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並不得書寫、畫記、作答。

國立清華大學 108 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 丙組

考試科目(代碼)：有機化學(2801)

— 作答注意事項 —

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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共 8 頁，第 1 頁 *請在【答案卡】作答

一、單選題 (每題 4 分共 100 分) 請在【答案卡】作答

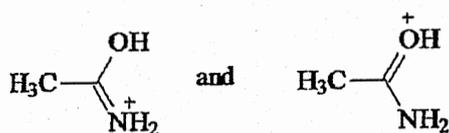
1. The rate of an S_N2 reaction run in a polar aprotic solvent relative to the same reaction in a polar protic solvent would be

- (A) the same
- (B) slower
- (C) faster
- (D) unpredictable
- (E) unimolecular

2. Which of following would react most rapidly with sodium ethoxide to produce an ether?

- (A) chlorobenzene
- (B) *p*-nitrotoluene
- (C) *p*-nitrochlorobenzene
- (D) *m*-(chloromethyl)-toluene
- (E) *m*-chlorotoluene

3. What is the relationship between the following two structures?



- (A) resonance forms
- (B) stereoisomers
- (C) constitutional isomers
- (D) tautomers
- (E) diastereomers

4. Which of these compounds has highest pK_a ?

- (A) phenol
- (B) 3-nitrophenol
- (C) 4-nitrophenol
- (D) benzoic acid
- (E) *p*-toluenesulfonic acid

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5. Which of the following has the largest acid dissociation constant (K_a)?

- (A) CH_3CH_3
- (B) $\text{H}_2\text{C}=\text{CH}_2$
- (C) $\text{HC}\equiv\text{CH}$
- (D) $\text{CH}_3\text{CH}_2\text{OH}$
- (E) CH_3COOH

6. In UV spectroscopy, the closer the energies of the HOMO and LUMO

- (A) The longer will be λ_{max}
- (B) The lower will be the frequency of the absorbed light
- (C) When the system is highly conjugated
- (D) All of above
- (E) None of above

7. Which of the following compounds most readily undergoes a unimolecular elimination (E_1) reaction?

- (A) $\text{CH}_3\text{CH}_2\underset{\text{Br}}{\text{CH}}\text{CH}_3$
- (B) $\text{CH}_3\underset{\text{CH}_3}{\text{CH}}\text{CH}_2\text{Br}$
- (C) $\text{CH}_3\underset{\text{Br}}{\text{CH}}\text{CH}_3$
- (D) $\text{H}_3\text{C}-\underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}}-\text{Br}$
- (E) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$

8. Which one if the following compounds would have the largest value of λ_{max} (in nm) in its UV-Vis spectrum?

- (A) 1,3,5-cycloheptatriene
- (B) β -carotene
- (C) o-methoxytoluene
- (D) bicyclo[2.2.2]octa-2,5-diene

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共 8 頁，第 3 頁 *請在【答案卡】作答

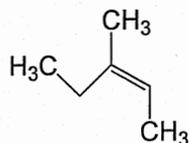
9. The singlet appearing at δ 2.2 in the H^1 NMR spectrum of 3-hydroxy-2-butanone corresponds to:

- (A) the OH group
- (B) the proton at C-1
- (C) the proton at C-3
- (D) the proton at C-4

10. A molecule has three degrees of unsaturation. In this molecule there would be

- (A) three rings
- (B) three double bonds
- (C) two rings and one double bond
- (D) one ring and two double bonds
- (E) any of the above

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



- (A) (E)-3-methylpent-3-ene
- (B) (Z)-3-methylpent-3-ene
- (C) (E)-3-methylpent-2-ene
- (D) (Z)-3-methylpent-2-ene

12. Which of the following amines is the most basic?

- (A) aniline
- (B) N-ethylaniline
- (C) N,N-diethylaniline
- (D) piperidine
- (E) pyrrole

13. Which reagent(s) would convert cyclohexene into a *cis*-glycol?

- (A) cold dilute potassium permanganate
- (B) hydrogen peroxide and aqueous acetic acid
- (C) ozone and moist zinc dust
- (D) periodic acid
- (E) sodium tert-butoxide in chloroform

