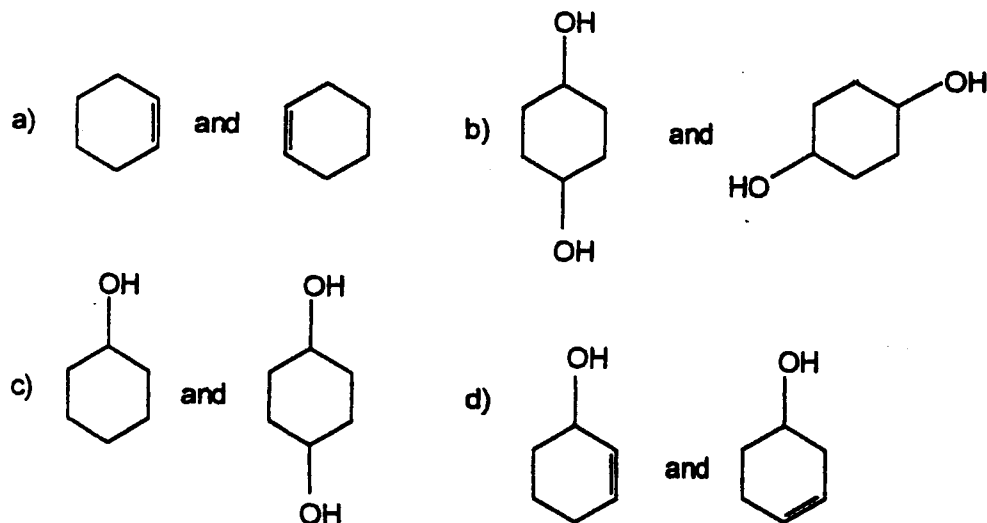


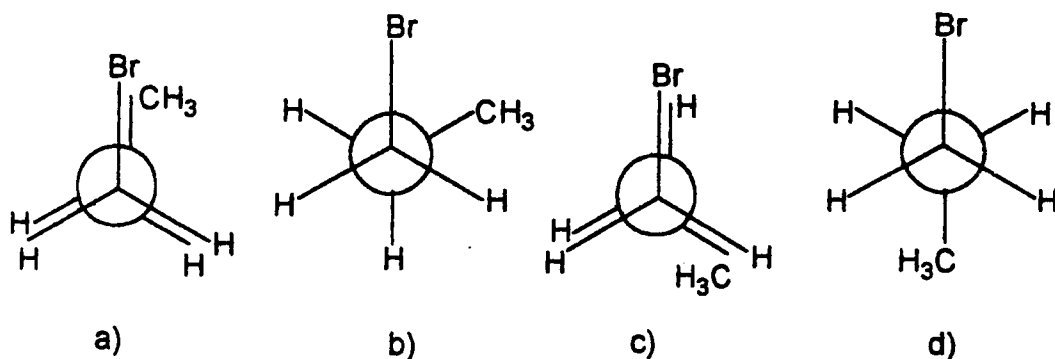
說明: 答案一律寫在答案紙並請標明題號依序作答

單選選擇題: (共 20 題, 每題 2 分)

1. Which of the following pairs of molecules are constitutional isomers?



2. Which of the following is the gauche form of propyl bromide?

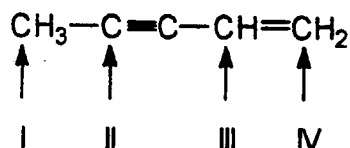


3. Which of the following acids has the highest pKa?

- a)  $\text{CH}_3\text{CO}_2\text{H}$       b)  $\text{H}_2\text{O}$       c)  $\text{NH}_4^+$       d)  $\text{HCl}$

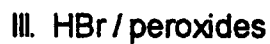
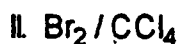
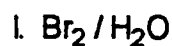
(背面仍有題目, 請繼續作答)

4. What is the correct hybridization for the carbon atoms in the following alkene?



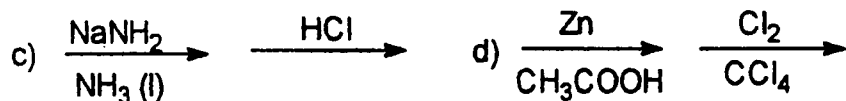
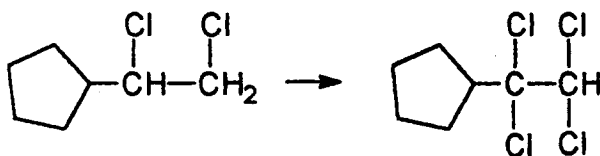
- a)  $sp^3, sp, sp^2, sp^2$     b) s, p, p, p    c)  $sp^3, sp^2, sp^2, sp^3$     d)  $sp^3, sp, sp, sp$

5. Which of the following reagents add to an alkene by an electrophilic mechanism?

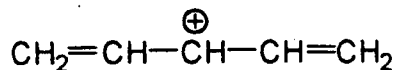
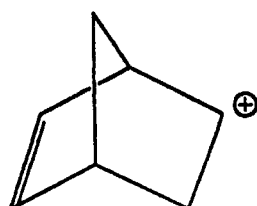
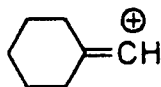
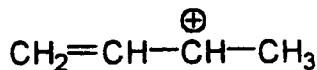
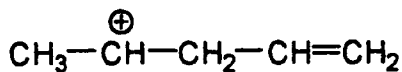
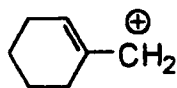


- a) I, II, III    b) I, II, IV    c) II, IV    d) II, III, IV

6. What are the best conditions for the following conversion?

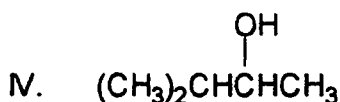
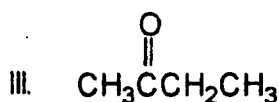
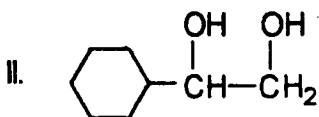
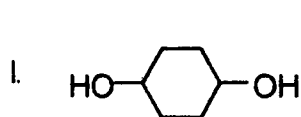


7. Which of the following are examples of allylic carbocations?



- a) II, III, V    b) II, III, IV    c) I, III, VI    d) IV, V, VI

8. Which of the following compounds contain stereocenters?



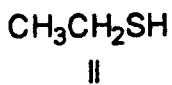
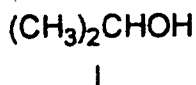
a) I, II

b) III, IV

c) I, III

d) II, IV

9. Arrange the following compounds in the order of increasing acidity (least first).



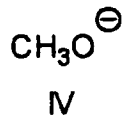
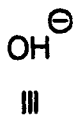
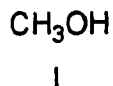
a) II, I, III, IV

b) I, IV, II, III

c) III, II, I, IV

d) II, I, IV, III

10. What is the order of increasing reactivity for the following nucleophiles (least first)?



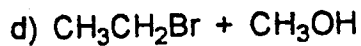
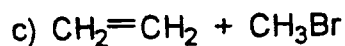
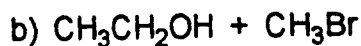
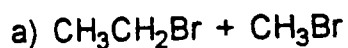
a) I, IV, II, III

b) IV, II, I, II

c) II, I, III, IV

d) IV, III, I, II

11. What are the products from the  $\text{S}_{\text{N}}2$  reaction of ethyl methyl ether with  $\text{HBr}$ ?



12. What kinds of compounds give an allylic cation as a common fragmentation ion?

a) alkenes

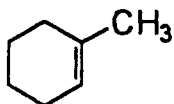
b) alkynes

c) cycloalkanes

d) cyclohexenes

(背面仍有題目, 請繼續作答)

13. How many sets of equivalent hydrogen atoms are there for the following compound?



- a) 3                      b) 4                      c) 5                      d) 6
14. Place the following species in the order of increasing bond stretching frequencies (lowest first).



I

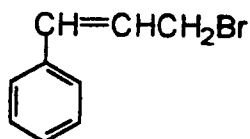
II

III

IV

- a) II, I, IV, III              b) I, II, IV, III              c) III, I, II, IV              d) IV, III, I, II

15. What is the correct name for the following structure?

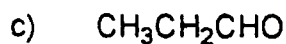
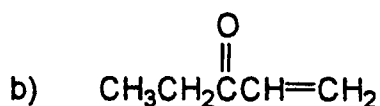
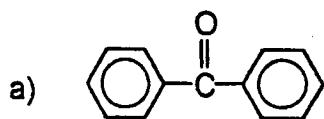


- a)  $\alpha$ -styryl bromide                      b)  $\beta$ -styryl bromide  
c) cinnamyl bromide                      d) 1-bromo-3-phenylpropene

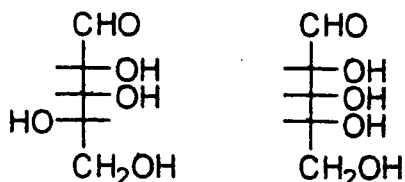
16. Which of the following groups is an ortho-para director?

- a)  $-\text{OCOCH}_3$     b)  $-\text{COOCH}_3$     c)  $-\text{CHO}$     d)  $-\text{COOH}$

17. A compound has a sharp, strong IR peak at  $\sim 1700 \text{ cm}^{-1}$  and a weaker band at  $2700 \text{ cm}^{-1}$ . The proton NMR spectra has signals at 7.0 and 9.5 ppm in addition to other signals. What is the most likely structure for this compound?

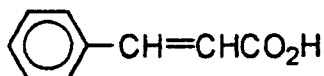


18. What is the relationship between the following compounds?



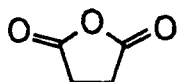
- a) enantiomers      b) anomers      c) meso compounds      d) epimers

19. What is the correct name for the following structure?



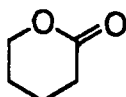
- a) 3-phenylpropenoic acid      b) 3-carboxy-1-phenylethene  
c) 1-phenylpropenoic acid      d) benzylacrylic acid

20. Which of the following compounds are named correctly?



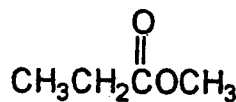
succinic anhydride

I



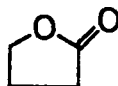
cyclohexyl anhydride

II



ethyl acetate

III



γ-butyrolactone

IV



N,N-dimethyl formamide (DMF)

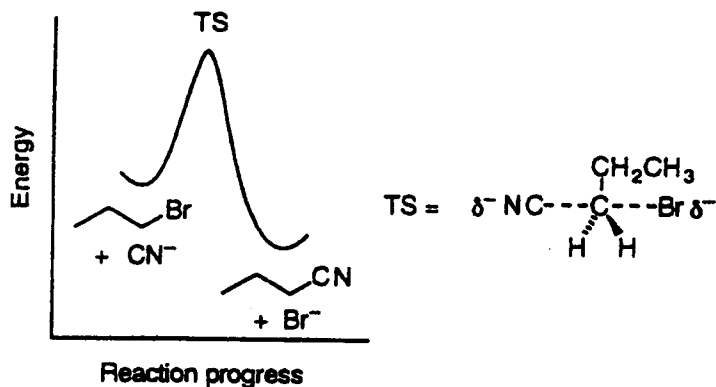
V

- a) I, II, III      b) II, III, IV      c) I, IV, V      d) III, IV, V

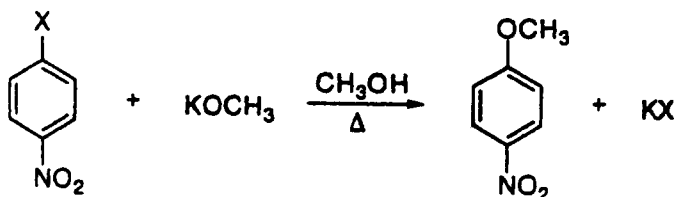
(背面仍有題目, 請繼續作答)

## 簡答題：(共 10 題，每題 6 分)

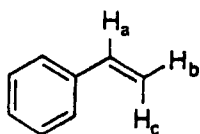
1. The reaction is a one-step,  $S_N2$  process that does not involve any distinct intermediates. Only one transition state is involved.



