
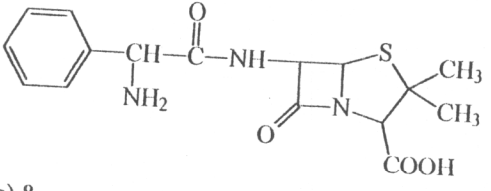
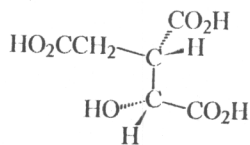


說明：答案一律寫在答案紙並請標明題號依序作答

單選選擇題：(共 20 題，每題 2 分)

- Which isomer of pentane has the lowest boiling point?  
a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$  b)  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$  c)  $(\text{CH}_3)_2\text{C}(\text{CH}_3)_2$  d) 
- How many isomers (constitutional and geometric) are there for dimethylcyclopentane?  
a) 3 b) 5 c) 7 d) 9
- 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
- At what percent ionization of acetic acid does the pKa equal the observed pH?  
a) 1% b) 10% c) 50% d) 100%
- Which of the following alkenes do not show cis-trans isomerization?  
I. 2-methyl-2-hexene II. 1-chloro-1-butene  
III. 1-methylcyclohexene IV. 2-methyl-3-hexene  
a) I, II b) III, IV c) II, III, IV d) I, III
- How many stereoisomers are possible for the following structure?  
  
a) 4 b) 8 c) 16 d) 32
- Which is the R, S configuration for the following structure of isocitric acid?

(背面仍有題目,請繼續作答)



- a) 2-*R*, 3-*R*      b) 2-*R*, 3-*S*      c) 2-*S*, 3-*R*      d) 2-*S*, 3-*S*
8. Calculate the enantiomeric excess for the reaction that give 75% of the *S*-form and 25% of the *R*-form.  
 a) 25%      b) 33 1/3%      c) 50%      d) 75%
9. Arrange the following compounds in the order of increasing acidity (least first).  
 I. (CH<sub>3</sub>)<sub>2</sub>CHOH    II. CH<sub>3</sub>CH<sub>2</sub>SH    III. H<sub>2</sub>S    IV. H<sub>2</sub>O  
 a) II, I, III, IV    b) I, IV, II, III    c) III, II, I, IV    d) II, I, IV, III
10. What is the product from the following reaction?
- 
- a)    b)    c)    d)
11. What are the best conditions for preparing 2-iodohexane from 1-hexene?  
 a) I<sub>2</sub> and heat      b) HI      c) HI and peroxides      d) HIO<sub>4</sub>
12. What are the best conditions for preparing trans-2-butene oxide?  
 a) *E*-2-butene + 3-chloroperoxybenzoic acid  
 b) *Z*-2-butene + 3-chloroperoxybenzoic acid  
 c) 1-butene + chlorine and water followed by aqueous sodium hydroxide  
 d) 1,4-dichlorobutane + sodium sulfide
13. What are the products from S<sub>N</sub>2 reaction of ethyl methyl ether with HBr?  
 a) CH<sub>3</sub>CH<sub>2</sub>Br + CH<sub>3</sub>Br      b) CH<sub>3</sub>CH<sub>2</sub>OH + CH<sub>3</sub>Br  
 c) CH<sub>2</sub>=CH<sub>2</sub> + CH<sub>3</sub>Br      d) CH<sub>3</sub>CH<sub>2</sub>Br + CH<sub>3</sub>OH
14. Which peak in the mass spectra could distinguish between 1-butanol and 2-butanol?

- a) 74                      b) 28                      c) M-18                      d) M+2

15. A large peak is very often found in all mass spectra at  $m/e = 28$ . What is the likely source of this peak?

- a)  $H_2C=CH_2$                       b) CO                      c) HCN                      d)  $N_2$

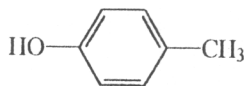
16. What are the relative areas of integration in the  $^1H$ -NMR spectrum for 3-chloro-2-methylpentane?

