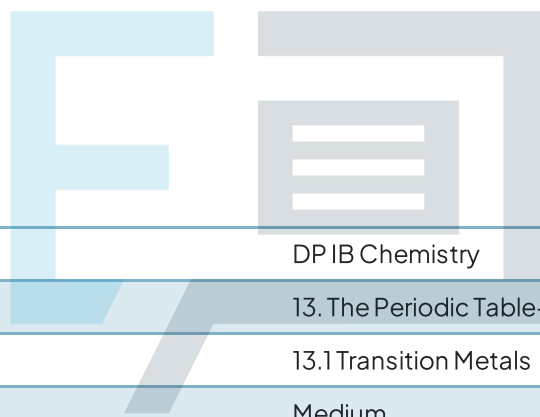




# 13.1 Transition Metals

## Mark Schemes



Course	DP IB Chemistry
Section	13. The Periodic Table- Transition Metals (HL only)
Topic	13.1 Transition Metals
Difficulty	Medium

# Exam Papers Practice

To be used by all students preparing for DP IB Chemistry HL  
Students of other boards may also find this useful

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The correct answer is **D** because:

- The charge on Fe in complex I can be found as follows:
  - $\text{Fe} + (6 \times \text{H}_2\text{O}) = +3$
  - $\text{Fe} + (6 \times 0) = +3$
  - $\text{Fe} = +3$
- The charge on Fe in complex II can be found as follows:
  - $\text{Fe} + (5 \times \text{H}_2\text{O}) + \text{CN} = +2$
  - $\text{Fe} + (5 \times 0) + (-1) = +2$
  - $\text{Fe} - 1 = +2$
  - $\text{Fe} = +3$
- The charge on Fe in complex III can be found as follows:
  - $\text{Fe} + (6 \times \text{CN}) = -3$
  - $\text{Fe} + (6 \times -1) = -3$
  - $\text{Fe} - 6 = -3$
  - $\text{Fe} = +3$

**A, B & C** are incorrect as

All three complexes contain iron with an oxidation state of +3

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The correct answer is **A** because:

- Zn is not a transition metal so does not form coloured compounds

**B, C & D** are incorrect as

the metals in these compounds are transition metals so will form coloured compounds



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The correct answer is **B** because:

- The spectrochemical series arranges ligands in order of increasing energy separation between the two sets of d orbitals

<b>A</b> is incorrect as	the spectrochemical series does not arrange ligands in terms of separation between the p and d orbitals
<b>C</b> is incorrect as	$\text{Cl}^-$ will absorb longer wavelengths of light than $\text{NH}_3$ (corresponding to the red end of the spectrum). However the colour of a complex depends on the wavelengths of light transmitted. These are the complementary colours to those absorbed so $\text{Cl}^-$ is more likely to appear blue.
<b>D</b> is incorrect as	colour depends on the central transition metal ion present as well as the ligand in the complex

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The correct answer is **C** because:

- The copper(II) will form a hexaaqua complex in solution with water as ligands
- As ammonia is a stronger ligand it will displace some of the water ligands in the hexaaqua complex



<b>A</b> is incorrect as	the d orbitals in the copper ion are already split as it has formed a complex ion with water ligands
<b>B</b> is incorrect as	there would be a greater splitting of the d-orbitals as ammonia is higher in the spectrochemical series than water
<b>D</b> is incorrect as	the colour would not fade but changes shade as ammonia ligands absorb slightly different wavelengths of light compared to water

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The correct answer is **B** because:

- Cobalt accepts lone pairs from the ligands hence acting as a Lewis acid
- The complex is octahedral having 90 degree bond angles
- cobalt has an oxidation number of +3:
  - $\text{Co} + (\text{NH}_3 \times 5) + \text{Cl}^- = +2$
  - $\text{Co} + (0 \times 5) + (-1) = +2$
  - $\text{Co} - 1 = +2$
  - $\text{Co} = +3$
  - Hence, statement II is incorrect

<b>A, C &amp; D</b> are incorrect as	these include statement II
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