

注意：本試題包含單選題及問答題兩部份

Part I. 單選題 (30 題, 共 60 分) 請於試卷內之「選擇題作答區」依序作答。

1. Which of the following regions in the electromagnetic spectrum corresponds to the radiation with the longest wavelength?

- (A) ultraviolet (B) microwaves (C) infrared (D) visible (E) radio waves

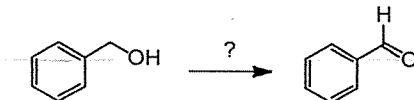
2. Which of the following ethers *cannot* be prepared by a Williamson ether synthesis?

- (A) *tert*-butyl phenyl ether (B) isopropyl methyl ether  
(C) methyl phenyl ether (D) isopropyl phenyl ether  
(E) *tert*-butyl methyl ether

3. Which of the following alcohols reacts fastest with HBr to give the corresponding alkyl bromide?

- (A) methanol (B) 2-propanol (C) 1-butanol  
(D) 2-methyl-2-propanol (E) ethanol

4. What is the best choice of reagent to perform the following transformation?



- (A) HCl (B) PCC (C) SOCl<sub>2</sub> (D) HIO<sub>4</sub> (E) Cl<sub>2</sub>, light

5. Which of the following reactions corresponds to a *substitution*?

- (A) 3,3-dimethyl-2-butanol → 2,3-dimethyl-2-butene  
(B) cyclohexene → 1,2-dichlorocyclohexane  
(C) *tert*-butanol → *tert*-butyl chloride  
(D) propene → propane  
(E) *tert*-butanol → 2-methylpropene

6. Which of the following concepts explains Markovnikov's rule as applied to the addition of HBr to propene?

- (A) the relative stability of carbocations (B) the nucleophilicity of bromide anion  
(C) the acidity of HBr (D) the steric hindrance of propene  
(E) the aufbau principle

7. What is the index of hydrogen deficiency of a compound with a molecular formula of C<sub>6</sub>H<sub>7</sub>Br?

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 0

8. Which of the following has the lowest pK<sub>a</sub>?

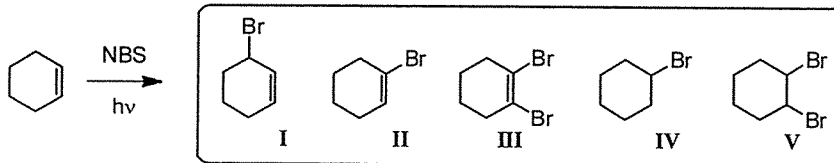
- (A) 2-butyne (B) 1-butyne (C) 1-butene (D) butane (E) 2-butene

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9. Which of the following combinations of peaks appears in the  $^1\text{H}$  NMR spectrum of  $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_3$ ?  
 (A) a singlet and a triplet (B) a singlet and two triplets (C) two singlets  
 (D) a doublet and a triplet (E) a triplet and a quartet

10. What is the characteristic of a radical chain propagation step?  
 (A) Two radicals combine to give a molecule.  
 (B) Radicals are formed.  
 (C) Byproducts are formed.  
 (D) A radical reacts with a molecule to give a new radical and a new molecule.  
 (E) None of the above.

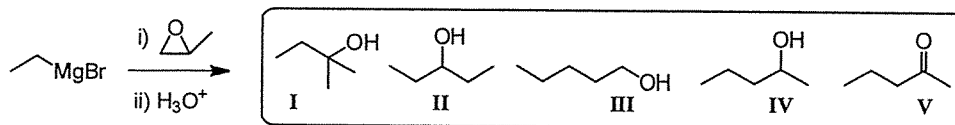
11. What is the major organic product obtained from the following reaction?



