MOLE CONCEPT

1) A) moles of $C_2H_6 = \frac{15}{30}$, mole of C-atom $= \frac{15}{30} \times 2$
$= 1$

B) $n_{Na_2C_2O_4} = \frac{40.2}{134} = 0.3$, $n_C = 0.3 \times 2 = 0.6$

c) $n_{C_6H_{12}O_6} = \frac{72}{180} = 0.4$, $n_C = 2.4$

D) $n_{C_5H_{10}} = \frac{35}{70} = 0.5$, $n_C = 0.5 \times 5 = 2.5$

2) $W_{NaI} = \frac{0.5}{100} \times 3 = \frac{1.5}{100}$ gm.

$n_{NaI} = \frac{\frac{1.5}{100}}{150} = 10^{-4}$.

No. of $I^{\ominus}$ ions $= 6.02 \times 10^{19}$

3)

	NO_2	NO
let % by mole	x %	$(100-x)$ %

$$34 = \frac{x \times 46 + (100-x) \times 30}{x + (100-x)} = 25$$

4) $W_{CO} = \frac{2.01 \times 10^{23}}{6.02 \times 10^{23}} \times 28 = 9.3$ gm.

5) 8 moles of O atom will be contained by = 1 mole

$\therefore$ 0.25 mole " ——— $= \frac{1}{8} \times 0.25$ mole of $Mg_3(PO_4)_2$

$= 3.125 \times 10^{-2}$

(6) $2Al_{(s)} + 6HCl_{(aq.)} \longrightarrow 2Al^{+3}_{(aq.)} + 6Cl^{-}_{(aq.)} + 3H_{2(g)}$

1 mole $\qquad\qquad \frac{3}{2}$ mole

$= \frac{3}{2} \times 22.4$

At STP

(7) $n_C = \frac{1.2 \times 10^{-3}}{12} = 10^{-4}$

No. of C-atoms $= 6.02 \times 10^{19}$

(8) $\qquad Mg^{24} \quad Mg^{25} \quad Mg^{26}$

mole % $= \quad 79 \quad (21-x) \quad x$ (let)

$$24.31 = \frac{79 \times 24 + (21-x)25 + x(26)}{79 + (21-x) + x}$$

$x = 10$

(9) $BaCO_3 \longrightarrow BaO + CO_2$

$n = \frac{9.85}{197}$

$= 0.05$ moles $\qquad$ 0.05 mole $\quad$ At STP

$V_{CO_2} = (0.05 \times 22.7)\ l$

$= 1.135\ l.$

(10) Note that! 1.013 bar = 1 atm

$2Al + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2$

$= 0.01$ mole $\qquad\qquad \frac{3}{2} \times 0.01$ mole

$PV = nRT$

$V = \frac{3}{2} \times 0.01 \times 0.0821 \times 300$

$= 369$ ml.

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(11) $2NaNO_3 \longrightarrow 2NaNO_2 + O_2$

$= \frac{8.5}{85}$

$= 0.1$ mole

$= \frac{0.1}{2}$ mole

$V = nRT/P$

$= 1.12 L.$

(12) $6C_{(s)} + 11H_{2(g)} + \frac{11}{2}O_{2(g)} \longrightarrow C_{12}H_{22}O_{11(s)}$

$= \frac{84}{12}$ $= \frac{12}{2}$ $= \frac{56}{22.4}$

$= 7$ mole $= 6$ mole $= 2.5$ mole

W

$= \frac{2}{11} \times 2.5 \times 342$

$= 155.5$ gm

(13) If we are required to produce maximum products from a given mass of reactant mixture, then always the reactant should be in stoichiometric ratio

$C_2H_4O_2 + 2O_2 \longrightarrow 2CO_2 + 2H_2O$

let: n moles 2n mole

60n gm 64n gm.

$60n + 64n = 620$

$n = 5$

10 mole

$= 440$ gm.

(14) $3Mg + 2NH_3 \longrightarrow Mg_3N_2 + 3H_2$

$n = 48/24$ $34/17$

$= 2$ mole $= 2$ mole

$2/3$ mole

Mg is L.R.

$= \frac{2}{3} \times 100$ gm.

(15) $H_2 + \frac{1}{2}O_2 \xrightarrow[\text{yield}]{50\%} H_2O$

$\underbrace{H_2 + \frac{1}{2}O_2}_{90\ gm}$ $\quad H_2O \downarrow 45\ gm$

(16) Let us assume, impure sample of $CaCO_3 = 100\ gm$.

$W_{Ca} = 38\ gm.$

$n_{Ca} = 38/40 = 0.95$

$n_{CaCO_3} = 0.95 \qquad W_t$ of $CaCO_3 = 95\ gm.\ [0.95 \times 100]$

(17) $NH_3 \longrightarrow \frac{1}{2}N_2 + 3/2\ H_2$

$t=0$ 1 mole

$t=t$ $(1-0.2)$ mole $= 0.2/2 \qquad = 3/2 \times 0.2$

$= 0.8$ mole $\qquad = 0.1$ mole $\qquad = 0.3$ mole

$$W_{N_2}/W_{NH_3} = \frac{0.\cancel{8} \times 28}{0.8 \times 17} = 7/34$$

(18) for 10^{-2} · P atom ∴ = 100 molecule

∴ 31 wt of P $= 31 \times 10^5$.

