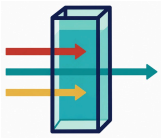
# Transition Metal Reactions Map

Edexcel A Level Chemistry · Topic 15 Colour, Redox and Reactions of Ions

## 1 Why ions are coloured

15A.7–15A.9

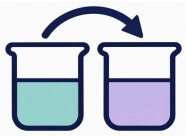
- Ligands **split** the 3d orbitals
- An electron absorbs light: ΔE
- We see the **complementary** colour
- $3d^0$ and $3d^{10}$: colourless



## 2 Changing the colour

15A.10

- Oxidation number: $Fe^{2+} \rightarrow Fe^{3+}$
- Ligand: $H_2O \rightarrow NH_3$
- Coordination number: 6 → 4
- Each changes the **size of ΔE**

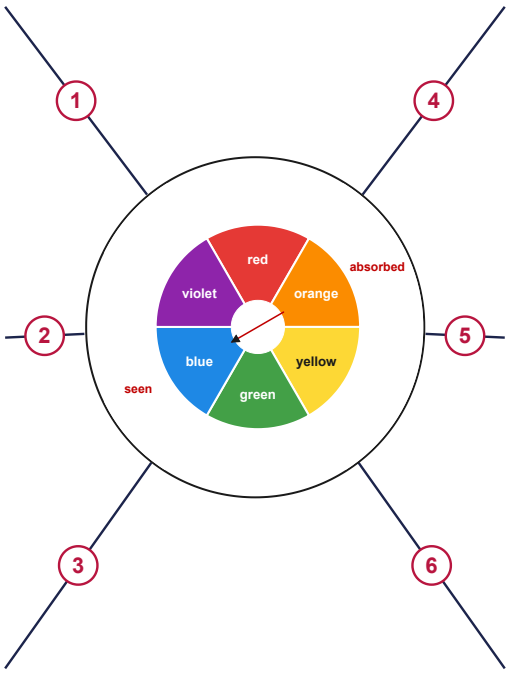


## 3 Vanadium

15B.20, 15B.21

- +5 yellow, +4 blue
- +3 green, +2 violet
- Zinc in acid reaches $V^{2+}$
- Tin stops at $V^{3+}$






## 4 Chromium

15B.22, 15B.23

- $Cr_2O_7^{2-}$ orange; $Cr^{3+}$ green
- Zinc: on to **blue $Cr^{2+}$**
- $H_2O_2$ + alkali: yellow $CrO_4^{2-}$
- Acid: orange again (not redox)



## 5 Hydroxide precipitates

15B.24, 15B.25

- $OH^-$ and $NH_3$ remove $H^+$
- Neutral complex: a **precipitate**
- $Fe(OH)_2$, $Co(OH)_2$ darken in air
- $Cr(OH)_3$: **amphoteric**



## 6 Excess ammonia; CP12

15B.26, 15B.27, CP12

- $NH_3$ replaces $H_2O$: **exchange**
- Cu: deep blue ammine complex
- Cr and Co also dissolve
- CP12: crystals of the ammine



## Metal ions with aqueous hydroxide and ammonia

precipitate, then in excess

| Ion | Precipitate | Excess $OH^-$ | Excess $NH_3$ |
|---|---|---|---|
| $Cr^{3+}$ | green | dark green solution | violet solution |
| $Fe^{2+}$ | dirty green | stays | stays |
| $Fe^{3+}$ | orange-brown | stays | stays |
| $Co^{2+}$ | blue | stays | pale brown solution |
| $Cu^{2+}$ | pale blue | stays | deep blue solution |

## Worked examples

### Absorbing light

- $[Cu(H_2O)_6]^{2+}$ absorbs orange
- Complement: blue
- **Looks blue**

### Feasibility

- $Zn + 2V^{3+} \rightarrow Zn^{2+} + 2V^{2+}$
- −0.26 − (−0.76)
- **+0.50 V: feasible**

### Deprotonation

- $[Fe(H_2O)_6]^{3+} + 3OH^-$
- $\rightarrow [Fe(OH)_3(H_2O)_3]$
- **+ $3H_2O$**

Half-cell values come from Topic 14; ligand exchange with chloride and the chelate effect come next.

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