

注意：本試題包含單選題及問答題兩部份

Part I. 單選題 (25 題, 共 50 分) ※ 注意：請於試卷內之「選擇題作答區」依序作答。

- In the lowest energy chair conformation of *cis*-1,3-dimethylcyclohexane, how many axial positions are occupied by hydrogen atoms?  
(A) 2 (B) 3 (C) 4 (D) 5 (E) 6
- What reactive species is produced in the initiation step of the free radical chlorination of 2,2-dimethylpropane?  
(A) a chlorine atom (B) a chlorine radical anion (C) a carbon radical  
(D) a carbocation (E) none of the above
- Which of the statements below correctly describes an achiral molecule?  
(A) The molecule has a nonsuperimposable mirror image.  
(B) The molecule exhibits optical activity when it interacts with plane-polarized light.  
(C) The molecule has an enantiomer.  
(D) The molecule might be a meso form.  
(E) None of the above.
- Which of the following alkyl halides reacts most rapidly via an  $S_N1$  solvolysis reaction in hot methanol?  
(A) 1-iodohexane (B) 1-iodo-1-methylcyclohexane (C) iodocyclohexane  
(D) 1-fluorohexane (E) (*R*)-2-bromohexane
- Which of the alkyl chlorides listed below undergoes dehydrohalogenation in the presence of a strong base to give 2-pentene as the **only** alkene product?  
(A) 1-chloropentane (B) 2-chloropentane (C) 3-chloropentane  
(D) 1-chloro-2-methylbutane (E) 1-chloro-3-methylbutane
- Which of the following is the same as the tropylium ion?  
(A) cycloheptatrienyl cation (B) cycloheptatrienyl anion (C) cyclopentadienyl cation  
(D) cyclopentadienyl anion (E) cyclopropenyl anion
- The hydrolysis of esters in base is called:  
(A) the Fischer esterification. (B) transesterification. (C) saponification.  
(D) the Hunsdiecker reaction. (E) the Dieckmann condensation.
- (*S*)-2-Methylbutanal \_\_\_\_\_ upon sitting in an acidic or a basic aqueous solution.  
(A) esterifies (B) racemizes  
(C) hydrolyzes (D) inverts completely to the *R* configuration  
(E) irreversibly forms the hydrate