(19) $Na_2SO_4 \cdot xH_2O_{(s)} \longrightarrow Na_2SO_{4(s)} + xH_2O_{(g)}$

$n = \frac{13.4}{142+18x}$ $\qquad\qquad xH_2O_{(g)} \downarrow 6.3\ gm$

$$n_{H_2O} = \frac{(13.4)x}{142+18x} = \frac{6.3}{18}$$

$x = 7$

(20) for min. molecular wt.; we consider that at least one sullphur atom should be there in one molecule

4 wt. of S ⟶ 100 wt of molecule

32 wt of S ⟶ $\frac{100}{4} \times 32 = 800$ wt of molecule.

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(21)

	C	H	N
wt	$9x$	$1x$	$3.5x$
n	$\frac{9x}{12} = 0.75x$	x	$\frac{3.5x}{14} = \frac{0.5x}{2}$

Simplest ratio ⇒ 3 4 1

Empirical formula $= C_3H_4N$ $\quad n = \frac{108}{54} = 2$

M.F. $= C_6H_8N_2$

(22) The molecules having same Empirical formula will have same percent of constituent atom

$HCHO$, CH_3COOH, $C_6H_{12}O_6$

Emp. formula: CH_2O, CH_2O, CH_2O

$\% C = \frac{12}{30} \times 100 = 40\%$

(23)

	N	O
mole ratio	$\frac{30.5}{14}$	$\frac{69.5}{16}$
	2.178	4.34
	1	2

EMP. formula $= NO_2$

$n = \frac{MW}{EMP\,wt} = \frac{92}{46} = 2$

Mol. formula $= (NO_2)_2 = N_2O_4$

(24) $C_6H_{12}O_6 \longrightarrow CH_2O$ (Emp. formula)

$CH_3COOH \longrightarrow CH_2O$ (Emp. formula)

(25)

	X	Y
mole ratio	$\frac{m}{30}$	$\frac{m}{20}$
	2	3

$\boxed{X_2Y_3}$

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(26) $C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O_{(l)}$

$2x \qquad\qquad 4x$

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O_{(l)}$

$5x \qquad\qquad 5x$

$W_{C_2H_6} + W_{CH_4} = 280$

$\Rightarrow 2x(30) + 5x(16) = 280$

$\boxed{x = 2}$

$n_{CO_2} = 4x + 5x$

$= 9x = 18$ mol

(27) $MgCO_3 \xrightarrow{\Delta} MgO + CO_2$

$a \qquad a \qquad a$

$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2$

$2b \qquad b \qquad b \qquad b$

$$\frac{a+b}{b} = \frac{3}{1}$$

$a = 2 \qquad b = 1$

mass % of $NaHCO_3$ $= \dfrac{(2b) \times 84}{(2b) \times 84 + a(84)} \times 100 = 50\%$

(28) $PCl_5 \rightarrow PCl_3 + Cl_2$

$t=0 \quad 1$ mole

$t=t \quad 1-\alpha \qquad \alpha \qquad \alpha$

$0.5 \qquad 0.5 \qquad 0.5$

$\alpha = 0.5$

$M_{avg} = \dfrac{\text{total Mass}}{\text{total Mole}} = \dfrac{208.5}{1.5}$

% change $= \dfrac{1}{3} \times \dfrac{208.5}{208.5} \times 100 = 33.33\%$

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29) loss in mass due to gaseous product $CO_{2(g)}$

$$M_2CO_{3(s)} \longrightarrow M_2O_{(s)} + CO_{2(g)}$$

264 gm   220 gm   44 gm

$$\%\text{ loss in mass} = \frac{44}{264} \times 100 = \frac{50}{3}\%$$

30) $$C_6H_5NH_2 + HNO_2 + HCl \longrightarrow C_6H_5N_2^+Cl^- + 2H_2O$$

$$n = \frac{9.30}{93} = 0.1$$ 0.1 mole

$$C_6H_5N_2^+Cl^- + KI \longrightarrow C_6H_5I + N_2 + KCl$$

0.1 mole   0.1 mole

$W = 20.4$ gm.

$$\%\text{ yield} = \frac{16.32}{20.4} \times 100 = 80\%$$

CONCENTRATION TERMS

31) $$NaOH + HCl \longrightarrow NaCl + H_2O$$

$$n_1 = \frac{8}{40} \times \frac{125}{100} \qquad = \frac{10}{100} \times \frac{125}{36.5}$$

LR

Solution will be acidic

32) $$M = \frac{8}{40} = 0.2\,M$$

33) $$M_{H_2O} = \frac{1000}{18} = 55.6\,M$$

34) $$X_{Gly} = \frac{\frac{46}{92}}{\frac{46}{92} + \frac{36}{18}} = 0.2$$

35) $$X_{O_2} = \frac{\frac{8}{32}}{\frac{8}{32} + \frac{7}{28}} = \frac{\frac{1}{4}}{\frac{1}{4} + \frac{1}{4}} = \frac{1}{2}$$

36) $M = \frac{5.85}{58.5} \times \frac{1000}{500} = 0.2$

37) $M_{H_2SO_4} = \frac{10 \times 98 \times 1.8}{98} = 18$

38) Molality does not depend on temperature

39) $\frac{W_{H_2SO_4}}{98} \times \frac{1}{1} = 0.1 \Rightarrow W = 9.8$ gm.

