

系所組別： 生物化學暨分子生物學研究所甲、乙組

考試科目： 有機化學

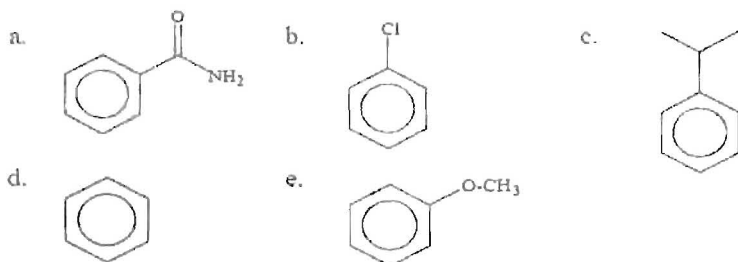
考試日期： 0220 · 節次： 2

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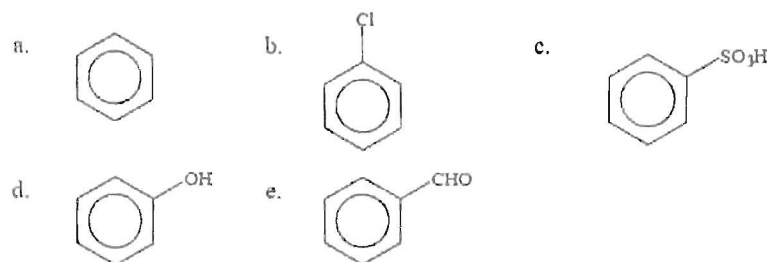
請勿在本試題紙上作答，否則不予計分

1-50 (2 points for each; wrong answer will deduct 1point)

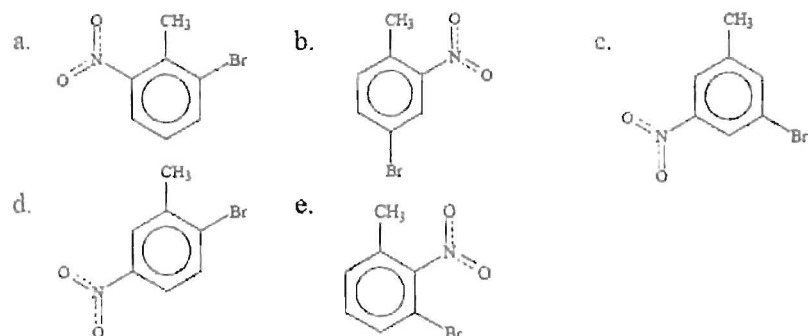
1. Which of these gives mostly the meta product when treated with Br<sub>2</sub> / Fe?



2. Which undergoes electrophilic substitution on the ring most rapidly?



3. In the reaction of 2-nitrotoluene with bromine in the presence of iron, which of the products shown below is the most abundant in the mixture?



4. Which of the following would be the most likely to undergo a nucleophilic aromatic substitution with hydroxide ion in normal conditions?

- a. Benzene
- b. Chlorobenzene
- c. Benzoic acid
- d. p-Chlorotoluene
- e. 2,4,6-Trinitro-1-chlorobenzene

(背面仍有題目,請繼續作答)

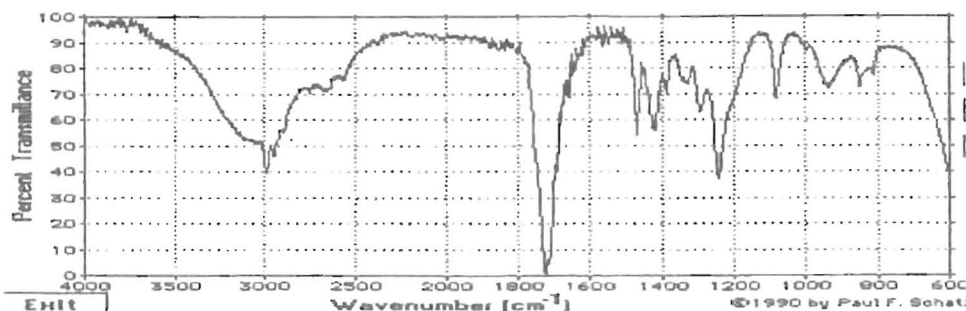
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5. Below might be the spectrum of a carboxylic acid. Which two features make this likely?



