CHAPTER - 01

SOME BASIC CONCEPTS OF CHEMISTRY

1. 3 $(NH_4)_2Cr_2O_7$
 1 mol contains 19 mol atoms
 $\therefore$ Total number of atoms = 19 × N_A = 114.42 × 10^{23}
2. 4 Mass of a given amount of a substance is a constant quantity
3. 4 22.4 L N_2 at NTP $\equiv$ 1 mol N_2
 5.6 L O_2 at NTP $\equiv \frac{1}{4}$ mol O_2
 According to Avogadro's hypothesis, equal volumes of all gases contain equal number of molecules under similar conditions of temperature and pressure.
4. 3 $5[M_A + 2M_B] = 125$
 $M_A + 2M_B = 25$ .... (1)
 $2M_A + 2M_B = 30$ ..... (2)
 From eq. (1) and (2), $M_A = 5$, $M_B = 10$
5. 2 100g compound contains 40g C, 6.66 g H and 53.34 g O. i.e., 3.33 mol C, 6.66 mol H and 3.33 mol O
 Molar ratio, C : H : O = 3.33 : 6.66 : 3.33 = 1 :2 : 1
 Thus, empirical formula = CH_2O
 Molecular formula = $CH_2O \times \frac{60}{30} = C_2H_4O_2$
6. 2 $N_2 + 3H_2 \longrightarrow 2NH_3$
 According to Gay Lussac's law, 1L of N_2 reacts with 3L of H_2 to form 2L of NH_3. Here, 30 L of N_2 and 30L of H_2 are taken for reaction. Then a maximum of 10L of N_2 can react with 30 L of H_2 to form 20L of NH_3 (Since H_2 is the limiting reagent). Since the yield is only 50%, 5L of N_2 has reacted with 15L of H_2 and 10L of NH_3 has formed.
 Final mixture will contain : 30 – 5 = 25 L N_2; 30 –15 = 15 L H_2 and 10 L NH_3
7. 1 1L solution $\equiv$ 1250 g solution
 3M NaCl $\Rightarrow$ 3 mol NaCl in 1250g solution or 3 mol NaCl in 1074.5g solvent
 Thus, molality = $\frac{3\text{ mol}}{1.0745\text{kg}}$ = 2.79 mol/kg
8. 10 ppm = $\frac{10.3\times10^{-3}\text{g } O_2}{1030\text{ g solution}}\times10^6 = 10\text{ ppm}$
9. 160 $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
 1 mol CH_4 gives 44g CO_2 and 36g H_2O
 $\therefore$ 2mol CH_4 givs 88g CO_2 and 72 g H_2O
 Thus, total mass of CO_2 and H_2O = 88 + 72 = 160g
10. 1 $3BaCl_2 + 2Na_3PO_4 \longrightarrow Ba_3(PO_4)_2\downarrow + 6NaCl$

11. A

6.022×10^{23} Ax atoms $\equiv 40g$

$\therefore 3.00 \times 10^{24}$ Ax atoms $\equiv \frac{40}{6.022 \times 10^{23}} \times 3.00 \times 10^{24}$ g

$\equiv 199g$

12. C

A) 74u Ca$(OH)_2$ = 324 O

B) Atomic mass = $3.82 \times 10^{-23} \times 6 \times 10^{23}$

= 22.92u

c) 100g $CaCO_3$ $\equiv$ 3 g atom of oxygen

D) Number of atoms of

$S = 2N_A \times 8 = 16N_A$

$S = 55N_A \times 1 = 55N_A$

13. B

$HgO \longrightarrow Hg + \frac{1}{2}O_2$

216g　　16g

21.6g　　1.6g

$KClO_3 \longrightarrow KCl + \frac{3}{2}O_2$

122.5g　　48g

$\therefore 1.6g\ O_2 \equiv \frac{122.5}{48} \times 1.6$ g $KClO_3$

$\equiv 4.08$ g $KClO_3$

14. A

Weight gain = $75kg - \frac{75 \times 10}{100} + \frac{75 \times 10 \times 2}{100}$