40) $m = \frac{X_A \times 1000}{(1-X_A) \times 18} = \frac{55.5(X_A)}{(1-X_A)}$

41) m = 3 molal = 3 mole/kg.

1000 gm = $W_{solvent}$. $W_{soln} = 1000 + 120$

$= 1120$ gm.

$n_{solute} = 3$ mole

$W_{solute} = 3 \times 40 = 120$ gm

$V_{soln} = \frac{1120}{1.12} = 1000$ ml

$= 1$ L

$M = \frac{3}{1} = 3$

42) $M = \frac{5}{34} \times \frac{1000}{100} = 1.5$ M

43) 20 % w/w $\Rightarrow$ 100 gm soln has = 20 gm glucose

$W_{solvent} = 80$ gm

$m = \frac{20}{180} \times \frac{1000}{80} = \frac{25}{18}$ m

44) $n_{HCl} = \frac{1000 \times 1.17}{36.5} = 32.05$ M

45) $M = \frac{50 \times 18}{100} = 9$ M

46) $m = \frac{1000 \times M}{1000d - M(M_W)_{solute}} \Rightarrow d = .$

47) $M_{H_2O_2} = \frac{34 \times 1000}{34 \times 1135} = \frac{1000}{1135}$

Vol. strength $= 11.35 \times \frac{1000}{1135} = 10V$

48) $\cancel{X}_{SO_3} = 0.6$

$w_{SO_3} = 60 gm$, $w_{H_2SO_4} = 40 gm$.

$w_T = 100 gm$

$SO_3 + H_2O \rightarrow H_2SO_4$

$n = \frac{60}{80}$ $\quad w = \frac{60}{80} \times 18$

$= 13.5 gm$

% labelling $= (100 + 13.5)\% = 113.5\%$

49) $\underline{118\%}$

18 gm water required for complete hydrolysis for 100 gm sample of oleum

for 50 gm oleum, $(W_{H_2O})_{req.} = 9 gm$.

So, final sol^n contain 59 gm H_2SO_4 & 9 gm water

50) ∵ for 100 gm oleum, $W_{H_2SO_4}$ total $= 112 gm$.

for 12.5 gm —— " —— $= \frac{112}{100} \times 12.5 = 14 gm$.

~~[illegible]~~ $W_{H_2SO_4} = 14 gm$ after hydrolysis

$[H^+] = \frac{14 \times 2}{98} \times \frac{1}{100} = \frac{2}{700}$

10 ml CH_4 gas is burnt completely in air (O_2 = 20%, by volume). The minimum volume of air needed is -

(A) 20 ml (B) 50 ml (C) 80 ml (D) 100 ml

12

air has 20% O_2 by volume.

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

10ml

required = 20ml.

volume of air = V ; $20 = \frac{20}{V} \times 100 \Rightarrow V = 100$ ml.

$\left\{ \%O_2 = \frac{V_{O_2}}{V_{air}} \times 100 \right\}$

52.

$$2O_3 \longrightarrow 3O_2$$

$t=0$ $\quad 2V$

$t=t$ $\quad 0 \qquad 3V$

So, $3V + (20-2V) = 29$

$\underline{V = 9\ ml}$

$\%$ of $O_2 = \dfrac{20-2V}{20} \times 100 = 10\%$

48. When one litre of CO_2 is passed over hot coke, the volume becomes 1.4 litres. The composition of final products will not be.

(A) $V_{CO_2} : V_{CO} = 3:4$ (B) $V_{CO} = 1.6$ ltr. (C) $n_{CO_2} : n_{CO} = 3:4$ (D) % V of CO $= \frac{400}{7}$

48

$CO_2(g) + C(s) \longrightarrow 2CO(g)$

initial: $V = 1\,l$ (coke)

final: $(1 - V)$ $2V$

Total vol $= 1 - V + 2V = 1 + V = 1.4$

$V = 0.4\ l.$

finally: $CO_2 \downarrow 0.6\ l$ $CO \downarrow 0.8\ l.$

54

$$C_xH_y + \left(x+\frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$$

20 ml. $\left(x+\frac{y}{4}\right)20$ $\quad \downarrow \quad 20x \quad \downarrow \quad \frac{y}{2}\times 20$

$V_{CO_2} = 60$ ml.

$20x = 60$ ml.

