CHEM 4571 – *Organometallic Chemistry* **Name:** _____

EXAM # 1 – Feb 21, 2008 **Signature:** _____

Check the box to the right if you want your graded exam to be placed in the public rack outside Prof. Stanley's office. Otherwise you will have to pick it up from Prof. Stanley in person: ☐

Please answer all questions!

1. (40 pts) Sketch out the structure of the following transition metal complexes as accurately as possible and clearly show the electron counting for each including the metal oxidation state and ligand charges. You don't have to draw out phenyl rings on ligands (e.g., PPh_3).

a) $[Cr(PH_2)(CO)_5]^-$

b) $Cp_2Rh_2(\mu\text{-}NHMe)_2$

c) $[ReCl(H_2C{=}CH_2)(dppe)_2]^+$ [dppe = $Ph_2PCH_2CH_2PPh_2$]

d) $CpY(NR_2)(CH_3)(THF)$ (THF = )

e) $CpMo(PMe_3)_2(C{\equiv}CMe)(CO)$

f) $[trans\text{-}AuI_2Ph_2]^-$ (Ph = C_6H_5)

g) $V(NMe)Cl_3(CH_3OCH_2CH_2OCH_3)$

h) $Ir_2(\mu\text{-}Br)_2(CO)_4$

2. (40 pts) For each of the following pairs of complexes, which will have the ***lowest*** average CO infrared stretching frequency? Circle your choice and briefly explain your reasoning.

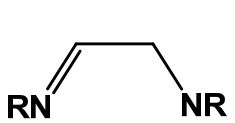
a) $CpFe(CO)_2(PF_3)$ -or- $CpOs(CO)(PMe_3)_2$

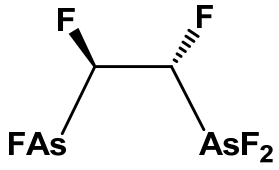
b) $Cp_2Y(CH_3)(CO)$ -or- $Cp_2V(CH_3)(CO)$

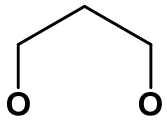
c) $Cr(CO)_4(PEt_3)_2$ -or- $W(CO)_4(PPh_3)_2$

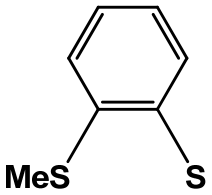
d) $PtCl_4(CO)_2$ -or- $NiBr_2(CO)_2$

3. (30 points) a) (20 pts) Show the charges (may be 0) and number of electron pairs (may be zero) on the donor atoms that will coordinate to the metal center for the following chelating ligands:









b) (10 pts) Order the ligands above from strongest to weakest donor for a Zr(+4) metal center and include your reasoning. You can refer to the ligands by their primary donor atom type (e.g., S, O, N, etc) and do not have to sketch them out.

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). Show your electron counting. Ligands are shown *without* *charges*, please indicate the proper ligand charge and metal oxidation state in your electron counting.

a) W, μ-PR_2, CO, H

b) Hf, Cp, N≡CCH_3, NCH_3

c) Pt, CH, Cl, PMe_3

d) Nb, O, CH_3, Cp, PMe_3

Bonus (10 pts): Why is C≡NMe a weaker π-acceptor than C≡O? There are two primary reasons.

Periodic Table of the Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen							Group 8										2 He Helium
3 Li Lithium	4 Be Berylium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Galium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 Ac Actinium	104	105													

Lanthanides	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
Actinides	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium