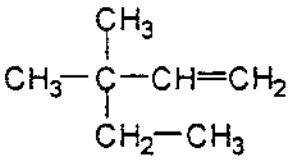
說明：答案一律寫在答案紙上並請標明題號依序作答

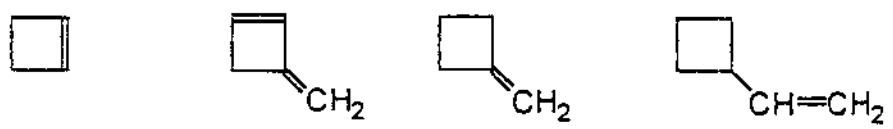
單選選擇題：(共 25 題，每題 2 分)

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



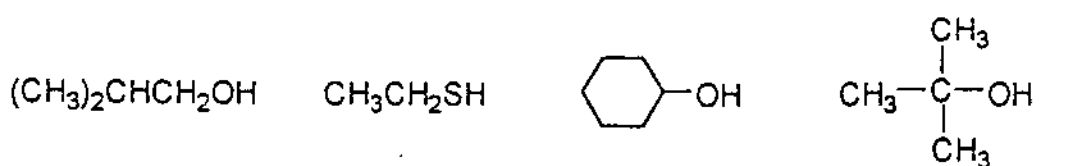
a) 3,3-dimethyl-4-pentene
b) 3-methyl-3-ethyl-1-butene
c) isopropylpentene
d) 3,3-dimethyl-1-pentene

2. What is the correct structure for vinylcyclobutane?



a) b) c) d)

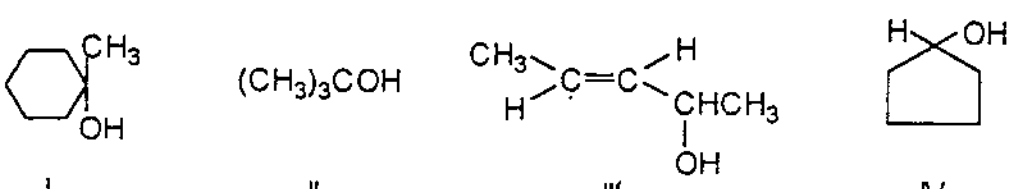
3. Which of the following structures have the correct common name?



isobutyl alcohol (I) butyl mercaptan (II) cyclohexyl alcohol (III) sec-butyl alcohol (IV)

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

4. Which of the following are secondary alcohols?



I II III IV

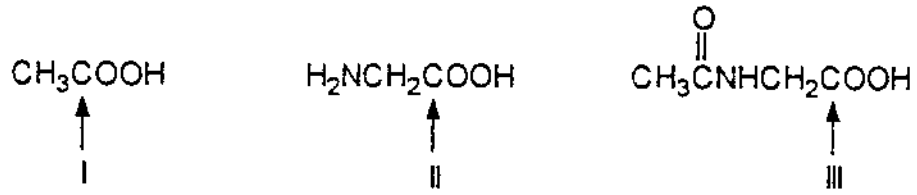
a) I, III
b) II, III
c) III, IV
d) I, IV

(背面仍有題目,請繼續作答)

5. What is the isoelectric point for an amino acid?

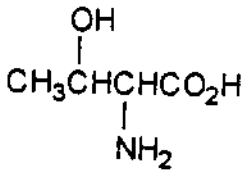
a) The degree of ionization of the amino acid at pH 7.
b) The pH at which there is no net charge for the amino acid.
c) The pH at which the ionized form predominates.
d) The pH at which the amino acid is present as the dipolar ion.

6. What is the order of increasing acidity for the indicated carboxyl groups (least first)?



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

7. How many stereoisomers are possible for the following structure?

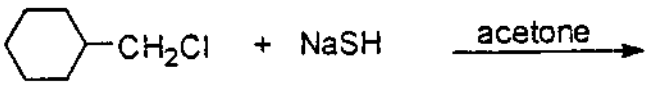


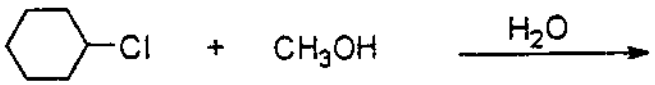
a) 1 b) 2 c) 3 d) 4

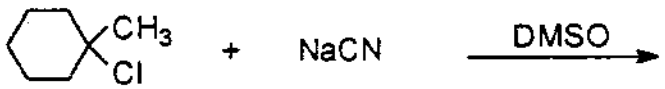
8. How many different alkenes with the molecular formula C_5H_9Cl are chiral?

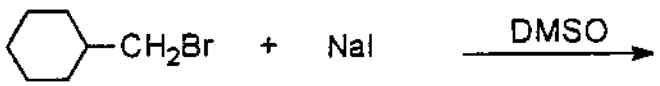
a) 2 b) 3 c) 4 d) 5

9. Which of the following are optimum conditions for an SN_2 reaction?

I. 

