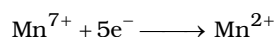
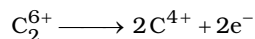


16. Let weight of  $\text{H}_2\text{C}_2\text{O}_4 = a \text{ g}$  in 1L and weight of  $\text{NaHC}_2\text{O}_4 = b \text{ g}$  in 1L for acid base reaction now  
(Meq. of  $\text{H}_2\text{C}_2\text{O}_4 + \text{Meq. of NaHC}_2\text{O}_4$ ) in 10 mL =  $3 \times 0.1$

$$\therefore \text{Meq. of H}_2\text{C}_2\text{O}_4 + \text{Meq. of NaHC}_2\text{O}_4 \text{ in 1L} = 3 \times 0.1 \times 100 = 30$$

$$\therefore \frac{a}{45} \times 1000 + \frac{b}{112/1} \times 1000 = 30 \quad \dots\dots\dots (i)$$

For redox change :



$$\text{Meq. of H}_2\text{C}_2\text{O}_4 + \text{Meq. of NaHC}_2\text{O}_4 \text{ in 10 mL} = 4 \times 0.1$$

$$\therefore \text{Meq. of H}_2\text{C}_2\text{O}_4 + \text{Meq. of NaHC}_2\text{O}_4 \text{ in 1L} = 4 \times 0.1 \times 100 = 40$$

$$(\because \text{Eq. wt. of H}_2\text{C}_2\text{O}_4 = \frac{M}{2} \text{ and Eq. wt. of NaHC}_2\text{O}_4 = \frac{M}{2} \text{ as reductant})$$

$$\therefore \frac{1000a}{45} + \frac{2000b}{112} = 40 \quad \dots\dots\dots (ii)$$

Solving, equations (i) and (ii), we get,  $a = 0.9 \text{ g}$  and  $b = 1.12 \text{ g}$

- 17.(B) Normality of 10 volume  $\text{H}_2\text{O}_2 = 1.78 \text{ N}$

Thus, volume strength of 1.78 N solution = 10

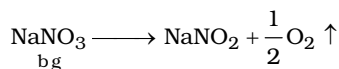
$$\therefore \text{Volume strength of 1.5 N H}_2\text{O}_2 = 1.5 \times \frac{10}{1.78} = \frac{15}{1.78} = 8.4$$

- 18.(C)  $2 + 2(2 + x - 4) = 0$  [ $\because \text{Ba}(\text{H}_2\text{PO}_2)_2$  is neutral molecule]

$$\text{or } 2x - 2 = 0$$

$$\Rightarrow x = +1$$

19.  $\text{Pb}(\text{NO}_3)_2 \xrightarrow{a \text{ g}} \text{PbO} + 2\text{NO}_2 \uparrow + \frac{1}{2}\text{O}_2 \uparrow$



$$\therefore a + b = 5 \text{ g} \quad \dots\dots\dots (i)$$

$$\text{The loss in weight for 5 g mixture} = 5 \times \frac{28}{100} = 1.4 \text{ g}$$

$$\therefore \text{Residue left} = 5 - 1.4 = 3.6 \text{ g}$$

The residue contains  $\text{PbO} + \text{NaNO}_2$

$$\therefore 331 \text{ g Pb}(\text{NO}_3)_2 \text{ gives } = 223 \text{ g PbO}$$

$$\therefore a \text{ g Pb}(\text{NO}_3)_2 \text{ gives } = \frac{223 \times a}{332} \text{ g PbO}$$

Similarly,

$$\therefore 85 \text{ g NaNO}_3 \text{ gives } = 69 \text{ g NaNO}_2$$

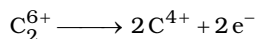
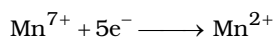
$$\therefore b \text{ g NaNO}_3 \text{ gives } = \frac{69 \times b}{85} \text{ g NaNO}_2$$

$$\therefore \frac{223 \times a}{331} + \frac{69 \times b}{85} = 3.6 \quad \dots\dots\dots (ii)$$

Solving equation, (i) and (ii)  $a = 3.32 \text{ g}$  and  $b = 1.68 \text{ g}$

20. Let 'a' moles of  $\text{Cu}^{2+}$  and 'b' moles of  $\text{C}_2\text{O}_4^{2-}$  be present in solution

(i) The solution is oxidised by  $\text{KMnO}_4$  with only  $\text{C}_2\text{O}_4^{2-}$

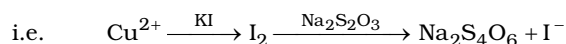


$$\therefore \text{Meq. of } \text{C}_2\text{O}_4^{2-} = \text{Meq. of } \text{KMnO}_4$$

$$\therefore b \times 2 \times 1000 = 0.02 \times 5 \times 22.6$$

$$\therefore b = 1.13 \times 10^{-3}$$

(ii) After oxidation of  $\text{C}_2\text{O}_4^{2-}$ , the resulting solution is neutralized by  $\text{Na}_2\text{CO}_3$ , acidified with dilute  $\text{CH}_3\text{COOH}$  and then treated with excess of  $\text{KI}$ . The liberated  $\text{I}_2$  required  $\text{Na}_2\text{S}_2\text{O}_3$  for its neutralization,



$$\therefore \text{Meq. of } \text{Cu}^{2+} = \text{Meq. of } \text{I}_2 \text{ liberated} = \text{Meq. of } \text{Na}_2\text{S}_2\text{O}_3 \text{ used}$$

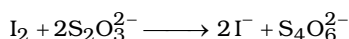
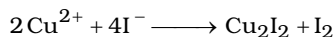
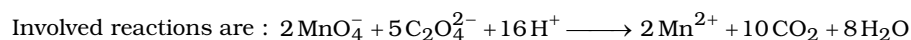
$$\therefore \text{Meq. of } \text{Cu}^{2+} = \text{Meq. of } \text{Na}_2\text{S}_2\text{O}_3 \text{ used}$$

$$a \times 1 \times 1000 = 11.3 \times 0.5 \times 1$$

$$\therefore a = 5.65 \times 10^{-3}$$

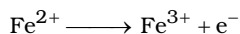
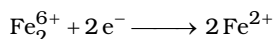
$$\therefore \text{Molar ratio of } \frac{\text{Cu}^{2+}}{\text{C}_2\text{O}_4^{2-}} = \frac{a}{b} \Rightarrow \frac{5.65 \times 10^{-3}}{1.13 \times 10^{-3}} = \frac{5}{1}$$

Hence, molar ratio of  $\text{Cu}^{2+}$ ;  $\text{C}_2\text{O}_4^{2-} = 5 : 1$



21. The redox changes are :

For reduction of  $\text{Fe}_2\text{O}_3$  by zinc dust



oxidant + ne<sup>-</sup> → reductant

Meq. of  $\text{Fe}_2\text{O}_3$  in 25 mL

$$= \text{Meq. of } \text{Fe}^{2+} \text{ formed} = \text{Meq. of oxidant used to oxidize } \text{Fe}^{2+} \text{ again}$$

$$\therefore \text{Meq. of } \text{Fe}_2\text{O}_3 \text{ in 25 mL} = \text{Meq. of oxidant} = 17 \times 0.0167 \times n$$

Where n is the number of electrons gained by 1 molecule of oxidant

$$\therefore \text{Meq. of } \text{Fe}_2\text{O}_3 \text{ in 100 mL} = 17 \times 0.0167 \times n \times \frac{100}{25}$$

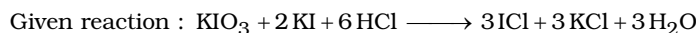
$$\therefore \frac{1 \times 55.2 \times 1000}{100 \times \frac{M}{2}} = 17 \times 0.0167 \times n \times 4$$

$$\therefore \text{Molecule wt. of } \text{Fe}_2\text{O}_3 = 160$$

$$\therefore n = \frac{1 \times 55.2 \times 2 \times 1000}{100 \times 160 \times 17 \times 0.0167 \times 4} = 6$$

Hence, number of electrons gained by one molecule of oxidant = 6

22. Number of millimoles of  $\text{KIO}_3$  in 30 mL of solution = molarity  $\times$  volume in mL =  $\frac{1}{10} \times 30 = 3$



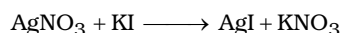
According to the equation given, 1 mole of  $\text{KIO}_3$  is equivalent to 2 moles of KI

$\therefore$  Number of millimoles of KI in 20 mL of stock solution =  $2 \times 3 = 6$

$\therefore$  Number of millimoles of KI in 50 mL of the same solution =  $6 \times \frac{50}{20} = 15$

Number of millimoles of  $\text{KIO}_3$  in 50 mL of solution =  $\frac{1}{10} \times 50 = 5$

