

國立臺灣海洋大學 101 學年度研究所碩士班暨碩士在職專班入學考試試題

考試科目：有機化學

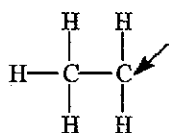
系所名稱：生物科技研究所碩士班乙組、生物科技研究所碩士班甲組

1. 答案以橫式由左至右書寫。2. 請依題號順序作答。

PART I : Multiple Choice(50%)

Identify the choice that **best completes** the statement. (2%/pt)

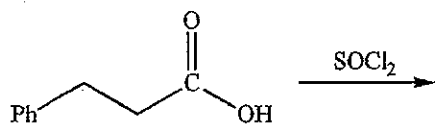
1. According to atomic theory:
 - a. the nucleus is positively charged.
 - b. the nucleus contains both charged and uncharged particles.
 - c. the electrons contribute very little to the total mass of the atom.
 - d. the electrons are located in the atomic space outside the nucleus.
 - e. all of these
2. Which of the following statements is **not true**?
 - a. The carbon-carbon single bond of an alkane is weaker than the carbon-carbon triple bond of an alkyne.
 - b. The carbon-carbon triple bond of an alkyne is shorter than the carbon-carbon double bond of an alkene.
 - c. The carbon-carbon triple bond of an alkyne is exactly three times as strong as a carbon-carbon single bond of an alkane.
 - d. The carbon-carbon single bond of an alkane is longer than the carbon-carbon triple bond of an alkyne.
3. The following species forms during an organic reaction.



What is the formal charge on the carbon atom indicated by the arrow?

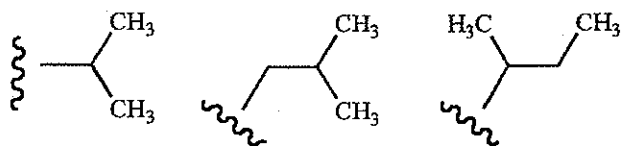
- a. 0
 - b. +1
 - c. -1
 - d. +2
 - e. -2
4. The most stable conformation of an alkane occurs when
 - a. carbon-carbon bonds are staggered and bulky groups are gauche.
 - b. carbon-carbon bonds are staggered and bulky groups are anti.
 - c. carbon-carbon bonds are eclipsed and bulky groups are gauche.
 - d. carbon-carbon bonds are eclipsed and bulky groups are anti.

5. What is the major organic product obtained from the following reaction?



- a.
- b.
- c.
- d.

6. Name these groups (left to right).

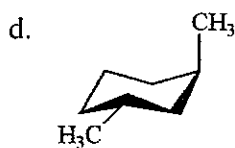
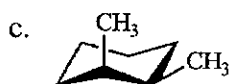
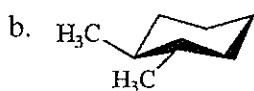


where represents the parent chain.

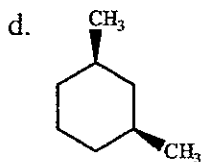
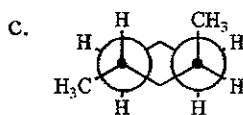
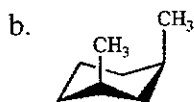
- a. *sec*-propyl, *sec*-butyl, isobutyl
 b. isopropyl, isobutyl, *sec*-butyl
 c. *sec*-propyl, *tert*-butyl, isobutyl
 d. isopropyl, *tert*-butyl, isobutyl
 e. isopropyl, *tert*-butyl, *sec*-butyl
7. How many constitutional isomers are there with the molecular formula C_6H_{14} ?
- a. 3
 b. 4
 c. 5
 d. 8

8. Substitution of which of the following groups on a cycloalkane would result in the greatest amount of steric strain?
- bromo
 - ethyl
 - isopropyl
 - hydroxyl

9. Which of the following structures represents *trans*-1,2-dimethylcyclohexane?



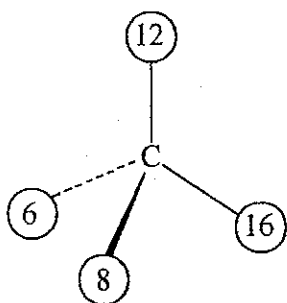
10. Which one of the following structures represents a different compound from the other three?



