solutions

Volumetric Analysis

HOME ASSIGNMENT - I

① (a) $NH_3 = 0$ $N = -3$

(b) $O = -2$, $H = +1$ $N = -1$

(c) $N_2H_5 = +1$ $N = -2$

(d) $N = -3$

② $+ ClO_4^{\ominus} \longrightarrow ClO^{\ominus}$

$+7 \quad\quad +1$

$n = 6$

$\overset{+4}{MnO_2} \longrightarrow \overset{+6}{MnO_4^{-2}}$

$n = 2$

$~~3~~ ClO_4^{\ominus} + 3MnO_2 + \longrightarrow ClO^{\ominus} + 3MnO_4^{-2}$

~~$+6H^+$~~ $3H_2O$ ~~$+3H_2O$~~

~~$+6OH$~~ $+6H^+$

$+ 6\overset{\ominus}{O}H$ $+ 6\overset{\ominus}{O}H$

$ClO_4^{\ominus} + 3MnO_2 + 6\overset{\ominus}{O}H \longrightarrow ClO_4^{\ominus} + 3MnO_4^{2} + 3H_2O$

$x = 1$, $y = 3$, $z = 6$

Q③

$Fe_2(C_2O_4)_3 \longrightarrow 2Fe^{+3} + 6CO_2 + 6e^{\ominus}$

ferric oxalate $\downarrow n = 6$

$FeC_2O_4 \longrightarrow Fe^{+3} + 2CO_2 + 3e^{\ominus}$

ferrous oxalate $\downarrow n = 3$

$6 \times$ moles of $Fe_2(C_2O_4)_3$ = $5 \times$ moles of $MnO_4^{\ominus}$

$$x = \frac{6 \times 1}{5} = \frac{6}{5}$$

$3 \times$ moles of FeC_2O_4 = $5 \times$ moles of $MnO_4^{\ominus}$

$$y = \frac{3 \times 1}{5} = 3/5$$

$$\frac{x}{y} = \frac{2}{1}$$

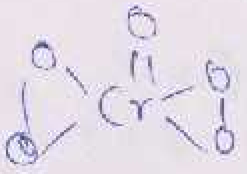
Q.(4)

$$\overset{+7}{Mn}O_4^{\ominus} \xrightarrow{n=5} Mn^{+2}$$

$5 \times$ moles of $KMnO_4$ = $3 \times$ moles of FeC_2O_4

$$\text{Ans} = \frac{3}{5}$$

Q.(5)



$$CrO_5 = Cr(O_2)_2O$$

$$Cr = +6$$

Q.(6)

$$\overset{-2}{N_2}H_4 \longrightarrow 2N^{+y}$$

$$[y-(-2)] \times 2 = 10$$

$$y+2 = 5$$

$$y = 3$$

(7)

$$3Pb(N_3)_2 + 22H_2O \longrightarrow Pb_3O_4 + 18NO + 44H^+ + 44e^-$$

So e^- change per mole $= \frac{44}{3}$

(8)

$$\overset{0}{Zn} + 2\overset{\ominus}{O}\underset{+1}{H} \longrightarrow \underset{+2}{Zn}O_2^{-2} + \underset{0}{H_2}$$

n=2 (Zn → ZnO_2^{-2}), n=2 (H → H_2)

Balanced eq^n

$$Zn + 2\overset{\ominus}{O}H \longrightarrow ZnO_2^{-2} + H_2$$

(9)

$$Zn \longrightarrow Zn^{+2} \quad n=2$$

$$Na\overset{+5}{N}O_3 \longrightarrow \overset{-3}{N}H_3 \quad n=8$$

$$4Zn + NaNO_3 + 5H_2O + 10\overset{\ominus}{O}H \longrightarrow 4Na_2ZnO_2 + NH_3 + 10H^+ + 10\overset{\ominus}{O}H$$

$$4Zn + NaNO_3 + 10\overset{\ominus}{O}H \longrightarrow 4Na_2ZnO_2 + NH_3 + 5H_2O$$

Q(10)

CH_3Cl $C = ~~+2~~ -2$

CCl_4 $C = +4$

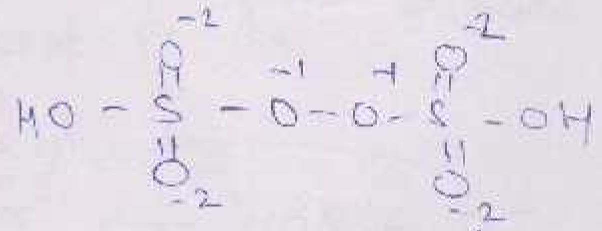
$CHCl_3$ $C = +2$

CH_2Cl_2 $C = 0$

Q.(11)

$$\overset{+5}{N_2O_5} \longrightarrow H\overset{+5}{N}O_3$$

Q.(12)



Marshall's acid

$H_2S_2O_6(O_2)$

$+2+2x+6(-2)+2(-1)=0$

$x=+6$

Q.(13) (a) $MnO_4^{\ominus}$, $Mn=+7$ (b) $[Cr(CN)_6]^{-3}$

$Cr=+3$

(c) $[NiF_6]^{-2}$ $Ni=+4$ (d) CrO_2Cl_2

$Cr=+6$

Q.(14)

$$2S_2O_3^{-2} \longrightarrow S_4O_6^{-2} + 2e^{\ominus}$$

oxidised

reduced I_2 to $I^{\ominus}$

so a R.A.

Q.(15) (a) in peroxides $O=-1$

Q.(16) highest ox. states of are

$Mn=+7$, $Cr=+6$, $Co=+6$, $Ni=+4$

HOME ASSIGNMENT - (2)

