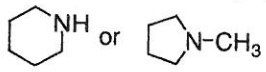
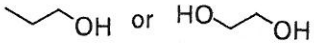
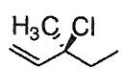
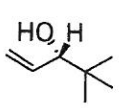
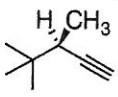
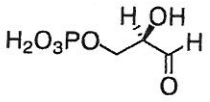
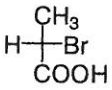
總分 100 分

1. Which compound in each of the following pairs would have the higher boiling point? Explain your answers. (3 pts each, 6 pts)

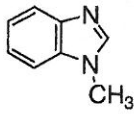
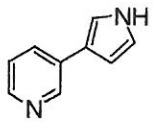
(a)  **(b)** 

2. Assign (*R*) or (*S*) designations to each of the following compounds. (2 pts each, 10 pts)

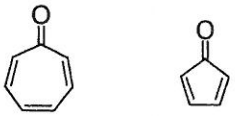
(a)  **(b)**  **(c)** 

(d)  **(e)** 

3. Write the structure of the product formed when each of the following compounds reacts with one molar equivalent of HCl. (2 pts each, 4 pts)

(a)  **(b)** 

4. Cycloheptatrienone (**I**) is very stable. Cyclopentadienone (**II**) by contrast is quite unstable and rapidly undergoes a Diels-Alder reaction with itself.
   (a) Propose an explanation for the different stabilities of these two compounds. (4 pts)
   (b) Write the structure of the Diels-Alder adduct of cyclopentadienone. (2 pts)

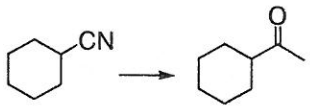


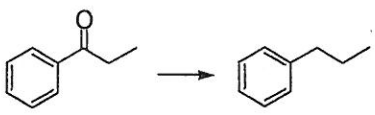
I　　**II**

5. When dissolved in $CDCl_3$, a compound (**A**) with the molecular formula $C_4H_8O_2$ gives a ^1H NMR spectrum that consists of a doublet at δ 1.35, a singlet at δ 2.15, a broad singlet at δ 3.75 (1H), and a quartet at δ 4.25 (1H). When dissolved in D_2O, the compound gives a similar ^1H NMR spectrum, with the exception that the signal at δ 3.75 has disappeared. The IR spectrum

of the compound shows a strong absorption peak near 1720 cm^{-1}. Propose a structure for compound **A**. (4 pts)

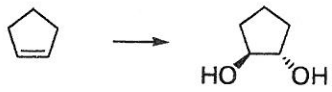
6. Indicate reagents that would accomplish each of following transformations. More than one reaction may be necessary in some cases. (2 pts each, 20 pts)

(a) 

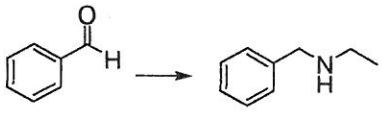
(b) 

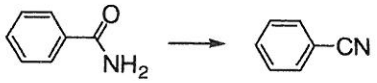
(c) 

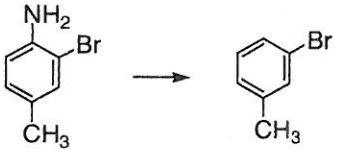
(d) 

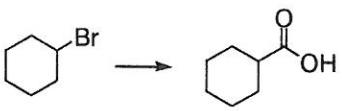
(e) 

(f) 

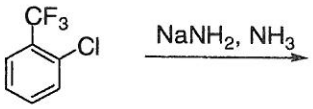
(g) 

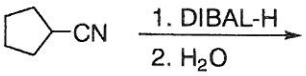
(h) 

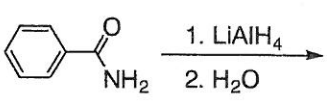
(i) 

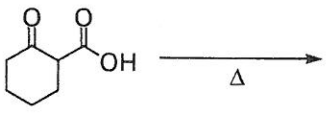
(j) 

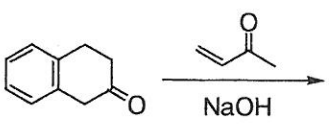
7. Give the expected major product of the following reactions. (2 pts each, 20 pts)

(a) 

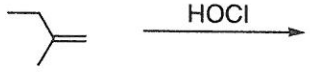
(b) 

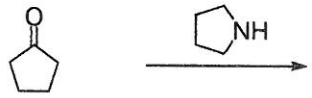
(c) 

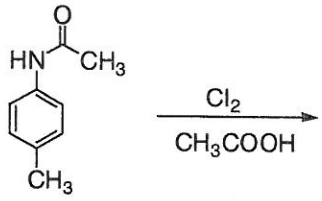
(d) 

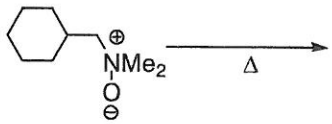
(e) 

(f) 

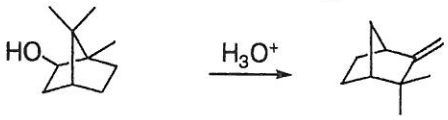
(g) 

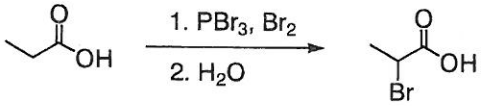
(h) 

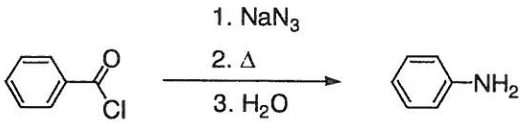
(i) 

(j) 

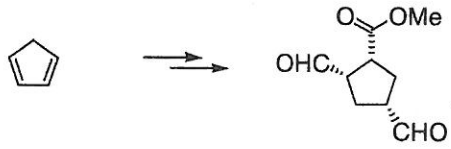
8. Propose a mechanism for the following reactions. (5 pts each, 15 pts)

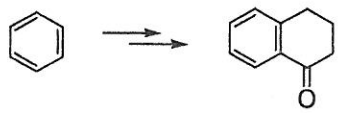
(a) 

(b) 

(c) 

9. Propose a synthetic scheme for each of the following compounds from the readily available starting materials. (5 pts each, 15 pts)

(a) 

(b) 

(c)