

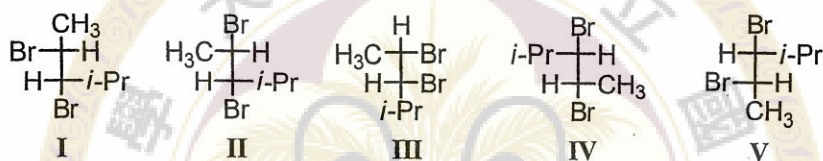
注意：本試題包含單選題及問答題兩部份

Part I. 單選題 (28題, 84分) ※ 注意：選擇題請於答案卷之「選擇題作答區」依序作答。

1. Which statement(s) is/are true about a molecule with the molecular formula $C_{10}H_{20}$, that when subjected to catalytic hydrogenation there is no consumption of hydrogen?

- (A) The molecule has no degrees of unsaturation.
- (B) There is one degree of unsaturation, which happens to be a pi-bond.
- (C) There are two degrees of unsaturation where one is a ring and the other is a pi-bond.
- (D) There is one degree of unsaturation, which happens to be a ring.
- (E) None of the above.

2. Which Fischer projection illustrates (2*R*,3*S*)-2,3-dibromo-4-methylpentane?



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

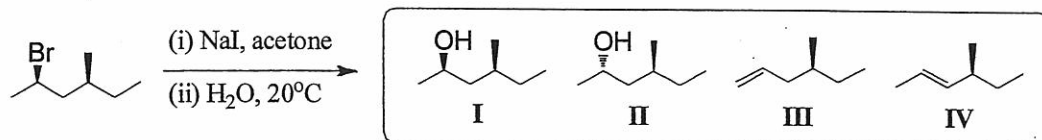
3. The Hammond-Leffler postulate, when applied to nucleophilic substitutions and elimination reactions, states that:

- (A) a negatively-charged nucleophile is stronger than its conjugate acid.
- (B) polar aprotic solvents strongly accelerate the rate of S_N2 processes.
- (C) bimolecular nucleophilic substitutions are 2nd order kinetically.
- (D) the transition state for an endergonic reaction step (one accompanied by an increase in free energy) resembles the product of that step.
- (E) elimination reactions will always compete with nucleophilic substitution reactions.

4. Which alkyl halide, when treated with sodium ethoxide in ethanol, would afford a product mixture consisting of more than one elimination product?

- (A) 1-bromo-3,3-dimethylpentane
- (B) 1-bromo-2,3-dimethylpentane
- (C) 2-bromo-3,4-dimethylpentane
- (D) 2-bromo-3,3-dimethylpentane
- (E) None of the above would yield more than one elimination product.

5. Predict the major product(s) for the following reaction sequence.



- (A) I
- (B) II
- (C) III
- (D) IV
- (E) mixture of I and II

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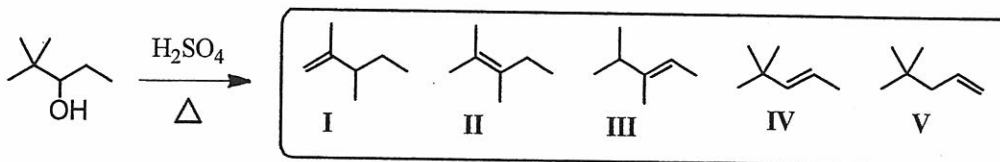
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6. Which alkene would you expect to be the major product of the following dehydration?



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

7. Which reaction conditions would *not* yield 2-butyne from 1-propyne?

- (A) (i) EtONa, EtOH; (ii) CH₃I (B) (i) CH₃Li, THF; (ii) CH₃I
 (C) (i) NaNH₂, NH₃(l); (ii) CH₃I (D) (i) BuLi, hexane; (ii) CH₃I
 (E) More than one of these

8. What compound would yield an equimolar mixture of CH₃CH₂CH₂CHO and CH₃CHO upon treatment with O₃, followed by Zn/HOAc?

