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 Na_2SO_4

= [(2 x 23.0) + (32.066) + 4(16.00)]

=142.066 g

Formula to calculate mass percent of an element = $\frac{Mass\ of\ that\ element\ in\ the\ compound}{Molar\ mass\ of\ the\ compound} \times 100$

Therefore, Mass percent of the sodium element:

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

= 32.379

=32.4%

Mass percent of the sulphur element:

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

= 22.57

=22.6%

Mass percent of the oxygen element:

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

=45.049

=45.05%

Q3. Find out the empirical formula of an oxide of iron having 69.9% Fe and 30.1% O_2 by mass.

Ans.

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

Percent of O_2 by mass = 30.1 % [As given above]

Relative moles of Fe in iron oxide:

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

= $\frac{69.9}{55.85}$

= 1.25

Relative moles of O in iron oxide:

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

= $\frac{30.1}{16.00}$

= 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.

$C + O_2 \rightarrow CO_2$

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 $82.0245\ g\ mol^{-1}$

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 = $82.0245\ g\ mol^{-1}$

Therefore, mass that is required of CH_3COONa

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

= 15.38 gram

Q6. A sample of HNO_3 has a density of $1.41\ g\ mL^{-1}$ find the concentration of HNO_3 in moles per litre and the mass percent of HNO_3 in it is 69%.

Ans.

Mass percent of HNO_3 in sample is 69 %

Thus, 100 g of HNO_3 contains 69 g of HNO_3 by mass.

Molar mass of HNO_3

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

= 1 + 14 + 48

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

Now, No. of moles in 69 g of HNO_3:

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

= 1.095 mol

Volume of 100g HNO_3 solution

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

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

= 70.92mL

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

Concentration of HNO_3

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

= 15.44mol/L

Therefore, Concentration of HNO_3 = 15.44 mol/L

Q7. How much Cu (Copper) can be obtained from 100 gram of $CuSO_4$(copper sulphate)?

Ans.

1 mole of $CuSO_4$ contains 1 mole of Cu.

Molar mass of $CuSO_4$

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

= 63.5 + 32.00 + 64.00

= 159.5 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. $159.69\ g\ mol^{-1}$ ***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

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

= 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***
$^{35}\mathrm{Cl}$	***75.77***	***34.9689***
$^{37}\mathrm{Cl}$	***24.23***	***36.9659***

Ans.

Average atomic mass of Cl.

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

=[{($\frac{75.77}{100}(34.9689u)$ } + {($\frac{24.23}{100}(34.9659\ u)$ }]

= 26.4959 + 8.9568

= 35.4527 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 * 6.023 * 10^{23}

= 18.069 * 10^{23}

Q11. What is the concentration of sugar $C_{12}H_{22}O_{11}$ in 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,

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

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

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

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

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

= 0.02925 molL^{-1}

Therefore, Molar concentration = 0.02925 molL^{-1}

Q12. The density of CH_3OH (methanol) is 0.793 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 * 12) + (4 * 1) + (1 * 16)

= 32 g mol^{-1}

= 0.032 kg mol^{-1}

Molarity of the solution

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

= 24.78 molL^{-1}

(From the definition of density)

$M_1V_1 = M_2V_2$

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

V_1 = 0.0252 Litre

V_1 = 25.22 Millilitre

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

1 Pa = 1 N m^{-2}

Assume that mass of air at the sea level is 1034 gcm^{-2}. Find out the pressure in Pascal.

Ans.

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

P = $\frac{F}{A}$

= $\frac{1034\ g\ \times\ 9.8\ ms^{-2}}{cm^2} \times \frac{1\ kg}{1000\ g} \times \frac{(100)^2\ cm^2}{1m^2}$

= 1.01332 × 10^5 kg $m^{-1}s^{-2}$

Now,

1 N = 1 kg ms^{-2}

Then,

1 Pa = 1 Nm^{-2}

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

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

∴ Pressure (P) = 1.01332 × 10^5 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:

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

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

= ≈ 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 $CHCl_3$.

∴ Molality of $CHCl_3$ in water

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

Molar mass ($CHCl_3$)

= 12 + 1 + 3 (35.5)

= 119.5 gram mol^{-1}

Therefore, molality of $CHCl_3$ I water

= 1.25 × 10^{-4} 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 ×10^{-3}

(b) 235,000 = 2.35 ×10^{5}

(c) 8009= 8.009 ×10^{3}

(d) 700.0 = 7.000 ×10^{2}

(e) 5.0013 = 5.0013

Q19. Find the number of significant figures in the numbers given belowt.

(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 km =_____ mm = _____ pm

(b) 1 mg = _____ kg = _____ ng

(c) 1 mL = _____ L =_____ dm^3

Ans.

(1) If we fix the mass of N_2 at 28 g, the masses of N_2 that will combine with the fixed mass of N_2 are 32 gram, 64 gram, 32 gram and 80 gram.

