

## HL Questions on First row d-block elements

- The first row d-block elements comprise of scandium (electron configuration  $[\text{Ar}]4s^23d^1$ ) through to zinc (electron configuration  $[\text{Ar}]4s^23d^{10}$ ). Explain why zinc is not considered to be a transition element.
- Explain why all first row transition elements show an oxidation state of +2 whereas only copper has compounds with an oxidation state of +1 and +2.
- Explain why carbon monoxide, CO, is a good ligand, whereas methane cannot function as a ligand.
- The following statement is from the 'Applications and skills' section of the syllabus: "Explain the ability of transition metals to form variable oxidation states by considering successive ionization energies."
  - Examine this statement by comparing the first six ionization energies of aluminium and vanadium.

**First six successive ionization energies of aluminium and vanadium (in  $\text{kJ mol}^{-1}$ )**

Element	1 <sup>st</sup> IE	2 <sup>nd</sup> IE	3 <sup>rd</sup> IE	4 <sup>th</sup> IE	5 <sup>th</sup> IE	6 <sup>th</sup> IE
Al	578	1820	2740	11600	14800	18400
V	651	1370	2870	4600	6280	12400

- Examine whether the statement is still valid for manganese which has the common oxidation states of +2, +3, +4, +6 and +7.

**First eight successive ionization energies of manganese (in  $\text{kJ mol}^{-1}$ )**

1 <sup>st</sup> IE	2 <sup>nd</sup> IE	3 <sup>rd</sup> IE	4 <sup>th</sup> IE	5 <sup>th</sup> IE	6 <sup>th</sup> IE	7 <sup>th</sup> IE	8 <sup>th</sup> IE
717	1510	3250	5190	7360	9750	11500	18800

- Explain why copper(I) and scandium(III) complex ions are diamagnetic whereas many of the complex ions of most transition metals are paramagnetic.
- Give the formula of the complex ion formed between:
  - iron(III) ions and six cyanide ions.
  - copper(II) ions and four chloride ions.
  - cobalt(III) ions and three 1,2-ethanediamine bidentate ligands.
  - iron(III) and one thiocyanate ion and five water molecules.