

Solutions

S1. Ans. (d)

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

$$(2) 4 \text{ g of Helium} = \frac{4 \text{ g}}{4 \text{ g}} \text{ mole} = 1 \text{ mole} = N_A \text{ He atom}$$

$$(3) 2.2710982 \text{ of He at STP} = \frac{2.271}{22.710982} \text{ mole} = 0.1 \text{ mole}$$

$$= 0.1 N_A \text{ He atom}$$

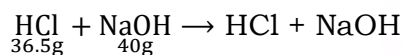
$$(4) 4 \text{ mol of He} = 4 N_A \text{ He atoms}$$

S2. Ans. (a)

$$M = \frac{W \times 1000}{M_2 \times V \text{ (in mL)}}$$

$$W = \frac{M \times M_2 \times V \text{ (in mL)}}{1000} = \frac{0.75 \times 36.5 \times 25}{1000}$$

$$= 0.684 \text{ g (Mass of HCl)}$$



36.5 g HCl reacts with NaOH = 40 g

0.684 g HCl reacts with NaOH

$$= \frac{40}{36.5} \times 0.684 = 0.750 \text{ g}$$

Amount of NaOH left = 1 g – 0.750 g

$$= 0.250 \text{ g} = 250 \text{ mg}$$

S3. Ans. (a)

Element	Mass (%)	No. of moles	No. of moles / Smallest number	Simplest whole number
A	32%	$\frac{32}{64} = \frac{1}{2}$	$\frac{1}{2} \times 2$	= 1
B	20%	$\frac{20}{40} = \frac{1}{2}$	$\frac{1}{2} \times 2$	= 1
C	48%	$\frac{48}{32} = \frac{3}{2}$	$\frac{3}{2} \times 2$	= 3

So, empirical formula of X = $\frac{A}{1} : \frac{B}{1} : \frac{C}{3}$

∴ The correct empirical formula of compound X is ABC_3

S4. Ans.(d)

$$m = \frac{1000 \times M}{1000 \times d - MM_w}$$

$$m = \frac{1000 \times 1}{1000 \times 1.25 - 1 \times 85}$$

$$m = \frac{1000}{1165} = 0.858$$

S5. Ans.(a)

Weight of impure limestone = 20 g

Weight of pure limestone (CaCO_3) = 20% of 20 g

$$= \frac{20}{100} \times 20$$

$$= 4 \text{ g}$$

$$n_{\text{CaCO}_3} = \frac{4}{100} = 0.04$$

$$n_{\text{CO}_2} = 0.04$$

$$W_{\text{CO}_2} = 0.04 \times 44$$

$$= 1.76 \text{ g}$$

S6. Ans.(c)

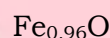
Mass = Volume × Density

$$= 2.5 \times 2.15$$

$$= 5.375 \text{ g}$$

Since 2.5 has two significant figures, so the mass of solution is correct significant figures will be 5.4 g.

S7. Ans.(b)



Let Fe(II) present in $\text{Fe}_{0.96}\text{O} = x$

Fe(III) present = $(0.96 - x)$

Total charge on Fe = $2x + (0.96 - x)3$

Total charge on O = -2

$$2x + (0.96 - x)3 = 2$$

$$2x + 2.88 - 3x = 2$$

$$-x = -0.88$$

$$x = 0.88$$

$$\text{Fe}^{2+} = 0.88, \text{Fe}^{3+} = 0.08$$

$$\text{Fraction of Fe}^{3+} = \frac{0.08}{0.96} = 1/12$$

S8. Ans.(b)

Molality is the moles of solute dissolved per kg of solvent therefore 500 g, 1 molal solution contains 0.5 of solute, as

$$m = \frac{\text{Moles of solute}}{\text{Mass of solvent (in kg)}}$$

$$1 = \frac{0.5}{\text{Mass of solvent (in kg)}}$$

$$\therefore \text{Mass of solvent (in kg)} = 0.5$$

$$= 500 \text{ g}$$

S9. Ans.(b)

Let m gram mass of CaCO_3 is required

$$\text{Pure CaCO}_3 \text{ in m gram} = \frac{95}{100} \times m$$

$$\text{Moles of CaCO}_3 = \frac{95}{100} \times \frac{m}{100}$$

Moles of HCl required = $2 \times$ moles of CaCO_3

$$= 2 \times \frac{95}{100} \times \frac{m}{100}$$

$$2 \times \frac{95}{100} \times \frac{m}{100} = \frac{50}{1000} \times 0.5$$

$$m = 1.315 \text{ g} \approx 1.32 \text{ g}$$

S10. Ans.(b)

Element	%	At Weight	% At weight	Simplest Ratio
C	78	12	6.5	1
H	22	1	22	3

Empirical formula of this compound is CH_3 .

S11. Ans.(c)

$$\begin{aligned} \text{(a) Number of Mg atoms} &= \frac{1}{24} \times N_A \\ &= \frac{1}{24} \times 6.022 \times 10^{23} \text{ atoms} \end{aligned}$$

$$\begin{aligned} \text{(b) Number of O atoms} &= \frac{1}{32} \times N_A \\ &= \frac{1}{32} \times 2 \times 6.022 \times 10^{23} \text{ atoms} \end{aligned}$$

$$\begin{aligned} \text{(c) Number of Li atoms} &= \frac{1}{7} \times N_A \\ &= \frac{1}{7} \times 6.022 \times 10^{23} \text{ atoms} \end{aligned}$$

$$\begin{aligned} \text{(d) Number of Ag atoms} &= \frac{1}{108} \times N_A \\ &= \frac{1}{108} \times 6.022 \times 10^{23} \text{ atoms} \end{aligned}$$

Hence, 1 g lithium has the largest number of atoms.

S12. Ans.(c)

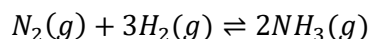
No of atom in 12 g carbon

$$= 12 \div (1.9926 \times 10^{-23})$$

Thus Number of atoms in 1 mole carbon
 $= 6.022 \times 10^{23}$ atoms

S13. Ans.(c)

Haber's process

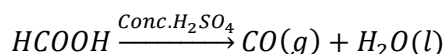


20 moles need to be produced

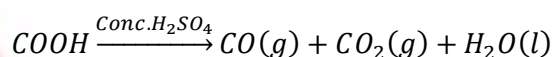
2 moles of $\text{NH}_3 \rightarrow 3$ moles of H_2

Hence 20 moles of $\text{NH}_3 \rightarrow \frac{3 \times 20}{2} = 30$ moles of H_2

S14. Ans.(d)



$$2.3\text{g or } \left(\frac{1}{20} \text{ mol}\right) \frac{1}{20} \text{ mol}$$



$$\begin{array}{ccc} \text{COOH} & \frac{1}{20} \text{ mol} & \frac{1}{20} \text{ mol} \end{array}$$

$$4.5 \text{ or } \left[\frac{1}{20} \text{ mol}\right]$$

Gaseous mixture formed is CO and CO_2 . When it is passed through KOH , only CO_2 is absorbed. So the remaining gas is CO . KOH pellets absorbs all CO_2 , H_2O is absorbed by H_2SO_4 thus CO is remaining product.

So, weight of remaining gaseous product CO is $\frac{2}{20} \times 28 = 2.8\text{g}$

So, the correct option is (d)

S15. Ans.(a)

$$\begin{aligned} \text{(a) Mass of water} &= 18 \times 1 = 18 \text{ g} \\ \text{Molecules of water} &= \text{mole} \times N_A = \frac{18}{18} N_A = 1 N_A \end{aligned}$$

$$\begin{aligned} \text{(b) Molecules of water} &\text{mole} \times N_A = \frac{0.18}{18} N_A \\ &= 10^{-2} N_A \end{aligned}$$

$$\begin{aligned} \text{(c) Molecules of water} &\text{mole} \times N_A = 10^{-3} N_A \end{aligned}$$

$$\text{(d) Moles of water} = \text{mole} \times N_A = 10^{-4} N_A$$

S16. Ans.(c)

%	Moles	Relative moles	
C	85.7	$\frac{85.7}{12} = 7.14$	1
H	14.3	$\frac{14.3}{1} = 14.3$	2

Hence, empirical formula = CH_2 .

empirical weight = 14

$$\frac{3.01 \times 10^{20}}{6.022 \times 10^{23}} = \text{No. of moles} = \frac{42 \times 10^{-3}}{M}$$

$$\frac{1}{2} \times 10^{-3} = \frac{42 \times 10^{-3}}{M}$$

$$M = 84$$

$$\therefore \text{Atomicity} = \frac{84}{14} = 6$$

$$\text{Molecular formula} = \text{C}_6\text{H}_{12}.$$

S17. Ans.(c)

For XY_2 , let atomic weight of X = A_x and of Y = A_y

$$\text{So, } n_{\text{xy}_2} = 0.1 = \frac{10}{A_x + 2A_y}$$

$$A_x + 2A_y = 100 \quad \dots(i)$$

Similarly for X_3Y_2 ,

$$3A_x + 2A_y = 180 \quad \dots(ii)$$

On solving (i) and (ii)

$$A_x = 40 \text{ and } A_y = 30$$

S18. Ans.(a)

(a) 18 mols of water will contain
 $= 18 \times 6.022 \times 10^{23}$ molecules of H_2O

(b) 18 molecules

(c) $\frac{1.8}{18} = 0.1$ mole will contain
 $= 0.1 \times 6.022 \times 10^{23}$ molecules of H_2O

(d) $\frac{18}{18} \text{ g} = 1$ mole $= 1 \times 6.022 \times 10^{23}$ molecules of H_2O

So, maximum number of molecules is present in 18 moles of H_2O .

S19. Ans.(c)

Avogadro's number 6.022×10^{23} is ideally the mass of number of atoms present in 1 mole that is 12 grams of C. If we change the Avogadro's number it will directly change the mass of 1 mole that is 12 g of C.

