OCR (B) Chemistry A-Level

DM4 - Inorganic Chemistry and the Periodic Table

Flashcards

What are transition metals?

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Transition metals are d-block elements that can form one or more stable ions which have an incomplete d-subshell.

What are the electronic configurations of chromium and copper?

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The electronic configurations of chromium and copper are exceptions to the rule of filling up subshells:

- Chromium: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 \mathbf{4s^1}$
- Copper: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} \mathbf{4s^1}$

What are the common oxidation states of copper and iron?

What are the common oxidation states of copper and iron?

- Copper normally has an oxidation state of one (Cu^{+}) or two (Cu^{2+}).
- Iron normally has an oxidation state of two (Fe^{2+}) or three (Fe^{3+}).

What are the colours of these ions (if any)?

What are the colours of solutions of these ions (if any)?

- Cu^{+} = colourless
- Cu^{2+} = blue
- Fe^{2+} = green
- Fe^{3+} = yellow / brown

Why do transition metals have variable oxidation states?

Why do transition metals have variable oxidation states?

The *d* subshell has a lot of stable states so different numbers of electrons can be lost to produce ions that are all stable.

What is a ligand?

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A ligand is an electron donor that forms a dative covalent/coordinate bond with a central metal ion/atom.

What is a complex ion?

What is a complex ion?

A central metal ion bonded via coordinate bonds to electron donors (ligands) that are either negatively charged or possess a lone pair of electrons.

What is a monodentate, bidentate and polydentate ligand?

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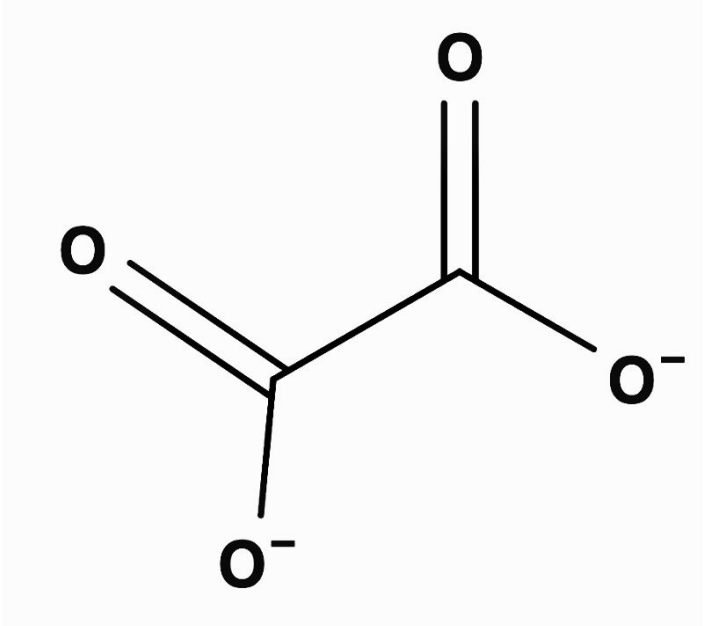
- Monodentate: Ligand forms 1 coordinate bond to the central metal ion, donating 1 electron pair.
- Bidentate: Ligand forms 2 coordinate bonds to the central metal ion, donating 2 electron pairs.
- Polydentate: Ligand forms many coordinate bonds to the central metal ion, donating many electron pairs.

What is an example of a bidentate ligand?

What is an example of a bidentate ligand?

- Ethanedioate:
- Each O^- has a lone pair of electrons which can be used to form a coordinate bond with the central metal ion.



What is ligand substitution?

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A ligand substitution reaction is where one ligand in a complex ion is replaced by another ligand.

What are some examples of complex ions of iron and copper?

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Iron: $[Fe(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{3+}$

Copper: $[Cu(H_2O)_6]^{2+}$, $[Cu(Cl)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$

What is a precipitation reaction?

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When two ionic aqueous solutions react together to form an insoluble ionic solid, this is known as a precipitate.

How does iron (II) and iron (III) react with NaOH in a precipitation reaction?

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$$Fe^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Fe(OH)_{2(s)}$$

Green solution

Green precipitate

$$Fe^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Fe(OH)_{3(s)}$$

Yellow solution

Orange/brown precipitate

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Blue precipitate

How does iron (II) and iron (III) react with NH_3 in a precipitation reaction?

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$$Fe^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Fe(OH)_{2(s)}$$

Green solution

Green precipitate

$$Fe^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Fe(OH)_{3(s)}$$

Yellow solution

Orange/brown precipitate

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$$Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Cu(OH)_{2(s)}$$

Blue solution

Blue precipitate

This precipitate dissolves in excess $NH_{3(aq)}$ to form:

$$[Cu(NH_3)_4(H_2O)_2]^{2+}$$

Dark blue solution

Why do transition metals make good homogeneous catalysts?

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- Since transition metals have various oxidation states, they make good homogeneous catalysts.
- This is because they are able to oxidise and reduce reactants and intermediates to form the desired product(s).

Why do transition metals make good heterogeneous catalysts?

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Using the 3d and 4s electrons of the atoms on the catalyst surface, transition metals can form weak bonds with reactants which makes them more reactive.

Why are transition metal complexes often coloured?

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- When light is incident on an object, some is absorbed.
- It will only be absorbed if its energy equals the difference in energies between two energy levels of the atom.
- If it does, an electron becomes excited and is raised to a higher energy level.
- The difference in energy between the two energy levels is often equivalent to the wavelengths/frequencies of the visible region of the electromagnetic spectrum.
- Therefore transition metal complexes often appear coloured.