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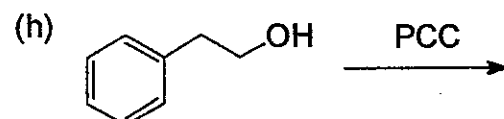
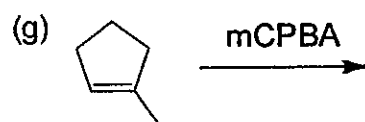
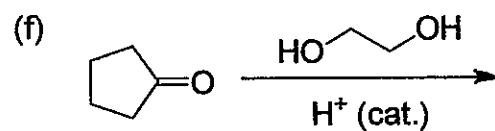
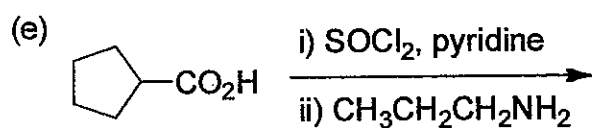
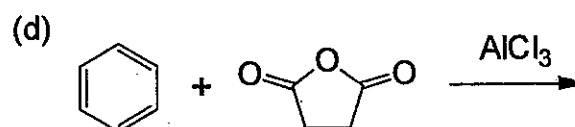
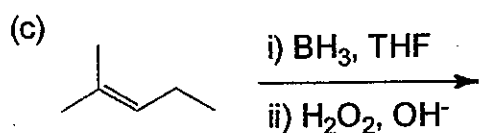
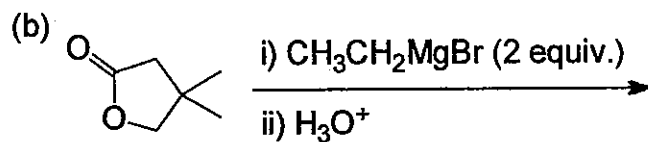
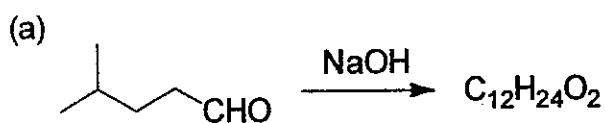
9. In biological systems, sulfonium salts such as SAM serve what function?  
(A) esterifying agents (B) epoxidizing agents (C) alkylating agents  
(D) nucleophilic agents (E) reducing agents
10. By what mechanism does cyclohexanol react when treated in sulfuric acid and what compound results?  
(A) E1; methoxycyclohexane (B) E2; methoxycyclohexane (C) S<sub>N</sub>1; methoxycyclohexane  
(D) E1; cyclohexene (E) E2; cyclohexene
11. When (*R*)-butan-2-ol is treated with TsCl in pyridine, the product formed is:  
(A) a single enantiomer. (B) a racemic mixture. (C) a mixture of diastereomers.  
(D) an achiral compound. (E) none of the above
12. HBr can be added to an alkene in the presence of peroxides (ROOR). What function does the peroxide serve in this reaction?  
(A) nucleophile (B) electrophile (C) radical chain initiator  
(D) acid catalyst (E) solvent
13. Reaction of ethylmagnesium bromide with which of the following compounds yields a secondary alcohol after quenching with aqueous acid?  
(A) H<sub>2</sub>CO (B) CH<sub>3</sub>CHO (C) (CH<sub>3</sub>)<sub>2</sub>CO  
(D) ethylene oxide (E) *n*-butyllithium
14. What is the pK<sub>a</sub> of a terminal alkyne?  
(A) 4 (B) 10 (C) 16 (D) 25 (E) 44
15. Addition of Br<sub>2</sub> to (*E*)-hex-3-ene produces \_\_\_\_\_.  
(A) (*Z*)-3,4-dibromo-3-hexene  
(B) (*E*)-3,4-dibromo-3-hexene  
(C) a mixture of enantiomeric dibromides which is optically active  
(D) a mixture of enantiomeric dibromides which is optically inactive  
(E) a meso dibromide
16. Consider the equilibrium of each of the carbonyl compounds with HCN to produce cyanohydrins. Which is the correct ranking of compounds in order of increasing K<sub>eq</sub> for this equilibrium?  
(A) H<sub>2</sub>CO < cyclohexanone < CH<sub>3</sub>CHO < 2-methylcyclohexanone  
(B) CH<sub>3</sub>CHO < 2-methylcyclohexanone < cyclohexanone < H<sub>2</sub>CO  
(C) 2-methylcyclohexanone < cyclohexanone < CH<sub>3</sub>CHO < H<sub>2</sub>CO  
(D) cyclohexanone < 2-methylcyclohexanone < H<sub>2</sub>CO < CH<sub>3</sub>CHO  
(E) cyclohexanone < 2-methylcyclohexanone < CH<sub>3</sub>CHO < H<sub>2</sub>CO

17. What is the major organic product which results when cycloheptene is irradiated in the presence of *N*-bromosuccinimide?
- (A) 4-bromocycloheptene      (B) 3-bromocycloheptene      (C) 2-bromocycloheptene  
(D) 1-bromocycloheptene      (E) 1,2-dibromocycloheptane
18. Which pair of reagents would produce the highest yield of (*R*)-2-ethoxybutane?
- (A) sodium (*R*)-2-butoxide + iodoethane      (B) sodium (*S*)-2-butoxide + iodoethane  
(C) sodium ethoxide + (*R*)-2-iodobutane      (D) sodium ethoxide + (*S*)-2-iodobutane  
(E) Both B and D would work equally well.
19. Which of the following is the strongest activating group in electrophilic aromatic substitution reactions?
- (A) -N(CH<sub>3</sub>)<sub>2</sub>      (B) -CO<sub>2</sub>CH<sub>3</sub>      (C) -NO<sub>2</sub>      (D) -CH<sub>2</sub>CH<sub>3</sub>      (E) -OCH<sub>3</sub>
20. The reagent which converts a carbonyl group of a ketone into a methylene group is \_\_\_\_\_.
- (A) Na, NH<sub>3</sub>, EtOH      (B) LiAlH<sub>4</sub>      (C) NaBH<sub>4</sub>, EtOH  
(D) Zn(Hg), conc. HCl      (E) LiAlH[OC(CH<sub>3</sub>)<sub>3</sub>]<sub>3</sub>
21. Which of the following are strongly hydrogen bonded in the liquid phase?
- (A) nitriles      (B) esters      (C) secondary amides  
(D) tertiary amides      (E) acid chlorides
22. When CH<sub>3</sub>CH<sub>2</sub>CHO reacts with PhNHNH<sub>2</sub> under conditions of acid catalysis, the major organic product is \_\_\_\_\_.
- (A) a ketone      (B) a nitrile      (C) an imine      (D) an oxime      (E) a hydrazone
23. What is the carbon nucleophile which attacks molecular bromine in the acid-catalyzed α-bromination of a ketone?
- (A) an enolate      (B) a Grignard reagent      (C) an acetylide  
(D) a carbocation      (E) an enol
24. What compound is produced when (CH<sub>3</sub>)<sub>2</sub>CHCH<sub>2</sub>Br is subjected to the following sequence of steps? (i) Mg, Et<sub>2</sub>O; (ii) CO<sub>2</sub>.
- (A) 2-methylpropanoic acid      (B) 3-methylpropanoic acid      (C) 2-methylbutanoic acid  
(D) 3-methylbutanoic acid      (E) 2-methylhexanoic acid
25. Which of the following will react most slowly with an enamine?
- (A) isopropyl chloride      (B) methyl bromide      (C) acetyl chloride  
(D) benzyl chloride      (E) allyl bromide

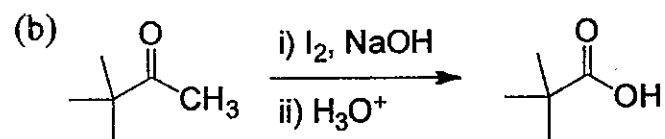
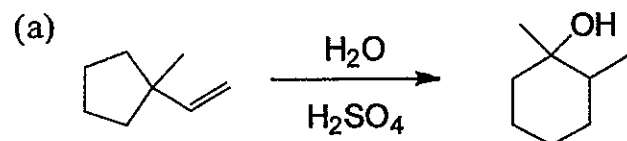
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Part II. 問答題 (3 題, 共 50 分) ※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

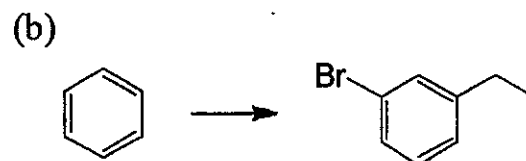
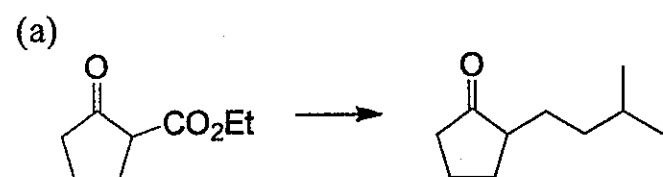
1. Give the major organic product for each of the following reactions. (24 points)



2. Give a detailed reaction mechanism for the following reactions. (14 points)



3. Show how to synthesize each of the following compounds from the designated starting materials. More than one step is needed and you may use any other required reagents. (12 points)



試題隨卷繳回