13.1 Transition Metals

Question Paper

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

Time allowed: 40

Score: /29

Percentage: /100

Question 1a

a)
Transition metals can form complex ions where ligands are coordinately bonded to the central metal ion.

i) Define the term *ligand.*

[1]

ii) State what is meant by the term *bidentate ligand*

[1]

[2 marks]

Question 1b

b)
Transition metals are located in the d-block of the periodic table.

i)
State the electron configuration of V^{2+}.

[1]

ii)
Explain why scandium is not considered a transition metal.

[1]

[2 marks]

Question 1c

c)
State the oxidation state of Fe in $[Fe(CN)_6]^{4-}$.

[1]

[1 mark]

Question 1d

d)
Iron and zinc are in the d-block of the Periodic Table. Iron(II) ions, $[Fe(H_2O)_6]^{2+}$, form a pale green solution but zinc ions, $[Zn(H_2O)_6]^{2+}$, form a colourless solution.

i)
Write the electron configuration of Zn^{2+}.

[1]

ii)
Explain why zinc ions are colourless.

[2]

[3 marks]

Question 2a

a)
A complex ion contains one Fe^{3+} ion, four ammonia molecules and two chloride ions.

State the formula of this complex ion.

[1]

[1 mark]

Question 2b

b)
State **two** characteristic properties of transition elements.

[2]

[2 marks]

Question 2c

c)
Transition metals can be used as successful catalysts in a range of reactions.

State what is meant by the term *homogeneous* catalyst.

[1]

[1 mark]

Question 2d

d)
Transition metals can form complexes with different ligands.

Identify **one** species from the following list that does not act as a ligand and explain your answer.

CO H_2O SCN^- H_2

[2]

[2 marks]

Question 3a

a)
Using section 16 of the data booklet, state the formula of a bidentate ligand.

[1]

[1 mark]

Question 3b

b)
State three factors that affect the value of the splitting energy, ΔE, in the d-orbitals.

[3]

[3 marks]

Question 3c

c)
Outline why transition metals form coloured compounds.

[5]

[5 marks]

Question 3d

d)
Using section 15 of the data booklet, explain why adding ammonia to aqueous copper(II) ions results in a darker blue complex.

[2]

[2 marks]

Question 4a

a)
Deduce the oxidation state of vanadium in the compound NH_4VO_3.

[1]

[1 mark]

Question 4b

b)
Transition elements can be used to catalyse certain reactions.
Define the term *heterogeneous* in relation to catalysts.

[1]

[1 mark]

Question 4c

c)
Outline the difference between diamagnetic and paramagnetic elements in terms of electron arrangement.

[1]

[1 mark]

Question 4d

d)
Describe the splitting of the d orbitals in an octahedral crystal field.

[1]

[1 mark]