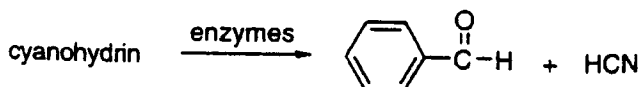
2. Explain why *p*-fluoronitrobenzene ( $X = \text{F}$ ) is approximately 800 times more reactive than *p*-iodonitrobenzene ( $X = \text{I}$ ) toward  $\text{KOCH}_3$  in nucleophilic aromatic substitution. Recall that the leaving group reactivity is just the opposite in aliphatic substitution.



3. Describe the spin-spin splitting patterns expected for protons *a*, *b*, and *c* of the following compound:



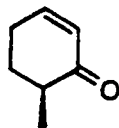
4. Some cyanohydrins are utilized by insects as defense agents against predators. The millipede, for example, stores in its glands a cyanohydrin that is enzymatically converted into benzaldehyde and  $\text{HCN}$  when the insect is under attack. This mixture is then rapidly squirted onto the predator. Suggest a structure for this cyanohydrin.



5. The most stable chair conformation of *cis*-1,3-cyclohexanediol has both hydroxyl groups in axial positions. Explain.

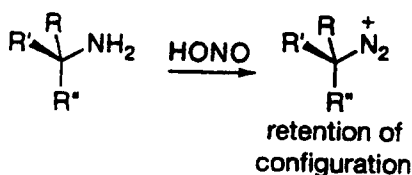
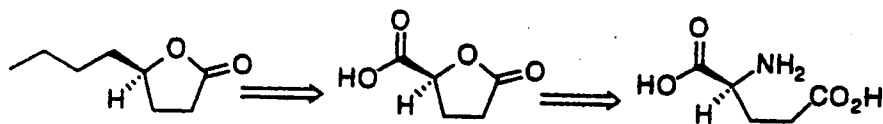


- b. The enantiomerically pure cyclic ketone below loses its optical activity on standing in a solution of NaOEt in EtOH. Explain.

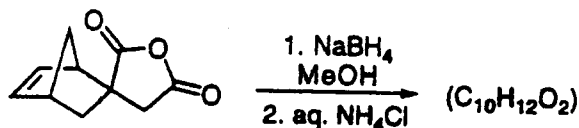


optically active

7. The optically active lactone A [(*R*)-4-butyl-4-butanolide], shown below, was synthesized from the readily available (*S*)-(+)-glutamate. Suggest a feasible synthetic sequence for the preparation of this compound given the following additional information: an amine may be converted to the corresponding diazonium salt with retention of configuration on treatment with HONO, and carboxylic acids may be reduced to alcohols in the presence of esters and lactones (which will not be affected) with  $\text{BH}_3$ .



8. Identify the compound formed in the following reaction:



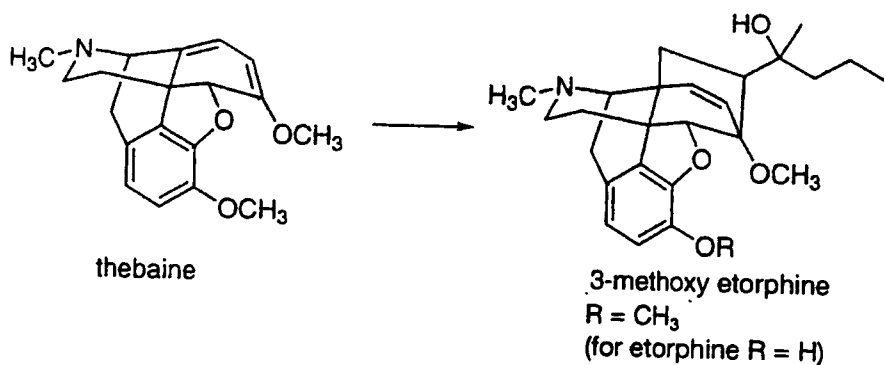
(背面仍有題目, 請繼續作答)

編號: 94  
89

系所: 生物科技研究所甲組, 2 組

科目: 有機化學

9. Morphine and many of its derivatives are extremely potent pain killers. Among the synthetic analogues of morphine is etorphine, which is some 1000 times more potent than morphine itself. Etorphine is not safe for humans; however, it is used to tranquilize elephants and other large animals. Etorphine is readily prepared from thebaine in a few steps. Use this compound and any necessary reagents and suggest an efficient route to the 3-methoxy derivative of etorphine shown below.



10. Provide a mechanism for the following reaction:

