

**Chapter 6: Chemical Equivalence**

**Q1.**

**Sol:** No, In  $\text{FeCl}_2$ , Iron is in  $\text{Fe}^{2+}$  state.

$$\therefore \text{Eq. wt.} = \frac{\text{At. wt.}}{2} = \frac{56}{2} = 28$$

In  $\text{FeCl}_3$ , Iron is in  $\text{Fe}^{3+}$  state.

$$\therefore \text{Eq. wt.} = \frac{\text{At. wt.}}{3} = \frac{56}{3}$$

**Q2.**

**Sol:** Eq. Wt. of oxide = Eq. Wt. of metal + Eq. Wt. of oxygen  
 $= 12 + 8 = 20$

[Since Eq. Wt. of compound = (Eq. wt. of cation + Eq. wt. of anion)]

**Q3.**

**Sol:** From law of gm equivalence

**For Oxides**

gm eq. of cation = gm eq. of anion

gm eq. of metal = gm eq. of oxygen

$$= \frac{0.2 \text{ g}}{8} = \frac{1}{40}$$

**Also for chloride**

gm eq. of metal = gm eq. of halogen

$$\frac{1}{40} = \frac{3.17}{\text{eq. wt of halogen}}$$

Eq. wt of halogen =  $403 \times .17 = 127$  **Ans**

**Q4.**

**Sol:** In first oxide

gm eq. of oxygen = gm eq. of Arsenic

$$\left( \frac{100 - 65.2}{8} \right) = \frac{65.2}{\text{eq. wt of Arsenic}}$$

$\therefore$  eq. wt of Arsenic = 15 g **Ans**

**In 2<sup>nd</sup> oxide**

gm eq. of oxygen = gm eq. of Arsenic

$$\left( \frac{100 - 75 - 7}{8} \right) = \frac{75.7}{\text{eq. wt of arsenic}}$$

$\therefore$  Eq. Wt. of Arsenic =  $\frac{75.7 \times 8}{24.3} = 24.9 \text{ g}$  **Ans**

**Q5.**

**Sol:** Metal oxide +  $\text{H}_2 \longrightarrow$  Metal

From law of chemical equivalence.

gm eq. of metal oxide = gm eq. of  $\text{H}_2$

$$\frac{1.80}{\text{eq. wt of oxide}} = \frac{833}{11200}$$

$$\text{eq. wt. of oxide} = \frac{1.80 \times 11200}{833} = 24.2 \text{ g Ans}$$

∴ Eq. Wt. of oxide = Eq. Wt. of metal = Eq. Wt. of oxygen

$$24.2 = \text{Eq. Wt. of Metal} + 8$$

$$\text{Eq. Wt. of metal} = 24.2 - 8 = 16.2 \text{ g Ans}$$

**Q6.**

**Sol:** Metal + Acid  $\longrightarrow$  H<sub>2</sub> ↑

$$\text{Eq. wt} = 18 \quad 0.7 \text{ lit}$$

gm eq. of metal = gm eq of H<sub>2</sub> evolved

$$\frac{\text{wt of metal}}{\text{Eq. wt of metal}} = \frac{\text{wt of H}_2}{\text{Eq. wt. of H}_2}$$

$$\frac{\text{wt of metal}}{28} = \frac{0.7}{11.2}$$

$$\text{Wt of metal} = \frac{0.7 \times 28}{11.2} = 1.75 \text{ g Ans}$$

**Q7.**

**Sol:** From principle of gram equivalence.

gm eq. of metal = gm eq. of oxygen

$$\frac{\text{wt of metal}}{\text{eg. wt of metal}} = \frac{\text{wt of oxygen}}{\text{eg. wt of oxygen}}$$

$$\frac{5}{\text{eq. wt of metal}} = \frac{4.44}{8}$$

$$\text{Eq. wt of metal} = \frac{5 \times 8}{4.44} = 9.01 \text{ g Ans}$$

**Q8.**

**Sol:** Metal + sulphuric acid  $\longrightarrow$  dissolve

From principle of chemical equivalence

gm equivalent of metal = gm equivalent of sulphuric acid

$$\Rightarrow \frac{\text{wt}}{\text{Eq. wt of metal}} = \frac{\text{wt of H}_2\text{SO}_4}{\text{Eq. wt of H}_2\text{SO}_4}$$

$$\Rightarrow \frac{\text{wt}}{\text{Eq. wt of metal}} = \frac{\text{wt of H}_2\text{SO}_4}{\text{Eq. wt of H}_2\text{SO}_4}$$

$$\frac{16.8}{\text{eq. wt of metal}} = \frac{14.7}{\frac{98}{2}}$$

$$\text{Eq. wt of metal} = \frac{16.8 \times 49}{14.7} = 56 \text{ g}$$

Also, gm eq. of H<sub>2</sub> evolved = gm eq. of H<sub>2</sub>SO<sub>4</sub>



$$\frac{\text{volume at NTP}}{\text{Eq. volume at NTP}} = \frac{14.7}{\frac{98}{2}}$$

$$\text{Volume at NTP} = \frac{14.7}{49} \times 11.2 = 3.36 \text{ lit Ans}$$

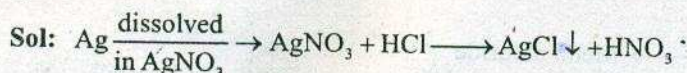
**Q9.**



Since 2 hydrogen are removed from  $\text{H}_3\text{PO}_4$ , so its v.f. = 2

$$\therefore \text{eq. wt of orthophosphoric acid} = \frac{\text{wt}}{\text{v.f}} = \frac{98}{2} = 49 \text{ g Ans}$$

**Q10.**



gm eq. of Ag = gm eq. of AgCl = gm eq. of chlorine

$$\frac{\text{wt of Ag}}{\text{Eq. wt of Ag}} = \frac{\text{wt of chlorine}}{\text{Eq. wt of Cl}_2}$$

$$\frac{0.501 \text{ g}}{\text{eq. wt of Ag}} = \frac{0.6655 - 0.501}{35.5} = \frac{0.1645}{35.5}$$

$$\text{Eq. wt of Ag} = \frac{0.501}{0.00463} = 108.2 \text{ g Ans}$$

**Q11.**



$$\begin{array}{cc} 5 \text{ g} & 4.864 \text{ g} \end{array}$$

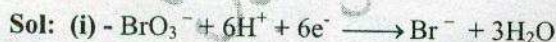
Gm eq. of Zn = Gm eq of Cu

$$\frac{\text{wt of Zn}}{\text{Eq. wt of Zn}} = \frac{\text{wt of Cu}}{\text{Eq. wt of Cu}}$$

$$\frac{5 \text{ g}}{32.5 \text{ g}} = \frac{4.846}{\text{eq. wt of Cu}}$$

$$\text{Eq. wt of Cu} = \frac{4.846 \times 32.5}{5} = 31.5 \text{ g Ans}$$

**Q12.**



Molarity  $\times$  valancy factor = Normality

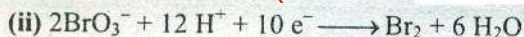
$$\text{Molarity} = \frac{0.672}{6} = 0.112 \text{ M Ans}$$

$$\text{Also no. of moles of Bromate} = \text{Molarity} \times \text{Vol. (in lit)} = 0.112 \times \frac{85.5}{1000}$$

$$\frac{\text{wt}}{\text{Mol. wt of NaBrO}_3} = 9.576 \times 10^{-3}$$

$$\frac{\text{wt}}{151 \text{ g}} = 9.576 \times 10^{-3} \rightarrow \text{wt} = 1.4479 \text{ g; Ans}$$

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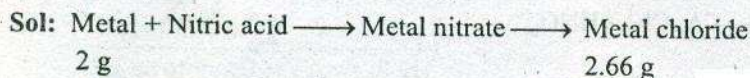


$$\begin{aligned}\text{Molarity} &= \frac{\text{Normality}}{\text{valancy factor}} \\ &= \frac{0.672}{\frac{10}{2}} \quad (\text{Since 10 electron taken by 2 BrO}_3^-, \text{ So 5 electron by one BrO}_3^-) \\ &= \frac{0.672}{5} = 0.134\text{ M Ans}\end{aligned}$$

$$\frac{\text{Weight}}{\text{Mol.wt.}} = 0.134 \times 85.5 \times 10^{-3}$$

$$\text{Weight} = 0.134 \times 85.5 \times 10^{-3} \times 151 \text{ g} = 1.7235 \text{ g Ans}$$

**Q13.**



From principle of chemical equivalence

gm equivalent of metal = gm equivalent of chloride

$$\frac{2\text{g}}{\text{eq. wt of metal}} = \frac{2.66\text{g}}{\text{eq. wt Metal chloride}}$$

$$\frac{2\text{g}}{\text{eq. wt of Metal}} = \frac{2.66\text{g}}{\text{eq. wt of Metal} + \text{eq. wt of chlorine}}$$

