

Chapter 4: Atomic Weight

Q1.

Sol: Let W is the atomic weight of Cd.

$$\therefore \text{Mol. Wt of CdCl}_2 = \text{Wt} + 2 \times 35.5 = (W + 71) \text{ g}$$

$\therefore (W + 71) \text{ g of CdCl}_2 \text{ contains W g of Cd}$

$$\therefore 1 \text{ ————— } \frac{W}{W + 71}$$

$$\therefore 1.5276 \text{ ————— } \frac{W}{(W + 71)} \times 1.5276$$

$$\text{A/q, } \frac{W}{(W + 71)} \times 1.5276 = 0.9367$$

$$1.5276 W = 0.9367 (W + 71)$$

$$0.591 W = 0.9367 \times 71$$

$$W = \frac{0.9367 \times 71}{0.591} = 112.4 \text{ g/mole}$$

$\therefore \text{Atomic wt of Cd} = 112.4 \text{ amu / atom or } 112.4 \text{ g/ mole}$

Q2.

Sol: Let W is the atomic weight of X.



Given moles 1 1 1

Weight W 32g (W+32)g

$\therefore W \text{ g of X reacts with } 32 \text{ g of } O_2$

$$\therefore 1 \text{ ————— } \frac{32}{W}$$

$$\therefore \text{A/q, } \frac{32}{W} = 0.696$$

$$W = \frac{32}{0.696} = 46 \text{ g/ mole}$$

$\therefore \text{At wt of X} = 46 \text{ amu/atom} = 46 \text{ g/ mole} \quad \text{Ans}$

Q3.

Sol: $\text{BaBr}_2 + \text{Cl}_2 \longrightarrow \text{BaCl}_2 + \text{Br}_2$

1.5 \longrightarrow 1.05 g

Let w is the atomic wt of Ba,

$$\therefore \text{Mol wt of BaBr}_2 = w + 2 \times 80 = (w + 160) \text{ g}$$

$$\text{Mol wt of BaCl}_2 = (w + 2 \times 35.5) = (w + 71) \text{ g}$$

According to balanced chemical reaction

1 mole of $\text{BaBr}_2 \equiv$ 1 mole of BaCl_2

Mole of $\text{BaBr}_2 =$ mole of BaCl_2

$$\frac{1.5}{w + 160} = \frac{1.05}{w + 71}$$

$$1.5w + 106.5 = 1.05w + 168$$

$$0.45w = 61.5$$

$$w = \frac{61.5}{0.45} = 136.67 \text{ g/mole} \quad \text{Ans}$$

Q4.

Sol: Let % of 1st isotope (B^{10}) is x

\therefore % of 2nd isotope (B^{11}) is $(100 - x)$

$$\therefore \text{Av. Atomic weight} = \frac{x + 10.1 + (100 - x) \times 11.01}{100}$$

$$10.81 = \frac{11.01 \times 100 - 1.01x}{100}$$

$$1081 = 1101 - 1.01x$$

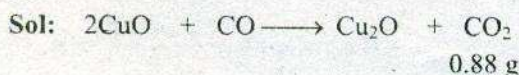
$$1.01x = 1101 - 1081 = 20$$

$$x = 20\%$$

$$\% \text{ of } B^{10} = 20\% \quad \text{Ans}$$

$$\% \text{ of } B^{11} = 80\% \quad \text{Ans}$$

Q5.



Let w is the atomic weight of carbon, then moles of CO_2 produced = $\frac{0.88}{(w + 32)}$

A/q, weight loss of Cu-oxide = 0.3232 g

From the balanced chemical reaction

Moles of CuO reacted = $2 \times$ moles of CO_2

Moles of Cu_2O produced = moles of CO_2

\therefore Wt loss = moles of CuO \times Mol. wt CuO — moles of Cu_2O produced \times mole wt. Cu

$$0.3232 = \frac{2 \times 0.88}{w + 32} \times 79.5 - \frac{0.88}{w + 32} \times 143$$

$$0.3232w + 10.3424 = 139.92 - 125.84$$

$$0.3232w = 14.08 - 10.3424 = 3.7376$$

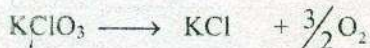
$$w \frac{3.7376}{0.32} = 11.8 \approx 12 \quad \text{Ans}$$

Q6.

Sol: Let the atomic weight of K = X

----- Cl = Y

----- Ag = Z



$$4.008 \text{ g} \quad 2.438 \text{ g}$$

$$\therefore \text{Wt of } \text{O}_2 \text{ produced} = 4.008 - 2.438 = 1.57$$

A/q, Above eqⁿ

$$\text{moles of O}_2 = \frac{3}{2} \times \text{moles of KCl}$$

$$\frac{1.57}{32} = \frac{3}{2} \times \frac{2.438}{x+y}$$

$$\Rightarrow x+y = 74.54 \text{ -----(1)}$$



$$2.438 \text{ g} \qquad \qquad 4.678 \text{ g}$$

moles of KCl = moles of AgCl

$$\frac{2.438}{x+y} = \frac{4.678}{Z+y} \text{ -----(2)}$$

$$\text{Also moles of Ag in AgCl (4.678 g)} = \frac{3.531}{Z}$$

$$\therefore \frac{4.678}{Z+y} = \frac{3.531}{Z} \Rightarrow \frac{4.678}{3.531} Z = Z+y \Rightarrow 1.325 Z - Z = y$$

$$Z = \frac{y}{0.325} \text{ -----(3)}$$

From (2) & (3)

$$\Rightarrow \frac{2.438}{x+y} = \frac{4.678}{\frac{y}{0.325} + y} = \frac{1.52}{1.325y}$$

$$\Rightarrow \frac{2.438 \times 1.325}{1.52} y = x+y$$

$$2.126 y = x+y \text{ -----(4)}$$

$$\text{From (1) \& (4)} \Rightarrow 2.126 y = 74.54 \Rightarrow Y = 35.5$$

$$\therefore x = 74.54 - 35.5 = 39.04$$

$$Z = \frac{35.5}{0.325} = 108.8 \text{ y}$$

At. Wt. of K = 39 g / At. Wt. of Cl = 35.5 g / At. Wt. of Ag = 108.8 Ans

Q7.

Sol:

(I) Vapour density = 14

$$\therefore \text{Mol. wt} = 2 \times \text{V.d} = 28 \text{ g}$$

If W is the at wt of carbon.

$$28 \times 42.8\% = w$$

$$28 \times \frac{42.8}{100} = W$$

Similarly in other case ---

$$\text{(II)} \quad 38 \times 2 \times \frac{15.8}{100} = W \Rightarrow W = 12 \text{ gm}$$

$$\text{(I)} \quad \text{(III)} \quad 14 \times 2 \times \frac{85.7}{100} = 2W \Rightarrow W = 12 \text{ gm}$$

$$\text{(IV)} \quad 22 \times 2 \times \frac{81.4}{100} = 3W \Rightarrow W = 12 \text{ g}$$

$$\text{(V)} \quad 39 \times 2 \times \frac{92.3}{100} = 6W \Rightarrow W = 12 \text{ g}$$

Q8.

Sol: Vapour density of chloride = 74.6

$$\therefore \text{Mol. wt of chloride} = 74.6 \times 2 = 149.2$$

We know that

$$\text{At. wt. X Sp. heat} = 6.4$$

$$\text{At. Wt.} = \frac{6.4}{0.88} = 7.2$$

Note:- [In question, sp. Heat of metal is given 0.55. it should be actually 0.88]

Now if the formula of metal chloride is MCl_x

$$\text{Then } 7.2 + x \times 35.5 = 149.2$$

$$x \times 35.5 = 149.2 - 7.2 = 142$$

$$x = \frac{142}{35.5} = 4$$

$$\therefore \text{Molecular formula of chloride} = \text{MCl}_4$$

Q9.