- a) 9:2:1:1                      b) 3:3:3:2:1:1                      c) 6:3:2:1:1                      d) 6:3:2:2:1

17. Compound A gives three signals in  $^{13}C$  NMR spectrum and two signals 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

18. How many carbon resonances are there in the  $^{13}C$  NMR spectrum for the following compound?

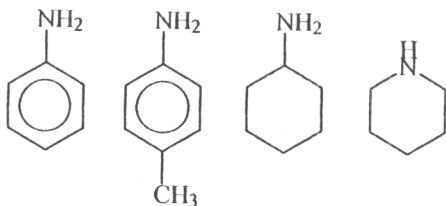


- a) 3                      b) 4                      c) 5                      d) 6

19. Carboxylic acids and amides have in general higher boiling points than esters and anhydrides because of which property?

- a) dipolar association                      b) resonance stabilization  
c) conjugated functional groups                      d) hydrogen bonding

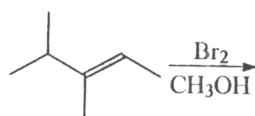
20. What is the order of increasing basicity for the following amines (weakest first)?



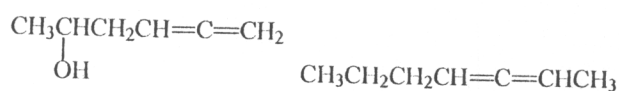
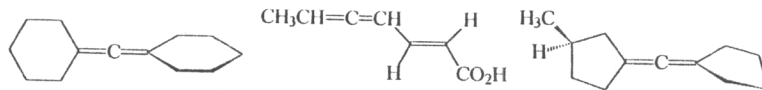
- a) IV, II, III, I                      b) II, I, III, IV                      c) I, II, III, IV                      d) II, I, IV, III

簡答題：(共 10 題，每題 6 分)

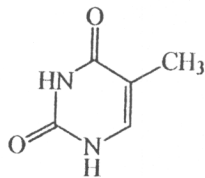
1. Explain how catalysts affect hydrogenation of alkenes and draw an energy diagram for both catalyzed and uncatalyzed hydrogenation.
2. Give the expected major product. Pay attention to stereochemistry when appropriate.



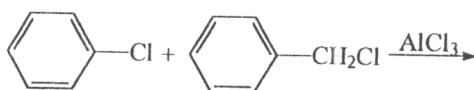
3. Which of the following allenes is(are) chiral?



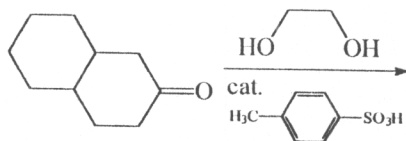
4. Draw the molecular orbital description of the  $\pi$  system of the cycloheptatrienyl anion. Indicate which orbitals are bonding, antibonding, or nonbonding.
5. Thymine and adenine are two of the four bases of DNA, forming complementary pairs through hydrogen bonding. Thymine can exist in three tautomeric forms (keto, enol, and dienol) one of which is shown below. Draw the other two tautomers and indicate which of those if any are aromatic.



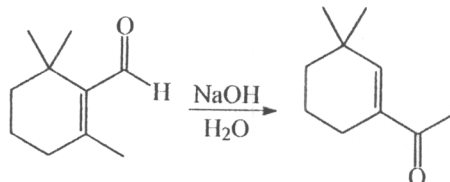
6. Give the products and identify the major product if a mixture is expected.



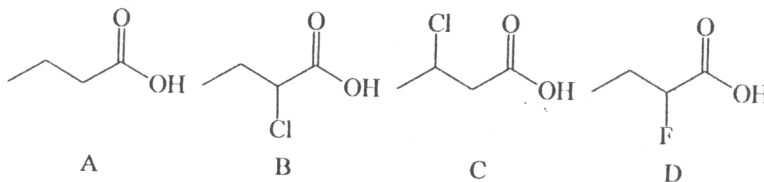
7. Give the expected product.



8. Propose a mechanism for the following reaction.



9. Arrange the following carboxylic acids in order of increasing acidity (least acidic → most acidic). Briefly explain your reasoning.



10. Aspirin is a common analgesic that exerts its effects by inhibiting the first step in the biosynthesis of prostaglandins. It does this by reacting with the OH group of serine 530 residue of the cyclooxygenase enzyme that is responsible for converting arachidonic acid to prostaglandin H<sub>2</sub>. Based on the overall reaction scheme shown below, propose a mechanism for this transformation. What is aspirin converted to in this reaction?