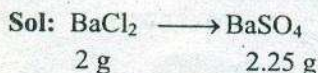
$$\frac{2\text{g}}{E} = \frac{2.66}{E + 35.5}$$

(Let eq. wt of Metal = E)

$$(2.66 - 2)E = 2 \times 35.5$$

$$E = 53.78 \times 2 = 107.55 \text{ g Ans}$$

**Q14.**



gm eq. of  $\text{BaCl}_2$  = gm eq. of  $\text{BaSO}_4$ .

$$\frac{2\text{g}}{\text{eq. wt of BaCl}_2} = \frac{2.25\text{g}}{\text{eq. wt of BaSO}_4}$$

If E is the equivalent weight of Ba, then

$$\frac{2}{E + 35.5} = \frac{2.25}{E + 48}$$

$$2.25E + 2.25 \times 35.5 = 2E + 96 \rightarrow E = \frac{96 - 2.25 \times 35.5}{0.25} = 64.5 \text{ g Ans}$$

**Q15.**

**Sol:** Metal chloride contains 47.23% of Metal

$\therefore$  100 g of Metal chloride contain (100 - 47.23) g of chlorine

In any compound, from principle of gm equivalent;

gm equivalent of cation = gm equivalent of anion.

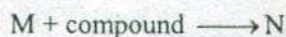


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$$\frac{47.23}{\text{Eq. wt of M}} = \frac{(100 - 47.23)}{\text{Eq. wt of chlorine}}$$

$$\frac{47.23 \text{ g}}{\text{eq. wt of M}} = \frac{52.77 \text{ g}}{35.5 \text{ g}}$$

$$\text{eq. wt. of M} = \frac{47.23 \times 35.5}{52.77} = 31.77 \text{ g}$$



1 gm  $\qquad\qquad\qquad$  0.88 g

$\therefore$  From principle of chemical equivalence

gm eq of M = gm eq of N

$$\frac{1 \text{ g}}{\text{eq. wt of M}} = \frac{0.88 \text{ g}}{\text{eq. wt of N}}$$

Eq. wt of N =  $0.88 \times \text{eq. wt of M}$

=  $0.883 \times 1.77 = 27.96 \text{ g Ans}$

**Q16.**

**Sol:** 0.5 lit of 0.01 M Cu (II) Sol<sup>n</sup>

moles of Cu(II) =  $0.5 \times 0.01 = 5 \times 10^{-3}$

$\therefore$  moles of Cu (II) = moles of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} = 5 \times 10^{-3}$

$\therefore \frac{\text{weight of } \text{CuSO}_4 \cdot 5\text{H}_2\text{O}}{18 \times 5 + 96 + 63.5} = 5 \times 10^{-3}$

Wt of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} = 1.248 \text{ g Ans}$

**Q17.**

**Sol:**  $\begin{matrix} +4 & +5 & -1 & +6 \\ \text{SO}_2 & + & \text{HClO}_3 & \longrightarrow & \text{HCl} & + & \text{SO}_4^{2-} \end{matrix}$



V=?  $\qquad\qquad$  16.9 gm

V.f=2  $\qquad$  V.f. = 6

(Note: only +6 oxidised state possible for  $\text{SO}_2$  because S has only -2, 0, 2, 4, 6 oxid. state possible)

$\therefore$  From principle of chemical equivalence

gm eq. of  $\text{SO}_2$  = gm eq. of  $\text{HClO}_3$

$$\frac{V \text{SO}_2}{22.4/2} = \frac{16.9}{84.5/6}$$

$V \text{SO}_2 = 13.44 \text{ lit Ans}$

**Q18.**

**Sol:**  $\begin{matrix} -2 & +7 & +6 & +4 \\ \text{H}_2\text{S} & + & \text{KMnO}_4 & \longrightarrow & \text{K}_2\text{SO}_4 & + & \text{MnO}_2 \end{matrix}$



wt ?  $\qquad$  6.32 g

v.f = 8  $\qquad$  v.f = 3

From principle of chemical equivalence

gm eq. of  $\text{H}_2\text{S}$  = gm eq. of  $\text{KMnO}_4$

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$$\frac{\text{wt}}{\frac{34}{8}} = \frac{6.32}{\frac{158}{3}}$$

$$\text{Wt} = 0.511 \text{ g} \quad \text{Ans}$$

**Q19.**

**Sol:**  $\text{C}_6\text{H}_{10}\text{O}_4 + \text{KOH} \longrightarrow \text{complete neutralisation}$

$$\begin{array}{cc} 1 \text{ g} & 0.768 \\ & \text{v.f} = 1 \end{array}$$

Let n is the no. of ionisable hydrogen in it gm eq. of  $\text{C}_6\text{H}_{10}\text{O}_4 = \text{gm eq. of KOH}$