- The broad peak above 3000  $\text{cm}^{-1}$  and the sharp peak at 1710  $\text{cm}^{-1}$
- The peaks at 1240 and 1090  $\text{cm}^{-1}$
- The peaks at 1240 and 3000  $\text{cm}^{-1}$
- The sharp peak at 3000  $\text{cm}^{-1}$  and the sharp peak at 1240  $\text{cm}^{-1}$
- This is probably not the spectrum of a carboxylic acid.

6. Which compound will reduce C=O but not C=C (at least not much)?

- Jones' Reagent
- PCC
- $\text{LiAlH}_4$
- $\text{NaBH}_4$
- Chromic Acid

7. Which of these is not an oxidizing agent?

- PCC
- DIBAH
- $\text{Na}_2\text{Cr}_2\text{O}_7$  in  $\text{H}_2\text{SO}_4$
- Jones' Reagent
- Hypochlorite

8. Alkoxymercuration followed by borohydride reduction would be used to produce

- an alcohol from an alkene.
- an aldehyde from alcohol.
- an acid from an alkyne.
- an ether from an alkene.
- an alkene from an aryl halide.

9. In proton NMR, which compound or groups will show a characteristic peak near 10 ppm?

- Alcohols
- Aldehydes
- Ketones
- C=O
- Methyl on a carbonyl

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10. How would you easily tell the difference between a proton NMR ( $^1\text{H}$  NMR) and a carbon ( $^{13}\text{C}$  NMR) spectrum?

- by looking at the size of the peaks
- by looking at the location of the peaks
- by looking at the horizontal scale
- by looking at peak splitting
- by looking for the internal standard peak

11. Hemiacetals and acetals are often found in

- carbohydrates.
- proteins.
- fats.
- oils.
- DNA.

12. In which of the following sequences are the compounds listed in order of decreasing acidity?

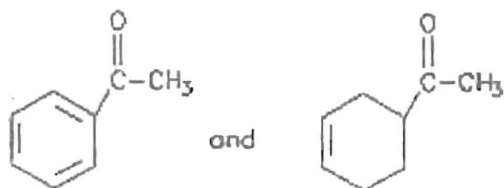
- $\text{CH}_3\text{COOH} > \text{H}_2\text{O} > \text{CH}_3\text{CH}_2\text{OH} > \text{HC}\equiv\text{CH} > \text{NH}_3$
- $\text{CH}_3\text{CH}_2\text{OH} > \text{CH}_3\text{COOH} > \text{H}_2\text{O} > \text{HC}\equiv\text{CH} > \text{NH}_3$
- $\text{CH}_3\text{COOH} > \text{CH}_3\text{CH}_2\text{OH} > \text{H}_2\text{O} > \text{NH}_3 > \text{HC}\equiv\text{CH}$
- $\text{H}_2\text{O} > \text{CH}_3\text{COOH} > \text{CH}_3\text{CH}_2\text{OH} > \text{HC}\equiv\text{CH} > \text{NH}_3$
- $\text{CH}_3\text{CH}_2\text{OH} > \text{H}_2\text{O} > \text{CH}_3\text{COOH} > \text{HC}\equiv\text{CH} > \text{NH}_3$

13. Which reagent would best serve as the basis for a simple chemical test to distinguish between



- $\text{NaOI}$  ( $\text{I}_2$  in  $\text{NaOH}$ )
- $\text{Br}_2/\text{CCl}_4$
- $\text{CrO}_3/\text{H}_2\text{SO}_4$
- $\text{NaHCO}_3/\text{H}_2\text{O}$
- $\text{Ag}(\text{NH}_3)_2^+$

14. Which reagent would best serve as the basis for a simple chemical test to distinguish between



- $\text{NaOI}$  ( $\text{I}_2$  in  $\text{NaOH}$ )
- $\text{Br}_2/\text{CCl}_4$
- $\text{CrO}_3/\text{H}_2\text{SO}_4$
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(背面仍有題目,請繼續作答)

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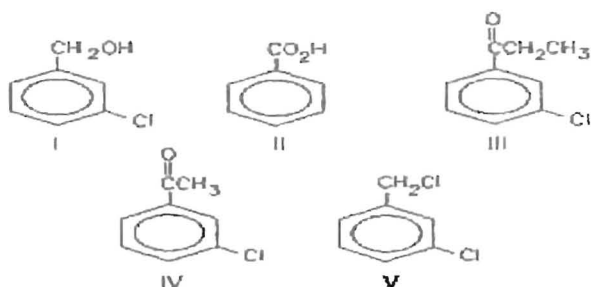
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15. In a solution of aspartic acid ( $pK_a=4.74$ ) adjusted to a pH of 2.74,