II. 

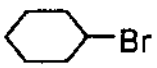
III. 

IV. 

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

10. Which of the following nucleophilic substitution reactions will proceed?

I $NaCl + CH_3CH_2I \xrightarrow{\text{acetone}}$

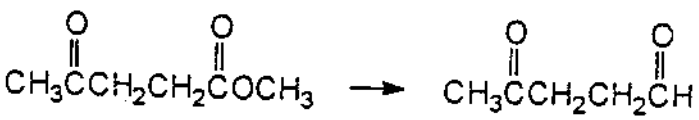
II. $NH_3 +$  $\xrightarrow{\text{ethanol}}$

III. $CH_3CH_2O^{\ominus} + CH_3CH_2CH_2Cl \xrightarrow{\text{ethanol}}$

IV. $LiCl + CH_3I \xrightarrow{\text{acetone}}$

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

11. What are the best conditions for the following transformation?



a) $\xrightarrow[HCl]{LiAlH_4 \quad H_2O}$ b) $\xrightarrow[HCl]{NaBH_4 \quad H_2O}$

c) $\xrightarrow[-78^0C]{DIBAL,\ toluene \quad H_2O/HCl}$ d) $\xrightarrow[quinoline]{Pd,\ BaSO_4}$

(背面仍有題目,請繼續作答)

12. What are the best conditions for the following reaction?

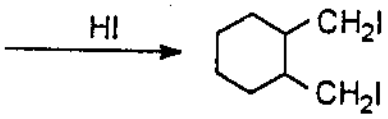
a) $LiAlH_4$ → H_2O, HCl

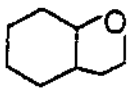
b) $NaBH_4$ → H_2O, HCl

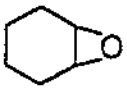
c) DIBAL, toluene, -78°C → H_2O, HCl

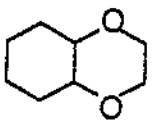
d) Pd, $BaSO_4$, quinoline

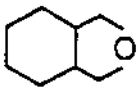
13. Which of the following ethers give the product shown in the reaction?



a) 

b) 

c) 

d) 

14. What are the best conditions for the following reaction?

15. UV-visible spectroscopy is used mostly to detect which of the following transitions?

a) electronic
b) molecular vibrational
c) dipole changes
d) symmetrical changes

16. What is the order of increasing energy for the following transitions (lowest first)?

I. π -------> π^* II. n -------> π^* III. n -------> σ^*

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

17. Which peak in the mass spectra could distinguish between 1-butanol and 2-butanol?

a) 74 b) 28 c) M - 18 d) M + 2

18. Which of the following compounds gives a base peak at 43?

a) $CH_3(CH_2)_4CH_3$ b) 

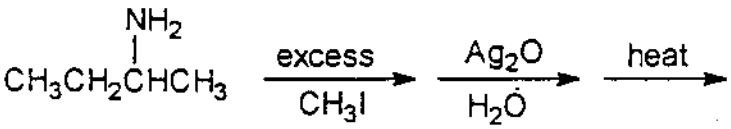
c) $(CH_3)_2CHCH_2CH_2CH_3$ d) $(CH_3)_2CHCH(CH_3)_2$

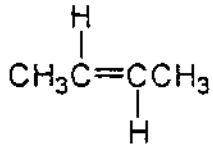
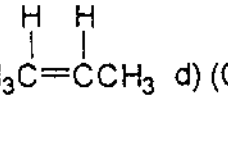
19. Compound A has the molecular formula $C_5H_{13}N$. It fails to react with acetic anhydride or with benzene sulfonyl chloride. Its proton NMR spectrum consists of 3 peaks: a six-proton singlet, a six-proton doublet, and a one-proton multiplet. What is the most likely structure for compound A?

a) $(CH_3)_2NCH_2CH_2CH_3$ b) $(CH_3CH_2)_2NCH_3$

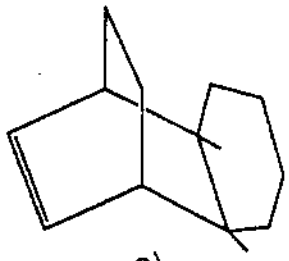
c) $(CH_3)_2NCH(CH_3)_2$ d) $CH_3NHCH_2CH(CH_3)$

20. What is the principal product from the following series of reactions?

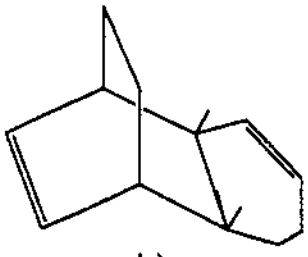


a) $CH_3CH_2CH{=}CH_2$ b)  c)  d) $(CH_3)_2C{=}CH_2$

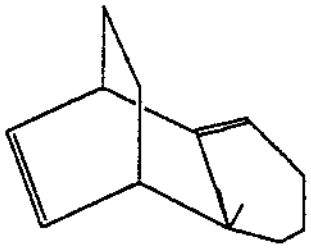
21. What is the Diels-Alder product from two moles of 1,3-cyclohexadiene?