$\underline{x = 3}$

Each volume of a gaseous organic compound containing C, H and S only produce 1 volume CO_2, 2 volume H_2O vapours and 1 volume SO_2 gases on complete combustion. The molecular formula of compound is -

(A) CH_2S (B) CH_4S (C) C_2H_4S (D) C_2H_6S

$$C_xH_yS_z \longrightarrow CO_2 + H_2O + SO_2$$

$$1 \text{ vol} \longrightarrow 1 \text{ vol} \quad 2 \text{ vol} \quad 1 \text{ vol}$$

POAC for C: $x \times 1 = 1 \times 1 \Rightarrow x = 1$

POAC for H: $y \times 1 = 2 \times 2 \Rightarrow y = 4$

POAC for S: $z \times 1 = 1 \times 1 \Rightarrow z = 1$

CH_4S

56

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O_{(l)}$$

$n = \frac{2.2}{44}$

$= 0.05$ mole $\qquad = 0.25$ mole

$$V_{O_2} = 22.4 \times 0.25 = 5.6\ L$$

57

$$C_2H_6 + 3.5O_2 \rightarrow 2CO_2 + 3H_2O$$

$a \qquad 3.5a$

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

$b \qquad 3b$

$a + b = \frac{28}{22.4}$ $\qquad a = 0.5$

$3.5a + 3b = 4$ $\qquad b = 1.05$

$X_{C_2H_6} = \frac{a}{a+b}$

$= \frac{0.5}{1.25}$

$= 0.4$

O 2 SOLUTIONS ________

12 g of Mg was burnt in a closed vessel containing 32 g oxygen. Which of the following is /are correct.

(A) 2 gm of Mg will be left unburnt.

(B) 0.75 gm-molecule of O_2 will be left unreacted.

(C) 20 gm of MgO will be formed.

(D) The mixture at the end will weight 44 g.

3)

$$\underset{\substack{12\,gm \\ 0.5\,mole \\ \uparrow \\ L.R}}{Mg} + \frac{1}{2}\underset{\substack{32\,gm \\ 1\,mole \\ (0.75\,mole\ left)}}{O_2} \longrightarrow \underset{\substack{\downarrow \\ 0.5\,mole\ formed \\ = 20\,gm}}{MgO}$$

final mass of mixture = initial mass of mixture = 12 + 32 = 44 gm.

[redacted]

). 50 gm of $CaCO_3$ is allowed to react with 68.6 gm of H_3PO_4 then select the correct option(s)-

$$3CaCO_3 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 3H_2O + 3CO_2$$

(A) 51.67 gm salt is formed

(B) Amount of unreacted reagent = 35.93 gm

(C) n_{CO_2} formed = 0.5 moles

(D) n_{H_2O} formed = 0.7 mole

(10)

$$\underset{\substack{50\,gm \\ 0.5\,mole}}{3CaCO_3} + \underset{\substack{68.6\,gm \\ 0.7\,mole}}{2H_3PO_4} \longrightarrow \underset{\frac{0.5}{3}\,mole}{Ca_3(PO_4)_2} + \underset{0.5\,mole}{3H_2O} + \underset{0.5\,mole}{3CO_2}$$

L.R. left $= \left(0.7 - \frac{2}{3} \times 0.5\right)$ mole.

moles of $Ca_3(PO_4)_2 = \frac{0.5}{3}$; wt of $Ca_3(PO_4)_2 = \left(\frac{0.5}{3} \times 310\right)$ gm

Select the correct statement(s) for $(NH_4)_3PO_4$.

(A) Ratio of number of oxygen atoms to number of hydrogen atoms is 1 : 3

(B) Ratio of number of cations to number of anions is 3 : 1

(C) Ratio of number of gm-atoms of nitrogen to gm-atoms of oxygen is 3 : 2

(D) Total number of atoms in one mole of $(NH_4)_3PO_4$ is 20.

11)

$$\underbrace{(NH_4)_3PO_4}_{\downarrow} \longrightarrow 3(NH_4^+) + 1\,PO_4^{-3}$$

No. of O-atoms = 4

No. of H-atoms = 12

Total moles of atoms in 1 mole $(NH_4)_3PO_4$ = 20 mole

No. of atoms = $(20 \times N_A)$

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The recommended daily dose is 17.6 milligrams of vitamin C (ascorbic acid) having formula $C_6H_8O_6$. Match the following. Given : $N_A = 6 \times 10^{23}$

Column I		Column II	
(A)	O-atoms present in daily dose	(P)	10^{-4} mole
(B)	Moles of vitamin C in 1 gm of vitamin C	(Q)	5.68×10^{-3}
(C)	Moles of vitamin C that should be consumed daily	(R)	3.6×10^{20}

30

$C_6H_8O_6$ (17.6 mg)

moles of vitamin C (daily) $= \dfrac{17.6 \times 10^{-3}}{176} = 10^{-4}$

in 1 gm vitamin C moles $= \dfrac{1}{176} = 5.68 \times 10^{-3}$

O-atoms $= 10^{-4} \times 6 \times 6 \times 10^{23} = 36 \times 10^{19}$

$= 3.6 \times 10^{20}$

Paragraph for Q.16 to Q.18

NaBr, used to produce AgBr for use in photography can be self prepared as follows :

$Fe + Br_2 \longrightarrow FeBr_2$ ....(i)

$FeBr_2 + Br_2 \longrightarrow Fe_3Br_8$ ....(ii) (not balanced)

$Fe_3Br_8 + Na_2CO_3 \longrightarrow NaBr + CO_2 + Fe_3O_4$ ....(iii) (not balanced)

(At. mass : Fe = 56, Br = 80)

Mass of iron required to produce 2.06×10^3 kg NaBr

(A) 420 gm (B) 420 kg (C) 4.2×10^5 kg (D) 4.2×10^8 gm

If the yield of (ii) is 60% & (iii) reaction is 70% then mass of iron required to produce 2.06×10^3 kg NaBr

(A) 10^5 kg (B) 10^5 gm (C) 10^3 kg (D) None

If yield of (iii) reaction is 90% then mole of CO_2 formed when 2.06×10^3 gm NaBr is formed

(A) 20 (B) 10 (C) 9 (D) 440

(16) $\underset{x \text{ moles}}{Fe} + Br_2 \longrightarrow \underset{x \text{ moles}}{FeBr_2}$

$\underset{x \text{ moles}}{3FeBr_2} + Br_2 \longrightarrow \underset{(x/3) \text{ moles}}{Fe_3Br_8}$

$\underset{\left(\frac{x}{3}\right)\text{moles}}{Fe_3Br_8} + 4Na_2CO_3 \longrightarrow 8NaBr + 4CO_2 + Fe_3O_4$

2.06×10^3 kg.

2×10^4 moles

$\frac{8x}{3} = 2 \times 10^4$

$x = 7500$

wt. of Fe $= (7500 \times 56)$ gm

$= 420$ kg.

17) $\frac{x}{3} \times \frac{60}{100} \times 8 \times \frac{70}{100} = 2 \times 10^4$

wt. of Fe $= x \times 56 = 10^6$ gm $= 10^3$ kg.

18) moles of NaBr $= \frac{2.06 \times 10^3}{103} = 20$ mole.

moles of $CO_2 = \frac{4}{8} \times 20 = 10$ moles

(8) $\boxtimes$ $\cdot m_{\text{pure liq.}} = \frac{1000}{MW}$

$m_{\text{ethanol}} = \frac{1000}{46} < m_{H_2O} = \frac{1000}{18}$

(9) A) 100 gm soln has = 80 gm NaOH

50 gm —"— = 40 gm NaOH

B) $\because$ 100 ml. soln has = 80 gm NaOH

$\therefore \frac{50}{1.2}$ ml. soln has $= \frac{80}{100} \times \frac{50}{1.2}$ gm $\left[d = \frac{w}{v} \Rightarrow 1.2 = \frac{50}{v}\right]$

$= 33.33$ gm

c) 1000 gm soln has $= 20 \times 40 = 800$ gm.

$\therefore$ 50 gm —"— $= \frac{800}{1000} \times 50 = 40$ gm

D) 1000 gm soln has $= 5 \times 40 = 200$ gm

$\therefore$ 50 gm —"— $= \frac{200}{1000} \times 50 = 10$ gm

O - II (Conc. Terms)

i) '2 M' $MgCl_2$ can be understood as:

1 l (1000 ml) solution contains 2 moles $MgCl_2$

(1000×1.09) gm solution contains (2×95) gm $MgCl_2$

1090 gm solution has 190 gm $MgCl_2$.

wt. of solvent $(H_2O) = 1090 - 190 = 900$ gm.

$$\text{molality } (MgCl_2) = \frac{2}{\frac{900}{1000}} = \frac{2000}{900} = \frac{20}{9}$$

$$\text{molality of } Cl^- = 2 \times m(MgCl_2) = \frac{2 \times 20}{9} = 4.44$$

$$X_{MgCl_2} = \frac{2}{2 + \frac{900}{18}} = \frac{2}{52} = 0.03846$$

$$M = \frac{\frac{w}{V}\% \times 10}{M_{solute}} \Rightarrow 2 = \frac{\frac{w}{V}\% \times 10}{95}$$

$$\frac{w}{V}\% = 19\%$$

$$ppm = \frac{19\cancel{0}}{109\cancel{0}} \times 10^6 = 0.1743 \times 10^6 \text{ ppm}$$

$$= 17.43 \times 10^4 \text{ ppm.}$$

O - II (Conc. Terms):

1)

$$M_{H_2O_2} = \frac{56.75}{11.35} = 5M \; ; \; d = 530 \frac{gm}{litre}$$

$$d = 0.53 \frac{gm}{ml}$$

'5M' means :

1 litre (1000 ml) solution contains 5 mole H_2O_2

530 gm solution $\longrightarrow$ 5×34 (170 gm) H_2O_2.

$$5 = \frac{\frac{w}{V}\% \times 10}{M_{solute}} \Rightarrow 5 = \frac{\frac{w}{V}\% \times 10}{34}$$

$$\frac{w}{V}\% = 17$$

530 gm solution has 170 gm H_2O_2

wt. of solvent = 530 − 170 = 360 gm.

$$x_{H_2O_2} = \frac{5}{5 + \frac{360}{18}} = \frac{5}{5+20} = 0.2$$

$$\text{molality} = \frac{5}{\frac{360}{1000}} = \frac{5000}{360} = \frac{125}{9}$$

(8)

do not dissociate into ions.