Q. (1) 0.1 gm metal gives

$= 34.2$ ml H_2 gas

$= \frac{34.2}{22400}$ moles of H_2 gas

x gm metal will give

$\frac{34.2}{22400} \times \frac{x}{0.1}$ moles

$=$ ~~34.2~~ $\frac{342x}{22400} \times 2 = 1.008$

$x = 32.7$ gm

Q. (2) 0.5 gm combining with

$(0.79 - 0.5)$ gm oxygen
$= 0.29$ gm

x will combine with

$\frac{0.29}{0.5} \times x = 8$

$x = \frac{4}{0.29} = 13.79 \simeq 14$

Q (3) 74.5 gm metal chloride combined with 35.5 gm chlorine

so wt of metal in chloride

$= 74.5 - 35.5 = 39$ gm

Q (4) $PV = nRT$

$1 \times 0.1 = \frac{0.72}{M_w} \times 0.0821 \times 273$

$M_w = 7.2 \times 22.4 = 161.28$

moles of chlorine $= \frac{65.5}{100} \times \frac{161.28}{35.5}$
$\simeq 3$

so formula is MCl_3

Q.(5) eq. wt of chloride $= 4.5 + 35.5$
$= 40$

so valancy $= \frac{80}{40} = 2$

so at. wt $= 2 \times 4.5 = 9$

Q (6) Metal is M^{+2}
eq of metal + sulphate will be same

$\frac{42.2}{E} = \frac{(100 - 42.2)}{(96/2)}$ SO_4^{-2}

$E \simeq 35.04$

Q.(7) eq. wt of chloride $= 4 + 35.5 = 39.5$

valency $= \frac{59.25 \times 2}{39.5} = 3$

(8) valancy = +3

at. wt of metal = 9×3 = 27

(9) valancy = $\frac{29.89}{8.9} \simeq 3.35$

since valancy can only be integer

so valancy = 3

so at. wt = 3 × 8.9 = 26.7

(10) eq. of Mg = eq of Cu

$\frac{0.534}{12} = \frac{1.415}{E_{Cu}}$

$E_{Cu} = 31.8$

(11) no. of equivalents will be same.

$\frac{m_1}{E_1} = \frac{m_2}{E_2}$

$\therefore E_1 = \frac{m_1}{m_2} \times E_2$

(12) $\frac{W}{12} = \frac{0.475}{12+35.5} = \frac{1}{100}$

W = 0.12 gm

Q. 13 Fe^{+3}

$$E = \frac{56}{3} = 18.6$$

14

$$\frac{1.5}{E} = \frac{4}{(64/2)} = \frac{4}{32} = 1/8$$

$E = 12$ so at. wt $= 12 \times 2$
$= 24$

15

$$K\overset{+7}{Mn}O_4 \rightarrow \overset{+2}{Mn}SO_4$$

$n = 5$

$E = M/5$

16

$$\frac{W_1}{E_1} = \frac{W_2}{E_2}$$

$$\frac{W_1}{W_2} = \frac{E_1}{E_2}$$

17

$$\frac{0.84}{E+1} = \frac{0.042}{1}$$

$E+1$ = eq wt of metal hydride = 20

18 60 gm metal has 40 gm oxygen

so 12 gm " " 8 gm "

so eq. wt = 12 gm

(19) on burning, combustion will take place

let 100 gm metal

so $\frac{100}{E} = \frac{124}{E+8}$

$100E + 800 = 124E$

$24E = 800$

$E = 33.3$

(20) $\frac{3}{E+8} = \frac{5}{E+35.5}$

$3E + 106.5 = 5E + 40$

$2E = 66.5 \Rightarrow E = 33.25$

(21) M^{+2} so M^{+} wt = 24

MO M.wt = 24 + 16 = 40

(22) n factor = 3

so eq. Wt = $\frac{98}{3}$ = 32.66.

Home Assignment - (3)

Q(1)

$16\,Cl^{\ominus} \rightarrow \cancel{2e} + 5Cl_2^{0} + 6Cl^{\ominus} + 10e^{\ominus}$

n factor $= \frac{10}{16} = 5/8$

$E = \frac{8M}{5}$

Q(2)

eq of metal = eq of sodium sulphite

$n \times 50 \times 0.1 = 2 \times 25 \times 0.1$

$n = 1$

so metal will be reduced to +2

Q(3)

eq of $K_2Cr_2O_7$ = eq of $FeSO_4$

$Cr_2O_7^{-2} \rightarrow 2Cr^{+3}$ (+6, n = 6) $Fe^{+2} \rightarrow Fe^{+3}$ (n = 1)

$6 \times M_1 V_1 = 1 \times M_2 \times V_2$

Q(4)

(n factor) $\times$ 2.6 $\times 10^{-3} = 6 \times 1.68 \times 10^{-3}$

nfactor = 3

so A^{-n} will be oxidised to

A^{-n+3} (A^{3-n})

Q.5

$n = 2 \times 2 = 4$

$As_2S_3 \rightarrow 2H_3AsO_4 + 3H_2SO_4$

$\overset{+3}{As}\ \overset{-2}{S}$ ... $\overset{+5}{As}$ ... $\overset{+6}{S}$

$n = 8 \times 3 = 24$

$\overset{+5}{HNO_3} \rightarrow \overset{+2}{NO}$

n factor = $24 + 4 = 28$

$28 \times x = 3 \times 1$

$x = 3/28$

Q.6

n factor = 2 for reductant

so $2 \times M \times 25 = 5 \times 20 \times 0.01$

$M = 0.02 = \frac{2.52}{M_w}$

$M_w = \frac{2.52}{0.02} = 126$

Q.7

$H_2O_2 \rightarrow 2H_2O$

$+2H^+$

$+2e^-$

eq of H_2O_2 = eq of Sn^{+2}

$100 \times M \times 2 = 2 \times 50 \times 0.2$

$M = 0.1$

if vol strength = x

molarity = $\frac{x}{11.2} = 0.1$

$x = 1.12$

(8)

$$H_2O_2 + 2I^{\ominus} \longrightarrow H_2O + I_2$$

($n = 2$, $n = 2$)

eq of H_2O_2 = eq of KI = eq of I_2 = eq of hypo

$2 \times 10 \times M = 1 \times 20 \times 0.1$ {n factor for hypo = 1}

$M = 0.1$

vol. strength = 11.2×0.1
= ~~2.24~~ 1.12

(9)

$$\overset{0}{P} \longrightarrow \overset{+5}{P}O_4^{-3}$$

5 × moles of P = 6 × moles of $Cr_2O_7^{-2}$

moles of P = $\frac{6 \times 0.2}{5} = \frac{1.2}{5} = 0.24$

(10)

$$4Cl^{\ominus} \longrightarrow 2Cl^{\ominus} + Cl_2 + 2e^{\ominus}$$

n factor = $2/4 = 1/2$

(11)

$$2Fe_3O_4 + H_2O \longrightarrow 3Fe_2O_3 + 2H^+ + 2e^{\ominus}$$

n factor = 1 $E = \frac{M}{1}$

(12)

$$As_2S_3 + 20H_2O \longrightarrow 2AsO_4^{-3} + 3SO_4^{-2} + 40H^+ + 28e^{\ominus}$$

$E = \frac{M}{28}$

(13)

HNO_3 itself is getting reduced

$\overset{+5}{HNO_3}$ so final product will have N as +1.

