Reading guide and suggested problems for Chapter 13

Chapter 13: Organometallic Chemistry. Chapter 13 discusses the basics of organometallic chemistry, including the ligands and bonding that occur in organometallic complexes and the 18 electron rule.

Learning goals:
1) Be able to count the number of electrons in an organometallic complex based on the "Donor Pair Method" (Method A).
2) Become familiar with the types of ligands that are found in organometallic complexes and have an understanding of the bonding interactions between these ligands and a metal center.
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Suggested reading

13.1: Historical background. You will not be directly tested on the history of organometallic chemistry (unless one of these compounds is a topic of a final project!), however this is an interesting read.

13.2: Organometallic ligands and nomenclature: Become familiar with the ligands discussed here, though I will not test you on your ability to know the names of each ligand. Familiarity will help you process questions regarding these compounds.

13.3, 13.3.1, 13.3.2, 13.3.2: The 18 electron rule: I will be teaching you the 18 electron rule using "Method A" AKA the "Donor Pair Method." You must know how to count electrons in inorganic/organometallic complexes. Note that square planar complexes often break the 18 electron rule and have 16 electrons instead.

13.4.1: Carbonyl complexes. You are already familiar with how bonding works in terminal CO complexes, however, how does this bonding affect the properties of the CO ligand? Back donation into π* orbitals effectively weakens the CO triple bond, resulting in lower frequency CO stretches. This effect is metal ion –dependent as detailed in this section. In addition to terminal CO complexes, CO can also act as a bridging ligand between two metal centers. You will NOT be tested on oxygen-bonded COs.

13.4.2: Ligands similar to CO. N_2 and CN- have very similar M-bonding interactions to CO. NO can interact with metals either in a linear or bent fashion.

13.4.3: Hydride and Hydrogen complexes. Describes the interactions between these ligands and a metal center.

13.4.4, 13.5.1, 13.5.2: Ligands having extended pi systems: Though we've long discussed complexes like Ferrocene, that contains two cyclopentadienyl ligands bound to an Fe center, how do these ligands interact with a metal center? They interact through their π electrons, and this can occur with many ligands containing pi systems. You will NOT need to memorize what the orbitals in these pi systems look like (13.4.4), however, given a set of π orbitals, you should be able to figure out what orbitals on the metal center can interact with them (13.5.1, 13.5.2).

13.6, 13.6.1, 13.6.2: M-C and M=C complexes. You should know the Lewis structures of alkyl and carbine ligands and understand the bonding interactions between these and a metal center.

13.8, 13.8.1: Using IR spectroscopy to characterize organometallic complexes. This is essentially repeat material from your molecular vibrations unit, with a little added information that gives more insight into how backbonding affects the frequency of the CO stretch (also covered in 13.4.1)

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Relevant homework problems:

13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.12, 13.13, 13.14, 13.15,

13.17, 13.19 (on an exam, the pi orbitals would be given to you)

13.21, 13.23, 13.27