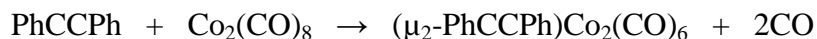
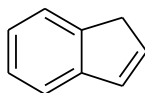


423/523 Organometallic Chemistry
Problem set 4

1. Strained alkenes such as cyclopropene or norbornene bind unusually strongly to metals. Suggest a reason why.
2. Alkynes readily bridge M-M bonds, in which case they act as 2e donors to each metal. Sketch the product of the reaction below, indicating the hybridization of the C atoms.



3. Draw as many bonding modes for cyclooctatetraene as you can think of.
4. Sketch the three π -MOs of the allyl anion, $[\text{C}_3\text{H}_5]^-$. Draw metal d -orbitals that can interact with these MOs, and name the type of bonding (e.g. $\text{M} \rightarrow \text{L} \pi$ -acceptor).
5. The M-P distance in $(\eta^5\text{-C}_5\text{H}_5)\text{Co}(\text{PEt}_3)_2$ is 221.8 pm and the P-C distance is 184.6 pm. The corresponding distances in $[(\eta^5\text{-C}_5\text{H}_5)\text{Co}(\text{PEt}_3)_2]^+$ are 223 pm and 182.9 pm. Account for the changes in these distances as the former complex is oxidised.
6. Predict the product of the reactions between:
 - (a) $[\text{Ru}(\eta^5\text{-C}_7\text{H}_9)(\eta^6\text{-C}_7\text{H}_8)]^+$ and H^-
 - (b) $[\text{W}(\eta^5\text{-C}_5\text{H}_5)_2(\eta^3\text{-C}_3\text{H}_5)]^+$ and H^- .
7. Ligands of type X-Y only give 3c-2e “agostic” bonds to transition metals if X = H and Y lacks lone pairs. Why do you think this is so (consider alternative structures if X and Y are not H)?
8. $[\text{IrH}_2(\text{H}_2\text{O})_2(\text{PPh}_3)_2]^+$ reacts with indene to give $[\text{Ir}(\text{C}_9\text{H}_{10})(\text{PPh}_3)_2]^+$ (**A**). On heating, this species rearranges with H_2 loss to give $[\text{IrH}(\text{C}_9\text{H}_7)(\text{PPh}_3)_2]^+$ (**B**). Only **A** reacts with ligands such as CO to displace C_9H_7 . What do you think are the structures of **A** and **B**?



indene