In N_2O $N = +1$

Home assignment - (4)

Q(1) eq of NH_3 = eq. of acid used

$$= 10^{-3}\left[150\times\frac{1}{5} - 20\times1\right]$$

$1\times$ moles of NH_3 = 10^{-2}

$W_{NH_3} = 10^{-2}\times17 = 0.17$ gm

% of NH_3 = $\frac{0.17}{0.5}\times100 = \frac{17}{0.5} = 34\%$

Q(2) eq of Na_2CO_3 = eq of H_2SO_4

In PH indicator n factor of $Na_2CO_3 = 1$

$1\times n_{Na_2CO_3}$ = ~~$2\times n_{H_2SO_4}$~~ $20\times10^{-3}\times0.1$

$n_{Na_2CO_3} = 2\times10^{-3} \Rightarrow w_{Na_2CO_3} = 2\times10^{-3}\times106$
$= 0.212$ gm

So in 2.25 gm mixture $w_{Na_2CO_3} = 2.12$ gm

Q(3) $M_{HCl} = \frac{109.5}{36.5} = 3$

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

$n_{Na_2CO_3} = \frac{1}{2}\times n_{HCl} = \frac{1}{2}\times\frac{32.9}{1000}\times3$

$M_{Na_2CO_3} = \frac{3\times32.9}{2000}\times\frac{1000}{25} = 1.974$

125 gm = 100 ml

$1.974 \times 100 \times 10^{-3} = \left(\frac{0.84}{2}\right) \times V$

$V = \frac{197.4}{0.42} \times 10^{-3}$ litre

$= 470$ ml

Q. (4)

eq of KOH + eq of $Ca(OH)_2$ = eq of acid

$\frac{x}{56} + \frac{4.2 - x}{74} \times 2 = 0.1$

~~$\frac{x}{56} + \frac{4.2 - x}{38} = 0.1$~~

~~$x = 1.24$ gm~~

~~% KOH = $\frac{1.24}{4.2}$~~

$\frac{x}{56} + \frac{4.2 - x}{37} = 0.1$

$x = 1.47$ gm

% KOH = $\frac{1.47}{4.2} \times 100$

$= 35\%$

Q (5)

~~$M_{H_2O_2} = \frac{10}{11.2}$ — H_2~~

Q (5)

Vol. of O_2 liberated $= 10 \times 100 = 1000$ ml

$Ca + \frac{1}{2}O_2 \rightarrow CaO$

$n_{CaO} = 2 \times$ moles of $O_2 = 2 \times \frac{1}{22.4} = \frac{1}{11.2}$

$CaO + H_2SO_4 \rightarrow CaSO_4 + H_2O$

$n_{H_2SO_4} = n_{CaO} = 1/11.2$

$m_{H_2SO_4} = \frac{1}{11.2} \times 20 = 1.79$ m

Q(6) only $NaHCO_3$ will give CO_2

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

let $n_{NaHCO_3} = \alpha$, $n_{Na_2CO_3} = \beta$

~~$1 \times y = \frac{x}{100}$~~ $\quad 1 \times \beta = \frac{x}{1000} \times 1$

& $\quad 1 \times \alpha + 2\beta = \frac{y}{1000}$

so,

$$\alpha = \frac{y - 2x}{1000}$$

so moles of $CO_2 = \frac{1}{2} \times \frac{y-2x}{1000} = \frac{y-2x}{2000}$

Q(7) n factor $= 2$

so $N = 0.1 \times 2 = 0.2$

Q(8) 3 acidic hydrogens so n factor $= 3$

$E = M/3$

Q(9)

H_3PO_3

n factor $= 2$

$N = 0.3 \times 2 = 0.6$

(10) ~~$\frac{2 \times 0.52}{...}$~~

(10) $\frac{0.52}{E} = 100 \times 10^{-3} \times 0.1$

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

$E = 52$

(11)

$Pb^{+2} + Cr_2O_7^{-2} \longrightarrow PbCrO_4$ yellow ppt.

n factor = no. of cationic charge replaced

= 2

so $N = 0.1 \times 2 = 0.2$

(12) $\frac{3}{E+8} = \frac{5}{E+35.5}$

$E = 33.25$

(13) oxalic acid dihydrate $H_2C_2O_4 \cdot 2H_2O$

~~M oxalic acid~~ moles $= \frac{6.3}{110}$ so molality = 0.23

$2 \times 0.23 \times 10 = 0.1 \times V$

$V = 46$ ml

(14) n factor = 2 $E = \frac{98}{2} = 49.$

ASSIGNMENT
(SUBJECTIVE)

Q(5) (i) $\overset{+5}{H_3PO_4} \longrightarrow NaH_2PO_4$

n factor = 1

(ii) $Fe_2S_3 \longrightarrow 2FeSO_4 + 3SO_2$

$\overset{+3}{Fe}$ $\overset{-2}{S}$ → $\overset{+2}{}$, $\overset{+4}{}$

n = 2 , n = 6×3 = 18

n = 20

or

$Fe_2S_3 \longrightarrow 2FeSO_4 + SO_2$

$+10H_2O$ $\qquad + 20H^+ + 20e^-$

(iii) $NH_3 \rightarrow NO_3^-$

-3 → +5, n = 8

(iv) $CuS \longrightarrow CuSO_4$

-2 → +6, n = 8

(v) $2S_2O_3^{-2} \longrightarrow S_4O_6^{-2} + 2e^-$

n = 1

Q(6) eq of metal = eq of hydrogen

$$\frac{W}{2} = 2 \times \frac{0.7}{22.4}$$

W = 0.125 gm

Q(7)

$$\frac{5}{E} = \frac{9.44}{E+8}$$

5E + 40 = 9.44E

E = 9.01 gm

(2)

Q(8)

$$\frac{14.7}{(98/2)} = \frac{16.8}{E}$$

$E = 56g$

eq of H_2 liberated $= \frac{16.8}{56}$

moles of H_2 " $= \frac{16.8}{56} \times \frac{1}{2}$

volume of $H_2 = \frac{16.8}{112} \times 22.4 = 3.36L$

Q(9)

$H_3PO_4 \longrightarrow Na_2HPO_4$

n factor = 2

$E = 98/2 = 49$

Q(10)

eq of Ag = eq of AgCl

$$\frac{0.501}{E} = \frac{0.6655}{E+35.5}$$

$E = 108$ gm

Q(11)

$$\frac{5}{32.5} = \frac{4.846}{E_{Cu}}$$

$E_{Cu} = 31.5$ gm

Q(12) let x acidic hydrogens are present

$$x \times \frac{1}{146} = \frac{0.768}{56}$$

$$x = 2$$

Q(13) Eq of $KMnO_4$ = eq of $FeSO_4$

$MnO_4^- \rightarrow Mn^{+2}$, +7 → +2, n=5

$$5 \times 0.2 \times V = 1 \times 0.05 \times 50$$

$$V = 2.5 ml$$

$FeSO_4 \rightarrow Fe_2(SO_4)_3$, n=1

Q(14) m.eq of HCl used = $10 \times 0.5 - 0.2 \times 10$

= 3

let x gm $Ba(OH)_2$ is present

$$\frac{x}{(171/2)} = 3 \times 10^{-3}$$

$$x = 256.5 \times 10^{-3} \text{ gm}$$

$$\% = \frac{256.5 \times 10^{-3}}{20} \times 100 = 1.28\%$$

(5)

Q.(15) n factor as an acid = 3

$M = \frac{0.2}{3} = \frac{0.2}{3}$

as R.A.

$\overset{+3}{C_2O_4^{-2}} \longrightarrow \overset{+4}{CO_2}$ n=2

so n factor (total) = 4

$N = 4\left(0.2/3\right)\frac{1}{1} = \frac{0.8}{3} = 0.267\ m$

Q.(16) $KIO_3 + KI \longrightarrow I_2$

$\overset{+5}{IO_3^-} + I^- \longrightarrow \frac{1}{2}\overset{0}{I_2} + \frac{1}{2}I_2$ (n=1) (n=5)

~~eq of IO_3^- = eq of I_2 = eq of hypo~~

~~$\frac{5 \times 0.1}{214} = 45 \times 10^{-3} \times M$~~

~~$M = \frac{0.5}{214} \times \frac{1000}{45} = \frac{500}{214 \times 45}$~~

$IO_3^- + 5I^- + 6H^+ \longrightarrow 3I_2 + 3H_2O$

$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$

$\frac{n_{IO_3^-}}{n_{I_2}} = \frac{1}{3}$

$\frac{n_{I_2}}{n_{hypo}} = \frac{1}{2}$

$\frac{n_{IO_3^-}}{n_{hypo}} = \frac{1}{6}$

$\frac{0.1/214}{M \times 0.045} = \frac{1}{6} \Rightarrow M = 0.063$

Q(17)

$CuS = x$ gm $\quad Cu_2S = (10-x)$ gm

eq of CuS + eq of Cu_2S = eq of $K_2Cr_2O_7$ used.

meq of Fe^{+2} = meq of $KMnO_4$

$1 \times 25 \times M = 5 \times 0.875 \times 20$

$M = 3.5$

So eq of $K_2Cr_2O_7$ used in first rxn

$= 6 \times 100 \times 10^{-3} \times 1.25 - 50 \times 10^{-3} \times 3.5$

$= 575 \times 10^{-3} = 0.575$

$\underset{-2}{CuS} \rightarrow Cu^{+2} + SO_2$ ($n = 6$) $\qquad Cu_2S^{-2} \rightarrow Cu^{+2} + \overset{+6}{SO_2}$ ($n = 2$, $n = 6$; $n = 8$)

$$6 \times \frac{x}{95.5} + \frac{8 \times (10-x)}{159} = 0.575$$

$x = 5.74$ gm

% of CuS = 57.4 %

(5)

Q. (18) let molarity of

$FeC_2O_4 = M_1$, $FeSO_4 = M_2$

$FeC_2O_4 \rightarrow Fe^{+3} + 2CO_2 + 3e^{\ominus}$, $n = 3$

$\overset{+2}{Fe}SO_4 \rightarrow Fe^{+3}$, $n = 1$

meq of FeC_2O_4 + meq of $FeSO_4$ = meq of $KMnO_4$

$3 \times (100 \times M_1) + 100 \times M_2 \times 1 = 5 \times 60 \times 0.02$

$3M_1 + M_2 = 0.06$ ... (1)

By Zn + dil HCl

all Fe^{+3} convert into Fe^{+2}

now all Fe^{+2} will converted into Fe^{+3} by $KMnO_4$

$1 \times M_1 \times 100 + 1 \times M_2 \times 100 = 40 \times 0.02 \times 5$

$M_1 + M_2 = 0.04$ ... (2)

(1) − (2)

$2M_1 = 0.02$

$M_1 = 0.01$

$M_2 = 0.03$

Q(19)

$AgNO_3 + KI \rightarrow AgI + KNO_3$

n=2

$I^{\ominus} + IO_3^{\ominus} \rightarrow I^+ + I^+$

+5, n=4

$2I^{\ominus} + IO_3^{\ominus} \rightarrow 3I^+ + 3H_2O$
$+6H^+$

so $\frac{n_{I^{\ominus}}}{n_{IO_3^{\ominus}}} = \frac{2}{1}$ let molality of KI = M

$\frac{25 \times 10^{-3} \times M}{30 \times 10^{-3} \times 1/10} = \frac{2}{1}$ ⇒ $M = 6/25$

So remaining KI ∘

$\frac{6/25 \times V}{50 \times 10^{-3} \times 1/10} = \frac{2}{1}$ ⇒ $V = \frac{250}{6}$ ml

$V = 125/3$ ml

So vol of KI used with $AgNO_3$

$50 - 125/3 = 25/3$ ml

moles of KI used = $6/25 \times 25/3 \times 10^{-3} = 2 \times 10^{-3}$

So ~~am~~ moles of $AgNO_3$ should be taken = 2×10^{-3}

since sample is 50% pure

so moles taken = 4×10^{-3}

mass taken = $4 \times 10^{-3} \times 170$

= 0.68 gm

(20)

$$\overset{\ominus}{S}CN + 4H_2O \rightarrow SO_4^{-2} + HCN + 7H^+ + 6e^\ominus$$

n factor for $\overset{\ominus}{S}CN = 6$

I_2 used with hypo

$$I_2 + 2Na_2S_2O_3 \rightarrow Na_2S_4O_6 + 2NaI$$

$n_{hypo} = 20 \times 0.1 \times 10^{-3}$
$= 2 \times 10^{-3}$

so moles of I_2 used $= 1 \times 10^{-3}$

so moles of I_2 used with $\overset{\ominus}{S}CN$
$= 50 \times 10^{-3} \times 0.\frac{1}{2} - 1 \times 10^{-3}$
$= \frac{3}{2} \times 10^{-3}$

so eq of I_2 = eq of $\overset{\ominus}{S}CN$
$2 \times \frac{3}{2} \times 10^{-3} = 6 \times$ moles of $\overset{\ominus}{S}CN$
~~$2 \times \frac{3}{2} \times 10^{-3} = 6 \times$ moles of $\overset{\ominus}{S}CN$~~

moles of $\overset{\ominus}{S}CN$ = ~~$\frac{1}{2} \times 10^{-3}$~~ $\frac{1}{2} \times 10^{-3}$

so moles of $Ba(SCN)_2$ = ~~$\frac{3}{2} \times 10^{-3}$~~ $\frac{1}{4} \times 10^{-3}$

mass of $Ba(SCN)_2$ = ~~$\frac{3}{2} \times 10^{-3}$~~ $\times$
$= \frac{1}{4} \times 10^{-3} \times 253$
$= 0.06325$ gm

