Transition element:

An element in the that forms an with an .

The transition elements have the following properties:

Are .

Good .

Have melting and boiling points.

The transition elements have the following properties:

Form compounds in more than .

Form compounds.

Act as either the or a of the element.

Form a variety of .

Electronic structure

Elements	Electronic configuration	Oxidation states of its ions
Sc	[Ar] $3d^1$ $4s^2$	+3
Ti	[Ar] $3d^2$ $4s^2$	+1, +2, +3, +4
V	[Ar] $3d^3$ $4s^2$	+1, +2, +3, +4, +5
Cr	[Ar] $3d^5$ $4s^1$	+1, +2, +3, +4, +5, +6
Mn	[Ar] $3d^5$ $4s^2$	+1, +2, +3, +4, +5, +6, +7
Fe	[Ar] $3d^6$ $4s^2$	+1, +2, +3, +4, +5, +6
Co	[Ar] $3d^7$ $4s^2$	+1, +2, +3, +4, +5
Ni	[Ar] $3d^8$ $4s^2$	+1, +2, +3, +4
Cu	[Ar] $3d^9$ $4s^1$	+1, +2, +3
Zn	[Ar] $3d^{10}$ $4s^2$	+2

Why can most transition elements form variable oxidation states?

They easily lose their electrons to form . They have similar size and consequent . This means the ions are in a variety of oxidation states.

Why are Zn and Sc not considered transition elements?

Transition elements as a catalyst

As . They can use their to other species onto the metal's surface. This the bond of the adsorbed species. This the activation energy hence the rate of a reaction. The products from the surface of the metal.

Four examples are:

in the Haber process.

in catalytic converters of car exhausts.

in the hydrogenation of alkenes.

in the decomposition of hydrogen peroxide.

Transition metals can also act as . The catalyst ion usually oxidation state during the reaction and is converted back to it's original at the end of a reaction.

An example is the use of in the contact process.

Coloured compounds:

Transition metal ions themselves are ! But they do form coloured . An example is when a transition metal ion is attached to molecules e.g. with vanadium

Colour changes arise because of ,
of the . The reason why they are coloured is complicated and not required for OCR, however it is to do with an being (given more energy) and promoted to a higher energy . The energy that is not by the , is seen as light.

Transition metals and complex ions:

Complex ion: An ion in which a number of or are bound to a by .

Or a surrounded by .

Ligand: A or that has at least of that bonds to a through a .

Co-ordinate bond: A formed between the and the central metal ion. When both come from the same atom.

Co-ordination number: The number of attached to the central metal ion.

Shapes of complexes:

Co-ordination number	Name of shape	Bond angle	Example

ligands such as and often form .

ligands such as often form and .

Monodentante: Form only co-ordinate bond with the central metal ion e.g.

Bidentante: Form co-ordinate bond with the central metal ion e.g.

Multidentate/polydentate: Form or co-ordinate bonds with the central metal ion e.g.

Stereoisomerism in transition metal ion complexes:

Transition metal ion complexes can exhibit and .

Cis/trans (E/Z)

In structures:

If the bond angle of is then the or isomer forms.

If the bond angle of is then the or isomer forms.

Cis-platin:

Cis-platin is a drug. Only the version of the structure will work as the ions are displaced and the molecule bonds with . This stops the replication of cancerous cells.

In structures:

If the bond angle of is then the or isomer forms.

If the bond angle of is then the or isomer forms.

Optical isomerism:

complexes can form optical isomers. They can only occur with ligands e.g.

Ligand Substitution

Ligands that are attached to a transition metal ion can often be for another ligand, this is known as . This usually occurs because the substituting ligand has a to the metal than the original ligand.

Reaction with ammonia:

and ligands are in size therefore the number does not .

Reaction with chloride ions:

Using a high such as in conc. or saturated . Because ligands are larger, there is usually a change in number from to .

Colours of hexaaquaion transition metal ion solutions

Aqueous transition metal ion solution	Colour
$[Cr(H_2O)_6]^{3+}$	
$[Ni(H_2O)_6]^{2+}$	
$[Fe(H_2O)_6]^{2+}$	
$[Fe(H_2O)_6]^{3+}$	
$[Co(H_2O)_6]^{2+}$	
$[Cu(H_2O)_6]^{2+}$	

Haemoglobin and oxygen transportation:

Haemoglobin (a complex containing) transports around the blood. This is done by the oxygen to the haemoglobin through a bond. The oxygen replaces a ligand. can form a co-ordinate bond than the bond. This means the will bond rather than oxygen. Meaning cannot be transported through the blood.

Precipitation reactions:

occur when ions are added to . The hydroxide ions can be added by either adding or to the solution.

Why can we use $NH_{3(aq)}$?

The reactions that occur are as follows:

Table for ions that can be tested:

Ion	Reaction	Colour of precipitate

Adding aqueous ammonia to aqueous copper ions:

Two observations will be seen

1. The ppt will be observed.

2. When ammonia is added to this solution. The will dissolve and form a solution

A similar reaction with occurs: