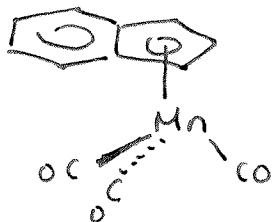


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1.



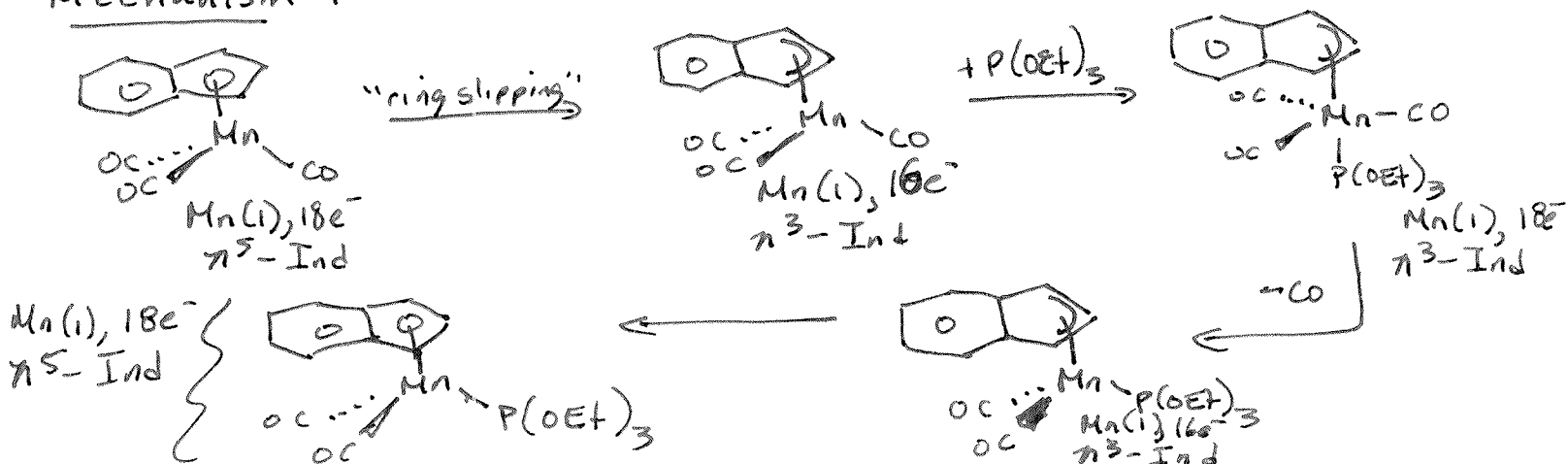
$$\begin{array}{l} \text{Mn(I)} \rightarrow 6e^- \\ 3 \times \text{CO} \rightarrow 6e^- \\ \text{Ind}^- \rightarrow 6e^- \\ \hline 18e^- \end{array}$$

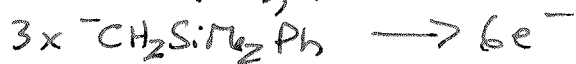
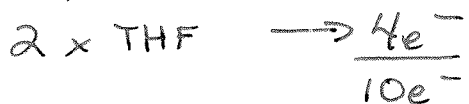


$$\begin{array}{l} \text{Mn(I)} \rightarrow 6e^- \\ 3 \times \text{CO} \rightarrow 6e^- \\ \text{Cp}^- \rightarrow 6e^- \\ \hline 18e^- \end{array}$$

- both Mn centres are Mn(I), and 18e⁻
- reaction with P(OEt)₃ would be expected to result in substitution of a CO ligand
- ↳ since the two compounds are sterically and electronically saturated the reaction must proceed via a dissociative substitution mechanism
- ↳ given both complexes contain 3 CO ligands, these are unlikely to give rise to the difference in reaction rate
- One complex has an indenyl group, while the other is supported by a Cp ligand. Indenyl ligands more readily change their bonding mode to η³ or η¹ than Cp ligands; thus, this fact is the likely cause for the difference in reaction rates

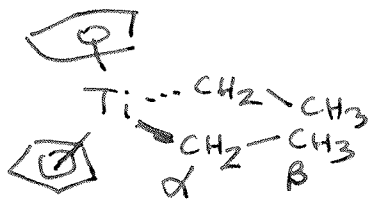
Mechanism:



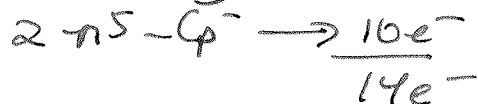
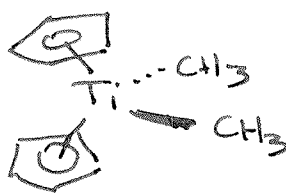


