八十七學年度<u>輻射生物研究所</u>系(所)_______組碩士班研究生入學考試 科目 有機化學 科號 / 406 共 5 頁第 1 頁 1 調在試卷【答案卷】內作答

1. Please choose a correct answer for each of the following questions,

(**60%**)

- Which of the following species are isoelectronic? I Be²⁺ II No III S²⁻ IV Mg²⁺ V N³⁻
 (A) I, IV, V (B) II, III, IV (C) I, II, V (D) II, IV, V
- 2. Which of the following belong in the group of constitutional isomers for C₃H₆O₂? I CH₃CO₂CH₃ II CH₂=CHCH₂OH III CH₂=CHCO₂H IV HOCH₂CH₂OH V CH₃OCH₂OH (A) II, III (B) II, IV, V (C) I, II, V (D) I
- 3. In which of the following molecules does carbon have both sigma and pi bonds? I CH₄ II C₂H₂ III H₂CO IV CH₃NH₂ V CO₂ (A) II, V (B) I, IV (C) II, III, V (D) II, III
- 4. Which of the following matches are correct? I tert II iso III sec IV neo

- (A) III and A, II and B (B) III and B, I and D (C) I and C, IV and D (D) II and A, IV and C
- How many isomers (constitutional and geometric) are there for dimethyleyclopentane?
 (A) 3 (B) 5 (C) 7 (D) 9
- 6. Which of the following are more stable isomers?
 - I. cis or trans 1,4-dibromocyclohexane II. cis or trans 1,3-dibromocyclohexane
 - (A) I cis and II cis (B) I cis and II trans (C) I trans and II cis (D) I trans and II trans
- 7. How many dichlorinated products would result from the following reaction?

- 8. What is the pH of a 10% ionized solution of vitamin C (pK_{a1} = 4.17)?
 - (A) 3.17 (B) 5.17 (C) 4.17 (D) 2.17
- 9. Arrange the following compounds in the order of increasing acid strength (weakest first). I phenol ($K_a = 1.12 \times 10^{-10}$) II pyruvic acid ($pK_a = 2.49$) III aspirin ($K_a = 3.3 \times 10^{-4}$)

IV carbonic acid ($pK_a = 6.38$)

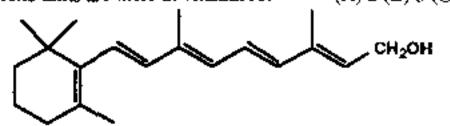
- (A) I, III, IV, II (B) I, IV, III, II (C) II, IV, III, I (D) IV, II, I, III
- 10. Which of the following alkenes are E-forms?

(A) I, II (B) II, III (C)III, IV (D) II, IV

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11. How many isoprene units are there in vitamin A?

(A) 2 (B) 3 (C) 4 (D) 8



12. Which of the following reagents will add to an alkene in a Markovnikov orientation?

I H2 II HBr/peroxides III HCl IV Hg(OAc)2/H2O

(A) I, II, III (B) III, IV (C) II, IV (D) II, III, IV

13. Which of the following react with alkenes by a free radical mechanism? I HBr/peroxide II BH₃ III Hg(OAc)₂ IV NBS/heat (A) I, II (B) II, IV (C) I, IV (D) II, III

14. Which of the following are examples of syn addition to alkenes?

l hydrogenation II hydration III hydrobromination IV hydroboration

(A) I, II (B) III, IV (C) II, III (D) I, IV

15. What is the order of increasing acidity for the following compounds (weakest first)?
I HC≡ CH II NH₃ IIICH₃OH IV H₂O

(A) IV, III, II, I (B) II, IV, III, I (C) I, II, III, IV (D) II, I, III, IV

16. What is the order of increasing stability of the following cations (least stable first)?

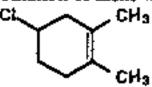
(A) I, III, IV, II (B) IV, II, II, I (C) II, I, III, IV (D) I, II, III, IV

17. Which of the following substituents will activate a diene in a Diels-Alder reaction?

$$--cH_3$$
 — cHo — $c\equiv N$ — $c(cH_3)_3$ — ocH_3 — No_2 I II III IV V VI

(A) II, III (B) I, IV, V (C) II, III, VI (D) I, IV

18. Which combination of diene and dienophile will form the following Diels-Alder product?



(A) 2-methyl-1,3-butadiene and 1-chloropropene (B) 2-chloro-1,3-butadiene and cis-2-butene

(C) 1.3-pentadiene and cis-2-chloropropene (D) 2.3-dimethyl-1,3-butadiene and vinyl chloride

19. The specific rotation of levorotatory tartaric acid is +15.9 degrees. A mixture of dextrotatory and levorotatory tartaric acid has a specific rotation of +7.45 degrees. What is the optical purity of the mixture? (A) 75% (B) 50% (C) 33.33% (D) 25%

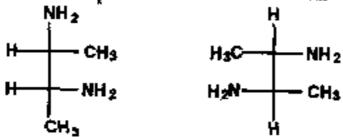
20. Which peak in the mass spectra could distinguish between 1-butanol and 2-butanol?

(A) 74 (B) 28 (C) M - 18 (D) M + 2

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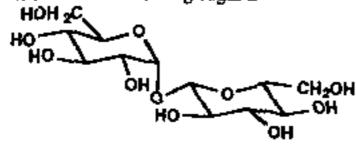
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21. What is the relationship between these two structures?



- (A) identical structures (B) enantiomers (C) diastereomers (D) constitutional isomers
- 22. A chiral compound, C₅H₈, on catalytic hydrogenation yields an achiral compound, C₅H₁₀. What is the original chiral compound? (A) 1-methylcyclobutene (B) 3-methylcyclobutene (C) 1,2-dimethylcyclopropene (D) cyclopentene
- 23. Which of the following statements apply to an S_N2 reaction?
 - The reaction is first order in alkyl halide and first order in the nucleophile.
 - II. The order of reactivity is methyl > $1^{\circ} > 2^{\circ} > 3^{\circ}$.
 - III. The reaction is first order in alkyl halide and zero order in the nucleophile.
 - IV. Rearrangements are common.
 - (A) I, II (B) III, IV (C) I, IV (D) II, IV
- 24. Compound A gives two signals in the ¹³C NMR spectrum and a single signal in the ¹H-NMR spectrum. Which of the following is most likely compound A?
 - (A) dimethyl ether (B) diethyl ether (C) neopentane (D) methyl acetate
- 25. What is the wavelength (µm) of an infrared absorption band at a wavenumber of 500 cm⁻¹?

 (A) 0.2 (B) 2.0 (C) 20 (D) 25
- 26. How can phenol be distinguished from cyclohexanol?
 - (A) solubility in water (B) solubility in hydrochloric acid (C) solubility in sodium bicarbonate (D) solubility in sodium hydroxide
- 27. Which of the following reactions does not create a C-H bond?
 - (A) Cannizzaro (B) Wolff-Kishner (C) Grinard (D) Wittig
- 28. Which of the statements about the following sugar are true?



I. It is a reducing sugar II. It will undergo mutarotation

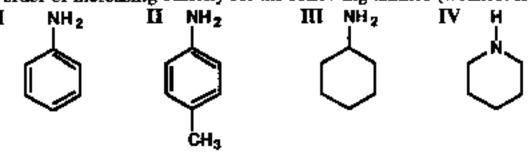
III. The linkage is 1,1 IV. It is composed of 2 units of D-glucose

(A) I, II (B) II, III (C) III, IV (D) I, IV

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科用

29. What is the order of increasing basicity for the following amines (weakest first)?



- (A) IV, II, III, I (B) II, I, III, IV (C) I, II, III, IV (D) II, I, IV, III
- 30. What is the structure of the pentapeptide that gave Lys-Leu-Phe on reaction with cyanogen bromide, and gave the fragments Met-Lys, Len-Phe and Arg on reaction with trypsin? (A) Arg-Met-Phe-Leu-Lys (B) Lys-Leu-Phe-Arg-Met (C) Arg-Met-Lys-Leu-Phe (D) Met-Arg-Lys-Leu-Phe
- II. Propose a structure for each based on its spectroscopic data.

(16%)

1.

$$H_3C - C = N \qquad CH_3MgBr \\ H_3C^+ \qquad P = P$$

 $MS: M^+ = 86$

IR: 1715 cm⁻¹ ¹H NMR: 1.05 ppm (6H, doublet, J = 7 Hz); 2.12 ppm (1H, septet, J = 7 Hz)

¹³C NMR: 18.2, 27.2, 41.6, 211.2 ppm

C₄H₇B₇O;

¹H NMR: 2.11 ppm (3H, singlet); 3.52 ppm (2H, triplet, I = 6 Hz);

4.4 ppm (2H, triplet, J = 6 Hz)

3. C9H11Br;

2.15 ppm (2H, quintet, J = 7 Hz): 2.75 ppm (2H, triplet, J = 7 Hz); ¹H NMR:

3.38 ppm (2H, triplet, J = 7 Hz); 7.22 ppm (5H singlet)

An optically active compound C₅H₁₀O with an IR absorption at 1730 cm⁻¹.

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111. Predict the major product for each of the following reactions.

(**24**%)

2.
$$\frac{CH_3NH_2}{CG_6H_5)_3P-CHCH_3} C$$

$$\frac{CG_6H_5)_3P-CHCH_3}{DG_6H_2CH_2OH} D$$

$$\frac{CH_3NH_2}{DG_6H_3} D$$

3.