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共 8 頁，第 4 頁 *請在【答案卡】作答

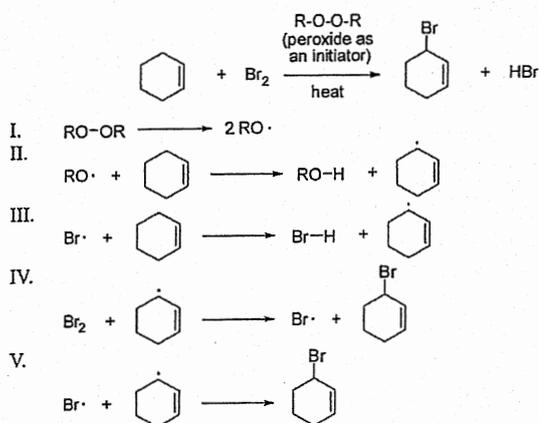
14. How are reactions between aldehydes and nucleophiles fundamentally different than reactions between acyl chlorides and nucleophiles?

- (A) Aldehydes are readily oxidized by nucleophiles to carboxylic acids.
- (B) Acyl chlorides have a leaving group, Cl⁻, whereas aldehydes do not.
- (C) Aldehydes do not form tetrahedral intermediates with nucleophiles.
- (D) Acyl chlorides readily form enol tautomers.

15. A hexa-peptide was found to contain the amino acids Phe, Gly, Ala and Ser. N-Terminal analysis yields N-(2,4-dinitrophenyl)phenylalanine. Partial hydrolysis of the peptide gives the dipeptides Phe-Gly, Ala-Ser, Gla-Ala, Met-Met, what is the peptide sequence?

- (A) Phe-Met-Met-Ala-Ser-Gly
- (B) Met-Met-Phe-Gly-Ala-Ser
- (C) Phe-Gly-Ala-Ser-Met-Met
- (D) Gly-Ala-Ser-Met-Met-Phe

16. Which of the following is(are) the propagation step(s) in the bromination of cyclohexene shown below:



- (A) I and II
- (B) I only
- (C) III, IV and V
- (D) II and IV
- (E) III and IV

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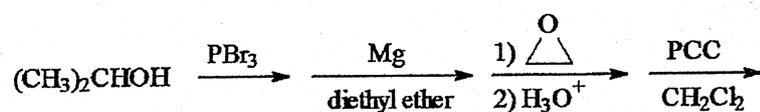
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17. Which of the following syntheses gives 3-methyl-1-hexanol?

- (A) 3-methylhex-1-ene $\xrightarrow[\text{H}_2\text{O}]{\text{OsO}_4, \text{Na}_2\text{SO}_3}$
- (B) 2-bromopentane $\xrightarrow[\text{diethyl ether}]{\text{Mg}}$ $\xrightarrow[2) \text{H}^+]{1) \text{epoxide}}$
- (C) 3-bromopentane $\xrightarrow[\text{diethyl ether}]{\text{Mg}}$ $\xrightarrow[2) \text{H}^+]{1) \text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}}$
- (D) 1-bromobutane $\xrightarrow[\text{diethyl ether}]{\text{Mg}}$ $\xrightarrow[2) \text{H}^+]{1) \text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3}$
- (E) 2-bromohexane $\xrightarrow[\text{diethyl ether}]{\text{Mg}}$ $\xrightarrow[2) \text{H}^+]{1) \text{H}_2\text{C}=\text{O}}$

18. What is the final product of the following sequence of reactions?



- (A) $(\text{CH}_3)_2\text{CHOCH}_2\text{CH}_2\text{OH}$
- (B) $(\text{CH}_3)_2\text{CH}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
- (C) $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$
- (D) $(\text{CH}_3)_2\text{CHCH}_2\text{CO}_2\text{H}$
- (E) $\text{CH}_3-\overset{\text{Br}}{\text{CH}}-\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$