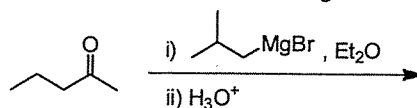
- (A) I (B) II (C) III (D) IV (E) V
12. What is the major product formed upon treatment of (*R*)-1-bromo-4-methylhexane with sodium cyanide?  
 (A) (*S*)-1-cyano-4-methylhexane (B) (*S*)-4-methyl-1-hexene  
 (C) (*R*)-1-cyano-4-methylhexane (D) ( $\pm$ )-1-cyano-4-methylhexane  
 (E) (*R*)-4-methyl-1-hexene

13. How many sets of equivalent protons are there in 2-methylhexane?  
 (A) 7 (B) 6 (C) 5 (D) 4 (E) 3

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

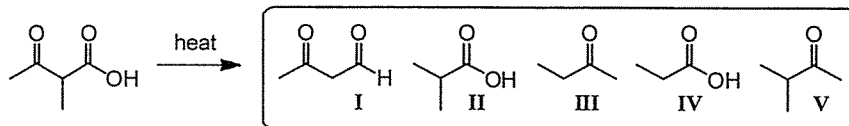


- (A) I (B) II (C) III (D) IV (E) V
15. What is the major organic product obtained from the following reaction?



- (A) 3,5-dimethyl-4-heptanol (B) 2,4-dimethyl-3-heptanol  
 (C) 2,3-dimethyl-3-heptanol (D) 3,5-dimethyl-3-heptanol  
 (E) 2,4-dimethyl-4-heptanol

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



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

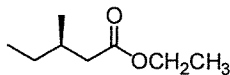
17. Which of the following can be made by acid-promoted hydrolysis of a nitrile?

- (A) an alcohol      (B) an acid      (C) an imine      (D) an ester      (E) an aldehyde

18. Which of the following best describes the key mechanistic steps in the reaction of an acid chloride and an alcohol to form an ester?

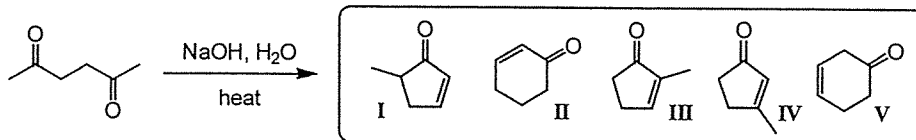
- (A) addition followed by elimination                      (B) substitution followed by addition  
 (C) elimination followed by addition                      (D) addition followed by decarboxylation  
 (E) None of the above.

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



- (A) ethyl (*R*)-3-methylpentanoate                      (B) ethyl (*S*)-3-methylpentanoate  
 (C) (*R*)-2-methylbutyl ethanoate                      (D) (*S*)-2-methylbutyl ethanoate  
 (E) ethyl (*S*)-3-ethylbutanoate

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



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

21. Which of the following reactions or sequences will provide 1-propylbenzene as the major product?

- (A) treatment of benzene with isopropyl alcohol and HF.  
 (B) treatment of benzene with 1-chloropropane and AlCl<sub>3</sub>.  
 (C) treatment of benzene with propanoyl chloride and AlCl<sub>3</sub>; followed by reaction with Zn(Hg) and HCl.  
 (D) treatment of benzene with 1-propene and HF.  
 (E) None of the above.

22. What is the electrophile in the reaction of benzene with a mixture of nitric acid and sulfuric acid?

- (A) benzene      (B) H<sup>+</sup>      (C) HONO      (D) NO<sup>+</sup>      (E) NO<sub>2</sub><sup>+</sup>

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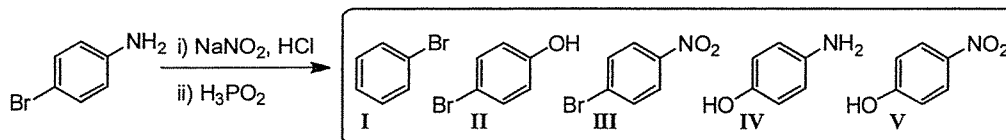
23. Which of the following will remove aniline from a solution of aniline in diethyl ether?

- (A) aqueous NaCl (B) aqueous NaOH (C) aqueous K<sub>2</sub>CO<sub>3</sub>  
 (D) aqueous CH<sub>3</sub>COONa (E) aqueous HCl

24. What is the hybridization of the nitrogen atom of pyridine?

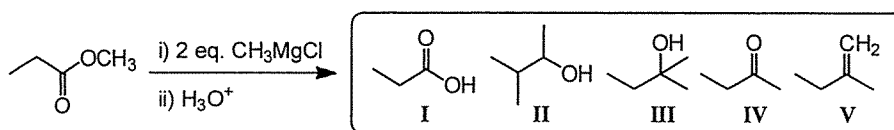
- (A) *p* (B) *s* (C) *sp* (D) *sp*<sup>2</sup> (E) *sp*<sup>3</sup>

