

Questions from the 2004 final exam

1. Compare and contrast the chemistry of the lanthanides with that of the actinides.

[15 marks]

2. (a) Metal-ligand multiple bonding is a feature of the heavy metals. Give examples of the types of ligand and the characteristics of the metals involved.

(b) Why are the oxo ligands *cis* in the molybdenum complex $\text{MoO}_2(\text{Ph}_3\text{PO})_2\text{Cl}_2$ but *trans* for the uranium complex $\text{UO}_2(\text{Ph}_3\text{PO})_2\text{Cl}_2$? Explain why the U-O bond lengths are about the same length as the Mo-O bond lengths.

[15 marks]

3. Use the following statements to help you illustrate the different types of electronic transition encountered in complexes of the heavy metals.

- (i) Rh^{III} complexes tend to have a characteristic rose color.
- (ii) Solutions prepared by treatment of MoO_3 with reducing agents result in an intense blue color that serves as a quantitative test for Mo.
- (iii) $[\text{Ru}(\text{bipy})_3]^{2+}$ complexes are intensely colored (bipy = 2,2'-bipyridyl).
- (iv) Complexes of actinides are generally more strongly colored than those of lanthanides.
- (v) $[\text{Re}_2\text{Cl}_8]^{2-}$ is royal blue and $[\text{Mo}_2\text{Cl}_8]^{4-}$ an intense red.

[20 marks]

5. The heavier transition metals of groups 3-6 have very different chemistry to that of groups 9-11 despite a similar range of oxidation states. Explain why, and give illustrative examples.

[20 marks]