h. $[M(CO)_4I(diphos)]^-$ A: $18 - 4\times2 - 2 - 4 = 4 =$ M, **Ti**
B: $18 - 4\times2 - 1 - 4 = 5 = M^-$, **Ti**

13.4 Calculating for each metal atom:

a. $[Fe(CO)_2(\eta^5\text{-}C_5H_5)]_2$ A: $7 + 2\times2 + 6 = 17$, single Fe–Fe
B: $8 + 2\times2 + 5 = 17$, single Fe–Fe

b. $[Mo(CO)_2(\eta^5\text{-}Cp)]_2^{2-}$ A: $5 + 2\times2 + 6 + 1 = 16$, double Mo=Mo
B: $6 + 2\times2 + 5 + 1 = 16$, double Mo=Mo

13.5 a. $[M(CO)_3(NO)]^-$ linear M–N–O: A: $18 - 3\times2 - 2 - 2 = 8 =$ M, **Ru**
B: $18 - 3\times2 - 3 = 9 = M^-$, **Ru**
bent M–N–O: A: $18 - 3\times2 - 2 = 10 =$ M, **Pd**
B: $18 - 3\times2 - 1 = 11 = M^-$, **Pd**

b. $[M(PF_3)_2(NO)_2]^+$ linear NO: A: $18 - 2\times2 - 2\times2 = 10 = M^-$, **Rh**
B: $18 - 2\times2 - 2\times3 = 8 = M^+$, **Rh**

c. $[M(CO)_4(\mu_2\text{–}H)]_3$ As a triangular structure with three M–M bonds:
A: $18 - 4\times2 - 2 - 2 = 6 = M^+$, **Tc**
B: $18 - 4\times2 - 1 - 2 = 7 =$ M, **Tc**

d. $M(CO)(PMe_3)_2Cl$ A: $16 - 2 - 2\times2 - 2 = 8 = M^+$, **Rh**
B: $16 - 2 - 2\times2 - 1 = 9 =$ M, **Rh**

13.6 Method B works better for calculating overall charge.

a. $[Co(CO)_3]^z$ $9 + 3\times2 = 15$, $z = 3-$

b. $[Ni(CO)_3(NO)]^z$ $10 + 3\times2 + 3 = 19$, $z = 1+$

c. $[Ru(CO)_4(GeMe_3)]^z$ $8 + 4\times2 + 1 = 17$, $z = 1-$

d. $[(\eta^3\text{-}C_3H_5)V(CNCH_3)_5]^z$ $3 + 5 + 5\times2 = 18$, $z = 0$

e. $[(\eta^5\text{-}C_5H_5)Fe(CO)_3]^z$ $5 + 8 + 3\times2 = 19$, $z = 1+$

f. $[(\eta^5\text{-}C_5H_5)_3Ni_3(\mu_3\text{–}CO)_2]^z$ $3 \times 5 + 3\times10 + 2\times2 = 49$, $z = 1+$, assuming three Ni–Ni bonds; calculating for each Ni: $5 + 10 + 2(2/3) + 2 = 18\ 1/3$; charge per Ni = 1/3+, overall charge = 1+
(Each triply bridging CO can be considered to donate 2 electrons overall, 2/3 electron to each metal.)

13.7 a. $[(\eta^5\text{-}C_5H_5)W(CO)_x]_2$, assuming a single W–W: A: $6 + 5 + 1 + x \times 2 = 18$, $x = 3$
B: $5 + 6 + 1 + x \times 2 = 18$, $x = 3$

b. $ReBr(CO)_x(CO_2C_2H_4)$ A: $6 + 2 + x \times 2 + 2 = 18$, $x = 4$
B: $7 + 1 + x \times 2 + 2 = 18$, $x = 4$

c. $[(CO)_3Ni\text{–}Co(CO)_3]^z$ A and B: $3 \times 2 + 10 + 2 + 9 + 3\times2 - z = 36$, $z = 3-$

d. $[Ni(NO)_3(SiMe_3)]^z$ B: $10 + 3\times3 + 1 - z = 18$, $z = 2+$

Problem 13.6:
Using Method A
d electrons+ ligand electrons must equal 18, calculate charge ‘z' based on metal charge and ligand charge

Metal complex	Total ligand electrons	Metal electrons to make 18	Overall charge
[Co(CO)3]	2x3=6	12 (gives Co 3- charge)	0 from ligand 3- from metal, overall charge 3-
[Ni(CO)3(NO)]	2+2x3=8	10 (gives Ni 0 charge)	+1 charge from linear NO+, 0 charge from metal, overall charge +1
[Ru(CO)4(GeMe3)]	2+2x4=10	8 (gives Ru 0 charge)	GeMe3 is like CMe3, an alkyl ligand. This will have a -1 charge and overall charge of complex will also be -1
[(eta-3-C3H5)V(CNCH3)5]	4+5x2=14	4 (gives V +1 charge)	V is +1, C3H5 is -1, overall charge 0
[(eta-5-C5H5)Fe(CO)3]	6+3x2+12	6 (gives Fe a +2 charge)	Fe is +2, C5H5 is -1, overall charge +1
[(eta-5-C5H5)3Ni3(mu-3–CO)2]	This compound is difficult to do if you don’t know number of metal-metal bonds. Something this complicated will not be on test		

Problem 13.7d

[Ni(NO)3(SiMe3)]
Method A treatment

Total ligand electrons: 2x3+2=8
Metal electrons to make 18: 10 (gives Ni a 0 charge)

Overall charge: +3 charge from three linear NO+, -1 charge from SiMe3-,
0 charge from metal, overall charge = +2