

Solutions

Original marking guidance: M1 method, A1 accuracy, B1 explanation.

2.1 Fe^{2+} : green; Fe^{3+} : red-brown. Fe^{2+} hydroxide oxidises and turns brown in air.

2.2 Zinc gives a white precipitate, dissolving to a colourless solution in excess. Copper gives pale blue precipitate, dissolving to deep blue solution in excess.

2.3 $\text{Zn}(\text{OH})_2(\text{s}) + 2\text{OH}^- \rightarrow [\text{Zn}(\text{OH})_4]^{2-}$. Correct species, coefficients/charge.

3.1 $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 2\text{NH}_3 \rightarrow \text{Cu}(\text{H}_2\text{O})_4(\text{OH})_2 + 2\text{NH}_4^+$. NH_3 accepts protons, acting as a base.

3.2 $[\text{Co}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^- \rightleftharpoons [\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O}$. Water favours pink aqueous complex through dilution of chloride/reversal of exchange.

3.3 $2\text{CrO}_4^{2-} + 2\text{H}^+ \rightleftharpoons \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$. Cr stays +6. V(V) yellow, V(IV) blue, V(III) green, V(II) violet.