Q1 (a) $1\,u = \dfrac{\text{mass of 1 atom C-12 (in grams)}}{12}$

mass 1 atom C-12 $= \left(\dfrac{12.00}{N_A}\right) g$ ($\because N_A$ = Avogadro no $= 6.022 \times 10^{23}\ mol^{-1}$)

$\therefore 1\,u = \dfrac{\left(\frac{12.00}{N_A}\right)}{12} g$

$= \left(\dfrac{12.00}{N_A} \times \dfrac{1}{12}\right) g$

$\therefore 1\,u = \left(\dfrac{1}{N_A}\right) g$

$1\,u = 1.66 \times 10^{-24} g$ (Ans)

Mass of 1 atom Li-7 $= \left(7.01600 \times \dfrac{1}{N_A}\right) g$

$\therefore$ Mass of 1 mol Li-7 $= \left(7.01600 \times \dfrac{1}{N_A} \times N_A\right) g$

$= 7.01600\ g$

Q1 (b) Using $PV = nRT$ @ $PV = \dfrac{m}{M_r} \cdot RT$

$\therefore M_r = \dfrac{mRT}{PV} = \dfrac{(2.96g)(0.082\ L\,atm\,K^{-1}mol^{-1})(680K)}{(1.0\ L)(462/760\ atm)}$

$= 271.51\ g\,mol^{-1}$

If the formula of the compound is MCl_x

$200.6 + x(35.453) = 271.51$

$x = 2.0$

$\therefore$ Molecular formula = MCl_2 (Ans)

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Q1 (6) – continued

$$n_M : n_{Cl}$$

$$\left(\frac{0.1892}{200.6}\right) : \left(\frac{0.0668}{35.453}\right)$$

$$9.43 \times 10^{-4} : 1.884 \times 10^{-3}$$

$$1 : \frac{1.884 \times 10^{-3}}{9.43 \times 10^{-4}}$$

$$1 : 2$$

Empirical formula : MCl_2 (Ans)

Q1 (c) Assume 1 mole Fe_7S_8 contains x mole FeS and y mole Fe_2S_3

x mole $FeS \longrightarrow x$ mol $Fe^{2+} + x$ mol S^{2-}

y mole $Fe_2S_3 \longrightarrow 2y$ mol $Fe^{3+} + 3y$ mol S^{2-}

Comparing : $x + 2y = 7$ ----(i)

$x + 3y = 8$ ----(ii)

Solving for x & y : $y = 1$; $x = 5$

∴ 5 mole of FeS and 1 mole of Fe_2S_3

which contains 5 mols of Fe^{2+} and 2 mols of Fe^{3+}

$n_{Fe^{2+}} : n_{Fe^{3+}} = 5 : 2$ (Ans)

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Sem 1: 2003/2004 : Q1c

Alternative method:

Sem 1 (2003/2004) : stoichiometry

Q1 (c) Assume x atom of Fe^{2+}

$\therefore$ No. of Fe^{3+} atom in $Fe_7S_8 = (7-x)$ $\Big\}$ $(Fe^{2+})_x (Fe^{3+})_{7-x} S_8$

$\therefore x(+2) + (7-x)(+3) + 8(-2) = 0$

$x = 5$

no. of Fe^{3+} ions $= 7-5 = 2$

no. of Fe^{2+} ions $= 5$

$\therefore \dfrac{n_{Fe^{2+}}}{n_{Fe^{3+}}} = \dfrac{5}{2}$

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