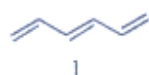


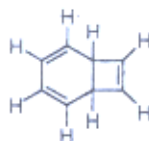
一、Select a best answer (40%)

1. Rank the following substances in decreasing order of heats of combustion (most exothermic → least exothermic).



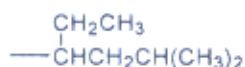
- (A) 2>1>3 (B) 3>1>2 (C) 2>3>1 (D) 3>2>1

2. The compound shown below has _____ sp^2-sp^2 σ bonds.



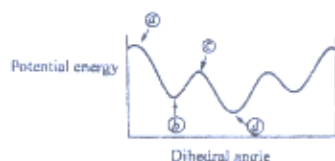
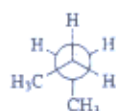
- (A) 3 (B) 4 (C) 6 (D) 14

3. What is the correct IUPAC name of the alkyl group shown below?



- (A) 5-methylhexyl (B) 4-ethyl-2-methylbutyl
(C) 1-ethyl-3,3-dimethylpropyl (D) 1-ethyl-3-methylbutyl

4. Which point on the potential energy diagram is represented by the Newman projection?



- (A) a (B) b (C) c (D) d

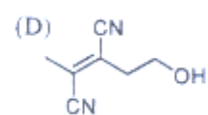
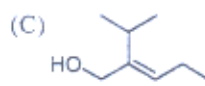
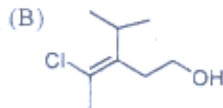
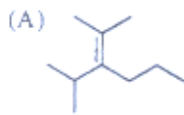
5. Referring to the following equilibrium (R = alkyl group)



- (A) $K = 1$, equal amounts of all species would be present
(B) $K > 1$, the equilibrium would be lie to the right
(C) $K < 1$, the equilibrium would be lie to the left
(D) not enough information is given
6. Complete hydrolysis of a nucleic acid yields each of the following, except
(A) a mixture of heterocyclic bases (B) an aldopentose, either ribose or deoxyribose
(C) phosphate ion (D) a mixture of amino acid
7. Which of the following alcohols would be most likely to undergo dehydration with rearrangement by a process involving a methyl shift?

(背面仍有題目,請繼續作答)

16. Which one of the alkenes shown below has the Z configuration of its double bond?



17. The two structures shown below are _____ each other.



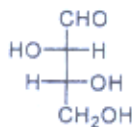
(A) identical with

(B) conformations of

(C) constitutional isomers of

(D) stereoisomers of

18. The configurations of the chirality center in D-threose are



(A) 2R,3R

(B) 2R,3S

(C) 2S,3R

(D) 2S,3S

19. An organic compound A is formed by the reaction of ethylmagnesium iodide with a substance B, followed by treatment with dilute aqueous acid. Compound A does not react with pyridinium chlorochromate in dichloromethane. Which of the following is a possible candidate for B?

(A) CH_3CHO

(B) $\text{CH}_3\text{CH}_2\text{OH}$

(C) $\text{CH}_3\text{CH}_2\text{COCH}_3$

(D) HCO_2CH_3

20. Which of the following compounds would have a ^1H NMR spectrum consisting of three singlets?

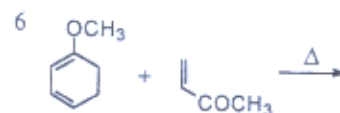
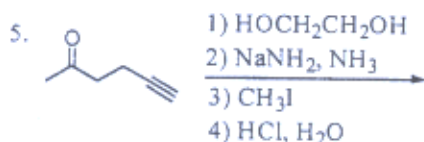
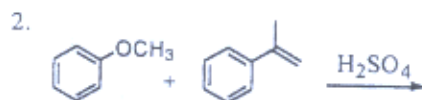
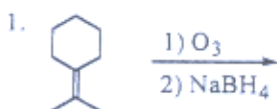
(A) $(\text{CH}_3)_3\text{CCH}_2\text{COCH}_3$

(B) $\text{OHCCH}_2\text{CH}_2\text{CH}_2\text{CHO}$

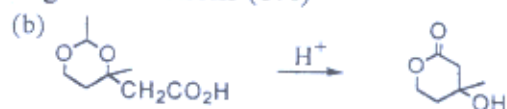
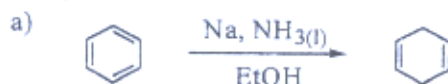
(C) $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$

(D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NO}_2$

二、Predict the major product with proper regiochemistry and stereochemistry for each of the following reactions. (18%)



三、Propose a reasonable mechanism for the following two reactions (6%)



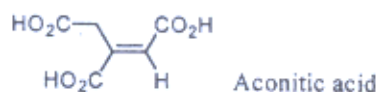
(背面仍有題目,請繼續作答)

四、Propose a reasonable synthetic route to carry out the following two transformations. (9%)

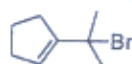


五、Answer the following questions (27% ; 除第 8 小題為 6 分外、其餘每小題 3 分)

1. Write the propagation steps for the light-initiated reaction of bromine with methylcyclohexane
2. The enzyme aconitase catalyzes the hydration of aconitic acid to two products: citric acid and isocitric acid. Isocitric acid is optically active; citric acid is not. What is the constitution of citric acid?



3. How many stereoisomeric products are obtained from the reaction of (*S*)-3-chloro-1-butene with hydrogen bromide? What is their relationship, enantiomers or diastereomers?
4. Briefly explain why the reaction of 1-bromobutane with sodium azide occurs faster in dimethyl sulfoxide than in water.
5. Draw the structure of the carbocation formed on ionization of the compound shown below. A constitutional isomer **X** of this compound gives the same carbocation; draw the structure of **X**.



6. Which is the stronger acid, *m*-hydroxybenzaldehyde or *p*-hydroxybenzaldehyde? Explain your answer.
7. Describe the splitting pattern and estimate the coupling constant for the proton at C-2 in (*Z*)-1-chloropropene.
8. On the basis of the spectral information of a compound **Y** provided,
 - Mass spectrum: m/z 113 (20, M^+)
 - ^1H NMR spectrum: δ 1.31 (3H, t), 3.50 (2H, s), 4.28 (2H, q)
 - ^{13}C NMR spectrum: δ 14, 25, 65, 113, 163
 - IR spectrum: 2980, 2260, 1747 cm^{-1}
 - (a) what is the molecular formula of **Y**?
 - (b) what kind of functional group does this compound have?
 - (c) what is the structural formula of **Y**?