$$\underset{\text{initial millimoles}=\ 6}{Ca(NO_3)_2} + \underset{3}{\overset{\downarrow L.R}{Na_2C_2O_4}} \longrightarrow CaC_2O_4\downarrow + 2NaNO_3$$

final : 3 m.mole   0   3 milli mole = 0.003 mole   6 milli mole.

$$[Ca^{+2}]_{final} = \frac{3}{150} = 0.02\ M$$

$$[C_2O_4^{-2}]_{final} = 0$$

(9) $9.8\%\ \frac{w}{w}\ (d=1.5\ gm/ml)$ + KOH
H_2SO_4 3 l, 1 M

$V = 2\ l$

$M = \frac{9.8 \times 10 \times 1.5}{98} = 1.5$

H_2SO_4 moles $= M \times V = 1.5 \times 2 = 3.$

(10)
$$H_2SO_4 + \overset{\downarrow L.R}{2KOH} \longrightarrow K_2SO_4 + 2H_2O$$

3 mole   3 mole

1.5 mole left   x

1.5 mole H_2SO_4 is left :

So : H^+ moles from $H_2SO_4 = 1.5 \times 2 = 3$

$$[H^+] = \frac{3}{5}\ M.$$

(14) $C_3H_8 + 5\,O_2 \longrightarrow 3CO_2 + 4H_2O_{(l)}$

$V_1 \quad 5V_1 \quad 3V_1 \quad 2V_1$

$CO + \frac{1}{2}O_2 \rightarrow CO_2$

$V_2 \quad V_2/2 \quad V_2$

$V_1 + V_2 = 20$ —① $3V_1 + V_2 = 40$

$V_1 = 10$ ml.

$V_2 = 10$ ml.

Vol. Contraction $= \left(6V_1 + \frac{3V_2}{2}\right) - (3V_1 + V_2) = 3V_1 + \frac{1}{2}V_2$

$= 35$ ml.

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JEE MAINS SOLUTION ____

A transition metal M forms a volatile chloride which has a vapour density of 94.8. If it contains 74.75% of chlorine the formula of the metal chloride will be [AIEEE 2012 (Online)]

(1) MCl_2 (2) MCl_4 (3) MCl_5 (4) MCl_3

(21) V.D = 94.8 ; Mol wt = 94.8 × 2 = 189.6

wt of % Cl = $\frac{74.75}{100} \times 189.6$ = 141.726 gm.

No. of Cl mole = $\frac{141.726}{35.5} \simeq 4.$

MCl_4

The ratio of number of oxygen atoms (O) in 16.0 g ozone (O_3), 28.0 g carbon monoxide (CO) and 16.0 g oxygen (O_2) is :-

(Atomic mass : C = 12, O = 16 and Avogadro's constant $N_A = 6.0 \times 10^{23}$ mol^{-1})

[AIEEE 2012 (Online)]

(1) 3 : 1 : 1 (2) 1 : 1 : 2 (3) 3 : 1 : 2 (4) 1 : 1 : 1

Ans 4

No. of O-atoms in 16gm O_3 = $\frac{16}{48} \times 3 \times N_A$

No. of O-atoms in 28gm CO = $\frac{28}{28} \times 1 \times N_A$

No. of O-atoms in 16gm O_2 = $\frac{16}{32} \times 2 \times N_A$

. A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g of CO_2. The empirical formula of the hydrocarbon is **[JEE(Main)-2013]**

(1) C_2H_4 (2) C_3H_4 (3) C_6H_5 (4) C_7H_8

$C_xH_y + O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

3.08 gm 0.72 gm

$\frac{3.08}{44}$ moles $\frac{0.72}{18}$ mole

0.07 mole 0.04 mole

$\frac{x}{y/2} = \frac{0.07}{0.04} \Rightarrow \frac{x}{y} = \frac{7}{8}$

Emp. formula $= C_7H_8$

The ratio of masses of oxygen and nitrogen in a particular gaseous mixture is 1 : 4. The ratio of number of their molecule is :

[JEE(Main)-2014]

(1) 1 : 8 (2) 3 : 16 (3) 1 : 4 (4) 7 : 32

19

$O_2 : N_2$

mass : $1 : 4$

moles : $\frac{1}{32} : \frac{4}{28}$

molecules : $\frac{1}{32} \times N_A : \frac{4}{28} \times N_A \Rightarrow 7 : 32$

. In Carius method of estimation of halogens, 250 mg of an organic compound gave 141 mg of AgBr. The percentage of bromine in the compound is :

(Atomic mass Ag = 108; Br = 80) **[JEE(Main)-2015]**

(1) 48 (2) 60 (3) 24 (4) 36

)

$$\underset{\substack{250\,mg \\ \text{organic comp}}}{\text{--- Br ---}} \xrightarrow[\text{to}]{\text{all 'Br' converted}} \underset{141\,mg}{AgBr}$$

m.moles of AgBr = m.moles of Br $= \frac{141}{188}$

mg. of Br $= \frac{141}{188} \times 80 = 60$ mg.

