CHEM. 342 (Dr. Aquino) **TEST #2** **MARCH 23, 2012**

Answer all questions in the booklets provided. A periodic table is attached. You have 50 min.

{15} Question 1

Draw the structure(s) of the **final** product(s) of the following reactions. (3 marks each).

a) $2\ CH_3MgCl + HgCl_2 \xrightarrow{\text{hexane}}$

b) $[Pt(CO)Br_3]^- + NH_3 \longrightarrow$

c) $(\eta^6\text{-bromobenzene})Mo(CO)_3 + KOH \longrightarrow$

d) $Mn(CO)_5^- + CH_2{=}CHCH_2Cl \longrightarrow \mathbf{A} \xrightarrow{\Delta} \mathbf{B}$ (1 mark for **A**, 2 marks for **B**)

e) $TiCl_4 + 2\ Tl(C_5H_5) \longrightarrow$

{11} Question 2

a) On the basis of the 18-electron rule, identify the first-row transition metal (M) for the following (2 marks each):

i) $M(CO)_2(CS)(PPh_3)Br$ ii) $[(\eta^4\text{-}C_4H_4)(\eta^5\text{-}C_5H_5)M]^+$

b) Determine the metal-metal bond-order consistent with the 18-electron rule for the following (2 marks each):

i) $[(\eta^5\text{-}C_5H_5)Fe(CO)_2]_2$ ii) $[(\eta^5\text{-}C_5H_5)Mo(CO)_2]_2^{2-}$

c) On the basis of the 18-electron rule, determine the expected charge (z) on the following (3 marks):

i) $[(\eta^5\text{-}C_5H_5)_3Ni_3(\mu_3\text{-}CO)_2]^z$

{9} Question 3

a) Of the compounds $Cr(CO)_5(PF_3)$ and $Cr(CO)_5(PCl_3)$, which would you expect to have:

i) the shorter C-O bonds? Explain (2 marks)
ii) the higher energy Cr-C stretching bands in the infrared? Explain (2 marks)

b) Explain why $Mo(PMe_3)_5H_2$ is a dihydride (contains two separate H ligands), but $Mo(CO)_3(PMe_3)_2(H_2)$ contains the dihydrogen ligand. (Me = methyl) (3 marks)

c) The compound $W(O)Cl_2(CO)(PPh_3)_2$ has ν(CO) at 2006 cm^{-1}. Would you predict the ν(CO) in $W(S)Cl_2(CO)(PPh_3)_2$ to be at higher or lower energy? Explain. (2 marks)

{5} Question 4

Reaction of nickel carbonyl, $Ni(CO)_4$, with cyclopentadiene results in a oxidation/reduction process that yields a red diamagnetic compound with the formula $NiC_{10}H_{12}$. The ^1H NMR spectrum of this compound shows four different types of hydrogens; integration of the hydrogen peaks gives relative areas of 5:4:2:1, with the most intense peak in the aromatic region. Suggest a structure for $NiC_{10}H_{12}$ and show that it is consistent with the NMR.