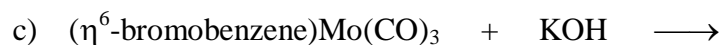
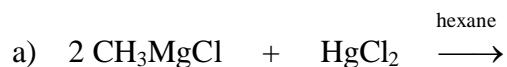


Answer all questions in the booklets provided. A periodic table is attached. You have 50 min.

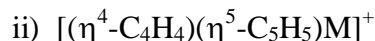
**{15} Question 1**

Draw the structure(s) of the **final** product(s) of the following reactions. (3 marks each).

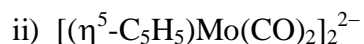
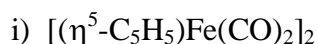


**{11} Question 2**

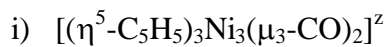
a) On the basis of the 18-electron rule, identify the first-row transition metal (**M**) for the following (2 marks each):



b) Determine the metal-metal bond-order consistent with the 18-electron rule for the following (2 marks each):



c) On the basis of the 18-electron rule, determine the expected charge (**z**) on the following (3 marks):



### {9} Question 3

- a) Of the compounds  $\text{Cr}(\text{CO})_5(\text{PF}_3)$  and  $\text{Cr}(\text{CO})_5(\text{PCl}_3)$ , which would you expect to have:
- the shorter C-O bonds? Explain (2 marks)
  - the higher energy Cr-C stretching bands in the infrared? Explain (2 marks)
- b) Explain why  $\text{Mo}(\text{PMe}_3)_5\text{H}_2$  is a dihydride (contains two separate H ligands), but  $\text{Mo}(\text{CO})_3(\text{PMe}_3)_2(\text{H}_2)$  contains the dihydrogen ligand. (Me = methyl) (3 marks)
- c) The compound  $\text{W}(\text{O})\text{Cl}_2(\text{CO})(\text{PPh}_3)_2$  has  $\nu(\text{CO})$  at  $2006\text{ cm}^{-1}$ . Would you predict the  $\nu(\text{CO})$  in  $\text{W}(\text{S})\text{Cl}_2(\text{CO})(\text{PPh}_3)_2$  to be at higher or lower energy? Explain. (2 marks)

### {5} Question 4

Reaction of nickel carbonyl,  $\text{Ni}(\text{CO})_4$ , with cyclopentadiene results in a oxidation/reduction process that yields a red diamagnetic compound with the formula  $\text{NiC}_{10}\text{H}_{12}$ . The  $^1\text{H}$  NMR spectrum of this compound shows four different types of hydrogens; integration of the hydrogen peaks gives relative areas of 5:4:2:1, with the most intense peak in the aromatic region. Suggest a structure for  $\text{NiC}_{10}\text{H}_{12}$  and show that it is consistent with the NMR.