- Select a best answer (40%)
- Rank the following substances in decreasing order of heats of combustion (most exothermic → least exothermic).



2

(A) 2>1>3

(B) 3>1>2

(C) 2>3>

(D) 3>2>1

2. The compound shown below has $____sp^2-sp^2 \sigma$ bonds.

(A)3

(B) 4

(C) 6

(D) 14

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

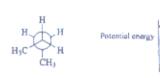
(A) 5-methylhexyl

(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

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)

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(A) OH (E	OH OH	(C) OH	(D)	> ОН		
8. For the reaction shown	below, the major pr	oduct is formed	by			
Br + CH ₃ C	Na					
(A) a E1 reaction (B) a E2 reaction	(C) a S _N 1 rea	action (D) a	S _N 2 reactio	n	
9. Which of the following in hydrochloric acid? (1) 17 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				with sodi	ım ni	trite
(A) N-Ethyl-2-methylaniline (C) p-Aminoacetophenone		(B) 4-Chloro-2-nitroaniline				
		(D) m-Ethyla				
10. Benzalacetone is the mi What is the structure?	xed aldol condensa	tion product for	ned between benz	aldehyde a	nd ac	etone.
(A) PhCH=CHCOCH ₃		(B) PhCOCH=CHCH ₃				
(C) PhCH=C(CH ₃) ₂		(D) PhCH ₂ C	OCH=CH ₂			
11. Which of the following	pairs of reactants is	most effective i	n forming an enar	nine?		
(A) O (CH ₃) ₃ CC-H + Et ₂ N	Н	(B) CH ₃ CH ₂ C	D CCH₂CH₃ + CH₃NH	I ₂		
(C) 0 CH ₃ CH ₂ C-H + Et ₂ N	Н	(D) CH ₃ CH ₂ (о Ссн ₂ сн ₃ + (СН ₃) ₃	N		
12. Which one of the follow	ing is best classifie	d as a heterocyc	lic aromatic comp	ound?		
(A) NH		(C)	(D)	NH ₂		
13. Which one of the follow	ing is a diastereom	er of (R)-4-brom	no-cis-2-hexene?			
(A) (S)-4-bromo-cis-2-h		(B) (R)-4-bro	mo-trans-2-hexen	e		
(C) (R)-5-bromo-cis-2-h	exene	(D) (S)-5-bro	mo-trans-2-hexen	e		
14. A meso compound						
(A) is an achiral molecular	le that contains chir	rality centers	(B) is optically ina	active		

(C) contains a plane of symmetry or a center of symmetry (D) is characterized by all of above

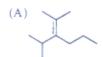
(B) 2,2-Dimethylbutanal

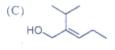
(D) α -Aminoethanoic acid

15. Which one of the following is chiral? (A) 1,3-Dibromo-1-chloropropane

(C) 1-Chloro-5-pentanol

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)CH₃CHO
- (B) CH_3CH_2OH
- (C) CH₃CH₂COCH₃
- (D) HCO₂CH₃

20. Which of the following compounds would have a ¹H NMR spectrum consisting of three singlets? (A) (CH₃)₃CCH₂COCH₃ (B) OHCCH₂CH₂CH₂CH₀ (C) C₆H₅CH₂CH₀ (D) CH₃CH₂CH₂NO₂

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

- 1.
- 1) O₃
- OCH₃ H_2SO_4

3. Br₂, FeBr₃

4. $OOO + 2 CH_3MgBr = \frac{1) \text{ diethyl ether}}{2) H_3O^+}$

- 5.
- 1) HOCH₂CH₂OH 2) NaNH₂, NH₃ 3) CH₃I

4) HCl, H2O

6 OCH₃ + COCH₂ -

= \ Propose a reasonable mechanism for the following two reactions (6%)

a)



- Na, NH_{3(I}
- (b) O CH₂CO₂H
- H⁺
- OH OH

(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.
- 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.

- 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)

¹³C 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?