→ both Sc complexes are $d^0, 10e^-$. The only difference lies in the size of the alkyl group. Since $\text{CH}_2\text{SiMe}_2\text{Ph}$ is larger than CH_3 it will protect the e^- deficient 5 coordinate metal centre better. Thus $\left[\text{Sc}(\text{CH}_2\text{SiMe}_2\text{Ph})_3(\text{THF})_2 \right]$ will be more stable than $\left[\text{ScMe}_3(\text{THF})_2 \right]$.

ii)

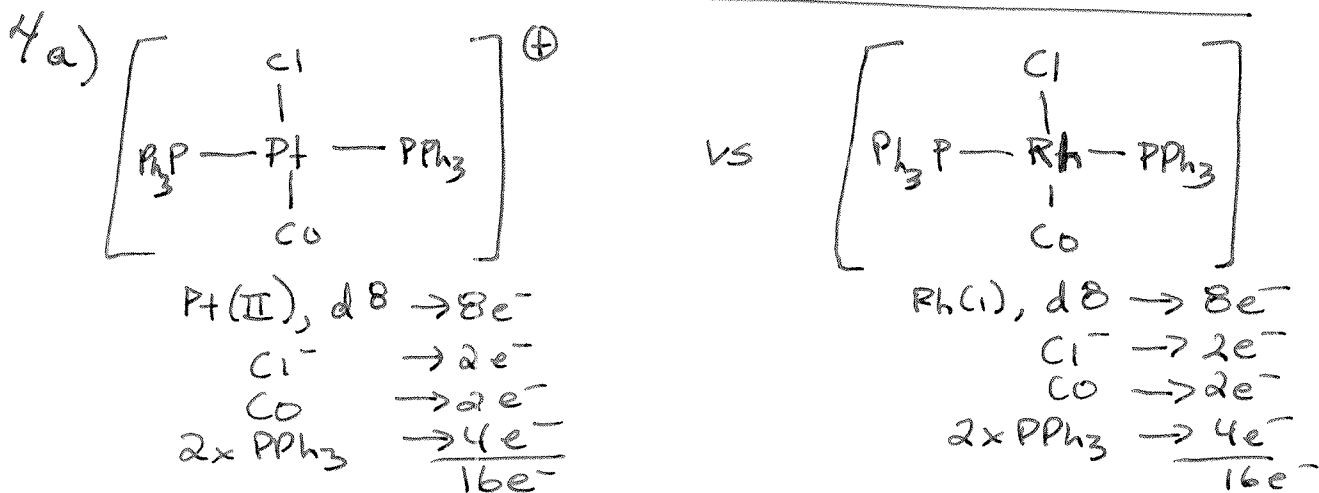
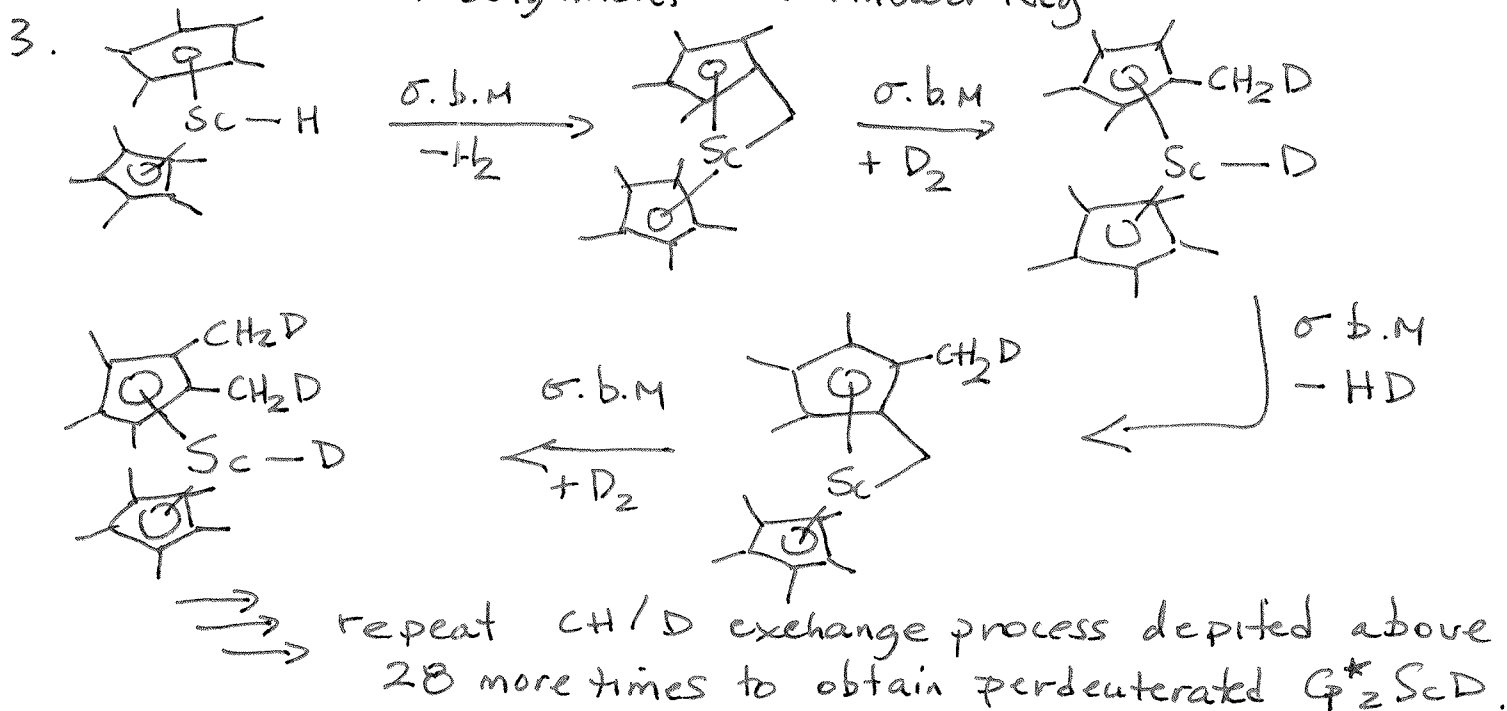


vs



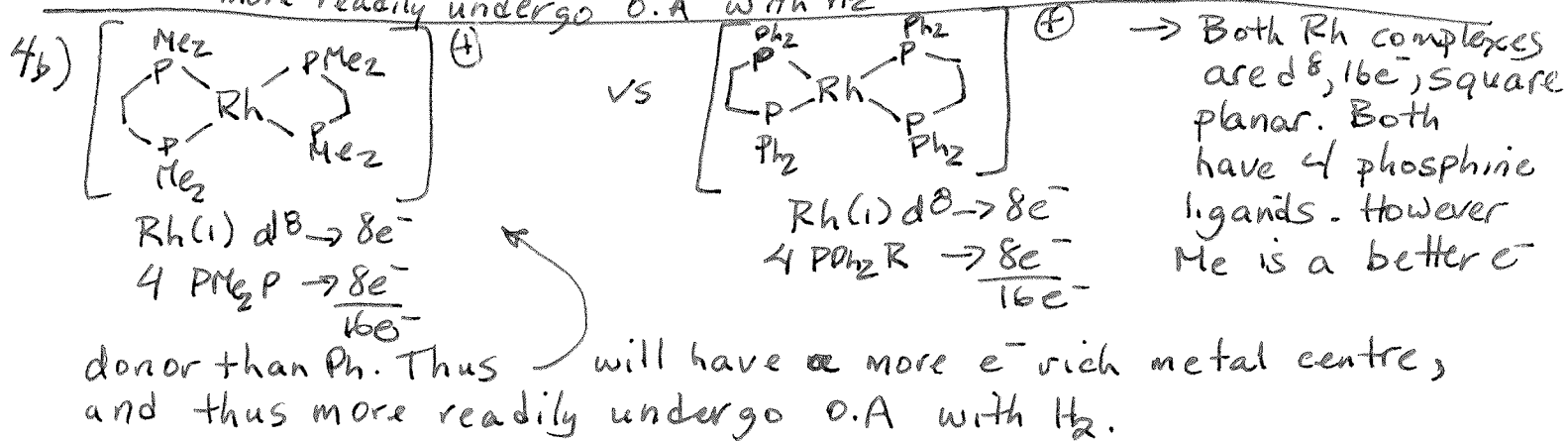
→ Both Ti are $d^0, 14e^-$. Both contain 2 Cp ligands. Ethyl groups are slightly larger than methyl, but they contain $\beta\text{-H}$ which render compounds containing such groups less stable than analogous compounds lacking $\beta\text{-H}$.

