QUESTION 8:

A solution contains Cu2+ and C2O42- ions which on titration with 1 M KMnO4 consumes 10 ml of the oxidizing agent for complete oxidation in acidic medium. The resulting solution is neutralized with Na2CO3, acidified with dilute CH3COOH and is treated with excess of KI. The liberated iodine requires 25 ml of 1 M of hypo solution, then what will be the molar ratio of Cu2+ to C2O42- ions in the solution?

Answer: (option 2) 1:2

$1st$ case : Only $C_2O_4^{2-}$ ions are oxidised by $KMnO_4$ solution.

Normality of $KMnO_4$ solution $= 0.02 \times 5 = 0.1\ N$

$22.6\ mL$ of $0.1\ N\ KMnO_4 = 22.6\ mL$ of $0.1\ N\ C_2O_4^{2-}$ soln.

Mass of $C_2O_4^{2-} ions$ in the solution $= \dfrac{N \times E \times V}{1000} = \dfrac{N \times M \times V}{1000 \times 2}$

No, of moles of $C_2O_4^{2-}$ ions in the solution $= \dfrac{N \times M \times V}{1000 \times 2 \times M}$

$= \dfrac{N \times V}{2000}$

$= \dfrac{0.1 \times 22.6}{2000}$

$= 11.3 \times 10^{-4}$

$2nd$ case : Only Cu^{2+} ions are reduced by KI and iodine liberated in neutralised by $Na_2S_2O_3$ solution.

$11.3\ mL$ of $0.05\ M\ Na_2S_2O_3 \equiv 11.3\ mL$ of $0.05\ N\ Na_2S_2O_3$

$= 11.3\ mL$ of $0.05\ N\ I_2$

$= 11.3\ mL$ of $0.05\ N\ Cu^{2+}$

Mass of Cu^{2+} ions in the solution $= \dfrac{N \times E \times V}{1000} = \dfrac{N \times M \times V}{1000}$

No, of moles of Cu^2 ions in the solution $= \dfrac{N \times M \times V}{1000 \times M}$

$= \dfrac{N \times V}{1000}$

$= \dfrac{0.05 \times 11.3}{1000}$

$= 5.65 \times 10^{-4}$

Molar ratio of $\dfrac{Cu^{2+}}{C_2O_4^{2-}} = \dfrac{5.65 \times 10^{-4}}{11.3 \times 10^{-4}} = \dfrac{1}{2}.$