You may use this cover page if you run out of space in the answer booklet.
1. Examine the scheme below. Draw structures for A, B, C, D, E and F. Describe steps a, b, c, d, e, f, g and h, including transition states for steps a and f. Given that [M] is IrL₂X, give oxidation states and electron counts for all metal complexes. What do you think is the desired product? Why? What other product(s) might you expect from the reaction?

[16 marks]

All metal complexes are +3 except for [M] which is +1
[M] is 14 then proceeding: 16, 18, 16, 16, 16
EtSiR₃; it is the atom-economical product
R₃SiCH=CHSiR₃, R₃SiCH₂CH₂SiR₃
2. The complex Rh(Me)(PPh$_3$)$_3$ reacts with D$_2$ to produce Rh(D)(PPh$_3$)$_2$(PPh$_2$(C$_6$H$_4$D)) and CH$_4$. Give reactions that explain this product distribution.

[8 marks]
3. Predict the products of the following reaction, showing the structure of each and the expected relative distributions. Choose ONE of the products, and describe in as much detail as you can its ν(CO) IR spectrum and its $^{31}$P NMR spectrum (proton decoupled).

[8 marks]

All products exhibit 2 CO stretches around 2000 cm$^{-1}$ and one around 1700 cm$^{-1}$. All $^{31}$P NMR should be 3 doublets of doublets.
4. Explain the difference between homogeneous and heterogeneous catalysts and detail the advantages/disadvantages of both.

[12 marks]

Straight from notes.
5. Propose a mechanism for the following reaction. Your mechanism must be consistent with the following observations: (a) using excess PPh₃, the rate is first order in rhodium complex; (b) $\Delta S^\ddagger$ is negative.

![Chemical structure](image)

[6 marks]

Associative. Intermediate must be 18e i.e. a ring-slipped cyclopentadienyi: