CHEM 4571 – *Organometallic Chemistry* Name _____

EXAM # 1 – Feb 15, 2007 Signature _____

Please answer all questions!

Check this box if you want your graded test put out in the public boxes outside Prof. Stanley's office: ☐

1. (60 pts) Sketch out the structure of the following transition metal complexes as accurately as possible and clearly show the electron counting (including the oxidation state of the metal center and ligand charges if present). You don't have to draw out phenyl rings on ligands (e.g., for PPh_3).

a) $[Co(CH_3)_3Cl_3]^{3-}$

b) $CpW(NO)(CO)(PR_3)$

c) $[Rh_2(\mu\text{-dppm})_2(\mu\text{-Cl})(N{\equiv}CMe)_2]^+$ (dppm = $Ph_2PCH_2PPh_2$)

d) $Cp_2Ta(CCH_3)$

e) Cp_2Co

f) $[AuCl_2Ph_2]^-$ (Ph = C_6H_5)

g) $V(NCH_3)Cl_3(dppe)$ (dppe = $Ph_2PCH_2CH_2PPh_2$)

h) $Ir_2(\mu\text{-}OMe)_2(H_2C{=}CH_2)_4$

i) $Cp_2Zr(NMe_2)(\eta^1\text{-}CH_2CH{=}CH_2)$

j) $[CpW(PR)(CO)_3)]^+$

k) $[Cr_2(CH_3)_8]^{4-}$

l) $V(CO)_6$

2. (30 pts) For each of the following pairs of complexes, which will have the ***highest*** average CO infrared stretching frequency? Circle your choice and briefly explain your reasoning.

a) $Ni(CO)_4$ - or - $[V(CO)_6]^-$

b) $CpNb(CR)Cl(CO)$ - or - $CpV(CH_3)_2(CO)$

c) $Cr(CO)_3(PMe_3)_3$ - or - $MnCl(CO)_5$

d) $Cp_2Zr(CO)_2$ - or - $[RhCl_2(CO)_2[P(OMe)_3]_2]^+$

e) $[Rh(CO)_4]^+$ - or - $[Ir(CH_3)_2(CO)_2(PMe_3)_2]^+$

f) $Mo(dmpe)_2(CO)_2$ - or - $W(dmpe)(CO)_4$ (dmpe = $Me_2PCH_2CH_2PMe_2$)

3. (20 pts) Consider the isocyanide (C≡NR, sometimes called isonitrile) and nitrile (N≡CR) ligands that are isomers of one another.

a) (10 pts) Sketch out a Lewis dot diagram for each showing the location of the lone pair(s) and any formal charges based on organic valence conventions.

b) (5 pts) Which ligand is the better σ-donor? Why?

c) (5 pts) Which ligand is the better π-acceptor? Why?

4. (40 pts) Sketch out a neutral 18-electron structure showing the geometry about the metal center as accurately as you can at this point in the course for the following metals and ligands. Use ***at least one metal and each type of ligand shown***. Try to keep your structure as simple as possible (bimetallic complexes are OK, nothing higher). Clearly show your electron counting. Ligands are shown *without charges*, please indicate the proper ligand charge and metal oxidation state in your electron counting.

a) Mo, μ-CR_2, dmpe, CO

b) Nb, NMe, NMe_2, Cp, Cl

c) Ru, C_6H_6, H, PMe_3

d) Mn, CH_3, CO