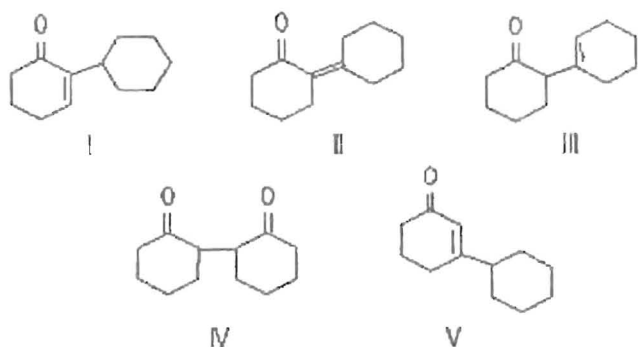
- a. the ratio of aspartate to aspartic acid is 10 to 1.
- b. the ratio of aspartate to aspartic acid is 100 to 1.
- c. the ratio of aspartate to aspartic acid is 1000 to 1.
- d. the ratio of aspartate to aspartic acid is 1 to 10.
- e. the ratio of aspartate to aspartic acid is 1 to 100.

16. Which compound could be subjected to a haloform reaction to produce m-chlorobenzoic acid?



- a. I
- b. II
- c. III
- d. IV
- e. V

17. The aldol reaction of cyclohexanone produces which of these self-condensation products?

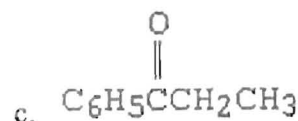
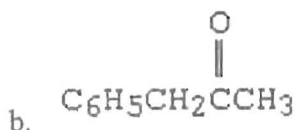
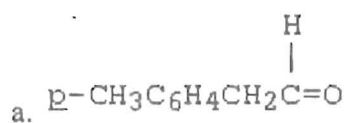


- a. I
- b. II
- c. III
- d. IV
- e. V

18. A compound, X,  $C_9H_{10}O$ , gives a strong IR absorption peak at  $1690\text{ cm}^{-1}$  and gives the following  $^1\text{H NMR}$  spectrum.

Triplet, 1.2 ppm  
 Quartet, 3.0 ppm  
 Multiplet, 7.7 ppm

Which is a possible structure for X?

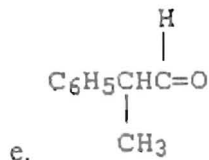
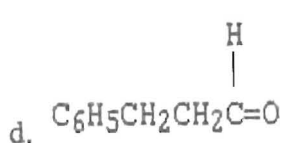


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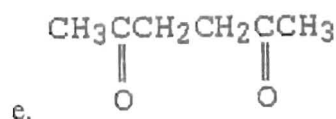
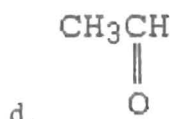
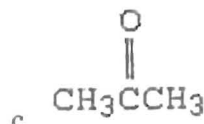
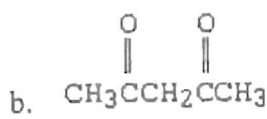
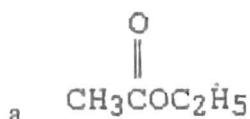
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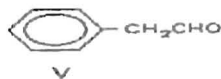
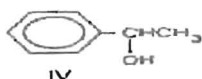
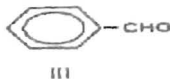
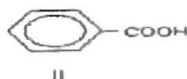
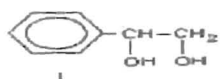
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19. Which of these compounds would exist in an enol form to the greatest extent?



20. Predict the major organic product of the reaction sequence below

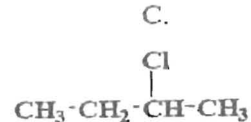
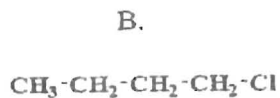
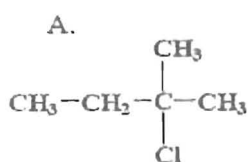


a. I    b. II    c. III    d. IV    e. V

21. The IUPAC name for the formula  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHOHCH}=\text{CH}_2$  is

a. 5-hexene-3-ol    b. 1-hexene-3-ol    c. 1-hexene-5-ol  
d. n-propyl allyl alcohol    e. allyl n-butyl ether

22. What is the order of reactivity toward  $\text{S}_\text{N}2$  displacement in the following series?



a. A>B>C    b. A>C>B    c. B>A>C  
d. B>C>A    e. C>A>B

(背面仍有題目,請繼續作答)

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23. The principal organic product formed in the reaction below is




- a.  $\text{CH}_3\text{CHBr}(\text{CH}_2)_8\text{COOH}$       b.  $\text{CH}_2\text{BrCH}_2(\text{CH}_2)_8\text{COOH}$       c.  $\text{CH}_2=\text{CH}(\text{CH}_2)_8\text{COBr}$   
 d.  $\text{CH}_2=\text{CH}(\text{CH}_2)_7\text{CHBrCOOH}$       e. None of them

24. The monochloroisomer that predominates in the mixture resulting from the free radical chlorination of  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$  is

- a.  $\text{ClCH}_2\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$       b.  $\text{CH}_3\text{CHClCH}_2\text{CH}=\text{CH}_2$       c.  $\text{CH}_3\text{CH}_2\text{CHClCH}=\text{CH}_2$   
 d.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CCl}=\text{CH}_2$       e.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CHCl}$

25. Sodium iodide in anhydrous acetone reacts most rapidly with

- a.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$       b.  $(\text{CH}_3)_3\text{CBr}$       c.  $\text{CH}_3\text{CHBrCH}_3$   
 d.  $\text{CH}_2=\text{CHBr}$       e. 

26. A reaction at a chiral carbon of an optically pure isomer which takes place exclusively by an  $\text{S}_\text{N}2$  reaction, and in which priorities do not change, proceeds with

- a. inversion and no racemization.  
 b. inversion and some racemization.  
 c. inversion and complete racemization.  
 d. retention of configuration and some racemization.  
 e. retention of configuration and no racemization.

27. Which species represents the electrophile in aromatic substitution?

- a.  $:\text{NO}_2^-$     b.  $\text{NO}_2^+$     c.  $\text{NO}_2$     d.  $\text{NO}_3^-$     e.  $\text{SO}_3\text{H}^+$

28. An aromatic hydrocarbon yields a single mononitro derivative. The hydrocarbon is

- a. ethylbenzene      b. *o*-xylene      c. propylbenzene  
 d. naphthalene      e. *p*-xylene

29. Which is the strongest acid in water?

- a. Phenol      b. 3-nitrophenol      c. 4-aminophenol  
 d. 4-nitrophenol      e. hydroquinone

30. The most direct malonic ester synthesis of 3-phenylpropanoic acid would involve the use of

- a.  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$       b.  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{Cl}$       c.  $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$   
 d.  $\text{C}_6\text{H}_5\text{Cl}$       e.  $\text{ClCH}_2\text{COOH}$

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31. What is true for the equilibrium reaction



- The use of equimolar quantities of  $\text{CH}_3\text{OH}$  and  $\text{CH}_3\text{COOH}$  will give the greatest yield of the ester at equilibrium.
- Removal of water will increase the amount of ester at equilibrium.
- Addition of  $\text{CH}_3\text{COOCH}_3$  will cause the formation of equal an equal number of moles of water.
- Application of pressure increases the amount of ester at equilibrium.
- Changing the catalyst will affect the position of the equilibrium.

32. Which reagent would bring about this transformation?



- $\text{Sn}$  and  $\text{HCl}$
- $\text{Zn}$  and  $\text{HCl}$
- $\text{H}_2$  and  $\text{Pt}$
- $\text{LiAlH}_4$  and ether
- $\text{Na}$  and alcohol

33. The reaction between carbon dioxide and a Grignard reagent will yield

- an alkane
- an alkylmagnesium halide
- an alcohol
- magnesium carbonate
- a carboxylic acid

34. Which is a practical method for the preparation of iodobenzene?

- iodine + benzene + iron
- iodine + benzene + UV light
- potassium iodide + chlorobenzene
- sodium hypoiodite + benzamide
- potassium iodide + benzenediazonium ion

35. Which reaction sequence would be best to prepare 3-chloroaniline from benzene?

- chlorination, nitration, reduction
- nitration, chlorination, reduction
- nitration, reduction, chlorination
- nitration, chlorination
- nitration, reduction, acetylation, chlorination, hydrolysis

36. The catalyst used in the halogenation of benzene is

- a proton donor
- an electron donor
- a Lewis base
- a Lewis acid
- a proton acceptor

37. The principal product of the reaction between methyl butanoate and 2 moles of  $\text{CH}_3\text{MgBr}$  after hydrolysis is

- $\text{C}_3\text{H}_7\text{COCH}_3$
- $\text{C}_3\text{H}_7\text{C}(\text{OH})(\text{CH}_3)_2$
- $\text{C}_3\text{H}_7\text{CHOHCH}_3$
- $\text{C}_3\text{H}_7\text{COCH}(\text{CH}_3)_2$
- $\text{C}_3\text{H}_7\text{CH}_2\text{OH}$

(背面仍有題目,請繼續作答)

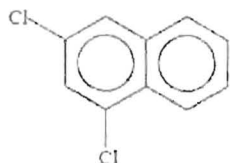
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38. The IUPAC name for



- a. 7,9-dichloronaphthalene      b. 3,5-dichloronaphthalene      c. 2,4-dichloronaphthalene  
 d. 1,3-dichloronaphthalene      e. 6,8-dichloronaphthalene

39. Which is NOT characteristic of a free radical chain reaction?

- a. It produces a mole of product for a mole of free radical initiated.  
 b. It gives the product derived from the most stable free radical.  
 c. It may be initiated by peroxides.  
 d. It may be initiated by high heat.  
 e. It may be initiated by ultraviolet light.

40. Which would yield 2-methyl-2-pentene when refluxed with zinc dust in alcohol?

- a.  $\text{CH}_3\text{-CH}_2\text{-CH}(\text{Br})\text{-C}(\text{CH}_3)_2\text{-CH}_3$   
 b.  $\text{CH}_3\text{-CH}_2\text{-CH}(\text{Br})\text{-CH}(\text{CH}_3)\text{-CH}_3$   
 c.  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-C}(\text{CH}_3)(\text{Br})\text{-CH}_2\text{-Br}$   
 d.  $\text{CH}_3\text{-CH}_2\text{-C}(\text{Br})_2\text{-CH}(\text{CH}_3)\text{-CH}_3$   
 e.  $\text{CH}_3\text{-CH}(\text{Br})\text{-CH}(\text{Br})\text{-CH}(\text{CH}_3)\text{-CH}_3$

41. Which represents an intermediate formed in the reaction of toluene and chlorine at elevated temperature in sunlight?

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



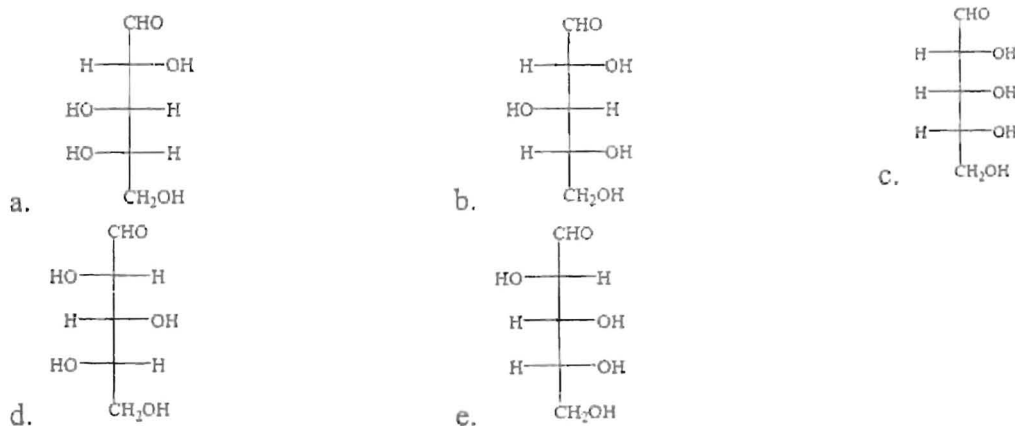
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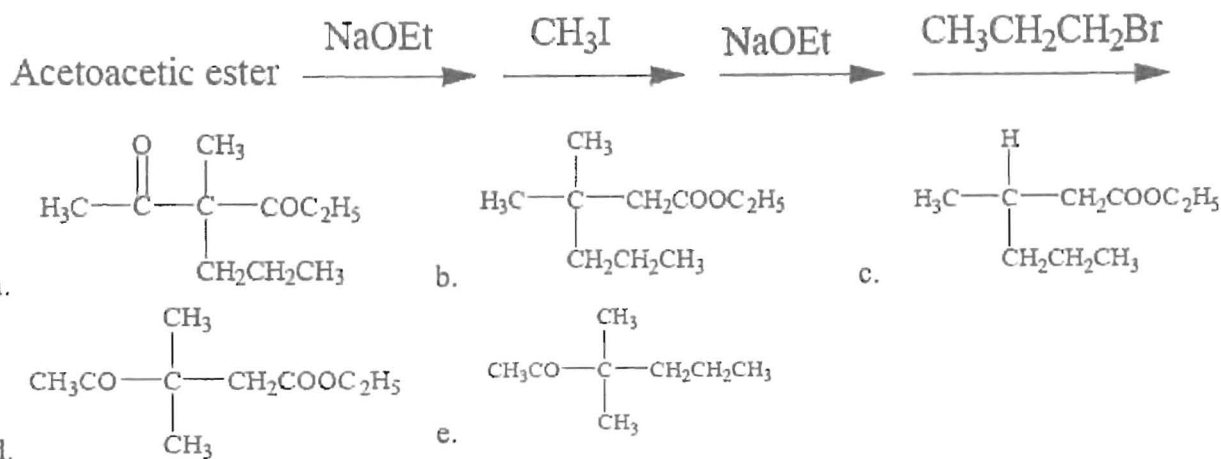
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42. Which is an L-sugar that on oxidation gives an optically inactive dibasic acid (2 COOH groups)?



