Sample Exam Questions

1. Short Snappers (2 points each):

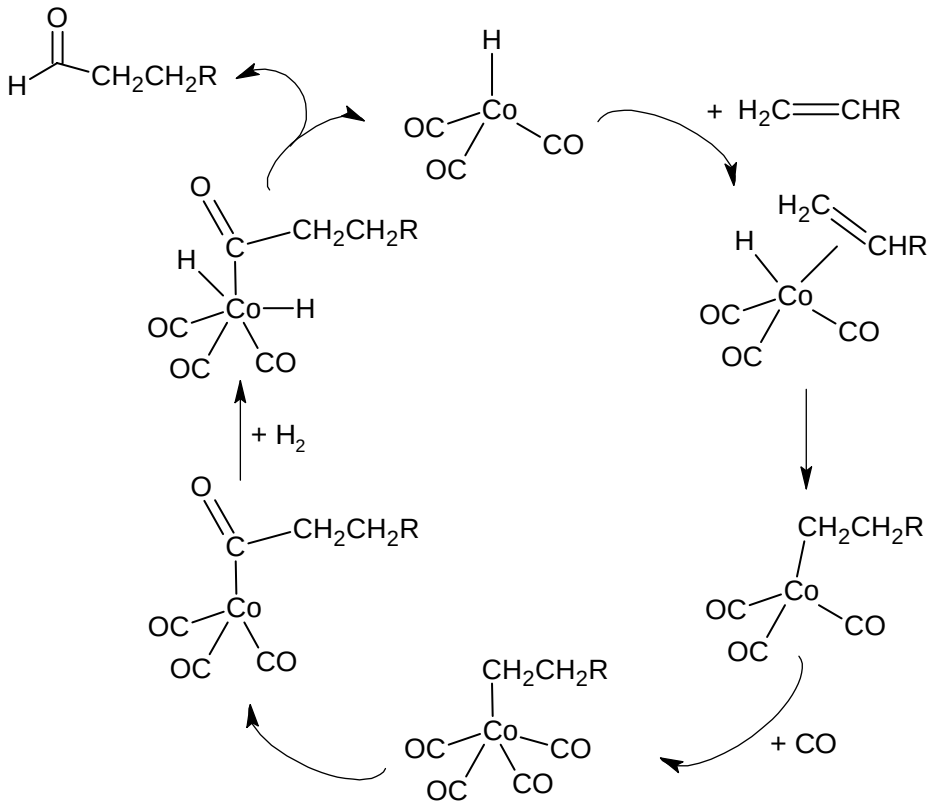
   a) Is the following electron transfer reaction inner sphere or outer sphere:
   $CoF(NH_3)_5^{2+} + Cr(H_2O)_6^{2+} \dashrightarrow Co(H_2O)(NH_3)_5^{2+} + CrF(H_2O)_5^{2+}$

   b) How many isomers are there in the species $Fe(CO)_3Cl_2$ trigonal bipyramidal? Draw them.

   c) Name the ground state for an f^{12} atomic configuration

   g) Calculate the magnetic moment of $Co(en)_3^{2+}$, which is a low spin species (en = ethylenediamine, $H_2NCH_2CH_2NH_2$).

2. Identify each step in the following catalytic cycle as one of oxidative addition, reductive elimination, migratory insertion, association (coordination) or dissociation (decoordination) (6 points).



3. Explain the bonding of carbon monoxide (CO) to a metal in an organometallic complex, including back-bonding. (6 points)

4. If B = 700 cm^{-1} and Δ_o is 15 000 cm^{-1}, sketch the spectrum of $V(H_2O)_3Cl_2$ in the 350-700 nm range. (4 points) (NOTE: you should be able to do this question roughly, but without using B you will not be able to calculate the exact energies of the transitions)

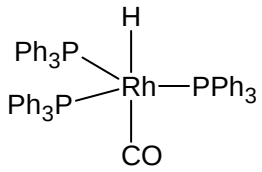
5. Explain the following (6 points):

   a) The chelate effect
   b) Cone angle

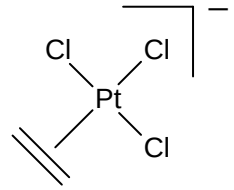
6. Explain one of the following (6 points):
   The mechanism for an inner sphere electron transfer reaction.

7. Give the electron count at the metal ($18e^-$ rule) for each compound. If it does not obey the $18e^-$ rule, *briefly* explain why (1 sentence should be sufficent) (15 points).

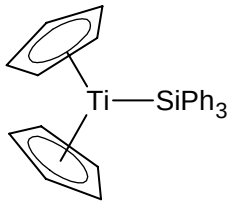
a)



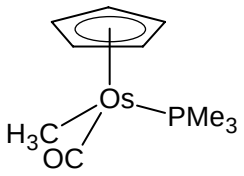
b)



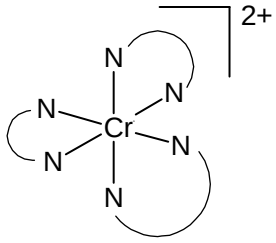
c)



d)



e)



8. Devise a synthesis for *cis*- and *trans*- $PtCl_2(NH_3)(PPh_3)$ using only $PtCl_4^{2-}$, PPh_3, and NH_3. The order of the *trans* effect of these ligands is $NH_3 < Cl^- < PPh_3$ (6 points).