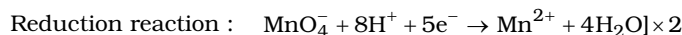
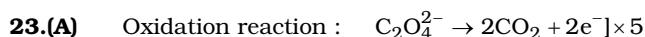
$\therefore$  Number of millimoles of KI used with  $\text{AgNO}_3 = 15 - 10 = 5$



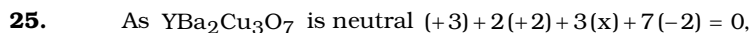
1 mole of  $\text{AgNO}_3$  reacts with 1 mole of KI. Therefore, number of millimoles of  $\text{AgNO}_3$  is equal to 5

$\therefore$  Weight of  $\text{AgNO}_3 = 5 \times 10^{-3} \times 170 \text{ g} = 0.85 \text{ g}$

$\therefore$  % of  $\text{AgNO}_3 = \frac{0.85 \times 100}{1.0} = 85.0\%$

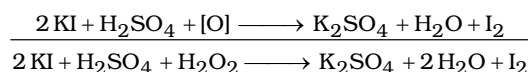
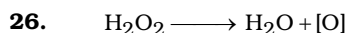


$(2n) + (3 \times 2) + (4 \times 6) + (-2 \times 18) = 0$  or  $2n + 30 - 36 = 0$  or  $2n = 6$  or  $n = 3$



or  $3 + 4 + 3x - 14 = 0$

$\Rightarrow 3x + 7 - 14 = 0$  or  $x = +\frac{7}{3}$



Liberated moles of  $\text{I}_2 = \frac{0.508 \times 10^3}{254} = 2$

Meq. of  $\text{I}_2 = 2 \times 2 = 4$

Meq. of liberated  $\text{I}_2 = \text{Meq. of used } \text{H}_2\text{O}_2$

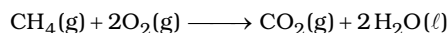
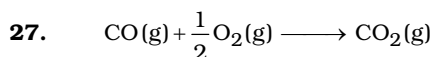
Meq. of  $\text{H}_2\text{O}_2 = 4$

Weight of  $\text{H}_2\text{O}_2 = \text{Meq.} \times \text{Eq. wt. of } \text{H}_2\text{O}_2 \times 10^{-3} = 4 \times 17 \times 10^{-3} \text{ g} = 0.068 \text{ g}$

Strength of  $\text{H}_2\text{O}_2 = \frac{0.068 \times 1000}{5} \text{ g/L} = 13.6 \text{ g/L}$

$\therefore$  60.7 g  $\text{H}_2\text{O}_2$  is used for 20 volume  $\text{H}_2\text{O}_2$

$\therefore$  13.6 g/L strength of  $\text{H}_2\text{O}_2$  is used for  $= \frac{20 \times 13.6}{60.7} \text{ volume} = 4.48 \text{ volume}$



'x' is the volume of CO and y is+ the volume of CH<sub>4</sub>

Thus,  $\frac{1}{2}x + y = 13$  ..... (i)

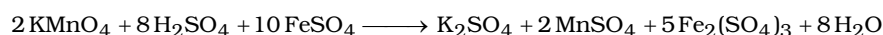
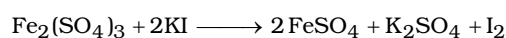
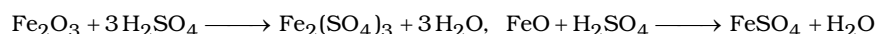
$x + y = 14$  ..... (ii)

∴ By solving eq. (i) & (ii), we get

$x = 2 \text{ cc}; \quad y = 12 \text{ cc}$

Thus, %CH<sub>4</sub> = 60, %CO = 10, %He = 30

28. The following reactions are involved in given data



∴ 1 mole Fe<sub>2</sub>O<sub>3</sub> ≡ 1 mole Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> ≡ 1 mole of I<sub>2</sub> ≡ 2 moles of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>

and 5 moles of FeSO<sub>4</sub> ≡ 1 mole of KMnO<sub>4</sub>

Number of millimoles of I<sub>2</sub> in 20 mL =  $5.5 \times \frac{1}{2} = 2.75$

So, the number of millimoles of I<sub>2</sub> in 100 mL =  $2.75 \times \frac{100}{20} = 13.75$