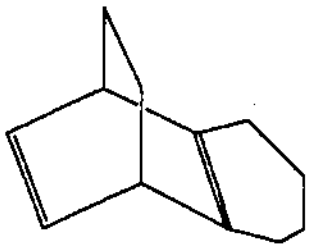
a)



b)

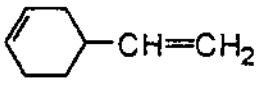


c)



d)

22. Which of the following dienophiles will react with butadiene to give the following product?



a) $CH_3CH{=}CH{-}CH{=}CH_2$

b) $CH_2{=}CH{-}CH{=}CH_2$

c) $CH_3{-}C{\equiv}CH{-}CH_3$

d) $CH_3C(CH_3){=}CH{-}CH_2{-}CH_3$

23. The specific rotation of dextrarotatory tartaric acid is +12.7 degrees. A mixture of dextrarotatory and levorotatory tartaric acid has a specific rotation of +6.35 degrees. What is the optical purity of the mixture?

a) 25% b) 33 1/3% c) 50% d) 75%

24. A chiral compound, C_5H_8, on catalytic hydrogenation yields an achiral compound, C_5H_{10}. What is the original chiral compound?

a) 1-methylcyclobutene
b) 3-methylcyclobutene
c) 1,2-dimethylcyclopropene
d) cyclopentene

25. A terminal alkyne, C_6H_{10}, loses its chirality when converted to C_6H_{14} by catalytic hydrogenation. What is the alkyne?

a) 1-hexyne
b) 3-methyl-1-pentyne
c) 4-methyl-1-pentyne
d) 3,3-dimethyl-1-butyne

簡答題：(共 10 題，每題 5 分)

*1. Find the conjugate bases of each of the following molecules:

CH_3COOH D_2O HCO_3^- CH_3NHCH_3 $(HO)_3PO$ HF

2. Explain why optically active (*R*)-2-iodopentane racemizes on standing in a solution of sodium iodide in acetone.

*3. Cyclopropenone is a surprisingly stable molecule. Draw another resonance form for cyclopropenone and explain how it might contribute to the overall stability of this molecule.

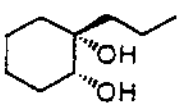
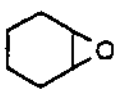
cyclopropenone

4. Give the products of each of the following reactions. If a mixture is expected, identify the major product.

a)  + $CH_3CH{=}CHCH_3$ $\xrightarrow{H_2SO_4}$

*5. Which compound, 3-pentanone or pentanal, is expected to have a lower ΔH of combustion? Explain your reasoning.

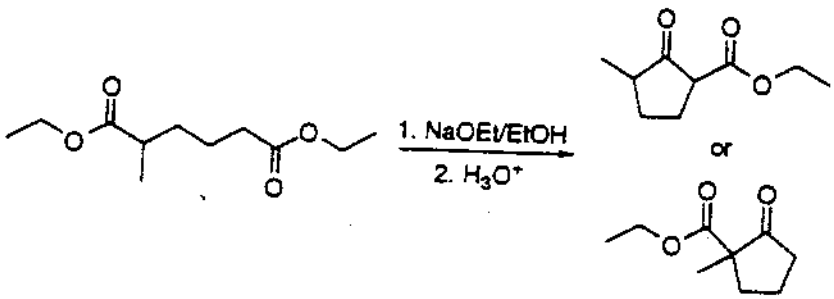
6. Suggest reasonable synthetic sequences for the preparation of each of the following compounds from the indicated starting material and any other necessary reagents:

a)  from 

(背面仍有題目，請繼續作答)

*7. Compound A of the molecular formula $C_{10}H_{12}O$ exhibits the following resonances in its ^1H NMR spectrum: 2.05 (s, 3H), 2.60–2.90 (two overlapping triplets, 4H), 7.20 (multiplet, 5H) ppm. Its ^{13}C NMR spectrum shows eight distinct signals - three between 20 and 50 ppm, four between 120 and 145 ppm, and a single peak at 207 ppm. Treatment of A with I_2/OH^- gives a yellow precipitate and reaction with $K_2Cr_2O_7/H_2SO_4/H_2O$ yields benzoic acid. Suggest a structure for A and justify your answer.

8. Only one cyclic product is formed in the following Dieckman condensation reaction. Which one? Explain.



*9. Provide a mechanistic explanation for the following reaction:

10. The following ^{14}C-labeled phenethyl-substituted sulfonate ester reacts over 1000 times faster with trifluoromethylacetic acid than does the ethyl substituted analogue. It also affords a substitution product in which the isotopic label is completely scrambled. Explain.