Complexes and Colour Map

AQA A-level Chemistry · 3.2.5 Complexes and colour

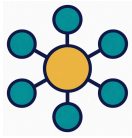
1 Transition metals 3.2.5.1

- Ti–Cu: an **incomplete d sub-level**
- Complexes and coloured ions
- Variable oxidation states
- Catalytic activity



2 Ligands 3.2.5.1, 3.2.5.2

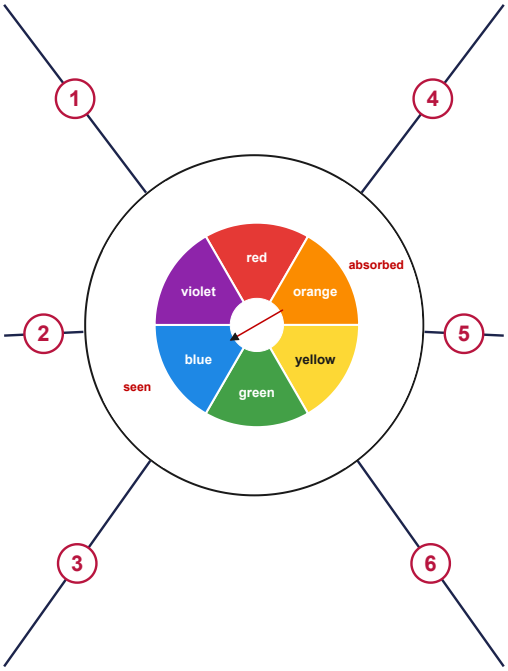
- Ligand: **donates an electron pair**
- Forms a **co-ordinate bond**
- Co-ordination number: those bonds
- H_2O, NH_3, Cl^-: monodentate



3 Multidentate; haem 3.2.5.2

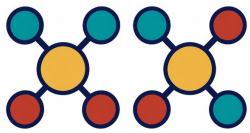
- $H_2NCH_2CH_2NH_2$, $C_2O_4^{2-}$: bidentate
- $EDTA^{4-}$: **multidentate**
- Haem: iron(II); O_2 binds
- **CO replaces O_2**: toxic





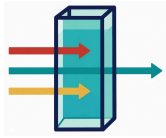
4 Isomers 3.2.5.3

- Square planar, octahedral: **cis-trans**
- Cis 90°; trans 180°
- Three bidentate ligands: **optical**
- Cisplatin: the cis isomer



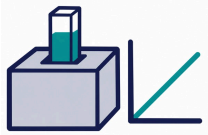
5 Colour 3.2.5.4

- d electrons: ground to excited state
- **$\Delta E = h\nu = hc/\lambda$**
- Remaining light transmitted
- Oxidation state, CN, ligand change ΔE



6 Colorimetry 3.2.5.4

- Filter: the colour absorbed
- Measure **standard solutions**
- Calibration graph: A against c
- Read off the unknown



Shapes of complexes

co-ordination number (CN), shape, angle

Example	CN	Shape	Angle
$[Cu(H_2O)_6]^{2+}$	6	Octahedral	90°
$[CoCl_4]^{2-}$	4	Tetrahedral (large Cl^-)	109.5°
$[Pt(NH_3)_2Cl_2]$	4	Square planar	90°
$[Ag(NH_3)_2]^+$	2	Linear	180°

Worked examples

Configuration

- Fe [Ar] $3d^6\ 4s^2$
- Lose 4s, then 3d
- **Fe^{3+} [Ar] $3d^5$**

$\Delta E = hc/\lambda$

- $\lambda = 5.10 \times 10^{-7}$ m
- $6.63 \times 10^{-34} \times 3.00 \times 10^{8} \div \lambda$
- **3.90×10^{-19} J**

Colorimetry

- Gradient 7.5; A = 0.36
- $c = 0.36 \div 7.5$
- **0.048 mol dm^{-3}**

Ligand exchange, vanadium and catalysis follow in the next section; aqua ions in 3.2.6.

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