1) a) $K_2[CoCl_4]$
   b) $[Ru(NH_3)_6(H_2O)]^{3+}$
   c) $[Co(NH_3)_2Cl(en)]I_2$
   d) $[Pt(NH_3)_4I_2][PtI_4]$

2) a) **Hexaaquacobalt(III) iodide**
   b) **Potassium hexacyanoferrate(II)** (a much less pretty name than its old one: Potassium ferrocyanide)
   c) **Triamminetrinitritocobalt(III)**
   d) **Tetraammineplatinum(II) tetrachlorocuprate(II)**

3) a) Here, trying the different structures helps figure out the kind of ligands we have. For example, the NO$_2^-$ ligand can be either nitrite (NO$_2^-$) or nitrogen dioxide (NO$_2$). When one does this, one finds, given that ammine is a neutral ligand, it must be NO$_2$ (nitrogen dioxide), so we get the Pt as +2. Pt$^{2+}$ has an electron configuration: 5d$^8$. For a square-planar complex, there would be no unpaired electrons, so we must have a **tetrahedral complex**, which we do. We have $(d_{x^2-y^2})^2(d_{xy})^2(d_{xz})^1(d_{yz})^1$ as the occupancy for the complex.
   
   b) It is pretty clear that we have Mn$^{2+}$ here, which has an electron configuration of d$^5$, Only **tetrahedral** would allow for this number of unpaired electrons from a d$^5$ complex. We have $(d_{x^2-y^2})^1(d_{xy})^1(d_{xz})^1(d_{yz})^1$ as the occupancy for the complex.
   
   c) It is pretty clear here that Ni must be +2 here, Ni$^{2+}$ has an electron configuration of d$^8$. Square planar would have no unpaired electrons, so we must have **tetrahedral** as our geometry. We have $(d_{x^2-y^2})^2(d_{xy})^2(d_{xz})^1(d_{yz})^1$ as the occupancy for the complex.
   
   d) Gold here must be +3. Au$^{3+}$ has an electron configuration of d$^8$. Since tetrahedral has more than zero unpaired electrons, and we have none, we must have **square planar** here. We have $(d_{xz})^2(d_{yz})^2(d_{xy})^2(d_{x^2-y^2})^0$ as the occupancy for the complex.

4) If we had a regular planar geometry, it would be a hexagonal geometry, which could look like any of the following:

Since, as you can see, there are three isomers possible, the existence of only two isomers does **rule out** hexagonal planar geometry.
5) Looking at the Ag(NH$_3$)$_2^+$ ion, we find that Ag$^+$ is d$^{10}$, whereas Cu$^{2+}$ is d$^9$. The silver complex is therefore expected to be colourless since there are no orbitals to which the d-electrons can be excited. (Another way to say this, spectroscopically, is that there are no allowed transitions.)