11. Which of the following has a plane of symmetry?

- a. boot
- b. laboratory beaker
- c. hammer
- d. both b and c
- e. none of these

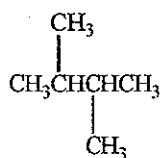
12. The numbers on the carbon center of the following molecule represent atomic numbers.



The molecule is in

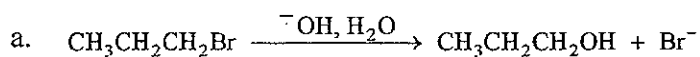
- a. the *R* configuration.
 - b. the *S* configuration.
 - c. The carbon is not a chiral center in this molecule.
 - d. The exact configuration cannot be determined without knowing additional atomic numbers.
13. Which of the following is the definition of a pair of diastereomers?
- a. A pair of structures that are superimposable mirror images of one another
 - b. A pair of stereoisomers that are non-superimposable mirror images of one another
 - c. A pair of stereoisomers that are not mirror images of one another
 - d. A pair of stereoisomers that have equal specific rotations
14. Which of the following correctly describes a molecule that is achiral?
- a. Non-superimposability of the molecule on its mirror image
 - b. Superimposability of the molecule on its mirror image
 - c. Contains a carbon atom with four different substituents
 - d. Does not have a plane of symmetry
 - e. Both b and d

15. How many stereoisomers of 2,3-dimethylbutane exist?



- a. 1
- b. 2
- c. 3
- d. 4

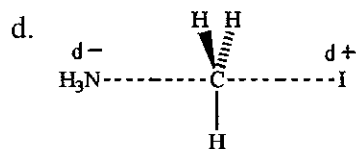
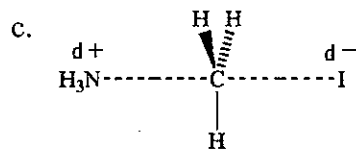
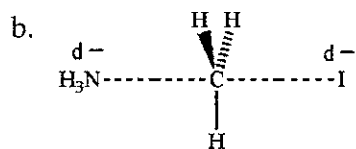
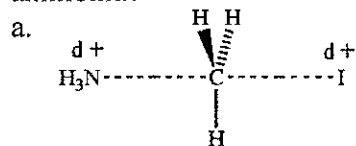
Instructions: Consider the pair of reactions below to answer the following question(s).



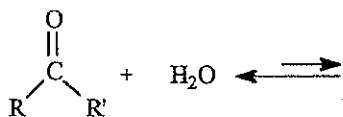
or



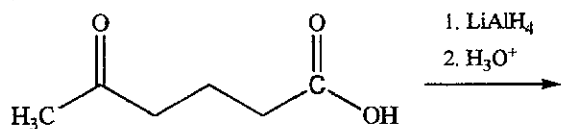
16. Which of the following represents the transition state of the $\text{S}_{\text{N}}2$ reaction between methyl iodide and ammonia?

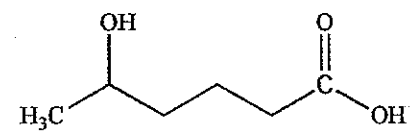
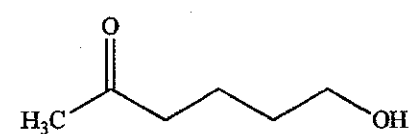
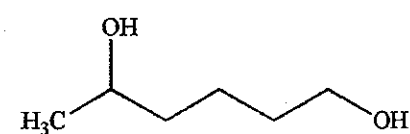
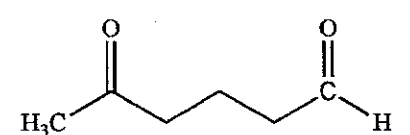


