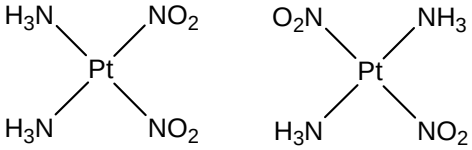
CH1012 Tutorial 4 Answers

1. Draw structures of the following complexes and identify those that may exist as geometric isomers:

- $[Pt(NH_3)_2(NO_2)_2]$



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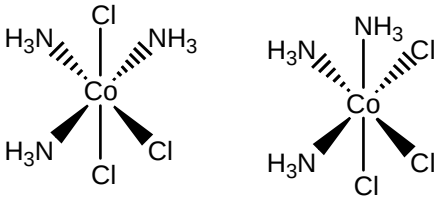
- $[Co(NH_3)_3Cl_3]$



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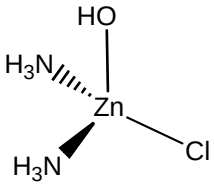
- $[Zn(NH_3)_2(OH)Cl]$



2. Ti(III) compounds are coloured, while Ti(IV) compounds are colourless. Why?

Ti(III) there is the possibility of d transitions
Ti(IV) the electrons in the 3p orbitals are much lower in energy than the 4s and 3d orbitals

3. What is the **crystal field splitting energy**?

The **crystal field splitting energy** Δ results from the increase in the energies of the dz^2 and dx^2-y^2 orbitals of the 5 x d orbitals as ligands approach the isolated metal ion (where all 5 orbital are of the same energy). The triply degenerate set of orbitals (dxy, dxz and dyz) at lower energy is called the t_{2g} set and the doubly degenerate set (dz^2 and dx^2-y^2) e_g . The energy separating the t_{2g} and e_g sets is called the crystal splitting energy Δ.

e_g --

Δ

t_{2g} ---

4. Assign the oxidation state of nitrogen in the following molecules:

NO_2^-	HNO_3	N_2O
+III	+V	+I

5. Determine if the following reactions are redox or metathesis reactions, explain your decision. For redox reaction(s) identify the oxidised and reduced species.

(i) $2HCl(aq) + Ca(OH)_2(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$ - metathesis

(ii) $CaCl_2(l) \rightarrow \underset{\textbf{reduced}}{Ca(s)} + \underset{\textbf{oxidised}}{Cl_2(g)}$ - redox

6. Balance the equation for the following redox reaction in **acidic solution**.
Your method for balancing the equation should be clearly presented.

$$MnO_4^-(aq) + ClO_3^-(aq) \rightarrow Mn^{2+}(aq) + ClO_4^-(g)$$

$$2[MnO_4^-(aq) + 8H^+ + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O$$
$$5[H_2O + ClO_3^-(aq) \rightarrow 2H^+ + ClO_4^-(aq) + 2e^-$$

$$\mathbf{2\,MnO_4^-(aq) + 6H^+(aq) + 5ClO_3^-(aq) \rightarrow 2\,Mn^{2+}(aq) + 5ClO_4^-(aq) + 3H_2O(l)}$$