43. Select the final product from this sequence of reactions.



44. Which reagent would convert cyclohexene into a *cis*-glycol?

- sodium *tert*-butoxide in chloroform
- hydrogen peroxide and aqueous acetic acid
- ozone and moist zinc dust
- periodic acid
- cold dilute potassium permanganate

45. The reagent which would distinguish between 1-hexyne and 1-hexene is

- a.  $\text{Ag}(\text{NH}_3)_2^+$    b.  $\text{KMnO}_4$    c.  $\text{Br}_2$  in  $\text{CCl}_4$    d.  $\text{H}_2\text{SO}_4$    e.  $\text{NaOH}$

46. If *tert*-butyl bromide and sodium amide ( $\text{NaNH}_2$ ) react, the product formed is

- tert*-butylamine. (amines are  $\text{R-NH}_2$ )
- tert*-butylammonium bromide.
- a mixture of butylamines.
- isobutylene. (2-methylpropene)
- none of these.

(背面仍有題目,請繼續作答)

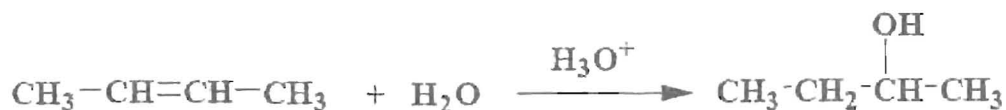
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47. In the reaction below, the product would be



- a. a mixture of diastereomers.
- b. optically active.
- c. unresolvable.
- d. a racemate.
- e. a meso compound.

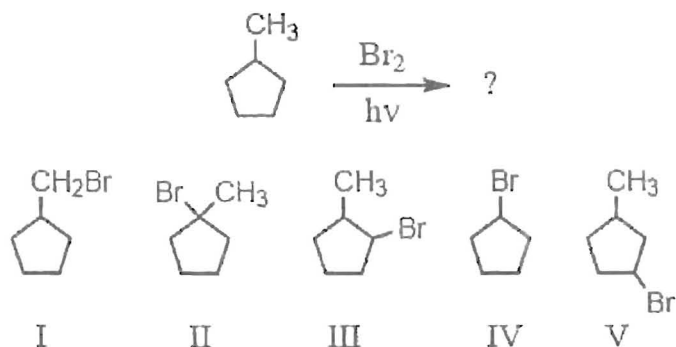
48. The rate of an S<sub>N</sub>2 reaction run in a polar aprotic solvent relative to the same reaction in a polar protic solvent would be

- a. the same
- b. slower
- c. faster
- d. unpredictable
- e. unimolecular

49. Which of the amines listed below would have the lowest boiling point?

- a. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub>
- b. CH<sub>3</sub>CH<sub>2</sub>NHCH<sub>3</sub>
- c. (CH<sub>3</sub>)<sub>3</sub>N
- d. (CH<sub>3</sub>)<sub>3</sub>CNH<sub>2</sub>
- e. (CH<sub>3</sub>)<sub>2</sub>CHNH<sub>2</sub>

50. Select the structure of the major product formed in the following reaction.



- a. I
- b. II
- c. III
- d. IV
- e. V