% purity $= \frac{0.06325}{0.506} \times 100 = 12.5\%$

(21)

$$(H_2O_2 \longrightarrow O_2 + 2H^+ + 2e^{\ominus}) \times 5$$

$$(MnO_4^{\ominus} + 8H^+ + 5e^{\ominus} \longrightarrow Mn^{+2} + 4H_2O) \times 2$$

$$5H_2O_2 + 2MnO_4^{\ominus} + 6H^+ \longrightarrow 5O_2 + 2Mn^{+2} + 8H_2O$$

moles of $O_2 = \frac{3.294}{22.4} = 0.147$

so moles of $H_2O_2 = 0.147$

molarity of $H_2O_2 = \frac{0.147}{100 \times 10^{-3}} = 1.47$

vol. stregth of H_2O_2 = ~~1.47 × 24~~ 1.47×11.2

$= 16.464$

Normality of $H_2O_2 = 2 \times 1.47 = 2.94$

moles of $KMnO_4 = \frac{2}{5} \times 0.147$

mass of $KMnO_4 = \frac{2}{5} \times 0.147 \times 158$

$= 9.29$ gm

Q.22 let molarity of $H_2O_2 = M_1$

" " $KMnO_4 = M_2$

so

$$2 \times 20 \times M_1 = 5 \times 20 \times M_2$$

$$2M_1 = 5M_2$$

now

$$\overset{+7}{MnO_4^{\ominus}} + Mn^{+2} \longrightarrow \overset{+4}{MnO_2} + \overset{+4}{MnO_2}$$

n = 3, n = 2

$$2MnO_4^{\ominus} + 3Mn^{+2} + 2H_2O \longrightarrow 5MnO_2 + 4H^+$$

$$\overset{+4}{MnO_2} + C_2O_4^{-2} \longrightarrow Mn^{+2} + 2CO_2$$

n = 2, n = 2

eq of MnO_2 = eq of ~~Mn^{+2}~~ $C_2O_4^{-2}$

$$2 \times \text{moles of } MnO_2 = 2 \times 10 \times 10^{-3} \times 0.2$$

$$\text{moles of } MnO_2 = 2 \times 10^{-3}$$

hence moles of $MnO_4^{\ominus} = \frac{2}{5} \times 2 \times 10^{-3} = \frac{4}{5} \times 10^{-3}$

$$\text{molarity of } KMnO_4 = M_2 = \frac{\frac{4}{5} \times 10^{-3}}{20 \times 10^{-3}} = 0.04$$

so $M_1 = \frac{5}{2} \times 0.04 = \underline{0.1}$

Q (23) moles of NaOH = 1/40

" " Na_2CO_3 = 1/106

" " $NaHCO_3$ = 1/84

(a) only Ph indicator

eq of Na_2CO_3 + eq of NaOH = eq of HCl

$$1 \times \frac{1}{106} + 1 \times \frac{1}{40} = 1 \times V$$

V = 34.4 ml

(b) only me. o as indicator

eq of Na_2CO_3 + eq of NaOH + eq of $NaHCO_3$ = eq of HCl

$$2 \times \frac{1}{106} + 1 \times \frac{1}{40} + 1 \times \frac{1}{84} = 1 \times V$$

V = 55.3 ml

(c) now no NaOH is left

& all Na_2CO_3 is converted to $NaHCO_3$

moles of converted $NaHCO_3$ = 1/106

moles of HCl = moles of $NaHCO_3$

(already present + converted)

$$1 \times V = \frac{1}{106} + \frac{1}{84}$$

V = 21.3 ml

12

(24) In PH n factor of $Na_2CO_3 = 1$

eq of Na_2CO_3 + eq of $NaOH$ = eq of H_2SO_4

$$1 \times \frac{w_1}{106} + 1 \times \frac{w_2}{40} = 2 \times 1 \times 10 \times 10^{-3}$$

$$\frac{w_1}{106} + \frac{w_2}{40} = 0.02 \quad -(1)$$

In m.o.

n factor for $Na_2CO_3 = 2$

$$2 \times \frac{w_1}{106} + 1 \times \frac{w_2}{40} = 2 \times 1 \times 15 \times 10^{-3}$$

$$\frac{2w_1}{106} + \frac{w_2}{40} = 0.03 \quad -(2)$$

(2) − (1)

$$\frac{w_1}{106} = 0.01 \Rightarrow w_1 = 1.06 \text{ gm}$$

hence $w_2 = 0.4$ gm

Hence in 1 dm³ = 1 litre soln.

$$w_{Na_2CO_3} = \frac{1.06}{25} \times 1000 = 42.4 \text{ gm}$$

$$w_{NaOH} = \frac{0.4}{25} \times 1000 = 16 \text{ gm}$$

(25) let in 10ml solⁿ

mass of $Na_2CO_3 = \omega_1$

" " $NaHCO_3 = \omega_2$

In Phe. only Na_2CO_3 will react till $NaHCO_3$

$$1 \times \frac{\omega_1}{106} = 2 \times 0.1 \times 2 \times 10^{-3}$$

$$\omega_1 = 42.4 \times 10^{-3} \text{ gm}$$

after Meo. is added it will react with $NaHCO_3$ already present & converted both

$$1 \times \frac{\omega_1}{106} + 1 \times \frac{\omega_2}{84} = 2 \times 0.2 \times 2.5 \times 10^{-3}$$

$$0.4 \times 10^{-3} + \frac{\omega_2}{84} = 1 \times 10^{-3}$$

$$\omega_2 = 50.4 \times 10^{-3} \text{ gm}$$

so strengths are

$$Na_2CO_3 = \frac{42.4 \times 10^{-3}}{10} \times 1000 = 4.24 \text{ gm/litre}$$

$$NaHCO_3 = \frac{50.4 \times 10^{-3}}{10} \times 1000 = 5.04 \text{ gm/Litre}$$

Get equipped for IIT-JEE

(1)

$2 \times \frac{x}{M_w} = 5 \times 0.1 \times 0.02$ | $1 \times \frac{y}{M_w} = 2 \times 0.1 \times 0.05$