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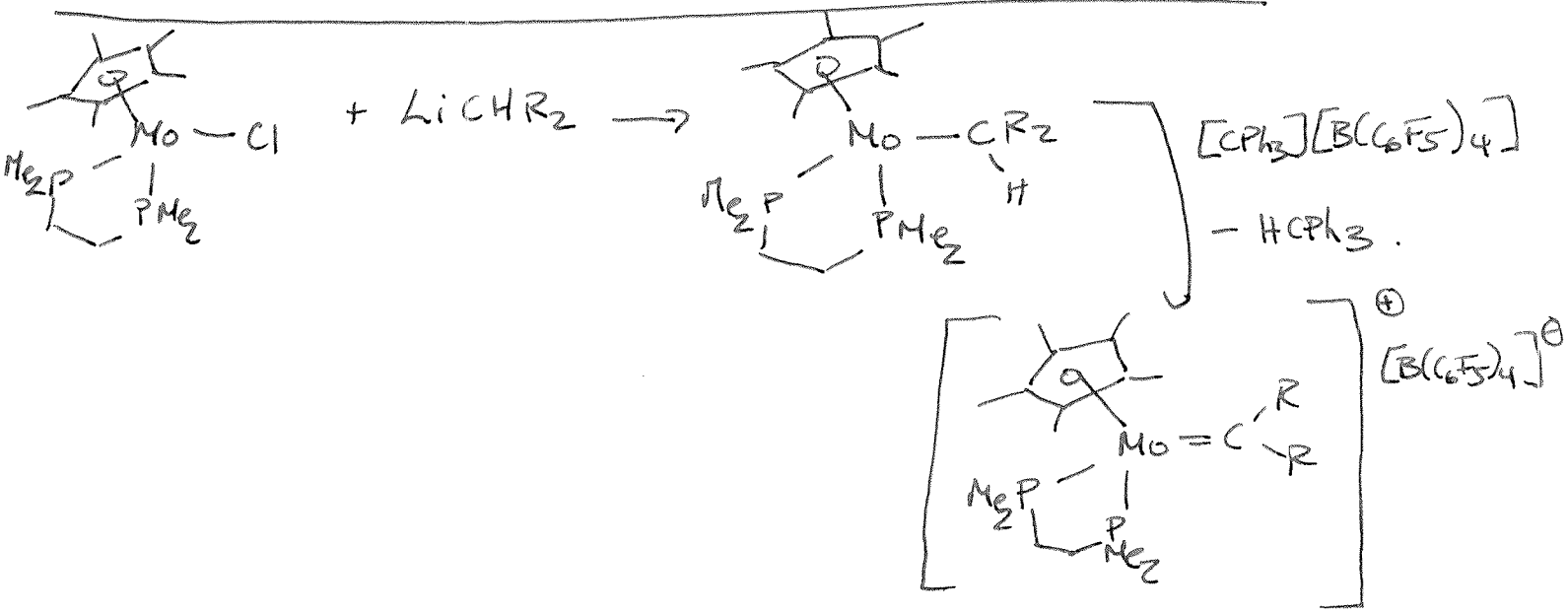
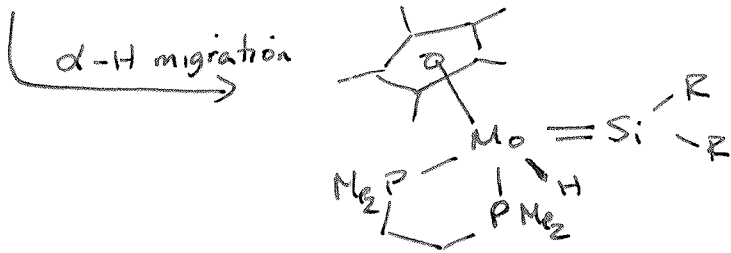
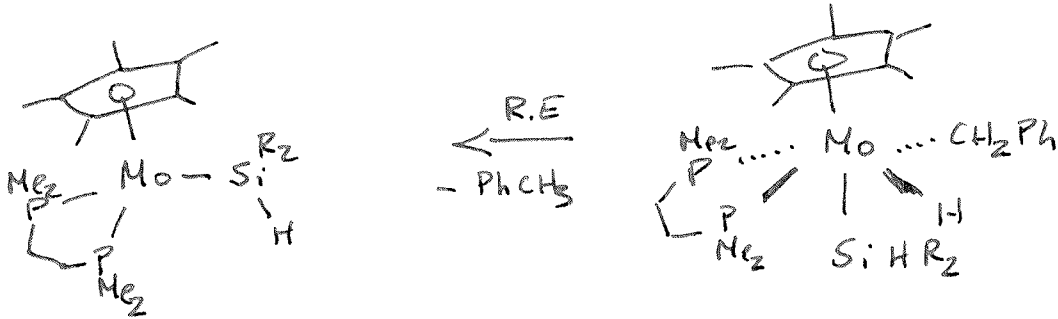
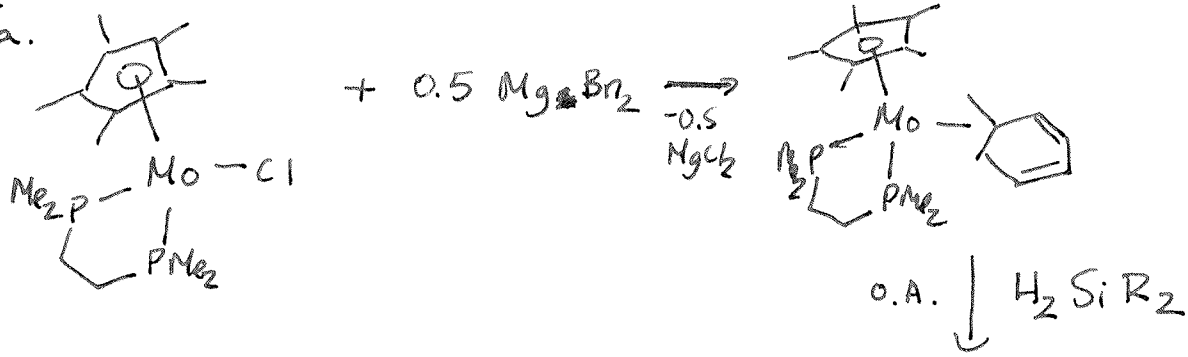
→ both compounds are d^8 , $16e^-$ and square planar.