% Br $= \frac{60}{250} \times 100 = 24\%$

The most abundant elements by mass in the body of a healthy human adult are :
Oxygen (61.4%) ; Carbon (22.9%), Hydrogen (10.0%) ; and Nitrogen (2.6%). The weight which a 75 kg person would gain if all ^{1}H atoms are replaced by ^{2}H atoms is [JEE(Main)-2017]

(1) 15 kg (2) 37.5 kg (3) 7.5 kg (4) 10 kg

16 J(M)

10% of 75 kg = 7.5 kg is $^{1}_{1}H$

if replaced by $^{2}_{1}H$ then wt = (7.5 × 2) = 15 kg

so gain is = 7.5 kg

1 gram of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01186 mole of CO_2. the molar mass of M_2CO_3 in g mol^{-1} is :- [JEE(Main)-2017]

(1) 1186 (2) 84.3 (3)118.6 (4) 11.86

$$M_2CO_3 + 2HCl \rightarrow 2MCl + H_2O + CO_2$$

$\left(\frac{1}{M.W}\right)$ moles $\qquad$ $\left(\frac{1}{M.W}\right)$ moles.

$\frac{1}{M.W} = 0.01186$

$M.W = 84.3$

. The ratio of mass percent of C and H of an organic compound ($C_XH_YO_Z$) is 6 : 1. If one molecule of the above compound ($C_XH_YO_Z$) contains half as much oxygen as required to burn one molecule of compound C_XH_Y completely to CO_2 and H_2O. The empirical formula of compound $C_XH_YO_Z$ is

[JEE(Main)-2018 (offline)]

(1) C_2H_4O (2) $C_3H_4O_2$ (3) $C_2H_4O_3$ (4) $C_3H_6O_3$

13 $C_xH_yO_z$: $\frac{12x}{y} = \frac{6}{1} \Rightarrow \boxed{y = 2x}$

To burn 1 molecule of C_xH_y

$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$

$O_2 = \left(x + \frac{y}{4}\right)$; $O = 2\left(x + \frac{y}{4}\right)$

$z = \frac{\cancel{2}\left(x + \frac{y}{4}\right)}{\cancel{2}} \Rightarrow \boxed{z = x + \frac{y}{4} = \frac{3x}{2}}$

From given options : $C_2H_4O_3 \rightarrow$ Emp. form

14. For per gram of reactant, the maximum quantity of N_2 gas is produced in which of the following thermal decomposition reactions ? **[JEE(Main)-2018 (online)]**

(Given : Atomic wt. – Cr = 52u, Ba = 137u)

(1) $2NH_4NO_3(s) \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$

(2) $Ba(N_3)_2(s) \rightarrow Ba(s) + 3N_2(g)$

(3) $(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + 4H_2O(g)$

(4) $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

(1) $2NH_4NO_3 \rightarrow 2N_2 + 4H_2O + O_2$

$\frac{1}{80}$ mol $\qquad \frac{1}{80}$ mol

(2) $Ba(N_3)_2 \rightarrow Ba + 3N_2$

$\frac{1}{221}$ mol $\qquad \frac{3}{221}$ mol

(3) $(NH_4)_2Cr_2O_7 \rightarrow N_2 + 4H_2O + Cr_2O_3$

$\frac{1}{252}$ mol $\qquad \frac{1}{252}$ mol

(4) $2NH_3 \rightarrow N_2 + 3H_2$

$\frac{1}{17}$ mol $\qquad \frac{1}{34}$ mol $\rightarrow$ maximum.

. An unknown chlorohydrocarbon has 3.55% of chlorine. If each molecule of the hydrocarbon has one chlorine atom only; chlorine atoms present in 1 g of chlorohydrocarbon are :

(Atomic wt. of Cl = 35.5 u; Avogadro constant = 6.023×10^{23} mol^{-1})**[JEE(Main)-2018 (online)]**

(1) 6.023×10^{21} (2) 6.023×10^{23} (3) 6.023×10^{20} (4) 6.023×10^{9}

15) wt. of Cl in 1gm of compound $= \left(\frac{3.55}{100} \times 1\right)$

moles of Cl $= \frac{3.55 \times 1}{100 \times 35.5}$

No. of Cl- atoms $= \frac{3.55}{100 \times 35.5} \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{20}$

(11) $C_2 = \dfrac{n_2 \times d \times 1000}{(n_1 M_1 + n_2 M_2)}$

$$= \dfrac{d \times \dfrac{n_2}{n_1+n_2} \times 1000}{\dfrac{n_1}{n_1+n_2} M_1 + \dfrac{n_2}{n_1+n_2} M_2}$$

{ Dividing componendo and dividendo by $n_1 + n_2$ }

$$= \dfrac{d\, x_2 \times 1000}{(1-x_2) M_1 + x_2 M_2}$$

$$= \dfrac{1000\, d\, x_2}{M_1 + x_2 (M_2 - M_1)}$$

(12) $M = \frac{5.6}{11.2} = 0.5\ M$ $\left[M = \frac{\text{Vol. strength}}{11.2} \right]$

$$\text{mass \%} = \frac{0.5 \times 34}{1000} \times 100 = 1.7\ \%$$

(13) Molar Mass of X = 100 gm.

$$M = \frac{5}{100} \times \frac{1}{2} = 25 \times 10^{-3}$$

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

28 gm 6 gm. 34 gm.

t=

(14) $N_2 + 3H_2 \longrightarrow 2NH_3$

$t=0$ $\frac{2.8 \times 1000}{28}$ $= \frac{1000}{2}$

$= 100$ $= 500$

200 mole

$= 3400$ gm.

