

# 義守大學 102 學年度碩士班入學招生考試試題

系所別	生物技術與化學工程研究所	考試日期	102/3/16
考試科目	有機化學	頁碼/總頁數	1/4

※此為試題卷，請將答案填寫在答案卷內，未寫於答案卷內者，不予計分。

※本科目不可使用計算機。

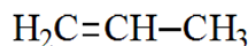
## 一、 單選題 (1-20 題，每題 4 分，共 80 分)

(1) Based on the VSEPR model, which of the following species has (have) a trigonal planar geometry?

I.  $\text{BCl}_3$     II.  $\text{NH}_3$     III.  $\text{NO}_3^-$

A) only I    B) I and II    C) I and III    D) I, II, and III

(2) The hybridization of carbon atoms 1, 2, and 3 in the following are, respectively



1    2    3

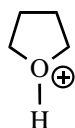
A)  $sp$ ,  $sp$ , and  $sp^2$

C)  $sp^2$ ,  $sp^3$ , and  $sp^3$

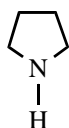
B)  $sp$ ,  $sp$ , and  $sp^3$

D)  $sp^2$ ,  $sp^2$ , and  $sp^3$

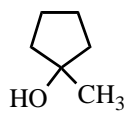
(3) Rank the following in order of decreasing acidity. (more acidic > less acidic)



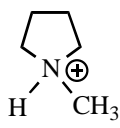
I



II



III



IV

A) I > IV > III > II

C) IV > I > II > III

B) III > II > I > IV

D) I > III > IV > II

(4) Arrange the following isomeric alkanes in order of increasing boiling point.

I. n-heptane

II. 2,3-dimethylpentane

III. 2,2,3-trimethylbutane

A) I < II < III    B) II < III < I    C) III < I < II    D) III < II < I

(5) Predict which of the following constitutional isomers of  $\text{C}_5\text{H}_{10}$  would have the highest heat of combustion?

A) methylcyclobutane

C) *cis*-1,2-dimethylcyclopropane

B) cyclopentane

D) *trans*-1,2-dimethylcyclopropane

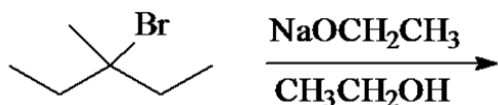
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- (6) Cyclohexane adopts the chair conformation rather than a planar structure because
- I. torsional strain is minimized.
  - II. the C—C—C bond angles are close to 109.5°.
  - III. there are no 1,3-diaxial interactions in a planar structure.
- A) only I    B) only II    C) I and II    D) I, II, and III
- (7) Which is more stable, cis-1,3-dimethylcyclohexane or trans-1,3-dimethylcyclohexane?
- A) trans-1,3-dimethylcyclohexane
  - B) cis-1,3-dimethylcyclohexane
  - C) They are equally stable.
  - D) Stabilities of cis, trans stereoisomers cannot be compared.
- (8) Which method or methods would work to quantitatively prepare a sodium ethoxide solution?
- I.  $\text{CH}_3\text{CH}_2\text{OH} + \text{NaOH}$
  - II.  $\text{CH}_3\text{CH}_2\text{OH} + \text{NaH}$
  - III.  $\text{CH}_3\text{CH}_2\text{OH} + \text{Na}$
- A) I and II    B) I and III    C) II and III    D) I, II, and III
- (9) Identify the major organic product expected from the acid-catalyzed dehydration of 2-methyl-2-pentanol.
- A) 2-methyl-1-pentene
  - B) *cis*-3-methyl-2-penten
  - C) 3-methyl-1-pentene
  - D) 2-methyl-2-pentene
- (10) How many isomeric alkenes are possible, including stereoisomers, in the following reaction?