→ M-H bonds stronger for 3rd row than 2nd row. Also higher oxidation states more accessible. ∴ $[PtCl(CO)(PPh_3)_2]$ will more readily undergo O.A with H_2



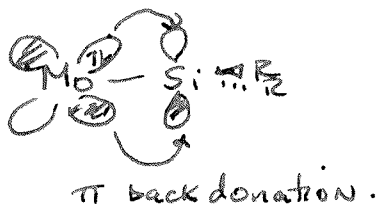
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5a.

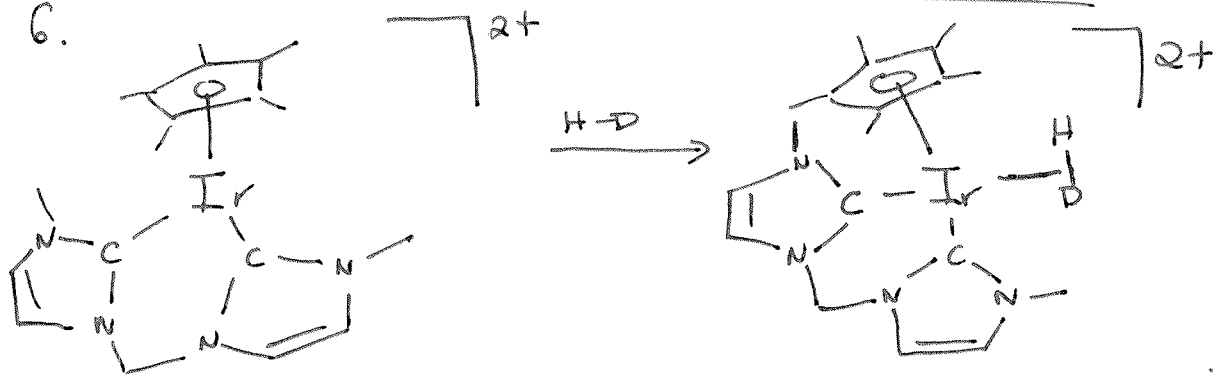


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5b)