17. The substance formed in the following reaction is called:

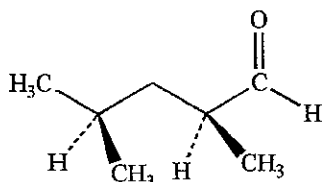


- vicinal diol
 - geminal diol
 - acetal
 - hydrate
 - b or d
18. If the 1,3-diaxial strain for an ethyl group is 4.0 kJ/mol, what is the energy difference between the axial and equatorial conformations of ethylcyclohexane?
- 2.0 kJ/mol
 - 4.0 kJ/mol
 - 8.0 kJ/mol
 - 16.0 kJ/mol
 - Cannot be determined from the 1,3-diaxial strain
19. What is the major organic product obtained from the following reaction?



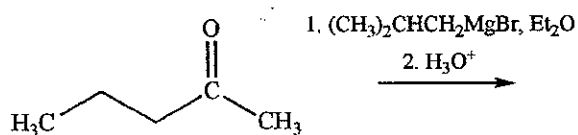
- 
- 
- 
- 

20. What is the IUPAC name of the following compound?



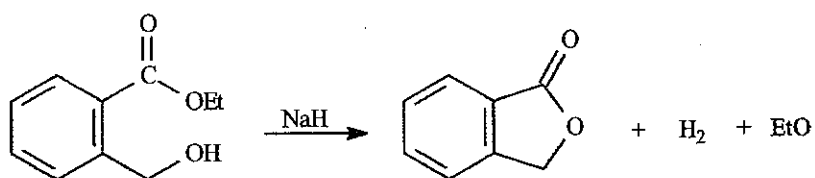
- a. (2*S*,4*R*)-dimethylpentanal
- b. (2*S*,4*S*)-dimethylpentanal
- c. (*R*)-2,4-dimethylpentanal
- d. (*S*)-2,4-dimethylpentanal

21. What is the name of the major organic product obtained from the following reaction?



- a. 2,3-dimethylheptan-3-ol
- b. 2,4-dimethylheptan-4-ol
- c. 3,5-dimethylheptan-4-ol
- d. 3,5-dimethylheptan-3-ol

Instructions: Consider the reaction below to answer the following question(s).

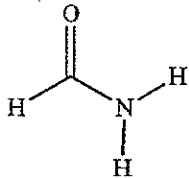


22. Refer to instructions. The product of this reaction is:

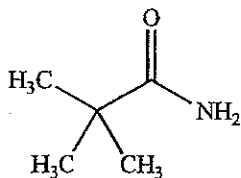
- a. a lactone
- b. an anhydride
- c. a lactam
- d. an ether

23. Which of the following compounds is a 2° amide?

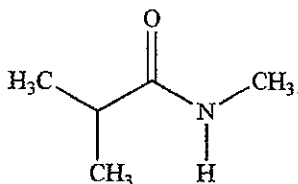
a.



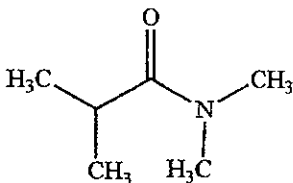
b.



c.



d.



24. Refer to instructions. Which of the following statements is *false*?

- a. The kinetics of these reactions are second-order
- b. The kinetics of these reactions are first-order in the nucleophile
- c. The rate law would be of the form $R = k[\text{alkyl halide}]^2$
- d. The kinetics of these reactions are first-order in alkyl halide

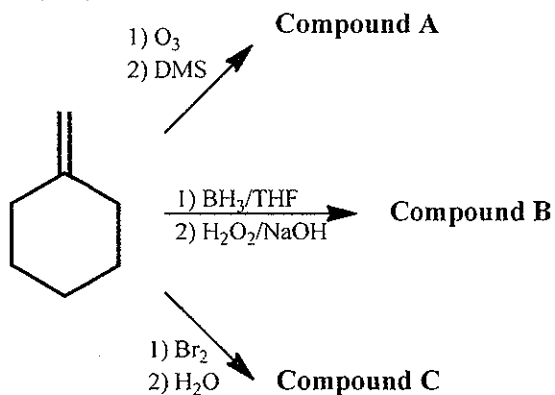
25. Which of the following is the correct order of decreasing reactivity in hydrolysis reactions (more reactive > less reactive)?