Sol: We have,

$$\text{At. Wt. of metal} \times \text{sp. heat} = 6.4$$

$$\text{At. wt. of metal} = \frac{6.4}{\text{sp.heat}} = 112$$

Let the metal chloride is MCl_x



$$0.22\text{g.} \quad 0.51\text{g}$$

moles of AgNO_3 required = x moles of MCl_x

$$\frac{0.51}{108 + 14 + 16 \times 3} = \frac{0.22x}{112 + 35.5x}$$

$$\Rightarrow 0.0136 (112 + 35.5x) = x$$

$$\Rightarrow 1.527 + 0.484x = x \Rightarrow 1.527 = 0.5159x$$

$$\Rightarrow x = \frac{1.527}{0.5159} = 2.96 = 3.$$

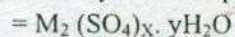
$$\therefore \text{Molecular formula} = \text{MCl}_x = \text{MCl}_3$$

Q10.

Ans: At wt of metal \times Sp. Heat = 6.4

$$\text{At. wt. of metal} \frac{6.4}{\text{sp.heat}} = \frac{6.4}{3.242} = 26.45\text{g}$$

Let the molecular formula of hydrated sulphate



$$\text{Then \% of metal} = \frac{52.9}{52.0 + 96x + 18y} \times 100 = 8.1$$

$$96x + 18y = 600 \quad -(1)$$

$$\% \text{ of sulphate} = \frac{96x}{92.9 + 96x + 18y} \times 100 = 43.2$$

$$\frac{96x}{52.9 + 600} \times 100 = 43.2 \quad [\text{from (1)}]$$

$$96x = \frac{43.2 \times 652.9}{100}$$

$$X = 3$$

$$\therefore \text{From (1)} \quad 96 \times 3 + 18y = 600 \Rightarrow y = \frac{318}{18} = 17.8 = 18$$

Integral value is taken for x & y

\therefore Molecular formula = $M_2(SO_4)_3 \cdot 18 H_2O$. **Ans**

Q11.

Ans: Let the at wt of Sn(tin) = W

Also valancy of Sn = 4

\therefore Molecular formula of stannic chloride = $SnCl_4$

\therefore Mol. wt = $W + 4 \times 35.5 = (W + 142)g$

$$A/q, \frac{142}{W + 142} \times 100 = 54.6$$

$$W + 142 = 260$$

$$W = 118 \text{ g; } \mathbf{Ans}$$

Q12.

Ans: Sp. heat of Metal = 0.055

At. Wt. x sp. heat = 6.4

$$\text{At. Wt.} = \frac{6.2}{0.055} = 116.36 \text{ g}$$

(Is diffⁿ from the answer because it is an approximate way ☺ The exact way is written below)

For 1st chloride

If the molecular formula is MCl_x

Then wt of Cl in compound = $35.5x$

$$\frac{35.5x}{149.2} \times 100 = 23.6$$

$$X = 1$$

Molecular formula = MCl .

Also Mol. Wt. of chloride = $W + 35.5 \times 1 = 149$

$$W = 149.2 - 35.5 = 113.8 \text{ g } \mathbf{Ans}$$

Similarly for 2nd chloride

Mol. wt = $2 \times 92.9 = 185.8 \text{ g}$

If the molecular formula is MCl_x

$$\frac{35.5x}{185.5} \times 100 = 38.2$$

$$X = 2$$

∴ Molecular formula = MCl_2

∴ $W + 71 = 185.8 \Rightarrow M = 114.8 \text{ g}$ Ans (M is the at wt of Metal)

Similarly for 3rd chloride

Mol. wt = $2 \times 110.6 = 221.2 \text{ g}$

If the Mole formula is Mds

$$\frac{35.5x}{221.2} \times 100 = 47.3 \Rightarrow x = \frac{106.8}{35.5} = 3$$

∴ Molecular formula = MCl_3

$W + 35.5 \times 3 = 221.2$

$W + 106.5 = 221.2 \Rightarrow W = 114.7 \text{ g}$ Ans

Q13.

Sol: % of sulphur in Cu_2S = 20.14%

$$\frac{x}{127+x} \times 100 = 20.14 \text{ (At.wt. of s = x (say))}$$

$$\Rightarrow 100x = 2557.78 + 20.14x$$

$$x = \frac{2557.78}{79.86} = 32$$

% of sulphur in Ag_2S = 12.94%

Let the at. wt. of Ag = w

$$\frac{32}{2w+32} \times 100 = 12.94 \Rightarrow \frac{1600}{w+16} = 12.94$$

$$1600 = 12.94w + 12.94 \times 16$$

$$12.94W = 1600 - 12.94 \times 16 = 1392.96$$

$$W = \frac{1392.96}{12.94} = 107.7 \approx 108 \text{ g}$$

Ans

Q14.

Sol: Let the at. wt. of Ti is W.

Since it is isomorphous with SnO_2

∴ So Molecular formula = TiO_2

A/q, % of oxygen = 39.95%

$$\frac{16 \times 2}{w+16 \times 2} \times 100 = 39.95$$

$$3200 = 39.95w + 1278.4 \Rightarrow 39.95w = 1921.6$$

$$w = \frac{1921.6}{39.95} = 48.1 \text{ g}$$

Ans

Q15.



6.2984 g

8.438 g

From the reaction

moles of Na_2CO_3 = moles of Na_2SO_4

$$\Rightarrow \frac{6.2984}{46+12+16 \times 3} = \frac{8.438}{46+x+16 \times 4} \quad (\text{where, } x = \text{At wt of S})$$

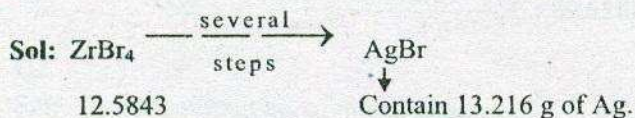
$$\frac{6.2984}{106} = \frac{8.438}{110 + x}$$

$$\Rightarrow 110 + x = \frac{8.438}{6.2984} \times 106 = 142$$

$$\Rightarrow x = 142 - 110 = 32 \text{ g}$$

\therefore At wt of S = 32 g Ans

Q16.



$$\therefore \text{Mol wt of AgBr} = 188 \text{ g}$$

Wt of silver present in 1889 of AgBr = 108 g

\therefore 108g of Ag present in 1889 g.

$$\therefore 1 - \frac{188}{108}$$

$$\therefore 13.216 \times \frac{188}{108} \times 13.216 = 23 \text{ g}$$

By POAC

$$\text{Mole of Br in ZrBr}_4 = \text{mole of Br in AgBr}$$

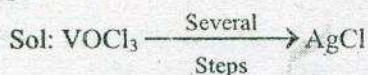
$4 \times$ moles of ZrBr

$$4 \times \frac{12.5843}{w + 320} = \frac{23}{188}$$

$$W + 320 = \frac{4 \times 12.5843}{0.1223} = 411.5$$

$$W = 411.5 - 320 = 91.45 \text{ g} \quad \text{Ans}$$

Q 17:



2.8934 g 7.1801 g

By POAC

$$\text{Moles of Cl in } \text{VOCl}_3 = \text{mole of Cl in AgCl}$$

$$3 \times \text{moles of } \text{VOCl}_3 = \text{moles of AgCl}$$

$$\frac{3 \times 2.8934}{w + 16 + 35.5 \times 3} = \frac{7.1801}{108 + 35.5}$$

$$\frac{8.6802}{W+122.5} = \frac{7.1801}{143.5}$$

$$W + 122.5 = 173.48 \Rightarrow W = 50.96 \text{ g Ans}$$