Exchange and Catalysis Map

AQA A-level Chemistry · 3.2.5 Exchange, vanadium and catalysis

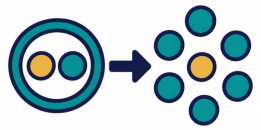
1 Ligand exchange 3.2.5.2

- NH_3 for H_2O: CN stays 6
- Incomplete: $[Cu(NH_3)_4(H_2O)_2]^{2+}$
- Cl^- for H_2O: CN falls to 4
- Co, Cu and Fe^{3+} chloro complexes



2 The chelate effect 3.2.5.2

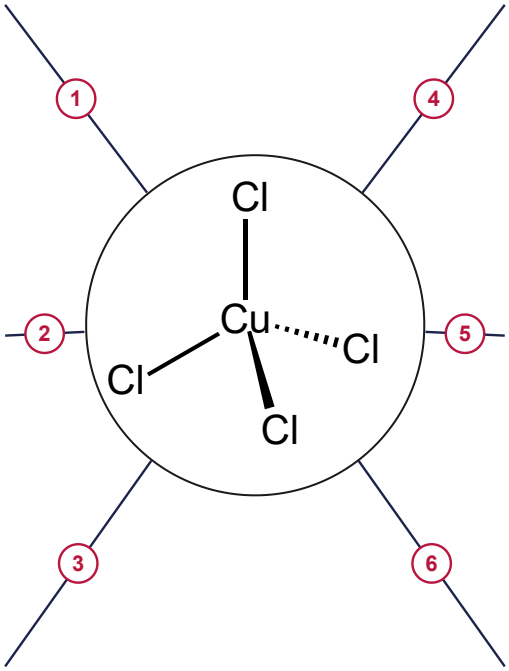
- Multidentate replaces monodentate
- **More particles**: ΔS positive
- ΔH close to zero
- **ΔG negative**



3 Vanadium 3.2.5.5

- +5 yellow, +4 blue
- +3 green, +2 violet
- Zinc in acid: down to V^{2+}
- Air re-oxidises V^{2+}





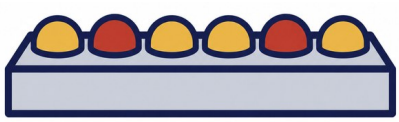
4 pH, ligands, Tollens' reagent 3.2.5.5

- Redox potential depends on pH
- It depends on the ligand too
- $[Ag(NH_3)_2]^+$ reduced to silver
- Aldehyde: **silver mirror**



5 Heterogeneous catalysts 3.2.5.6

- A **different phase**; active sites
- Support: more area, less cost
- V_2O_5 in the Contact process
- Poisons **block active sites**



6 Homogeneous catalysts 3.2.5.6

- Same phase; an intermediate
- Fe^{2+} with $S_2O_8^{2-}$ and I^-
- Mn^{2+} with MnO_4^- and $C_2O_4^{2-}$
- Autocatalysis: an S-shaped curve



Ligand exchange equations with colour changes

From	Reagent	To	Colour change
$[Cu(H_2O)_6]^{2+}$	excess NH_3	$[Cu(NH_3)_4(H_2O)_2]^{2+}$	blue to deep blue
$[Cu(H_2O)_6]^{2+}$	conc HCl	$[CuCl_4]^{2-}$	blue to yellow
$[Co(H_2O)_6]^{2+}$	conc HCl	$[CoCl_4]^{2-}$	pink to blue
$[Fe(H_2O)_6]^{3+}$	conc HCl	$[FeCl_4]^-$	to yellow
$[Co(H_2O)_6]^{2+}$	excess NH_3	$[Co(NH_3)_6]^{2+}$	pink to pale brown
$[Cu(H_2O)_6]^{2+}$	$EDTA^{4-}$	$[Cu(EDTA)]^{2-}$	blue to deeper blue

Worked examples

Chelate effect

- $[Cu(H_2O)_6]^{2+} + EDTA^{4-}$
- 2 particles → 7 particles
- **ΔS positive, ΔG negative**

V_2O_5 steps

- $SO_2 + V_2O_5 \rightarrow SO_3 + V_2O_4$
- $V_2O_4 + ½O_2 \rightarrow V_2O_5$
- **V_2O_5 regenerated**

Fe^{2+} catalyst

- $S_2O_8^{2-} + 2Fe^{2+} \rightarrow 2SO_4^{2-} + 2Fe^{3+}$
- $2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$
- **Fe^{2+} regenerated**

Redox titrations with manganate(VII) are on their own map (3.2.5.5).

Online Learning System · onlinelearningsystem.net · © 2026 Online Learning System. All rights reserved. Not for redistribution.