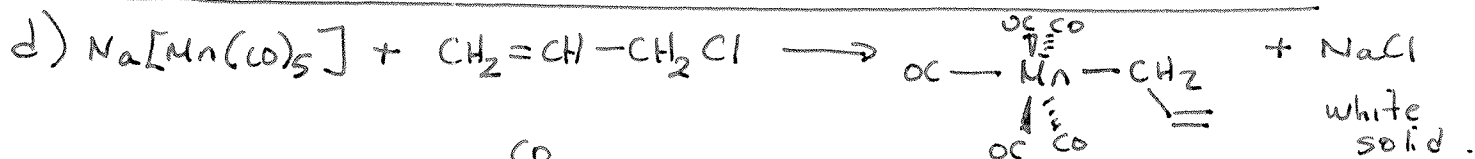
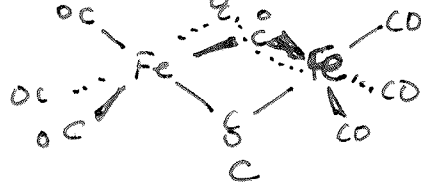
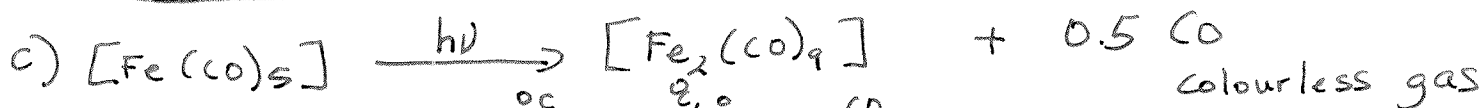
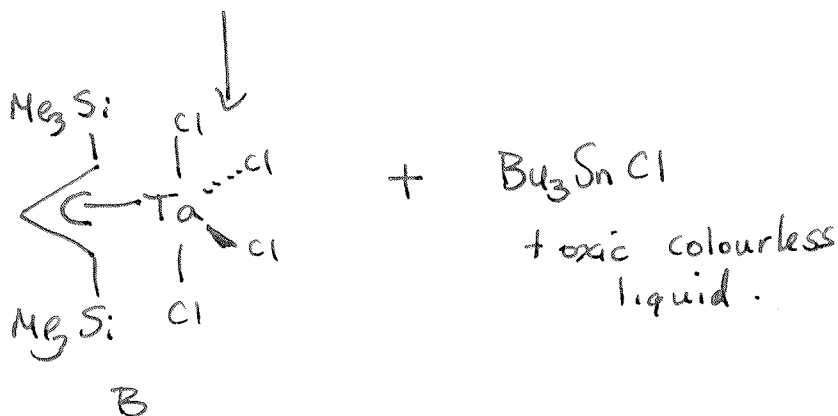
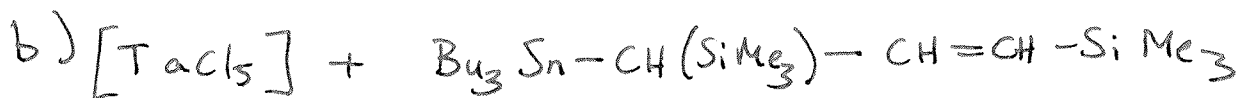
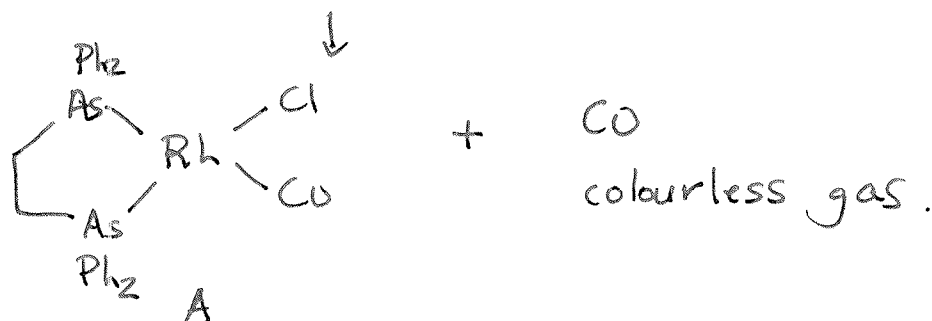
6.



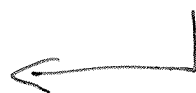
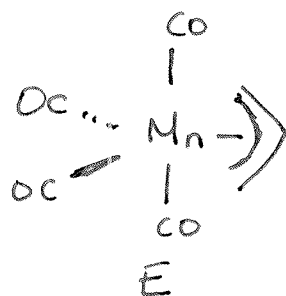
- 1:1:1 triplet due to coupling to D ($I=1$)
- $J_{HD} = 23.5 \text{ Hz}$ indicative of a dihydrogen complex.
- $\delta -7.2$ is consistent with both dihydride and dihydrogen complexes.

↳ In conclusion the above complex (a dihydrogen species) is consistent with the provided $^1\text{H NMR}$ data.

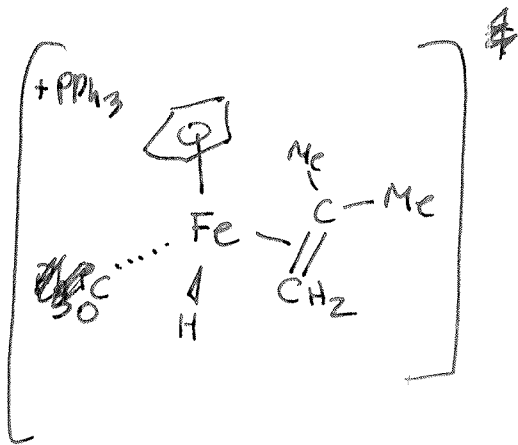
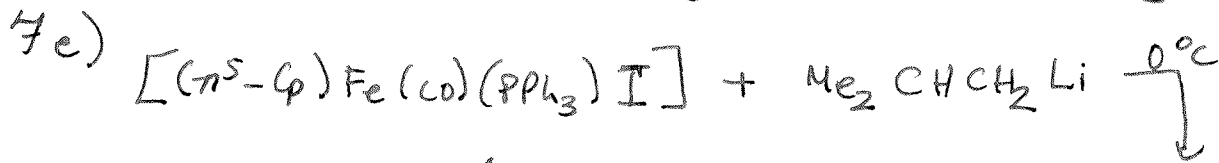
↳ Also, the Ir starting material is Ir(III) , d^6 , $16e^-$. Given that Ir(II) is not commonly available, and the compound is $16e^-$, one would not expect it to be e^- rich enough to participate in standard oxidative addition reactions.



