Question #72910, Chemistry / Other / Completed

A 3.7122 g sample of an unknown salt containing ferrous ion was dissolved and diluted to 250.0 mL. Repeat 25.00 mL samples of the total solution were titrated with 0.01860 M KMnO4 solution, and the mean of three accepted corrected titration volumes was 19.00 mL. Calculate the %w/w of iron in the original sample mass.

State your answer to 2 places after the decimal place. Do not enter units.

Solution

$$\mathbf{C}_a = \frac{\mathbf{C}_t \mathbf{V}_t \mathbf{M}}{\mathbf{V}_a}$$

where Ca is the concentration of the analyte, typically in molarity; Ct is the concentration of the titrant, typically in molarity; Vt is the volume of the titrant used, typically in liters; M is the mole ratio of the analyte and reactant from the balanced chemical equation; and Va is the volume of the analyte used, typically in liters.

$$\mathbf{MnO_4^- + 8H^+ + 5Fe^{2+} \longrightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O}$$

The quantity of Fe^{2+} ions are 5 times more than that of $KMnO_4$ by the reaction. So M = 5

The concentration of Fe^{2+}:

$C_a = C_tV_tM / V_a = 0.01860\ M \cdot 19.00\ mL \cdot 5 / 25\ mL = 0.07068\ M$

$n\ (Fe^{2+}) = 0.07068\ M \cdot 0.250\ L = 0.01767\ mol$ – in 250 mL of the solution

$m\ (Fe^{2+}) = n \cdot M = 0.01767\ mol \cdot 55.85\ g/mol = 0.9868695\ g$

$\%w/w\ (Fe^{2+}) = 0.9868695\ g \cdot 100\% / 3.7122\ g = 26.58\ \%$

Answer: 26.58.