| Question | Marking Guidance | Mark | Comments |
|---|---|---|---|
| 8(a) | | | For reactions 1 to 3 must show complex ions as reactants and products<br>Take care to look for possible identification on flow chart |
| | **Reaction 1** | | |
| | ammonia solution | 1 | |
| | **W** is $[Co(NH_3)_6]^{2+}$ | 1 | |
| | $[Co(H_2O)_6]^{2+} + 6NH_3 \rightarrow [Co(NH_3)_6]^{2+} + 6H_2O$ | 1 | Correct equation scores all 3 marks |
| | **Reaction 2** | | Allow oxygen, Do not allow air |
| | $H_2O_2$ | 1 | |
| | **X** is $[Co(NH_3)_6]^{3+}$ | 1 | |
| | $2[Co(NH_3)_6]^{2+} + H_2O_2 \rightarrow 2[Co(NH_3)_6]^{3+} + 2OH^-$ | 1 | Allow $2[Co(NH_3)_6]^{2+} + {}^1/_2O_2 + H_2O \rightarrow 2[Co(NH_3)_6]^{3+} + 2OH^-$<br>Correct equations score all 3 marks |
| | **Reaction 3** | | |
| | HCl | 1 | Do not allow $Cl^-$ but mark on |
| | **Y** is $[CoCl_4]^{2-}$ | 1 | |
| | $[Co(H_2O)_6]^{2+} + 4Cl^- \rightarrow [CoCl_4]^{2-} + 6H_2O$/ | 1 | Correct equation scores previous mark |
| | $[Co(H_2O)_6]^{2+} + 4HCl \rightarrow [CoCl_4]^{2-} + 6H_2O + 4H^+$ | | This equation scores all three marks |

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|---|---|---|---|
| | **Reaction 4**<br>$Na_2CO_3$ Or $NaOH/NH_3$<br>**Z** is $CoCO_3$ $Co(OH)_2/Co(H_2O)_4(OH)_2$<br>$[Co(H_2O)_6]^{2+} + CO_3^{2-} \rightarrow CoCO_3 + 6H_2O$ $[Co(H_2O)_6]^{2+}+2OH^- \rightarrow Co(H_2O)_4(OH)_2+2H_2O$ etc<br>Or $[Co(H_2O)_6]^{2+} + Na_2CO_3 \rightarrow CoCO_3 + 6H_2O + 2Na^+$ | 1<br>1<br>1 | Do not allow $CaCO_3$ as a reagent but mark on<br>Allow waters to stay co-ordinated to Co. This mark also previous mark<br>Allow $Co^{2+} + CO_3^{2-} \rightarrow CoCO_3$ |
| 8(b) | $SO_3^{2-} + {}^1/_2O_2 \rightarrow SO_4^{2-}$<br>The activation energy is lower (for the catalysed route)<br>${}^1/_2O_2 + 2Co^{2+} + 2H^+ \rightarrow H_2O + 2Co^{3+}$<br>$2Co^{3+} + SO_3^{2-} + H_2O \rightarrow 2Co^{2+} + SO_4^{2-} + 2H^+$ | 1<br>1<br>1<br>1 | Allow multiples<br>Or $Co^{3+}$ attracts $SO_3^{2-}$/$Co^{2+}$ attracts $SO_3^{2-}$ /oppositely charged ions attract<br>Allow these equations in either order |