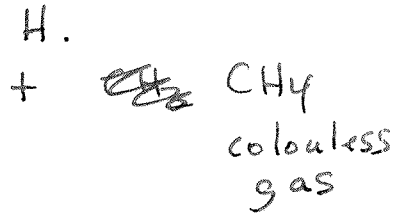
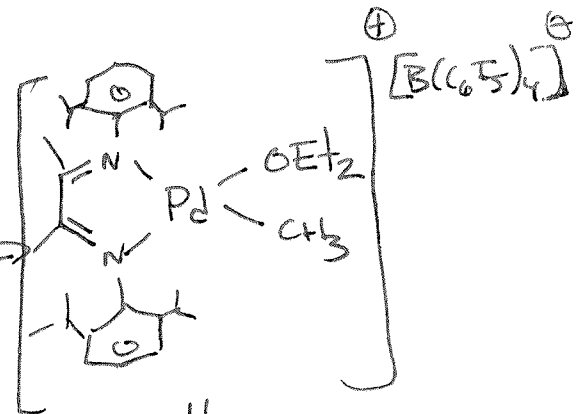
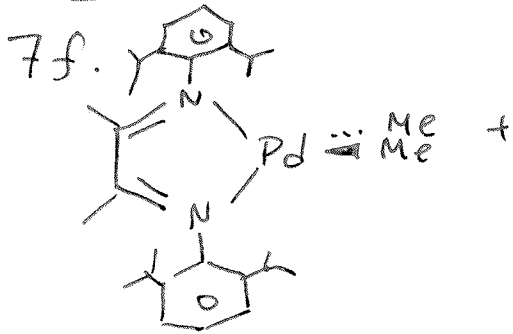
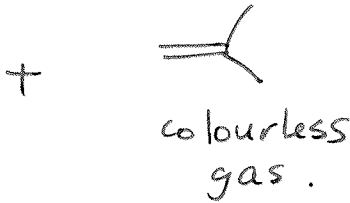
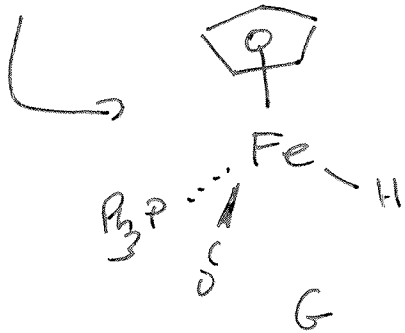
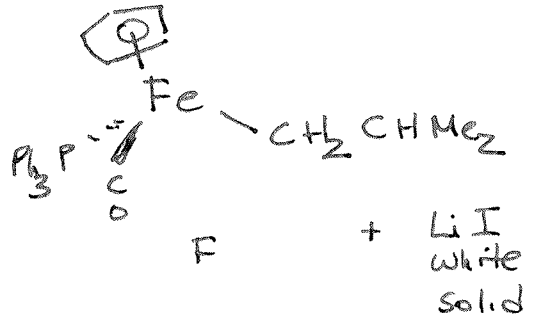
CO
colourless
gas.