$= 75kg - 7.5kg + 15kg$

$= 75kg + 7.5kg$

15. A Number of equivalents of Al = n_{eq} of HCl

$= NV$

$= 12 \times 0.05$

$= 0.6\,meq$

$= 0.6 \times 10^{-3}\,eq$

$= 6 \times 10^{-4}\,eq$

$W_{Al} = n_{eq} \times Eq.mass$

$= 6 \times 10^{-4} \times 9$

$= 54 \times 10^{-4}\,g$

Volume = Area × thickness

$$\text{Volume} = \frac{\text{mass}}{\text{density}} = \frac{54 \times 10^{-4}\,g}{2.7\,g\,mL^{-1}}$$

$= 2 \times 10^{-3}\,cm^3$

$$\therefore \text{Area} = \frac{\text{volume}}{\text{thickness}} = \frac{2 \times 10^{-3}}{10^{-2}}$$

$= 2 \times 10^{-1}\,cm^2$

16. A $HCl + AgNO_3 \longrightarrow AgCl + HNO_3$

m.equivalents of HCl left = 0.5

m. equivalents of HNO_3 formed = 1.5

$V_a N_a = V_b N_b$; $2 = V_b \times 0.05$

Volume of $NaOH$ = 40 ml

17. B $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

x litres pf propane produce 3x litre of CO_2

$C_4H_{10} + 6.5O_2 \rightarrow 4CO_2 + 5H_2O$

(3-x) litres of butane produce 4(3-x) lit of CO_2

$3x + 4(3 - x) = 11$; $3x + 12 - 4x = 11$

$12 - x = 11$; $x = 1$ litre

volume of butane : propane=2:1

18. A,D

No of atoms in $A = \frac{16}{32} N_A \times 2 = N_A$

No of atoms in $B = \frac{16}{48} N_A \times 3 = N_A$

No of molecules in $A = \frac{16}{32} N_A = \frac{N_A}{2}$

No of molecules in $B = \frac{16}{48} N_A = \frac{N_A}{3}$

19. A,B,D

A) Minimum molar mass of a hydrocarbon is 16u (CH_4)

B) 18g $H_2O(g) \equiv 22.4L$ at STP

C) No of Cl atoms $= \frac{5.6}{22.4} N_A \times 2$

$= 3.011 \times 10^{23}$

D) 1 molecule of HNO_3 contains 5 atoms

20. B, C

$$2H_2 + O_2 \longrightarrow 2H_2O$$

4g 32g 36g

given 64g 64g

Limiting reagent = O_2

$32g\ O_2 \equiv 36g\ H_2O$

$\therefore 64g\ O_2 \equiv 72g\ H_2O$

21. AD

Let molar mass of M_2O be 'x' and molar mass of M be 'y'

Now, $x \times \frac{36.4}{100} = 16g \rightarrow X = 43.95$

$\therefore 2y + 16 = 43.95 \Rightarrow y = 13.98 \approx 14g$

Let formula of second oxide be M_aO

Now, $(14a + 16) \times \frac{53.4}{100} = 16 \Rightarrow a = 1$

Thus, second oxide is 'MO'

The ratio of mass of metal that reacts with a fixed mass of oxygen to form the two oxides is 2:1

22. AB

On sparking CO is converted to CO_2 according to the equation, $CO + \frac{1}{2}O_2 \rightarrow CO_2$

In option A

$30mL\ CO + 60mL\ CO_2 + 10mL O_2 \xrightarrow{spark} 10mL CO + 80mL CO_2$

(90mL mixture)

In Option (B)

$30mL CO + 50mL CO_2 + 20mL O_2 \xrightarrow{spark} 80mL CO_2 + 5mL O_2$

(85mL mixture)

In Option (C)

$50mL\ CO + 30mL CO_2 + 20mL O_2 \xrightarrow{spark} 10mL CO + 70mL CO_2$

(80mL mixture)

In Option (D)

$20mL CO + 70mL CO_2 + 10mL O_2 \xrightarrow{spark} 90mL CO_2$

On passing the final mixture through KOH solution, all CO_2 gets absorbed in the solution. Clearly final mixture in option (A) and option (B) contain 80mL CO_2. So in these cases, contraction in volume occurs by 80mL

