

Solutions

Each answer shows the steps, then the **result**.

2.1

- geometrical (cis/trans) isomerism

2.2

- it has two non-superimposable mirror images (e.g. an octahedral complex with bidentate ligands)

3.1 B

- $[\text{Ni}(\text{en})_3]^{2+}$ (octahedral with three bidentate ligands) shows optical isomerism

3.2 B

- In the trans form the dipoles cancel, so it is non-polar

3.3

(a)

- cis — the two NH_3 (and two Cl) adjacent; trans — the two NH_3 (and two Cl) opposite

(b)

- it is octahedral with three bidentate (en) ligands, giving two non-superimposable mirror images (enantiomers)

3.4

- the cis form is polar; its two Pt–Cl dipoles are on the same side and do not cancel, while in the trans form they are opposite and cancel

3.5

(a)

- Square planar with Pt at the centre; **cis** has the two Cl on adjacent corners, **trans** has them opposite

(b)

- The **cis** isomer is polar: its two Pt–Cl bond dipoles point to the same side and add, whereas in the trans isomer they point in exactly opposite directions and cancel, so the molecule has no overall dipole

(c)

- Two: in the *cis* form the two chloride ligands occupy adjacent (90°) positions, in the *trans* form they are opposite (180°)

(d)

- The three bidentate ligands wrap round the metal in a propeller arrangement, so the complex has no plane of symmetry; it is therefore **chiral** and exists as two non-superimposable mirror images (optical isomers / enantiomers). They rotate the plane of plane-polarised light by equal amounts in **opposite** directions, which a polarimeter detects; in every other physical and chemical property they are identical