Number of millimoles of Fe<sub>2</sub>O<sub>3</sub> = 13.75

Number of moles of Fe<sub>2</sub>O<sub>3</sub> =  $13.75 \times 10^{-3}$

Suppose x moles of Fe<sub>3</sub>O<sub>4</sub> and y moles of Fe<sub>2</sub>O<sub>3</sub> are present in 3g sample. In this sample Fe<sub>3</sub>O<sub>4</sub> is an equimolar mixture of FeO and Fe<sub>2</sub>O<sub>3</sub>. Therefore, total number of moles of Fe<sub>2</sub>O<sub>3</sub> in the mixture = x + y

$x + y = 13.75 \times 10^{-3}$  ..... (i)

Number of millimoles of KMnO<sub>4</sub> =  $0.25 \times 12.80 = 3.2$

∴ Number of millimoles of FeSO<sub>4</sub> in 50 mL =  $3.2 \times 5 = 16$

and number of millimoles of FeSO<sub>4</sub> in 100 mL =  $16 \times \frac{100}{50} = 32$

1 mole Fe<sub>3</sub>SO<sub>4</sub> gives 3 moles of FeSO<sub>4</sub> and 1 mole of Fe<sub>2</sub>O<sub>3</sub> gives 2 moles of FeSO<sub>4</sub>

∴  $3x + 2y = 32 \times 10^{-3}$  ..... (ii)

On solving equations (i) and (ii)

Number of moles of Fe<sub>3</sub>O<sub>4</sub> in the mixture (x) =  $4.5 \times 10^{-3}$

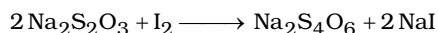
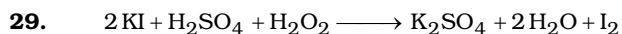
Number of moles of Fe<sub>2</sub>O<sub>3</sub> in the mixture (y) =  $9.25 \times 10^{-3}$

∴ Mass of Fe<sub>3</sub>O<sub>4</sub> =  $4.5 \times 10^{-3} \times 232 = 1.044 \text{ g}$

and Mass of Fe<sub>2</sub>O<sub>3</sub> =  $9.25 \times 10^{-3} \times 160 = 1.480 \text{ g}$

∴ % of Fe<sub>3</sub>O<sub>4</sub> =  $\frac{1.044}{3.00} \times 100 = 34.8\%$

and % of Fe<sub>2</sub>O<sub>3</sub> =  $\frac{1.480}{3.0} \times 100 = 49.33\%$



$$\text{Meq. of Na}_2\text{S}_2\text{O}_3 = 20 \times 0.3 = 6 \quad (\text{Normality} \times \text{volume})$$

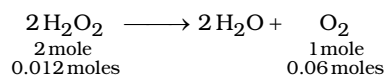
$$\text{Meq. of Na}_2\text{S}_2\text{O}_3 = \text{Meq. of I}_2 = 6$$

$$\text{Meq. of I}_2 = \text{Meq. of H}_2\text{O}_2 = 6$$

$$\text{Weight of H}_2\text{O}_2 = \text{Meq.} \times E \times 10^{-3} = 6 \times 17 \times 10^{-3} = 0.102 \text{ g} \quad (\because \text{Eq. wt. of H}_2\text{O}_2 = \frac{34}{2} = 17)$$

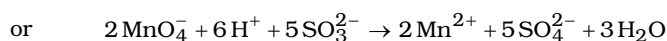
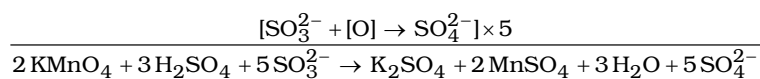
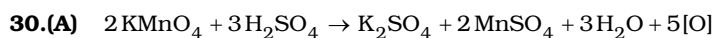
$$\text{Strength of H}_2\text{O}_2 = \frac{0.102 \times 1000}{25} = 0.408 \text{ g/L}$$

$$\text{Molarity of H}_2\text{O}_2 = \frac{0.408 \text{ g/L}}{\text{mol. wt. (34)}} = 0.012 \text{ M}$$



$$\therefore \text{Volume of O}_2 \text{ at STP} = 0.06 \times 22.4 \text{ L} = 1.344 \text{ L}$$

$$\text{Hence the volume strength of H}_2\text{O}_2 = 1.344 \text{ L}$$



Therefore, 5 moles of  $\text{SO}_3^{2-}$  will require 2 moles of  $\text{MnO}_4^-$

$$1 \text{ mole of SO}_3^{2-} \text{ will require } \frac{2}{5} \text{ moles of MnO}_4^-$$