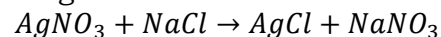
S20. Ans.(b)

Molecular weight of $\text{AgNO}_3 = 170$

Molecular weight of $\text{NaCl} = 58.5$

1. 16.9% solution of AgNO_3 means 16.9 g of AgNO_3 in 100 mL of solution
 So, 8.45 g of AgNO_3 in 50 mL of solution.

2. 5.8% solution of NaCl means 5.8 g of NaCl is in 100 mL solution. So, in 50 mL = 2.9 g NaCl



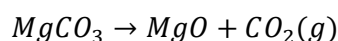
$$\begin{array}{cccc} \text{Initial Mole :} & \frac{8.45}{170} & \frac{2.9}{58.5} & 0 & 0 \\ & = 0.049 & = 0.049 & 0 & 0 \end{array}$$

$$\text{Final mole : } 0 \quad 0 \quad 0.049 \quad 0.049$$

Mass of AgCl precipitated = 0.049 mole
 $= 0.049 \times 143.3$

$$= 7.02 \text{ gm} \approx 7 \text{ gm}$$

S21. Ans.(c)



$$\text{Mg} \rightarrow 84 \text{ g} \quad 40 \text{ g}$$

According to question

84 g MgCO_3 gives = 40 g MgO

$$1 \text{ g } \text{MgCO}_3 \text{ gives} = \frac{40}{84}$$

$$20 \text{ g } \text{MgCO}_3 \text{ gives} = \frac{40}{84} \times 20$$

$$= 9.52 \text{ g of MgO}$$

But according to question yield of MgO is = 8 g

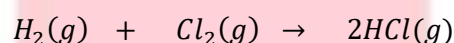
$$\% \text{ of purity} = \frac{8}{9.52} \times 100 = 84\%$$

S22. Ans.(d)

1 mole = 22.4 litres at S.T.P.

$$n_{\text{H}_2} = \frac{22.4}{22.4} = 1 \text{ mole}; n_{\text{Cl}_2} = \frac{11.2}{22.4} = 0.5 \text{ mol}$$

Reaction is as,



$$\begin{array}{ccc} \text{Initial} & 1 \text{ mol} & 0.5 \text{ mol} & 0 \end{array}$$

$$\begin{array}{ccc} \text{Final} & (1 - 0.5) & (0.5 - 0.5) & (2 \times 0.5) \\ & = 0.5 \text{ mol} & = 0 \text{ mol} & 1 \text{ mol} \end{array}$$

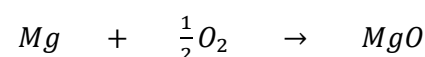
Here, Cl_2 is limiting reagent. So, 1 mole of HCl (g) is formed.

S23. Ans.(d)

$$n_{\text{Mg}} = \frac{1}{24} = 0.0416 \text{ moles}$$

$$n_{\text{O}_2} = \frac{0.56}{32} = 0.0175 \text{ moles}$$

The balanced chemical equation :



Initial	0.0416	0.0175	0
moles		moles	
Final	$(0.0416 - 2 \times 0.0175)$	0	2×0.0175

= 0.0066 moles (O_2 is limiting reagent)

\therefore Mass of Mg left in excess
 = $0.0066 \times 24 = 0.16$ g

S24. Ans.(c)

According to Avogadro's principle, ratio of volume of gases will be equal to the ratio of their number of moles

$$\text{mole} = \frac{w}{M_w}$$

$$n_{H_2} : n_{O_2} : n_{CH_4}$$

$$\frac{w}{2} : \frac{w}{32} : \frac{w}{16} \Rightarrow 16 : 1 : 2$$

S25. Ans.(b)

6.02×10^{23} number of molecules
 = 1 mole

$$6.02 \times 10^{20} = 0.001 \text{ mole}$$

$$\text{Concentration} = \frac{\text{mole}}{V(\text{mL})} \times 1000$$

$$= \frac{0.001}{100} \times 1000 \Rightarrow 0.01 \text{ M}$$

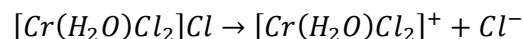
S26. Ans.(a)

Molarity of solution of dichlorotetra-aquachromium (III) chloride = 0.01 M.

Volume of solution of dichlorotetra-aquachromium (III) chloride = 100 ml.

The formula of dichlorotetra-aquachromium (III) chloride is $[Cr(H_2O)_4Cl_2]Cl$.

On ionisation,



Initial	100×0.01	0	0
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Final	0	1 mol	1 mol
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So, 1 mol of Cl^- ions will react with 1 mol of $AgNO_3$ mole of $[Cr(H_2O)_4Cl_2]Cl$ 0.1 M 100 ml solution is,

No. of moles = Molarity \times Volume

$$= 0.01 \times 0.1 = 0.001 \text{ mol}$$

Hence, 0.001 mol of Cl^- ions will react with 0.001 mole of $AgNO_3$.

So, number of moles of $AgCl$ formed is 0.001 mol.

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