1. Draw the σ-bonding molecular orbital diagram for Vaska’s complex illustrated below.

Make sure to: (i) include the relative energy levels of the metal orbitals, the LGOs, and the MOs; (ii) fill the metal orbitals, the LGOs, and the MOs with the appropriate number of the electrons; and (iii) provide orbital cartoons for all bonding and non-bonding molecular orbitals.

2. Consider the following transformation.

   ![Transformation Diagram]

   a. Draw the mechanism for this transformation.
   b. Illustrate what you would expect a plot of \([\text{Cp}^*\text{Ir}(\text{CO})(\text{PCy}_3)]\) vs. time to look like for this reaction.
   c. Illustrate what you would expect a plot of \(k_{\text{obs}}\) vs. \([\text{PCy}_3]\) to look like for this reaction.
   d. Illustrate the plot that you would use to determine \(\Delta H^\ddagger\) for this reaction. Be sure to label the axes and how you determine \(\Delta H^\ddagger\).

3. Fill in the blanks for the following oxidative addition reactions.

   a.  

   ![Oxidative Addition Reaction a]

   b.  

   ![Oxidative Addition Reaction b]
4. Predict the products of the following transformations.

a.

\[ \text{MeOH} \]

\[ \text{O} \]

\[ \text{OMe} \]

\[ \text{Me} \]

\[ \text{i-Pr} \]

\[ \text{Ru} \]

\[ \text{Ts} \]

\[ \text{N} \]

\[ \text{N} \]

\[ \text{Ph} \]

\[ \text{Ph} \]

\[ 2\text{Cl} \]

\[ \text{cat.} \]

\[ \text{H}_2 \]

\[ \text{cat.} \]

\[ \text{H}_2 \text{OTf} \]

\[ \text{CO}_2 \text{Me} \]

\[ \text{cat.} \]

\[ \text{Pd} \]

\[ \text{(dba)}_3 \]

\[ \text{cat.} \]

\[ \text{R-BINAP} \]

\[ \text{K}_2\text{CO}_3, \text{PhMe} \]

\[ 60 \degree \text{C} \]

b.

\[ \text{CO}_2\text{Me} \]

\[ \text{OTf} \]

\[ \text{cat.} \]

\[ \text{Pd}_2\text{(dba)}_3 \]

\[ \text{cat.} \]

\[ \text{dppf} \]

\[ 1\text{ equiv. PhI, PhMe} \]

\[ 60 \degree \text{C} \]

\[ \text{cat.} \]

\[ \text{Pd(OAc)}_2 \]

\[ 1\text{ equiv PhI(OAc)}_2 \]

\[ \text{HOAc, heat} \]

c.
5. Indicate the appropriate reagents required to achieve the following transformations. Note: Some transformation may require more than one step.

a.

b.

c.
d.

\[
\begin{align*}
\text{O} & \quad \text{SnBu}_3
\end{align*}
\]

\[
\begin{align*}
a \quad \text{Ph}
\end{align*}
\]

\[
\begin{align*}
\text{Ph} & \quad \text{Ph}
\end{align*}
\]

\[
\begin{align*}
\text{Ph} & \quad \text{Ph}
\end{align*}
\]

\[
\begin{align*}
\text{Ph} & \quad \text{Ph}
\end{align*}
\]

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