- A) two    B) three    C) four    D) five
- (11) Which of the following alkenes is expected to have the highest heat of hydrogenation?
- A) 1-pentene    B) *trans*-2-pentene    C) *cis*-2-pentene    D) 2-methyl-2-butene
- (12) Which species below acts as the nucleophile in the acid-catalyzed addition of water to an alkene?
- A)  $\text{H}_3\text{O}^+$     B) the carbocation    C)  $\text{OH}^-$     D)  $\text{H}_2\text{O}$

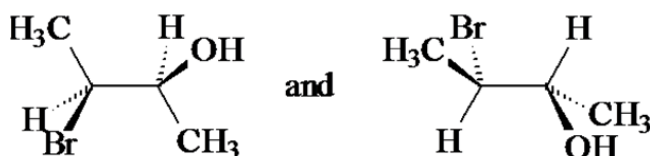
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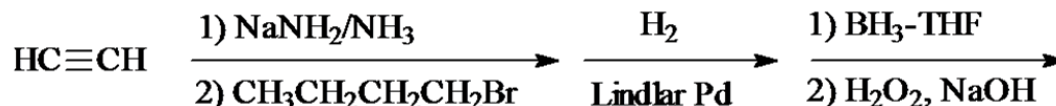
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(13) What is the relationship between the following two compounds?



- A) different conformations of the same compound  
 B) enantiomers  
 C) constitutional isomers  
 D) diastereomers
- (14) Identify the major product(s) in the reaction of (R)-2-bromopentane with sodium cyanide in DMSO?
- A) (R)-2-cyanopentane                      C) racemic mixture of 2-cyanopentane  
 B) (S)-2-cyanopentane                      D) *trans*-2-pentene
- (15) What is the product of the following reaction sequence?



- A) 1-hexanol    B) 2-hexanol    C) 1,2-hexanediol    D) 1-hexene
- (16) Which of the following compounds most readily undergoes solvolysis with methanol?
- A) (*E*)-1-bromo-1-butene                      C) 3-bromo-1-butene  
 B) 2-bromo-1-butene                              D) 4-bromo-1-butene
- (17) Which one of the following substituents is deactivating and ortho-para directing in electrophilic aromatic substitution reactions?
- A) -Cl    B) -N(CH<sub>3</sub>)<sub>2</sub>    C) -CO<sub>2</sub>H    D) -CH=CH<sub>2</sub>

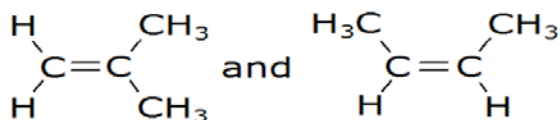
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- (18) Which of the methods below would be most useful in distinguishing between the following two compounds?



- A) UV spectroscopy  
 B) C-13 NMR  
 C) IR spectroscopy  
 D) mass spectrometry
- (19) In infrared spectroscopy, absorption of electromagnetic radiation results in transitions between \_\_\_\_\_ energy levels.  
 A) vibrational    B) electronic    C) rotational    D) nuclear
- (20) In proton NMR, <sup>1</sup>H-<sup>1</sup>H spin-spin splitting is common. Why is there no comparable <sup>13</sup>C-<sup>13</sup>C spin-spin splitting in C-13 NMR?  
 A) C-13 has a nuclear spin of zero.  
 B) The probability of two C-13 nuclei being next to each other in a compound is very low.  
 C) The coupling constant is very small—too small to be observed.  
 D) There is <sup>13</sup>C-<sup>13</sup>C spin-spin splitting but because of the complex splitting patterns decoupling techniques are used to suppress it.

## 二、簡答題 (1-2 題，每題 10 分，共 20 分)

- (1) Can primary alkyl halides react by S<sub>N</sub>2, S<sub>N</sub>1, E2, and E1 mechanisms? Are any of these mechanisms prohibited? What conditions favor a particular mechanism?
- (2) Provide the major organic product of the reaction below and a detailed, stepwise mechanism which accounts for its formation.