$= 3.4$ Kg.

(15) $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

1 mole = 5 mole req.

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

2 mole = 13 mole required

min. no of mole = 5 + 13 = 18 mole.

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(16) ^{35}Cl : ^{37}Cl

let mole ratio x : 1

$M_{avg} = 35.5 = \frac{x(35) + 1\times 37}{x+1} \Rightarrow x = 3$

(17) $\% \text{ of } Br = \frac{(MW)_{Br}}{(MW)_{AgBr}} \times \frac{W_{AgBr}}{W_{organic\ com}} \times 100$

$= \frac{80}{188} \times \frac{0.12}{0.15} \times 100 = 34.04\%$

(18) $C : H = 4 : 1$

$C : O = 3 : 4$

Mass ratio of $C : H : O = 12 : 3 : 16$

Mole ratio $\Rightarrow C : H : O = 1 : 3 : 1$

Emp. formula $= CH_3O$

Mol. formula $= C_2H_6O_2$

$C_2H_6O_2 + 5/2\, O_2 \longrightarrow 2CO_2 + 3H_2O$

2 mole 5 mole

$(n_{O_2})_{req.} = 5$ mole

(19) $\% \text{ mass of water} = \frac{x \times 18}{265} \times 100 = 13.5$

$\underline{x = 2}$

$[Cr(H_2O)_4Cl_2]Cl.2H_2O$

JEE ADVANCE SOLUTION _____

JEE Advance

1) $\cdot$ mole of $e^- = \frac{1000}{9.1 \times 10^{-31}} \times 6.02 \times 10^{23}$

$= \frac{6.023}{9.108} \times 10^{54}$

(2) $6CaO + P_4O_{10} \rightarrow 2Ca_3(PO_4)_2$

$w = 3 \times 6 \times 56$ $= \frac{852}{284}$

$= 1008 gm$ $= 3 mole$

(3) May $= \dfrac{5 \times 54 + 90 \times 56 + 5 \times 57}{100}$

$= 55.95$

JEE-Advance

The ammonia prepared by treating ammonium sulphate with calcium hydroxide is completely used by $NiCl_2.6H_2O$ to form a stable coordination compound. Assume that both the reactions are 100% complete. If 1584 g of ammonium sulphate and 952g of $NiCl_2.6H_2O$ are used in the preparation, the combined weight (in kg) of gypsum and the nickel-ammonia coordination compound thus produced is___. **[JEE 2018]**

$$(NH_4)_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4.2H_2O + 2NH_3$$

$$NiCl_2 \cdot 6H_2O + 6NH_3 \rightarrow [Ni(NH_3)_6]Cl_2 + 6H_2O$$

(Atomic weights in g mol^{-1}: H = 1, N = 14, O = 16, S = 32, Cl = 35.5, Ca = 40, Ni = 59)

D)

$Ca(OH)_2 + (NH_4)_2SO_4 \rightarrow 2NH_3 + CaSO_4 \cdot 2H_2O$

12 moles $\quad \frac{1584}{132} = 12$ mole $\quad$ 24 moles $\quad$ 12 mole.

× $\quad$ ×

$NiCl_2 \cdot 6H_2O + 6NH_3 \rightarrow [Ni(NH_3)_6]Cl_2$.

$\frac{952}{238} = 4$ moles $\quad$ 24 mole $\quad$ 4 moles.

$= (4 \times 232)$ gm.

$= 928$ gm.

wt of $CaSO_4 \cdot 2H_2O = 12 \times 172 = 2064$ gm

wt of $[Ni(NH_3)_6]Cl_2 = 928$ gm

Total wt = 2992 gm.

2. Galena (an ore) is partially oxidized by passing air through it at high temperature. After some time, the passage of air is stopped, but the heating is continued in a closed furnance such that the contents undergo self-reduction. The weight (in kg) of Pb produced per kg of O_2 consumed is ______ .

$PbS + O_2 \longrightarrow Pb + SO_2$ **[JEE 2018]**

(Atomic weights in g mol^{-1} : O = 16, S = 32, Pb = 207)

2

$$2PbS + 3O_2 \longrightarrow 2PbO + 2SO_2$$

$$2PbO + PbS \longrightarrow 3Pb + SO_2$$

Net reaction

$$3PbS + 3O_2 \longrightarrow 3Pb + 3SO_2$$

O_2: 1 kg, $\frac{1000}{32}$ moles $\rightarrow$ Pb: $\frac{1000}{32}$ moles

wt in kg of Pb = $\frac{207}{32} = 6.47$ kg.

LR

$$2Al + 3H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2$$

$n = \frac{5.4}{27} = 0.2$

$= \frac{50 \times 5}{1000} = 0.25$

$= \frac{3}{3} \times 0.25 = 0.25$

$V_{H_2} = 0.25 \times 0.0821 \times 300$

$= 6.15 L$

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