

- h.** $[\text{M}(\text{CO})_4\text{I}(\text{diphos})]^-$ A: $18 - 4 \times 2 - 2 - 4 = 4 = \text{M}$, **Ti**
B: $18 - 4 \times 2 - 1 - 4 = 5 = \text{M}^+$, **Ti**
- 13.4** Calculating for each metal atom:
- a.** $[\text{Fe}(\text{CO})_2(\eta^5\text{-C}_5\text{H}_5)]_2$ A: $7 + 2 \times 2 + 6 = 17$, single Fe–Fe
B: $8 + 2 \times 2 + 5 = 17$, single Fe–Fe
- b.** $[\text{Mo}(\text{CO})_2(\eta^5\text{-Cp})]_2^{2-}$ A: $5 + 2 \times 2 + 6 + 1 = 16$, double Mo=Mo
B: $6 + 2 \times 2 + 5 + 1 = 16$, double Mo=Mo
- 13.5 a.** $[\text{M}(\text{CO})_3(\text{NO})]^-$ linear M–N–O: A: $18 - 3 \times 2 - 2 - 2 = 8 = \text{M}$, **Ru**
B: $18 - 3 \times 2 - 3 = 9 = \text{M}^+$, **Ru**
bent M–N–O: A: $18 - 3 \times 2 - 2 = 10 = \text{M}$, **Pd**
B: $18 - 3 \times 2 - 1 = 11 = \text{M}^+$, **Pd**
- b.** $[\text{M}(\text{PF}_3)_2(\text{NO})_2]^+$ linear NO: A: $18 - 2 \times 2 - 2 \times 2 = 10 = \text{M}^+$, **Rh**
B: $18 - 2 \times 2 - 2 \times 3 = 8 = \text{M}^+$, **Rh**
- c.** $[\text{M}(\text{CO})_4(\mu_2\text{-H})]_3$ As a triangular structure with three M–M bonds:
A: $18 - 4 \times 2 - 2 - 2 = 6 = \text{M}^+$, **Tc**
B: $18 - 4 \times 2 - 1 - 2 = 7 = \text{M}$, **Tc**
- d.** $\text{M}(\text{CO})(\text{PMe}_3)_2\text{Cl}$ A: $16 - 2 - 2 \times 2 - 2 = 8 = \text{M}^+$, **Rh**
B: $16 - 2 - 2 \times 2 - 1 = 9 = \text{M}$, **Rh**
- 13.6** Method B works better for calculating overall charge.
- a.** $[\text{Co}(\text{CO})_3]^-$ $9 + 3 \times 2 = 15$, $z = 3-$
- b.** $[\text{Ni}(\text{CO})_3(\text{NO})]^+$ $10 + 3 \times 2 + 3 = 19$, $z = 1+$
- c.** $[\text{Ru}(\text{CO})_4(\text{GeMe}_3)]^-$ $8 + 4 \times 2 + 1 = 17$, $z = 1-$
- d.** $[(\eta^3\text{-C}_3\text{H}_5)\text{V}(\text{CNCH}_3)_5]^-$ $3 + 5 + 5 \times 2 = 18$, $z = 0$
- e.** $[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CO})_3]^-$ $5 + 8 + 3 \times 2 = 19$, $z = 1+$
- f.** $[(\eta^5\text{-C}_5\text{H}_5)_3\text{Ni}_3(\mu_3\text{-CO})_2]^-$ $3 \times 5 + 3 \times 10 + 2 \times 2 = 49$, $z = 1+$, assuming three Ni–Ni bonds; calculating for each Ni: $5 + 10 + 2(2/3) + 2 = 18\frac{1}{3}$; 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.** $[(\eta^5\text{-C}_5\text{H}_5)\text{W}(\text{CO})_x]_2$, 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.** $\text{ReBr}(\text{CO})_x(\text{CO}_2\text{C}_2\text{H}_4)$ A: $6 + 2 + x \times 2 + 2 = 18$, $x = 4$
B: $7 + 1 + x \times 2 + 2 = 18$, $x = 4$
- c.** $[(\text{CO})_3\text{Ni}-\text{Co}(\text{CO})_3]^-$ A and B: $3 \times 2 + 10 + 2 + 9 + 3 \times 2 - z = 36$, $z = 3-$
- d.** $[\text{Ni}(\text{NO})_3(\text{SiMe}_3)]^-$ B: $10 + 3 \times 3 + 1 - z = 18$, $z = 2+$

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 (GeMe ₃)]	2+2x4=10	8 (gives Ru 0 charge)	GeMe ₃ is like CMe ₃ , an alkyl ligand. This will have a -1 charge and overall charge of complex will also be -1
[(η -3-C ₃ H ₅)V(CNCH ₃) ₅]	4+5x2=14	4 (gives V +1 charge)	V is +1, C ₃ H ₅ is -1, overall charge 0
[(η -5-C ₅ H ₅)Fe(CO) ₃]	6+3x2+12	6 (gives Fe a +2 charge)	Fe is +2, C ₅ H ₅ is -1, overall charge +1
[(η -5-C ₅ H ₅) ₃ Ni ₃ (μ -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		