HL Questions on First row d-block elements

1. The first row d-block elements comprise of scandium (electron configuration [Ar]$4s^2 3d^1$) through to zinc (electron configuration[Ar]$4s^2 3d^{10}$). Explain why scandium and zinc are not considered to be transition elements.

2. Explain why all first row transition elements show an oxidation state of +2 whereas only copper has compounds with an oxidation number of +1 and +2.

3. Suggest why compounds of copper(I) and compounds of scandium(III) are colourless whilst compounds of copper(II) and iron(III) are coloured.

4. The hexahydrated iron(III) ion, $[Fe(H_2O)_6]^{3+}$, is yellowish brown in colour. Explain (i) why it is coloured and (ii) why it has a different colour to the iron(III) hexacyanide ion, $[Fe(CN)_6]^{3-}$.

5. Explain why carbon monoxide, CO, is a good ligand, whereas methane cannot function as a ligand.

6. State the name of the catalyst most widely used for each of the following processes:
   (a) the decomposition of hydrogen peroxide.
   (b) the Haber process for the production of ammonia.
   (c) the conversion of automobile exhaust gases to gases less harmful to the environment.
   (d) the Contact process for the production of sulfuric acid.