$x = 5 \times 10^{-3}$ | $y = 10 \times 10^{-3}$

$2x = y$

(2)

$MnO_4^- \rightarrow Mn^{+2}$, $n = 5$ | $Cr_2O_7^{-2} \rightarrow 2Cr^{+3}$, $n = 6$

$1 \times n_{Fe^{+2}} = 5 \times 1 \times V$ | $1 \times n_{Fe^{+2}} = 6 \times 1 \times V$

$n_{Fe^{+2}} = 5V$ | $n_{Fe^{+2}} = 6V$

(3) $0.1 \times 1 \times 5 = 2 \times 0.1 \times M_{H_2O_2}$

$M_{H_2O_2} = 5/2 = 2.5$

now $3 \times 1 \times V = 2 \times 2.5 \times 0.1$

$V = 0.5/3$ litre $= 500/3$ ml

(4)

$\frac{x}{11.2} \times 10 \times 2 = 10 \times 0.1$

$x = 0.56$

(5)

$20 \times x \times 1 = 10 \times 0.1 \times 1 + 5 \times 0.2 \times 2$

~~$x = 1/20$~~ $x = 3/20 = 0.15$

②

Q.⑥ $10 \times x \times 1 = 10 \times 0.1 \times 1$

$x = 0.1$

$2 \times x \times 10 = 5 \times 10 \times M_{KMnO_4}$

$M_{KMnO_4} = 2/50 = 0.04$

Q⑦ $Fe_2(C_2O_4)_3 \rightarrow 2Fe^{+3} + 6CO_2 + 6e^-$

$6 \times 1 = 5 \times x$

$x = 6/5$

$FeC_2O_4 \rightarrow Fe^{+3} + 2CO_2 + 3e^-$

$3 \times 1 = 5 \times y$

$y = 3/5$

$\frac{x}{y} = \frac{2}{1}$

Q⑧ moles of sesquicarbonate $= 40 \times 0.05 \times 10^{-3}$
$= 2 \times 10^{-3}$

$1 \times 2 \times 10^{-3} = 1 \times 0.05 \times x$

$x = \frac{2 \times 10^{-3}}{0.05} = 2/50$

$2 \times 2 \times 10^{-3} + 1 \times 2 \times 10^{-3} = 1 \times 0.05 \times y$

$y = \frac{6 \times 10^{-5}}{0.05} = 6/50$

$y - x = \frac{4}{50}$ litre $= \frac{4}{50} \times 1000 = 80$ ml

Q.9

$x \times 1 = .5 \times 0.1 \times 2$

$= 1$

$x = 1$ mole fraction $= 1/3$

Q.10

m.eq of M_2CO_3 = $150 \times 1 - 100 \times 0.5$

$= 100$

$\frac{5.3}{E} = 100 \times 10^{-3} = 0.1$

$E = 53$

Q.11

$H_3\overset{+1}{P}O_2 \rightarrow \overset{-3}{P}H_3 + H_3\overset{+3}{P}O_3$

($H_3PO_2 \rightarrow PH_3$: $n = 4$; $H_3PO_2 \rightarrow H_3PO_3$: $n = 2$)

$n = \frac{2 \times 4}{2 + 4}$

$n = 4/3$

$E = 3M/4$

Q.12

moles of I_2 = $\frac{1}{2} \times 0.1 \times 1 = 0.05$

$\overset{+2}{Cu}SO_4 \rightarrow Cu^{+1}$

n factor = 1

Eq of $CuSO_4$ = Eq of I_2

$1 \times$ moles of $CuSO_4 = 2 \times 0.05 = 0.1$

Q.13

$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

	Mg	H_2SO_4	$MgSO_4$	H_2
moles	0.05	0.1		
	–	0.05	0.05	0.05

molarity $= \frac{0.05}{0.1} = 0.5$

(14)

$18 \times v = 1 \times 0.9$

$v = 0.9/18 = \frac{1}{20}$ litre $= 50$ ml

(15)

~~$2 \times 0.5 \times V = 1 \times 0.5 \times V = 2 \times 40 \times 0.05$~~

~~$V = 80 \times 0.05 = 40$ ml~~

(15)

$1 \times V \times 0.5 = 2 \times 40 \times 0.05$

$V = \frac{80 \times 0.05}{0.5} = 8$ ml

(16)

$M = \frac{150 \times 6 + 250 \times 3}{400} = 4.125$

(17) molarity of oxalic acid $= \frac{0.9/90}{0.1} = 0.1$

$N_{C_2O_4^{-2}} = 0.2, \; N_{HC_2O_4^{0}} = 0.1$

(18)

$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

$n_{Cl_2} = \frac{0.1}{2} = 0.05 \Rightarrow n_{MnO_2} = 0.05$

$w_{MnO_2} = 0.05 \times 87 = 4.35$

% purity $= \frac{4.35}{10} \times 100 = 43.5$

(19)

$2 \times \frac{0.106}{106} = 0.04 \times N$

$N = \frac{2 \times 10^{-3}}{40 \times 10^{-3}} = 1/20$

(20) $5 \times 0.02 \times V = 1 \times 40 \times 0.1$

$V = 40\ ml$

(21) $\overset{+4}{SO_3^{-2}} \longrightarrow \overset{+6}{SO_4^{-2}}$ ($n = 2$)

$2 \times 20 \times M = 6 \times 30 \times 0.01$

$M = \dfrac{180 \times 0.01}{40} = 0.045$

(22) $2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$

0.15	0.0112	–	–
0.15 - 2×0.0112	–	0.0112	0.0112

moles of NaOH left = 0.1276

$M = \dfrac{0.1276}{1} = 0.1276$

(23) $1 \times \dfrac{a}{M_w} = 1 \times 0.1 \times 0.2$

$a = 0.02\ M_w$

$25 \times \dfrac{b}{M_w} = 5 \times 0.1 \times 0.2$

$b = 0.05\ M_w$

$\dfrac{a}{b} = 2/5$

(24) $2A + 4B = 5 \times 0.1 \times V$

$2A + 4B = 0.5V$

$3B = 1 \times 0.1 \times V$

$3B = 0.1V$

$2A = 0.5V - \dfrac{0.4}{3}V$

$= ~~...~~\ 1.1V$

$A = ~~0.4V~~\ 1.1V/6$

$B = 0.1V/...$

(5)

(25) $FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl$

$n_{Fe(OH)_3} = \frac{1.425}{107} = n_{FeCl_3}$

$M_{FeCl_3} = 0.133$

$N_{FeCl_3} = 0.4$

(26) $\frac{0.4}{96} \times n = \frac{0.5}{40}$

$n = 3$ so H_3A

At mass of A = 93

(27) $\overset{+5}{BrO_3^{\ominus}} \longrightarrow \overset{-1}{Br^{\ominus}}$ ($n = 6$)

$6 \times \frac{0.1262}{167}$ = eq of hypo $= 1 \times 0.045 \times M$

$M_{hypo} = 0.1$

(28) eq of $FeSO_4 \cdot 7H_2O$ = eq of $KMnO_4$

$1 \times 25 \times M = 20 \times 1/10 \times 10^{-3}$

$M = 2/25 \times$

mass of $FeSO_4 \cdot 7H_2O = \frac{2}{25} \times 278 \times 10^{-3}$

$= 22.24 \times 10^{-3}$

In 1000 litre soln

mass =

(28)

$$1 \times 25 \times M_{FeSO_4} = 20 \times 1/_{10}$$

$$M_{FeSO_4} = 2/25$$

mass of $FeSO_4 \cdot 7H_2O$ in 1 litre $= \frac{2}{25} \times 278$

$= 22.24$ gm

% of $FeSO_4 \cdot 7H_2O = \frac{22.24}{25} \times 100$

$= 89\%$

(29) $Fe + O_2 \rightarrow FeO + Fe_2O_3$

$\qquad\qquad\qquad\qquad x \qquad\quad y$

$1 = x + 2y$

$2 \times 0.65 = x + 3y = 1.3 \Rightarrow y = 0.3$

$x = 0.4$

(30) $N_1 \times 25 + N_2 \times 25 = 10 \times 1$

$N_1 + N_2 = 2/5$

$N_1 \times 20 \times 10^{-3} = \frac{0.1435}{143.5}$

$= 10^{-3}$

$N_1 = 1/20 = 0.05$

$N_2 = 7/20 = 0.35$

(38)

(31) $(NH_4)_2SO_4 + 2NaOH \longrightarrow 2NH_3 + 2H_2O + Na_2SO_4$

eq of NaOH reacted with H_2SO_4

$= 10\times10^{-3}\times0.1 = 1\times10^{-3}$

so in 250 ml, eq of NaOH remaining $= 10\times10^{-3}$

total eq of NaOH $= 0.1\times0.2 = 0.02 = 20\times10^{-3}$

so moles of NaOH = eq of NaOH reacted $= 10\times10^{-3} = 10^{-2}$

moles of $(NH_4)_2SO_4$ reacted $= \frac{10^{-2}}{2}$

mass $= 10^{-2}/2 \times 132 = 0.66$ gm

% purity $= \frac{0.66}{0.7}\times100 = 94\%$

(32) $KOH + Na_2CO_3$

w_1 (KOH), w_2 (Na_2CO_3)

$\frac{w_1}{56}\times1 + \frac{w_2}{106}\times1 = \frac{1}{20}\times15\times10^{-3} = 0.75\times10^{-3}$ —(1)

$\frac{w_1}{56}\times1 + \frac{w_2}{106}\times2 = \frac{1}{20}\times25\times10^{-3} = 1.25\times10^{-3}$ —(2)

(2) − (1)

$\frac{w_2}{106} = 0.5\times10^{-3}$

$\frac{w_1}{56} = 0.25\times10^{-3}$

$w_1 = 14\times10^{-3} = 0.014$ gm

Comprehension type

PASSAGE 1

Q. 1 only $1H^+$ replaced

n factor = 1

$$E = \frac{98}{1} = 98$$

Q. 2 $3Zn + 2K_4[Fe(CN)_6] \rightarrow K_2Zn_3[Fe(CN)_6]_2 + 6K$

per mole 3 K^+ is replaced so n factor = 3

$E = M/3$

Q. 3 $2FeS_2 + \frac{11}{2}O_2 \longrightarrow Fe_2O_3 + 4SO_2$

or $4FeS_2 + 11O_2 \longrightarrow 2Fe_2O_3 + 8SO_2$

Q. 4 $\overset{+2}{2Fe}\overset{-1}{S_2} \longrightarrow \overset{+3}{Fe_2}O_3 + 4\overset{+4}{S}O_2$

$n = 2\times1 = 2$ (Fe: +2 → +3)

$4\times5 = 20$ (S: −1 → +4)

$Fe<^{S}_{S}$

n factor = 22

n factor per mole = $\frac{22}{2} = 11$

$E = M/11$

(5) $\overset{-1}{S} \longrightarrow \overset{+4}{SO_2}$

$n = 5$

$E = M/5$

(6)

~~$2Fe_{0.95}O \longrightarrow 0.95 Fe_2O_3$~~

Q(6)

~~$2Fe_{0.95}O \longrightarrow 0.95 Fe_2O_3$~~

~~$+ 0.3H^+ \qquad + 0.15H_2O$~~

~~$+ 0.3e^{\ominus}$~~

Q(6)

$2Fe_{0.95}O \longrightarrow 0.95\ Fe_2O_3$

$+ 0.85H_2O \qquad + 1.7H^+$

$+ 1.7e^{\ominus}$

n factor $= 1.7/2 = 0.85$

$E = M/0.85$

Q(7)

$K_4[Fe(CN)_6] \rightarrow 4K^+ + Fe^{+3} + 6CO_3^{-2} + 6NO_3^{\ominus}$

$+ 36H_2O \qquad + 72H^+ + 61e^{\ominus}$

n factor for $Ba(MnO_4)_2 = 2 \times 5 = 10$

eq of $KMnO_4$ = eq of $Ba(MnO_4)_2$

$61 \times 1 = 10 \times x$

$x = 6.1$

PASSAGE-②

Q①

$CuSO_4$ will convert into Cu_2I_2

$Cu^{+2} \longrightarrow Cu^{+1}$ (n factor = 1) $2I^{\ominus} \longrightarrow I_2 + 2e^{\ominus}$

