CHEM. 342 (Dr. Aquino) **TEST #2** **MARCH 22, 2011**

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

[9] Question 1

Draw the most probable structure and give the valence electron count for the metal for each of the following species. **(Show your work!)**

a) $[Nb(CO)_5H]^{2-}$

b) $Hf(CO)_2(\eta^2\text{-}Me_2PCH_2CH_2PMe_2)_2I_2$ (yes Hf is 8-coordinate)

c) $(\eta^7\text{-}C_7H_7)Tc(\eta^2\text{-}MeC{\equiv}CMe)(CH_3)(Cl)$

[15] Question 2

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

a) $2\ H_2C{=}CHCH_3 + 2\ PtBr_2 \longrightarrow$

b) $Co_2(CO)_8 + HC{\equiv}CH \xrightarrow{\Delta}$

c) ferrocene + acetic anhydride $\xrightarrow{H_3PO_4}$

d) $2\ CH_3Li + ZnCl_2 \xrightarrow{\text{hexane}}$

e) $[(\eta^5\text{-}Cp)Ru(CO)_2]^- + C_6H_5C({=}O)Cl \longrightarrow$

[12] 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) The complex $(CO)_5CrN{\equiv}NCr(CO)_5$ has a longer N—N bond than $(CO)_5CrN{\equiv}N$ which in turn has a longer N—N bond than N_2. Explain thoroughly. (3 marks)

c) 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)

d) Explain why ν(CO) for $MnCp(CO)_3$ are at 2023 and 1939 cm^{-1} and those for $MnCp^*(CO)_3$ are at 2017 and 1928 cm^{-1}. ($Cp^* = C_5(Me)_5$) (2 marks)

[4] Question 4

Photolysis at -78°C of $[(\eta^5\text{-}C_5H_5)Fe(CO)_2]_2$ results in the loss of a colourless gas and the formation of an iron-containing product having a single carbonyl band at 1785 cm^{-1} and containing 14.7% oxygen by mass. Draw a plausible structure for the product. (4 marks)