

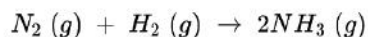
(d) 2.5 mol X + 5 mol Y

1 mole of X reacts with 1 mole of Y. Similarly, 2.5 moles of X reacts with 2.5 moles of Y, so 2.5 mole of Y is unused. Hence, X is limiting agent.

(e) 5 mol X + 2.5 mol Y

1 mole of X reacts with 1 mole of Y. Similarly 2.5 moles of X reacts with 2.5 moles of Y, so 2.5 mole of X is unused. Hence, Y is limiting agent.

**Q24.  $H_2$  and  $N_2$  react with each other to produce  $NH_3$  according to the given chemical equation**



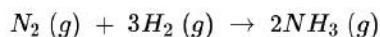
(a) What is the mass of  $NH_3$  produced if  $2 \times 10^3$  g  $N_2$  reacts with  $1 \times 10^3$  g of  $H_2$ ?

(b) Will the reactants  $N_2$  or  $H_2$  remain unreacted?

(c) If any, then which one and give it's mass.

Ans.

(a) Balance the given equation:



Thus, 1 mole (28 g) of  $N_2$  reacts with 3 mole (6 g) of  $H_2$  to give 2 mole (34 g) of  $NH_3$ .

$$2 \times 10^3 \text{ g of } N_2 \text{ will react with } \frac{6g}{28g} \times 2 \times 10^3 \text{ g } H_2$$

$$2 \times 10^3 \text{ g of } N_2 \text{ will react with } 428.6 \text{ g of } H_2.$$

Given:

$$\text{Amt of } H_2 = 1 \times 10^3$$

Therefore,  $N_2$  is limiting reagent.

28 g of  $N_2$  produces 34 g of  $NH_3$

Therefore, mass of  $NH_3$  produced by 2000 g of  $N_2$

$$= \frac{34 \text{ g}}{28 \text{ g}} \times 2000 \text{ g}$$

(b)  $N_2$  is limiting reagent and  $H_2$  is the excess reagent. Therefore,  $H_2$  will not react.

(c) Mass of  $H_2$  unreacted

$$= 1 \times 10^3 - 428.6 \text{ g}$$

$$= 571.4 \text{ g}$$

Q25. 0.50 mol  $Na_2CO_3$  and 0.50 M  $Na_2CO_3$  are different. How?

Ans.

Molar mass of  $Na_2CO_3$ :

$$= (2 \times 23) + 12 + (3 \times 16)$$

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

1 mole of  $Na_2CO_3$  means 106 g of  $Na_2CO_3$

Therefore, 0.5 mol of  $Na_2CO_3$

$$= \frac{106 \text{ g}}{1 \text{ mol}} \times 0.5 \text{ mol } Na_2CO_3$$

= 53 g of  $Na_2CO_3$

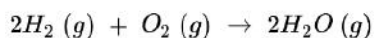
0.5 M of  $Na_2CO_3$  = 0.5 mol/L  $Na_2CO_3$

Hence, 0.5 mol of  $Na_2CO_3$  is in 1 L of water or 53 g of  $Na_2CO_3$  is in 1 L of water.

**Q26. If 10 volumes of dihydrogen gas react with 5 volumes of dioxygen gas, how many volumes of vapour would be obtained?**

**Ans.**

Reaction:



2 volumes of dihydrogen react with 1 volume of dioxygen to produce two volumes of vapour.

Hence, 10 volumes of dihydrogen will react with five volumes of dioxygen to produce 10 volumes of vapour.