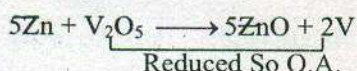
$$\frac{1}{\frac{146}{n}} = \frac{0.768}{\frac{56}{1}} \quad (\text{valancy factor of } \text{C}_6\text{H}_{10}\text{O}_4 = n)$$

$$n = \frac{0.768 \times 146}{56} = 2 \quad \text{Ans}$$

**Q20.**

**Sol:** oxidised  
So R.A

$$\begin{array}{ccc} 0 & +5 & +2 \end{array}$$



$$\text{V.f} = 2 \quad \text{V.f} = 10$$

Wt. in 1 g - equivalent of R.A = Eq. wt of Zn

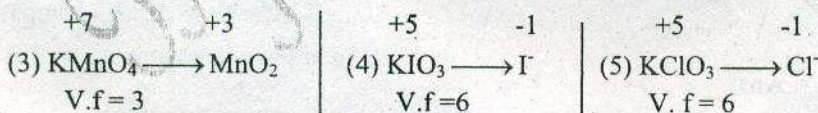
$$= \frac{\text{At wt}}{\text{v.f}} = \frac{65.4}{2} = 32.7 \text{ g}$$

Wt in 1 gm equivalent of O.A = Eq. Wt. of  $\text{V}_2\text{O}_5$

$$= \frac{\text{Mol.wt}}{\text{V.f}} = \frac{102 + 80}{10} = 18.2 \text{ g} \quad \text{Ans}$$

**Q21.**

**Sol:** +7 +6



$$\therefore \text{Eq. wt. in each case} = \frac{\text{Mol.wt of compound}}{\text{valancy factor}}$$

$\therefore$  Calculating for each one-

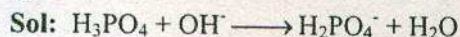
$$\begin{array}{ll} (1) \text{eq. wt} = 31.6 \text{ g} & (2) \text{eq. wt} = 49 \text{ g} \\ (3) \text{eq. wt} = 52.67 \text{ g} & (4) \text{eq. wt} = 35.67 \text{ g} \\ (5) \text{eq. wt} = 52.67 \text{ g} & \end{array}$$

$\therefore \text{KClO}_3, \text{KMnO}_4, \text{KIO}_3, \text{K}_2\text{Cr}_2\text{O}_7, \text{KMnO}_4$

$$(5) < (1) < (4) < (2) < (3)$$

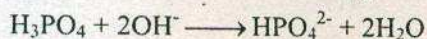


**Q22.**



(v.f = 1)

$$\therefore \text{eq. wt of } \text{H}_3\text{PO}_4 = \frac{\text{Mol. wt of } \text{H}_3\text{PO}_4}{\text{V.f}} = \frac{98}{1} = 98 \text{ g Ans}$$



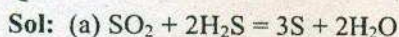
$$\therefore \text{eq. wt of } \text{H}_3\text{PO}_4 = \frac{\text{Mol. wt of } \text{H}_3\text{P}_4}{\text{V.f}} = \frac{98}{2} = 49 \text{ g Ans}$$



(v.f = 3)

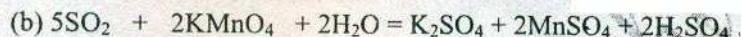
$$\text{eq. wt of } \text{H}_3\text{PO}_4 = \frac{\text{Mol. wt of } \text{H}_3\text{PO}_4}{3} = \frac{98}{3} = 32.67 \text{ Ans}$$

**Q23.**



(v.f = 4)

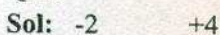
$$\text{Eq. Wt. of } \text{SO}_2 = \frac{\text{Mol. wt of } \text{SO}_2}{4} = \frac{64}{4} = 16 \text{ g Ans}$$



(v.f = 2)

$$\text{eq. wt of } \text{SO}_2 = \frac{\text{Mol. wt of } \text{SO}_2}{2} = \frac{64}{2} = 32 \text{ g Ans}$$

**Q24.**



$$\text{Eq. wt of } \text{H}_2\text{S} = \frac{34}{6}$$

$$\therefore \text{no. of equivalent} = \text{no. of moles} \times \text{v.f}$$

$$= 1 \times 6 = 6 \text{ Ans}$$