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



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

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

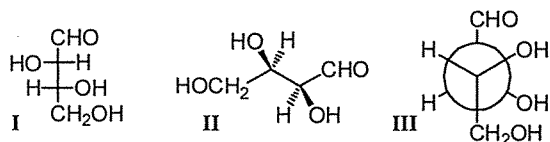


- (A) I (B) II (C) III (D) IV (E) V

27. Which of these reagents would NOT react with oleic acid?

- (A) DIBAL-H (B) O<sub>3</sub>/CH<sub>2</sub>Cl<sub>2</sub> (C) H<sub>2</sub>, Ni (D) NH<sub>3</sub>/H<sub>2</sub>O (E) LAH

28. Which of the following structures represent the same carbohydrate?



- (A) I and II (B) I and III (C) II and III  
 (D) I, II, and III (E) none of the above

29. How many isomers, including stereoisomers, exist for the triacylglycerol which, on saponification, gives glycerol, 2 molar equivalents of palmitate and 1 molar equivalent of stearate?

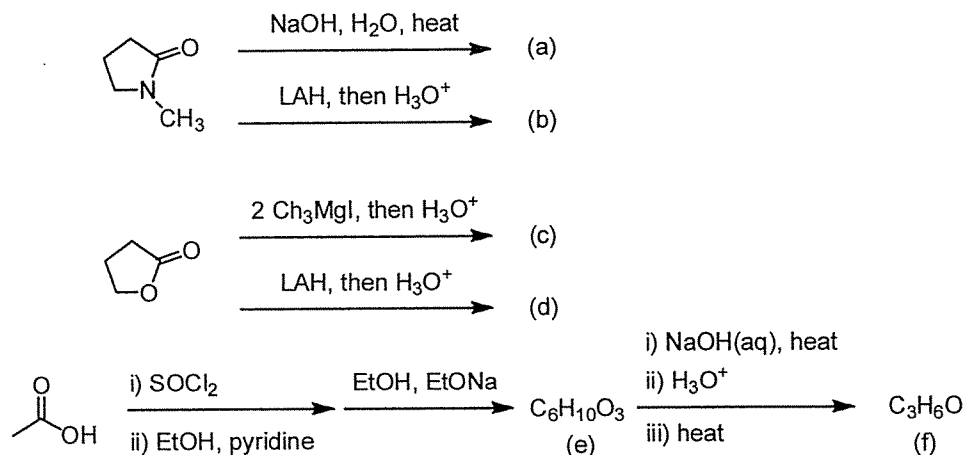
- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

30. Which of the following processes is used to harden an oil to give a fat?

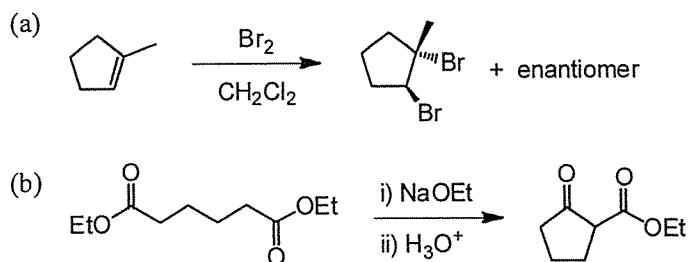
- (A) Oxidation (B) Hydrogenation (C) Halogenation  
 (D) Hydration (E) Hydrolysis

Part II. 問答題 (3 題, 共 40 分) ※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

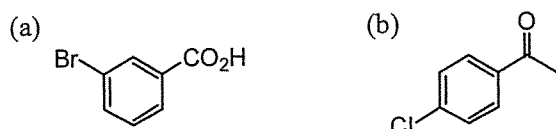
1. Give the product for the following reactions. (18 points)



2. Give a detailed reaction mechanism for the following reactions. (12 points)



3. Show how to synthesize the following compounds, starting with benzene or toluene as the only sources of aromatic rings. Assume that, in all synthesis, you can separate mixtures of *ortho-para* products to give the desired isomer in pure form. You may use any other required reagents. (10 points)



試題隨卷繳回