**Q27. Convert the given quantities into basic units:**

(i) 29.7 pm

(ii) 16.15 pm

(iii) 25366 mg

**Ans.**

(i) 29.7 pm

$$1 \text{ pm} = 10^{-12} \text{ m}$$

$$29.7 \text{ pm} = 29.7 \times 10^{-12} \text{ m}$$

$$= 2.97 \times 10^{-11} \text{ m}$$

(ii) 16.15 pm

$$1 \text{ pm} = 10^{-12} \text{ m}$$

$$16.15 \text{ pm} = 16.15 \times 10^{-12} \text{ m}$$

$$= 1.615 \times 10^{-11} \text{ m}$$

(iii) 25366 mg

$$1 \text{ mg} = 10^{-3} \text{ g}$$

$$25366 \text{ mg} = 2.5366 \times 10^{-1} \times 10^{-3} \text{ kg}$$

$$25366 \text{ mg} = 2.5366 \times 10^{-2} \text{ kg}$$

**Q28. Which of the given below have the largest no. of atoms?**

(i) 1 g Au (s)

(ii) 1 g Na (s)

(iii) 1 g Li (s)

(iv) 1 g of  $Cl_2$  (g)

Ans.

(i) 1 g Au (s)

$$= \frac{1}{197} \text{ mol of Au (s)}$$

$$= \frac{6.022 \times 10^{23}}{197} \text{ atoms of Au (s)}$$

$$= 3.06 \times 10^{21} \text{ atoms of Au (s)}$$

(ii) 1 g Na (s)

$$= \frac{1}{23} \text{ mol of Na (s)}$$

$$= \frac{6.022 \times 10^{23}}{23} \text{ atoms of Na (s)}$$

$$= 0.262 \times 10^{23} \text{ atoms of Na (s)}$$

$$= 26.2 \times 10^{21} \text{ atoms of Na (s)}$$

(iii) 1 g Li (s)

$$= \frac{1}{7} \text{ mol of Li (s)}$$

$$= \frac{6.022 \times 10^{23}}{7} \text{ atoms of Li (s)}$$

$$= 0.86 \times 10^{23} \text{ atoms of Li (s)}$$

$$= 86.0 \times 10^{21} \text{ atoms of Li (s)}$$

(iv) 1 g of  $Cl_2$  (g)

$$= \frac{1}{71} \text{ mol of } Cl_2 \text{ (g)}$$

(Molar mass of  $Cl_2$  molecule =  $35.5 \times 2 = 71 \text{ g mol}^{-1}$ )

$$= \frac{6.022 \times 10^{23}}{71} \text{ atoms of } Cl_2 \text{ (g)}$$

$$= 0.0848 \times 10^{23} \text{ atoms of } Cl_2 \text{ (g)}$$

$$= 8.48 \times 10^{21} \text{ atoms of } Cl_2 \text{ (g)}$$

Therefore, 1 g of Li (s) will have the largest no. of atoms.

**Q29.** What is the molarity of the solution of ethanol in water in which the mole fraction of ethanol is 0.040?

{Assume the density of water to be 1}

Ans.



Mole fraction of  $C_2H_5OH$

$$= \frac{\text{Number of moles of } C_2H_5OH}{\text{Number of moles of solution}}$$

$$0.040 = \frac{n_{C_2H_5OH}}{n_{C_2H_5OH} + n_{H_2O}} \quad \text{---(1)}$$

No. of moles present in 1 L water:

$$n_{H_2O} = \frac{1000 \text{ g}}{18 \text{ g mol}^{-1}}$$

$$n_{H_2O} = 55.55 \text{ mol}$$

Substituting the value of  $n_{H_2O}$  in eq (1),

$$\frac{n_{C_2H_5OH}}{n_{C_2H_5OH} + 55.55} = 0.040$$

$$n_{C_2H_5OH} = 0.040n_{C_2H_5OH} + (0.040)(55.55)$$

$$0.96n_{C_2H_5OH} = 2.222 \text{ mol}$$

$$n_{C_2H_5OH} = \frac{2.222}{0.96} \text{ mol}$$

$$n_{C_2H_5OH} = 2.314 \text{ mol}$$

Therefore, molarity of solution

$$= \frac{2.314 \text{ mol}}{1 \text{ L}}$$

$$= 2.314 \text{ M}$$

**Q30. Calculate the mass of 1  $^{12}\text{C}$  atom in g.**

**Ans.**

1 mole of carbon atoms

$$= 6.023 \times 10^{23} \text{ atoms of carbon}$$

= 12 g of carbon

Therefore, mass of 1  $^{12}\text{C}$  atom

$$= \frac{12 \text{ g}}{6.022 \times 10^{23}}$$

$$= 1.993 \times 10^{-23} \text{ g}$$

**Q31. How many significant numbers should be present in answer of the given calculations?**

$$(i) \frac{0.02856 \times 298.15 \times 0.112}{0.5785}$$

$$(ii) 5 \times 5.365$$

$$(iii) 0.012 + 0.7864 + 0.0215$$

**Ans.**

$$(i) \frac{0.02856 \times 298.15 \times 0.112}{0.5785}$$

Least precise no. of calculation = 0.112

Therefore, no. of significant numbers in the answer

= No. of significant numbers in the least precise no.

= 3

$$(ii) 5 \times 5.365$$

Least precise no. of calculation = 5.365

Therefore, no. of significant numbers in the answer

= No. of significant numbers in 5.365

= 4

$$(iii) 0.012 + 0.7864 + 0.0215$$

As the least no. of decimal place in each term is 4, the no. of significant numbers in the answer is also 4.

**Q32. Calculate molar mass of Argon isotopes according to the data given in the table.**

Isotope	Molar mass	Abundance
$^{36}\text{Ar}$	$35.96755 \text{ g mol}^{-1}$	0.337 %
$^{38}\text{Ar}$	$37.96272 \text{ g mol}^{-1}$	0.063 %
$^{40}\text{Ar}$	$39.9624 \text{ g mol}^{-1}$	99.600 %

**Ans.**

Molar mass of Argon:

$$= \left[ (35.96755 \times \frac{0.337}{100}) + (37.96272 \times \frac{0.063}{100}) + (39.9624 \times \frac{99.600}{100}) \right]$$

$$= [0.121 + 0.024 + 39.802] \text{ g mol}^{-1}$$

$$= 39.947 \text{ g mol}^{-1}$$

**Q33. What is the number of atoms in the following compounds?**

(i) 52 moles of Ar

(ii) 52 u of He

(iii) 52 g of He

**Ans.**

(i) 52 moles of Ar

$$1 \text{ mole of Ar} = 6.023 \times 10^{23} \text{ atoms of Ar}$$

Therefore, 52 mol of Ar =  $52 \times 6.023 \times 10^{23}$  atoms of Ar

$$= 3.131 \times 10^{25} \text{ atoms of Ar}$$

(ii) 52 u of He

1 atom of He = 4 u of He

OR

4 u of He = 1 atom of He

$$1 \text{ u of He} = \frac{1}{4} \text{ atom of He}$$

$$52 \text{ u of He} = \frac{52}{4} \text{ atom of He}$$

$$= 13 \text{ atoms of He}$$

(iii) 52 g of He

$$4 \text{ g of He} = 6.023 \times 10^{23} \text{ atoms of He}$$

$$52 \text{ g of He} = \frac{6.023 \times 10^{23} \times 52}{4} \text{ atoms of He}$$

$$= 7.8286 \times 10^{24} \text{ atoms of He}$$

**Q34. A welding fuel gas contains hydrogen and carbon. If we burn a small sample, we get 3.38 g of carbon dioxide and 0.69 g of water. A volume of 10 L (at STP) of this welding gas weighs 11.6 g.**