23. C $8g O_2 \equiv \frac{1}{4}$ mol $O_2 \equiv \frac{1}{4} \times 16$ mol protons (i.e, 4 mol protons)

11g $CO_2 \equiv \frac{1}{4} mol\, CO_2 \equiv \frac{1}{4} \times (6+16)$ mol protons (i.e. 5.5mol protons)

22g $CO_2 \equiv 2 \times 5.5$ mol protons (i.e. 11 mol protons)

7g $CO \equiv \frac{1}{4} mol\, CO \equiv \frac{1}{4} \times (6+8)$ mol protons (i.e. 3.5 mol protons)

14g CO $\equiv 2 \times 3.5$ mol protons (i.e. 7 mol protons)

24. 6.20

$$3CaCl_2 + 2Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6NaCl$$

3 mol   2 mol   1 mol

given $\frac{6.66}{111}$ $0.5 \times 100 \times 10^{-3}$

$= 0.06$ mol $= 0.05$ mol

Limiting reagent = $CaCl_2$

3 mol $CaCl_2$ $\equiv$ 1 mol $Ca_3(PO_4)_2$

$\therefore$ 0.06 mol $CaCl_2$ $\equiv \frac{1}{3} \times 0.06$ mol $Ca_3(PO_4)_2$

$\equiv 0.02$ mol $Ca_3(PO_4)_2$

$W = nM = 0.02 \times 310\,g$

$= 6.2\,g$

25. 0.21 $n_{HCl(g)} = \frac{V}{V_m} = \frac{1120}{22400} = 0.05 = n_{eq_{HCl}}$

$n_{eq\,H_2SO_4} = NV$

$= n_{factor} \times M \times V$

$= 2 \times 0.15 \times 20 \times 10^{-3}$

$= 6 \times 10^{-3}$

n_{eq} NaOH remains unreacted $= 6 \times 10^{-3}$ eq

n_{eq} NaOH initial $= NV = N \times 265 \times 10^{-3}$ eq

$n_{eq}\,HCl_{(g)} = N \times 265 \times 10^{-3} - 6 \times 10^{-3} = 0.05$

$N \times 265 \times 10^{-3} = 0.056$

$N = 0.21$

26. 32 1.6g metal $\rightarrow$ 2.0g metal oxide (i.e. 1.6g metal + 0.4g oxygen)

Mass of metal that combines with 16g of oxygen = $1.6 \times 40 = 64$g

$\therefore$ Equivalent mass of metal = $\frac{64}{2} = 32$ g

27. 2

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

	CH_4	$2O_2$	CO_2	$2H_2O$
Initial:	1mol	1mol	0	0
Final:	0.5mol	0	0.5mol	1mol

Total no. of moles in the final mixture = $0.5 + 0.5 + 1 = 2$ mol

28. 540.47 - 540.48

Wt. of S_8 in sample = 160g;

Moles of $S_8 = \frac{160}{32 \times 8} = 0.625$

No. of moles of O_2 required = 0.625×8

Vol. of O_2 required at STP = 22.7×5

$\therefore$ Vol. of air required at STP = $22.7 \times 5 \times \frac{100}{21}$

29. C Molar mass of urea = 60, HNO_3 = 63, H_2SO_4 = 98 and CH_3COOH = 60gmol^{-1}

Solution I

Molarity = $\frac{(120/60)\,\text{mol}}{1\text{L}} = 2\text{M}$

Mass of solution = $1\text{L} \times 1.2\text{kg/L} = 1.2\text{kg}$ or 1200g

Mass of solvent = 1200g – 120g = 1080g or 1.08kg

$\therefore$ molality = $\frac{2\text{mol}}{1.08\text{kg}} = 1.85\text{m}$

Solution II:

Data insufficient to calculate molarity of the solution

30. A 1 mol of gas at NTP will occupy 22.4L

Molar mass of SO_2 = 64, H_2 = 2, O_3 = 48 and O_2 = 32gmol^{-1},