$S_2O_3^{-2} \longrightarrow SO_4^{-2}$ (+2 → +6), n factor = 8

eq of hypo = eq of I_2 = eq of $CuSO_4$

$8 \times 50 \times 10^{-3} \times 1 = 1 \times$ moles of $CuSO_4$

moles of $CuSO_4$ = 0.4

mass of $CuSO_4$ = 63.8 gm

% purity = $63.8/79.75 \times 100$ = 80%

Q②

$IO_3^{\ominus} + 5I^{\ominus} + 6H^{+} \longrightarrow 3I_2 + 3H_2O$

$n_{IO_3^{\ominus}} = n_{KIO_3} = \frac{214}{214} = 1$, n_{I_2} produced = 3

eq of I_2 = eq of hypo

$2 \times 3 = 8 \times 1 \times V$

$V = 6/8$ litre = 750 ml

12

(3) $I^{\ominus} + \overset{+5}{I}O_3^{\ominus} \longrightarrow I^+ + I^+$

$n=4$, $n=2$

$2I^{\ominus} + IO_3^{\ominus} \rightarrow 3I^+ + 3H_2O$
$+ 6H^+$

$2KI + KIO_3 + 6HCl \longrightarrow 3ICl + 3H_2O + 3KCl$

$n_{KI} = \frac{1.66}{166} = 0.01$

$n_{KIO_3} = \frac{0.01}{2}$, $n_{ICl} = \frac{0.03}{2} =$

$= \underline{0.005}$ $= 0.015$

(4) $O_3 + 2I^{\ominus} \rightarrow I_2 + O_2 + H_2O$
$+ 2H^+$

eq of I_2 = eq of hypo = $1 \times 0.2 \times 0.1$
$= 0.02$

moles of $I_2 = \frac{0.02}{2} = 0.01$

moles of $O_3 = 0.01$

volume of $O_3 = 0.01 \times 22.4 = 0.224$ litre

% of $O_3 = \frac{0.224}{22.4} \times 100 = \underline{1\%}$

PASSAGE (3)

Q(1) molarity of H_2O_2 = $\frac{x}{11.2}$

if x = vol strength

$M = \frac{10}{11.2}$

strength $= \frac{10}{11.2} \times 34 = 30.3$ gm/litre

% strength = 3.03

Q(2) $Ba(MnO_4)_2 \longrightarrow 2Mn^{+2}$

$n = 10$

$10 \times$ moles of $Ba(MnO_4)_2 = 2 \times 0.1 \times \frac{56}{11.2}$

moles of $Ba(MnO_4)_2 = 0.1$

mass of " $= 0.1 \times 375 = 37.5$

% purity $= \frac{37.5}{55} \times 100 = 68.18\%$

Q(3) $S_2O_3^{-2} \longrightarrow SO_4^{-2}$

n factor = 8

eq of H_2O_2 = eq of I_2 = eq of hypo

$2 \times 0.1 \times M = 8 \times 0.025 \times 1$

$M = 1$ so vol. strength = 11.2

14

Q(4) eq of H_2O_2 = eq of I_2

$2 \times 0.1 \times M = 2 \times \frac{25.4}{254}$

$= 0.2$

$M = 1$ Vol. = 11.2

Q(5) 22.4 vol.

> 1 ml H_2O_2 can liberate 22.4 ml O_2

so for 2240 ml O_2 we need 100 ml H_2O_2

Q(6)

$Al(MnO_4)_3 \rightarrow Mn^{+2}$

n = 15

eq of H_2O_2 = eq of $Al(MnO_4)_3$

$2 \times 0.84 \times \frac{V}{11.2} = 15 \times M \times V \times 10^{-3}$

M = 10

Q(7) $2 \times 20 \times M = 5 \times 10 \times 0.1$

$M = 5/40 = 1/8$

so initial molarity = $\frac{400}{100} \times M = 4M = \frac{1}{2}$

Vol. strength = $\frac{1}{2} \times 11.2 = 5.6$

Matrix match

Q①

① $2CrI_3 \longrightarrow Cr_2O_7^{-2} + 6IO_4^{\ominus}$

$+31H_2O \qquad + 62H^+$

$\qquad 54e^{\ominus}$

n factor $= 54/2 = 27$

$E = M/27$

② $Fe(SCN)_2 \longrightarrow Fe^{+3} + 2SO_4^{-2} + 2CO_3^{-2} + 2NO_3^{\ominus}$

$+20H_2O \qquad + 40H^+$

$\qquad + 33e^{\ominus}$

$E = M/33$

③ $NH_4SCN \longrightarrow SO_4^{-2} + CO_3^{-2} + 2NO_3^{\ominus}$

$+13H_2O \qquad + 30H^+ + 24e^{\ominus}$

$E = M/24$

④ $K_4[Fe(CN)_6] \longrightarrow 4K^+ + Fe^{+3} + 6CO_3^{-2} + 6NO_3^{\ominus}$

$+36H_2O \qquad + 72H^+ + 61e^{\ominus}$

$E = M/61$

Q (2) (A) $P_2H_4 \rightarrow PH_3 + P_4H_2$

$-2 \qquad -3 \qquad -1/2$

$n = 2\times(3/2) = 3$; $n = 2$

$\frac{1}{n} = \frac{1}{2} + \frac{1}{3} = \frac{5}{6}$ $n = 6/5$ $\Rightarrow E = \frac{5M}{6}$

(B)

$I_2 \rightarrow I^{\ominus} + IO_3^{\ominus}$

$n = 2$

$2e^{\ominus} + I_2 \rightarrow 2I^{\ominus}$ | $I_2 \rightarrow 2IO_3^{\ominus}$
$+6H_2O \qquad +12H^+ + 10e^{\ominus}$

n factor $= \frac{10}{6} = 5/3$

$E = 3M/5$

(C)

$\overset{+8/3}{Mn_3O_4} \rightarrow Mn^{+2} + \overset{+7}{MnO_4^{\ominus}}$

$n = 3\times\left[\frac{8}{3} - 2\right] = 2$

$n = 3\left[7 - \frac{8}{3}\right] = 13$

$n = \frac{n_1 n_2}{n_1 + n_2} = \frac{26}{15}$ $E = \frac{15M}{26}$

(D) $H_3\overset{+1}{P}O_2 \rightarrow \overset{-3}{P}H_3 + H_3\overset{+3}{P}O_3$

$n = 4$; $n = 2$

$n = \frac{2\times4}{2+4} = \frac{8}{6} = 4/3$

$E = 3M/4$

Q (3)

$Br_2 \rightarrow Br^{\ominus} + BrO_3^{\ominus}$

$(2e^{\ominus} + Br_2 \rightarrow 2Br^{\ominus})\times 5$

$Br_2 \rightarrow 2BrO_3^{\ominus}$
$+6H_2O \qquad +12H^+ + 10e^{\ominus}$

$6Br_2 + 12\overset{\ominus}{O}H \rightarrow 10Br^{\ominus} + 2BrO_3^{\ominus} + 6H_2O$

$6Br_2 + 6H_2O \rightarrow 10Br^{\ominus} + 2BrO_3^{\ominus} + 12H^+$
$+12\overset{\ominus}{O}H \qquad +12\overset{\ominus}{O}H$