**Find:**

(i) Empirical formula

(ii) Molar mass of the gas, and

(iii) Molecular formula

**Ans.**

(i) Empirical formula

1 mole of  $CO_2$  contains 12 g of carbon

Therefore, 3.38 g of  $CO_2$  will contain carbon

$$= \frac{12 \text{ g}}{44 \text{ g}} \times 3.38 \text{ g}$$

$$= 0.9217 \text{ g}$$

18 g of water contains 2 g of hydrogen

Therefore, 0.690 g of water will contain hydrogen

$$= \frac{2 \text{ g}}{18 \text{ g}} \times 0.690$$

$$= 0.0767 \text{ g}$$

As hydrogen and carbon are the only elements of the compound. Now, the total

As hydrogen and carbon are the only elements of the compound. Now, the total mass is:

$$= 0.9217 \text{ g} + 0.0767 \text{ g}$$

$$= 0.9984 \text{ g}$$

Therefore, % of C in the compound

$$= \frac{0.9217 \text{ g}}{0.9984 \text{ g}} \times 100$$

$$= 92.32 \%$$

% of H in the compound

$$= \frac{0.0767 \text{ g}}{0.9984 \text{ g}} \times 100$$

$$= 7.68 \%$$

Moles of C in the compound,

$$= \frac{92.32}{12.00}$$

$$= 7.69$$

Moles of H in the compound,

$$= \frac{7.68}{1}$$

$$= 7.68$$

Therefore, the ratio of carbon to hydrogen is,

$$7.69: 7.68$$

$$1: 1$$

Therefore, the empirical formula is CH.

(ii) Molar mass of the gas, and

Weight of 10 L of gas at STP = 11.6 g

Therefore, weight of 22.4 L of gas at STP

$$= \frac{11.6 \text{ g}}{10 \text{ L}} \times 22.4 \text{ L}$$

$$= 25.984 \text{ g}$$

$$\approx 26 \text{ g}$$

(iii) Molecular formula

Empirical formula mass:

$$\text{CH} = 12 + 1$$

$$= 13 \text{ g}$$

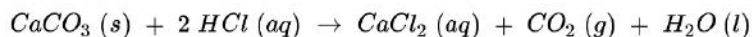
$$n = \frac{\text{Molar mass of gas}}{\text{Empirical formula mass of gas}}$$

$$= \frac{26 \text{ g}}{13 \text{ g}}$$

$$= 2$$

Therefore, molecular formula is  $(CH)_n$  that is  $C_2H_2$ .

**Q35. Calcium carbonate reacts with aqueous HCl and gives  $CaCl_2$  and  $CO_2$  according to the reaction:**



**Calculate the mass of  $CaCO_3$  required to react completely with 25 mL of 0.75 M HCl?**

**Ans.**

0.75 M of HCl

$\equiv$  0.75 mol of HCl are present in 1 L of water

$\equiv$  [(0.75 mol)  $\times$  (36.5 g mol<sup>-1</sup>)] HCl is present in 1 L of water

$\equiv$  27.375 g of HCl is present in 1 L of water

Thus, 1000 mL of solution contains 27.375 g of HCl

Therefore, amt of HCl present in 25 mL of solution

$$= \frac{27.375 \text{ g}}{1000 \text{ mL}} \times 25 \text{ mL}$$

$$= 0.6844 \text{ g}$$

Given chemical reaction,



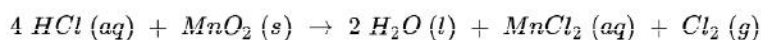
2 mol of HCl (2  $\times$  36.5 = 71 g) react with 1 mol of  $CaCO_3$  (100 g)

Therefore, amt of  $CaCO_3$  that will react with 0.6844 g

$$= \frac{100}{71} \times 0.6844 \text{ g}$$

$$= 0.9639 \text{ g}$$

**Q36. Chlorine is prepared by adding manganese dioxide with hydrochloric acid acc. to the reaction.**



**How many grams of HCl react with 5 g of manganese dioxide?**

**Ans.**

1 mol of  $MnO_2$  = 55 + 2  $\times$  16 = 87 g

4 mol of HCl = 4  $\times$  36.5 = 146 g

1 mol of  $MnO_2$  reacts with 4 mol of HCl

5 g of  $MnO_2$  will react with:

$$= \frac{146 \text{ g}}{87 \text{ g}} \times 5 \text{ g HCl}$$

$$= 8.4 \text{ g HCl}$$

Therefore, 8.4 g of HCl will react with 5 g of  $MnO_2$ .

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