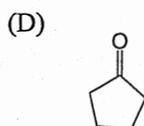
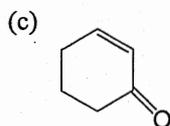
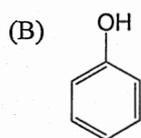
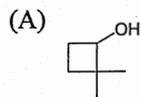
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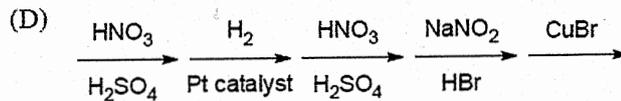
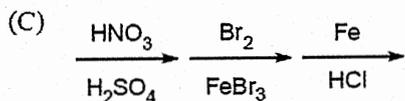
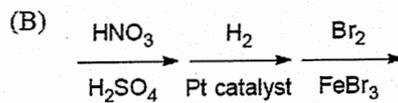
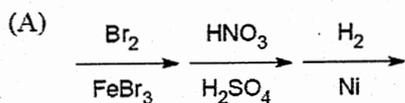
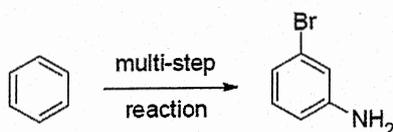
共 8 頁，第 6 頁 *請在【答案卡】作答

19. Which of the following compound is expected to show intense IR absorption at 1689 cm^{-1} .



(E) CH_3CHO

20. Which one of the following works best as the reaction steps to carry out the conversion below?



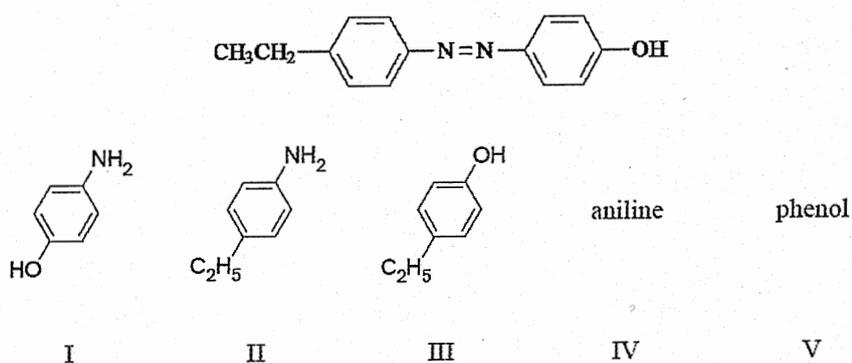
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21. Which of the following would be the starting reagents needed to make the compound shown below?



- (A) I + II (B) IV + III
(C) II + V (D) IV + V

22. How many different form(s) for 1,3-dichloroallene and the relationship is

- (A) 1 form only
(B) 2 forms and there are enantiomeric forms
(C) 2 forms and there are diastereomeric forms
(D) 3 forms and there are enantiomeric forms

23. A nucleotide unit in RNA is composed of:

- (A) a five carbon deoxy monosaccharide
(B) a carboxylic acid group
(C) a heterocyclic base
(D) an amino acid

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24. The double bond in ethane is made up of

- (A) a pi bond and a sigma bond formed by lateral overlap of two p orbitals
- (B) a sigma bond formed by overlap of two s orbitals and a pi bond formed by lateral overlap of two p orbitals
- (C) a sigma bond formed by end-on overlap of two sp^2 orbitals and a pi bond formed by lateral overlap of two s orbitals.
- (D) a pi bond formed by end-on overlap of two sp^2 orbitals and a sigma bond formed by overlap of two s orbitals
- (E) a pi bond formed by lateral overlap of two sp^2 orbitals and a sigma bond formed by end-on overlap of two sp^2 orbitals

25. What statement does NOT apply to the boiling points of alkanes?

- (A) The boiling point increases as the length of the carbon chain increase.
- (B) Straight chain alkanes have a higher boiling point than their branched isomers.
- (C) The boiling points are influenced by hydrogen bonding.
- (D) Because they are nonpolar, alkanes have lower boiling points than other organic compounds of similar molar mass.
- (E) The boiling points are affected by van der waals attractions