- a. anhydrides > amides > acid chlorides
- b. amides > acid chlorides > anhydrides
- c. anhydrides > acid chlorides > amides
- d. acid chlorides > anhydrides > amides

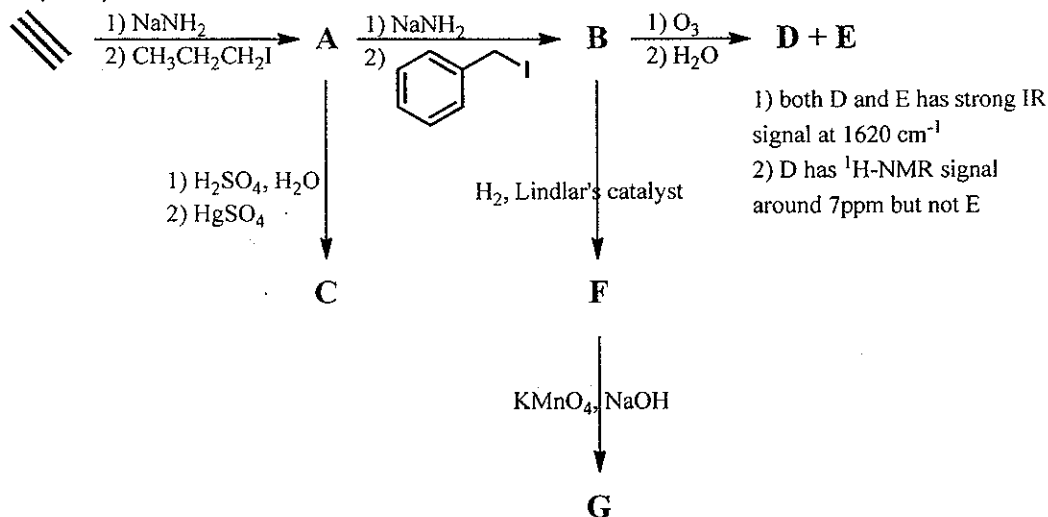
PART II : Short Answer (50%)

What are the structures of products in the following reactions? The correct stereochemistry view of structure has to be shown in order to get full credits. (%)

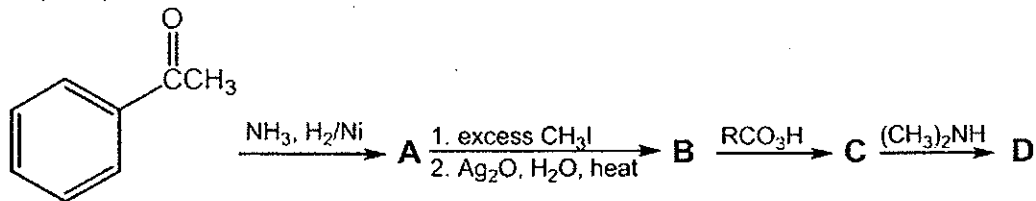
1. (6%)



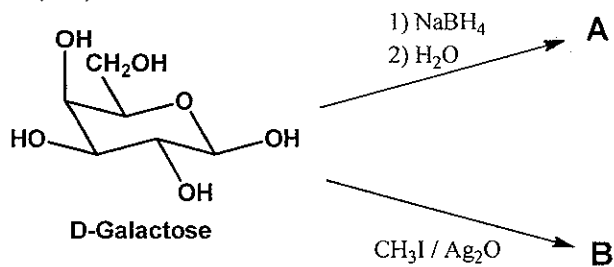
2. (21%)



3. (12%)



4. (6%)



5. Determine the structure of a compound with the molecular formula C₅H₁₀O based on the following information including peak list from mass spectrum, IR, ¹H- and ¹³C-NMR spectra. (5%)

Mass Spec. Data	
m/z	relative abund.
15	23
26	20
27	61
29	92
30	20
31	45
39	47
41	100
45	10
57	82
58	86
86	12