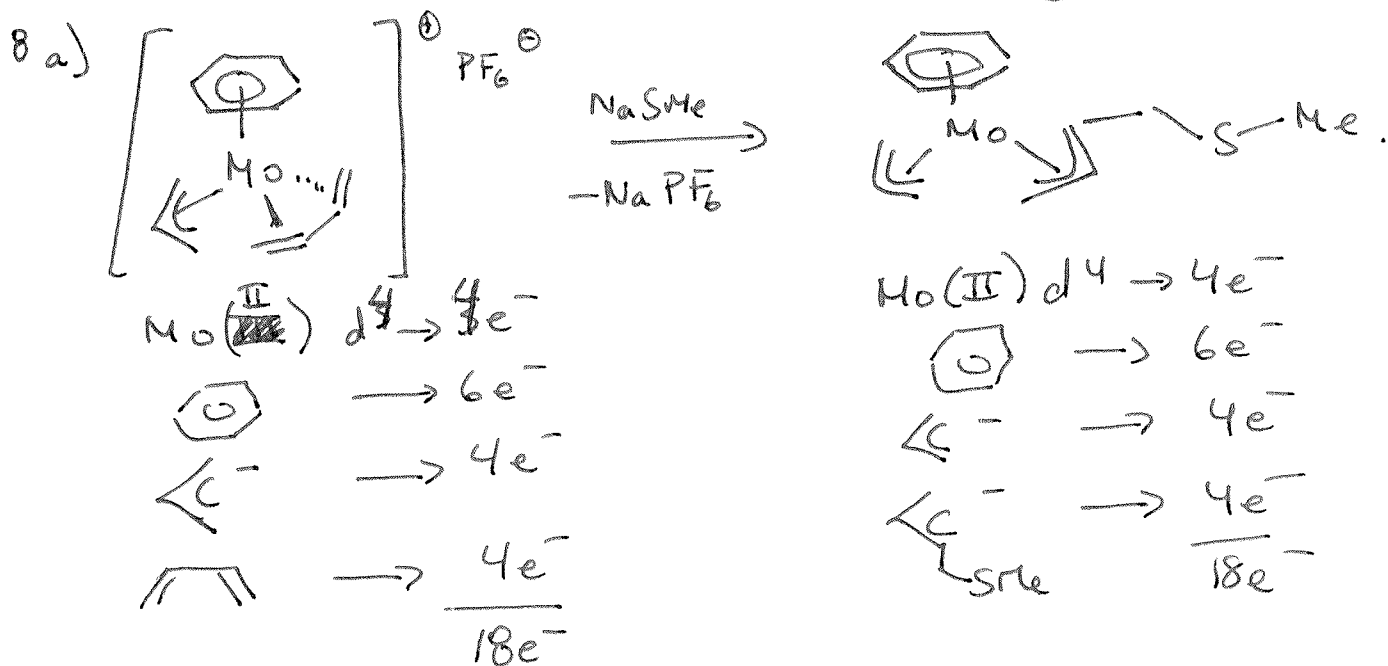


D.

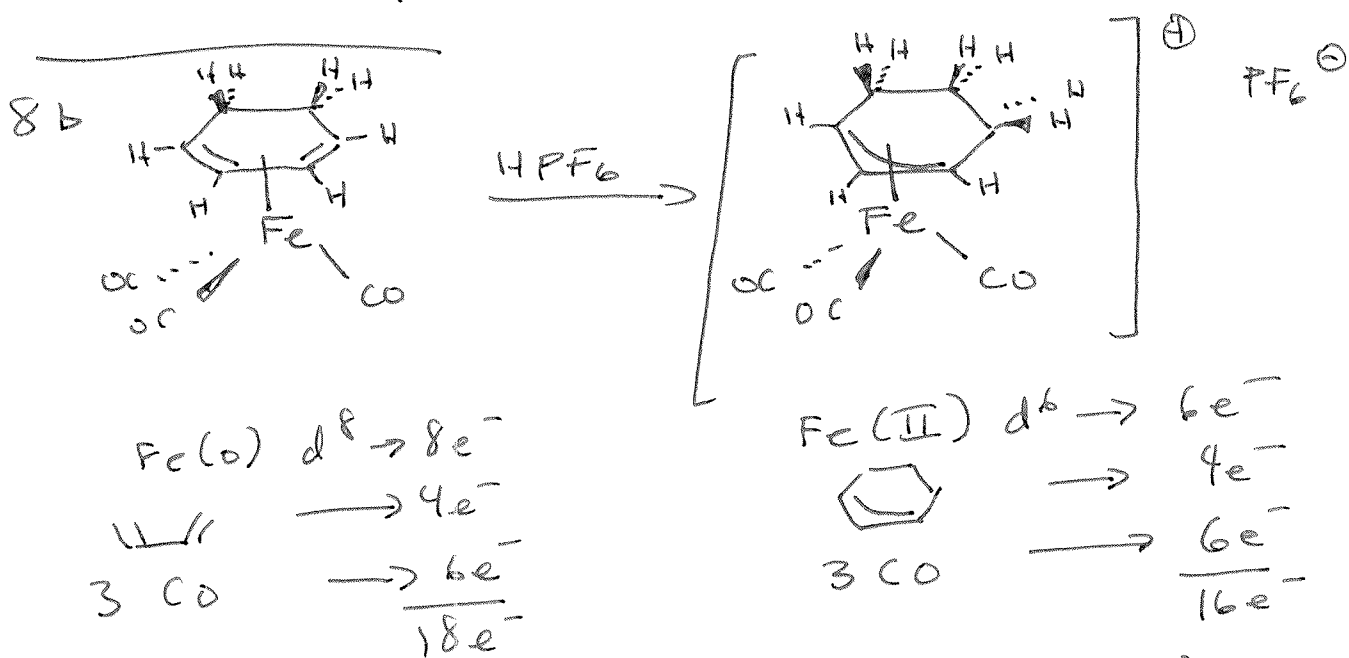


β -Elimination





→ Mo retains the same oxidation state (Mo(II))



→ Fe is oxidized from Fe(0) to Fe(II).