The mass of 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 km = ____ mm = ____ pm

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

$\therefore$ 1 km = 10^6 mm

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

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

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

(b) 1 mg = ____ kg = ____ ng

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

1 mg = 10^{-6} kg

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

1 mg = 10^{6} ng

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

(c) 1 mL = ____ L = ____ dm^3

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

1 mL = 10^{-3} L

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

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

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

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

Ans.

Time taken = 2 ns

= 2 × 10^{-9} s

Now,

Speed of light = 3 × $10^8\ ms^{-1}$

So,

Distance travelled in 2 ns = speed of light * time taken

= (3 × 10^8)(2 × 10^{-9})

= 6 × 10^{-1} m

= 0.6 m

Q23. In the reaction given below:

$X + Y_2 \rightarrow XY_2$

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 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

$$N_2\ (g)\ +\ H_2\ (g)\ \rightarrow\ 2NH_3\ (g)$$

(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:

$N_2\ (g)\ +\ 3H_2\ (g)\ \rightarrow\ 2NH_3\ (g)$

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.

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

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

Given:

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

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

= 571.4 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 × 23) + 12 + (3 × 16)

= 106 g mol^{-1}

1 mole of Na_2CO_3 means 106 g of Na_2CO_3

Therefore, 0.5 mol of Na_2CO_3

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

= 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:

$2H_2\ (g)\ +\ O_2\ (g)\ \rightarrow\ 2H_2O\ (g)$

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

29.7 pm = 29.7 × $10^{-12}\ m$

= 2.97 × $10^{-11}\ m$

(ii) 16.15 pm

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

16.15 pm = 16.15 × $10^{-12}\ m$

= 1.615 × $10^{-11}\ m$

(iii) 25366 mg

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

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

25366 mg = 2.5366 × $10^{-2}\ kg$

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)

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

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

= 3.06 × 10^{21} atoms of Au (s)

(ii) 1 g Na (s)

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

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

= 0.262 × 10^{23} atoms of Na (s)

= 26.2 × 10^{21} atoms of Na (s)

(iii) 1 g Li (s)

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

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

= 0.86 × 10^{23} atoms of Li (s)

= 86.0 × 10^{21} atoms of Li (s)

(iv)1 g of Cl_2 (g)

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

(Molar mass of Cl_2 molecule = 35.5 × 2 = 71 g mol^{-1})

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

= 0.0848 × 10^{23} atoms of Cl_2 (g)

= 8.48 × 10^{21} atoms of Cl_2 (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

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

$0.040 = \frac{n_{C_2H_5OH}}{n_{C_2H_5OH} + n_{H_2O}}$ ——(1)

No. of moles present in 1 L water:

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

n_{H_2O} = 55.55 mol

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

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

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

0.96$n_{C_2H_5OH}$ = 2.222 mol

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

$n_{C_2H_5OH}$ = 2.314 mol

Therefore, molarity of solution

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

= 2.314 M

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

Ans.

1 mole of carbon atoms

= 6.023×10^{23} atoms of carbon

= 12 g of carbon

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

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

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

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 × 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 × 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*
$_{36}\mathrm{Ar}$	***35.96755*** $g\ mol^{-1}$	***0.337 %***
$_{38}\mathrm{Ar}$	***37.96272*** $g\ mol^{-1}$	***0.063 %***
$_{40}\mathrm{Ar}$	***39.9624*** $g\ mol^{-1}$	***99.600 %***

Ans.

Molar mass of Argon:

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

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

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

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 mole of Ar = 6.023×10^{23} atoms of Ar

Therefore, 52 mol of Ar = 52 × 6.023×10^{23} atoms of Ar

= 3.131×10^{25} 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 u of He = $\frac{1}{4}$ atom of He

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

= 13 atoms of He

(iii) 52 g of He

4 g of He = 6.023×10^{23} atoms of He

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

= 7.8286×10^{24} 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

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

= 0.9217 g

18 g of water contains 2 g of hydrogen

Therefore, 0.690 g of water will contain hydrogen

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

= 0.0767 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 g + 0.0767 g

= 0.9984 g

Therefore, % of C in the compound

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

= 92.32 %

% of H in the compound

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

= 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

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

= 25.984 g

≈ 26 g

(iii) Molecular formula

Empirical formula mass:

CH = 12 + 1

= 13 g

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

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

= 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:

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

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

Ans.

0.75 M of HCl

≡ 0.75 mol of HCl are present in 1 L of water

≡ [(0.75 mol) × (36.5 g mol–1)] HCl is present in 1 L of water

≡ 27.375 g of HCl is present in 1 L of water

Thus, 1000 mL of solution contins 27.375 g of HCl

Therefore, amt of HCl present in 25 mL of solution

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

= 0.6844 g

Given chemical reaction,

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

2 mol of HCl (2 × 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

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

= 0.9639 g

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

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

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

Ans.

1 mol of MnO_2 = 55 + 2 × 16 = 87 g

4 mol of HCl = 4 × 36.5 = 146 g

1 mol of MnO_2 reacts with 4 mol of HCl

5 g of MnO_2 will react with:

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

= 8.4 g HCl

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

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