

**CHM102A**  
**Problem Set 3**

**1. What is the role of protein chain (globin) in dioxygen transport proteins like hemoglobin or myoglobin?**

**2. Which of the following statement(s) are TRUE for Hemoglobin (Hb) and/or myoglobin (Mb).**

- (i) Hemoglobin is tetramer of myoglobin.
- (ii) Proximal histidine makes a hydrogen bond with dioxygen at the active site of oxymyoglobin.
- (iii) Iron atom move away from heme plane upon oxygenation in Mb.
- (iv) Binding affinity of free heme group to CO is much higher compare to the binding affinity of CO to heme present in Mb.
- (v) Mb is having lower binding affinity than Hb at low partial pressure of O<sub>2</sub> (pO<sub>2</sub>)

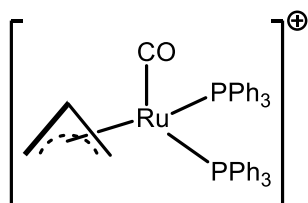
**3. Draw the crystal field splitting diagram for deoxy-myoglobin and oxy-myoglobin with proper labelling and filling up of the electrons.**

**4. Do the electron count around central metal ion for the following compounds:**

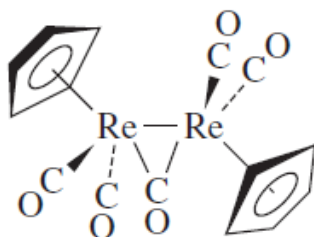
(a) Co<sub>2</sub>(CO)<sub>8</sub>

(b) [HMn(CO)<sub>3</sub>(PPh<sub>3</sub>)<sub>2</sub>]

(c)



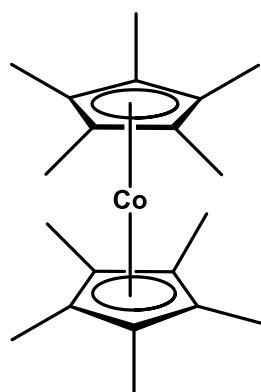
(d)



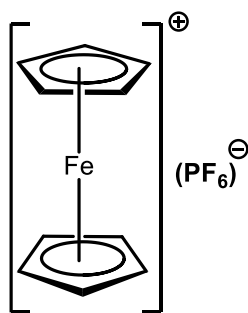
**5. Identify the first-row transition metal for the following 18-electron species:**

- (a) [M(CO)<sub>3</sub>(PPh<sub>3</sub>)<sub>3</sub>]<sup>-</sup>      (b) HMn(CO)<sub>5</sub>      (c) (η<sup>4</sup>-C<sub>8</sub>H<sub>8</sub>)M(CO)<sub>3</sub>      (d) [(η<sup>5</sup>-C<sub>5</sub>H<sub>5</sub>)M(CO)<sub>3</sub>]<sub>2</sub> (assume single M-M bond)      (e) (η<sup>5</sup>-C<sub>5</sub>H<sub>5</sub>)M(C<sub>2</sub>H<sub>4</sub>)<sub>2</sub>

6. Which of the following species will act as strong oxidizing or reducing agent?



Decamethylcobaltocene



Ferrocenium hexafluorophosphate

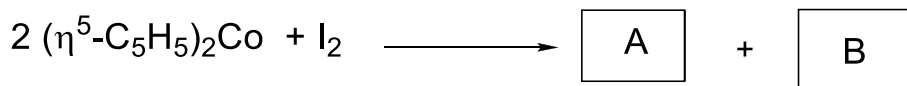
7. Why does CO bind a metal through its less electronegative carbon atom than its more electronegative oxygen? What makes it a good  $\pi$  acceptor ligand?

**(THIS PROBLEM IS NOT FOR ANY FINAL TEST/QUIZ)**

8. The CO stretching frequency of the following species is listed below. Provide a convincing explanation.

Compound	$\nu_{\text{CO}}$ ( $\text{cm}^{-1}$ )
free CO	2143
$[\text{Mn}(\text{CO})_6]^+$	2090
$\text{Cr}(\text{CO})_6$	2000
$[\text{V}(\text{CO})_6]^-$	1860
$[\text{Ti}(\text{CO})_6]^{2-}$	1750

9. Identify A and B in the following reaction with proper justification.



10. A metal complex having the empirical formula  $\text{FeC}_9\text{H}_7\text{O}_3\text{Cl}$ , has one ligand as a substituted cyclopentadienyl group. It is an ionic compound and has poor solubility in hydrocarbon solvents. The compound gives a white precipitate on treatment with  $\text{AgNO}_3$  solution. Assuming that it obeys the 18 electron rule, suggest its structure.