- (A) 1-Hexene (B) *cis*-2-Hexene
 (C) *trans*-2-Hexene (D) *trans*-3-Hexene
 (E) More than one of these.

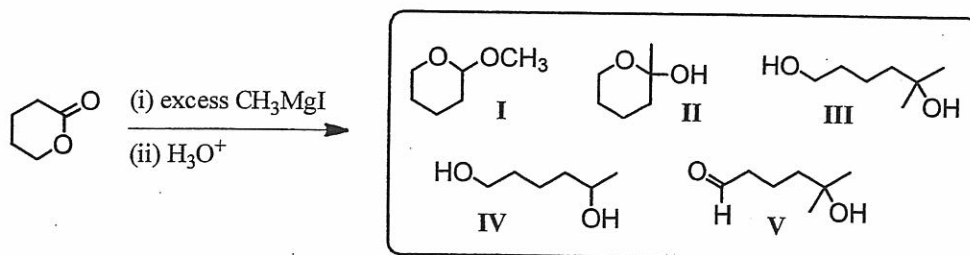
9. In a competition reaction, equimolar amounts of five alkanes compete for a deficiency of chlorine at 300°C. The greatest amount of reaction would occur in the case of which of these alkanes?

- (A) Ethane (B) Propane (C) Butane
 (D) Isobutane (E) Pentane

10. Which of the following synthetic procedures would be employed most effectively to transform ethanol into ethyl propyl ether?

- (A) Ethanol + HBr, then Mg/ether, then H₃O⁺, then NaH, then CH₃CH₂Br
 (B) Ethanol + HBr, then Mg/ether, then HCHO, then H₃O⁺, then NaH, then CH₃CH₂Br
 (C) Ethanol + CH₃CH₂CH₂OH + H₂SO₄/140°C
 (D) Ethanol + NaH, then HCHO, then H₃O⁺, then HBr, then Mg/ether, then CH₃CH₂CH₂Br
 (E) Ethanol + H₂SO₄/180°C, then CH₃CH₂CH₂Br

11. Which product is formed from the following transformation:



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

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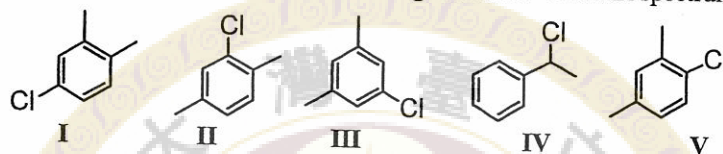
12. Which of these dienes can undergo the Diels-Alder reaction?

- (A) 1,3-Pentadiene (B) 1,4-Pentadiene (C) 1,2-Butadiene
(D) 1,4-Cyclohexadiene (E) All of the above.

13. A reaction under kinetic control will yield predominantly:

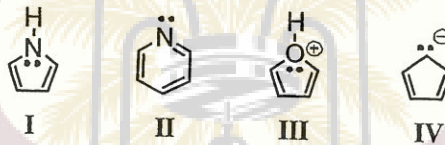
- (A) the most stable product. (B) the product that can be formed in the fewest steps.
(C) the product with the least potential energy. (D) the product with the greatest potential energy.
(E) the product whose formation requires the smallest free energy of activation.

14. Which of the following substances would exhibit six signals in its ^{13}C NMR spectrum?



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

15. In which case is the indicated unshared pair of electrons NOT a contributor to the π aromatic system?

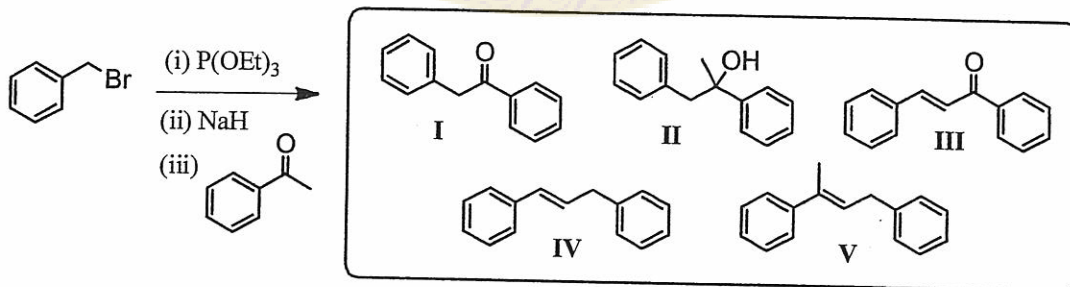


- (A) I (B) II (C) III (D) IV (E) None of the above.

16. Which of these is a satisfactory synthesis of 1-bromo-2-phenylethane?

- (A) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3 + \text{Br}_2, \text{Fe}^{3+}$ (B) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3 + \text{Br}_2, 400^\circ\text{C}$
(C) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{OH} + \text{Br}_2, \text{CCl}_4$ (D) $\text{C}_6\text{H}_5\text{CH}=\text{CH}_2 + \text{HBr}, \text{ROOR}$
(E) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3 + \text{NBS}, \text{ROOR}$

17. Predict the major product(s) for the following reaction sequence.



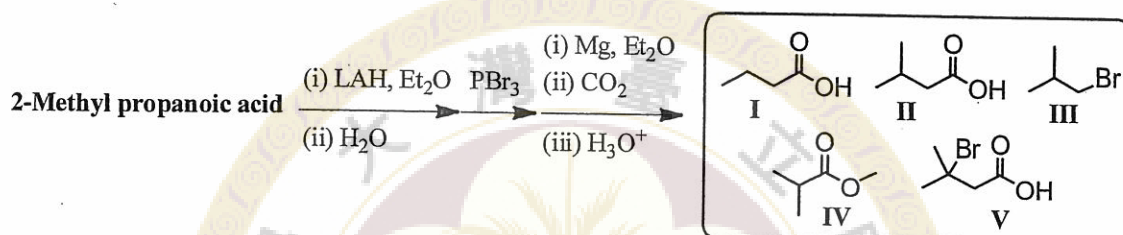
- (A) I (B) II (C) III (D) IV (E) V

18. Which reagent(s) could be used to carry out the following transformation?



- (A) Zn(Hg), HCl, reflux
 (B) LiAlH₄, ether
 (C) HSCH₂CH₂SH, BF₃; then Raney Ni (H₂)
 (D) All of the above
 (E) Two of the above

19. What would be the final product of the following sequence of reactions?



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

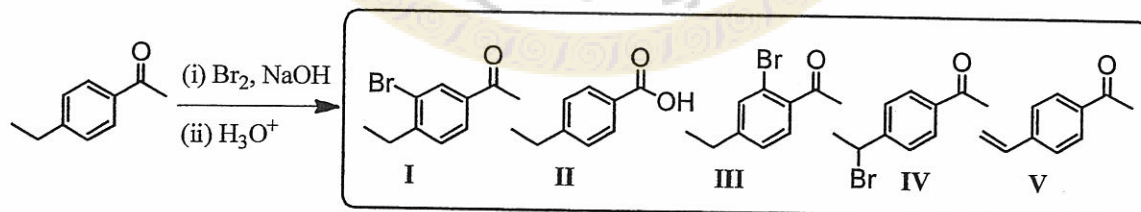
20. Which of the following acids would have the largest value for pK_a?

- (A) BrCH₂CH₂CH₂COOH (B) ClCH₂CH₂CH₂COOH (C) Cl₂CHCH₂CH₂COOH
 (D) ICHBrCH₂CH₂COOH (E) BrCCl₂CH₂CH₂COOH

21. Which of the following would not undergo racemization in base?

- (A) (*R*)-3-methyl-4-heptanone (B) (*R*)-3-methyl-2-heptanone (C) (*R*)-4-methyl-2-heptanone
 (D) (*R*)-2,4-dimethyl-3-heptanone (E) All of the above will undergo racemization in base.

22. What would be the major product of the following reaction?



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

23. Diethyl malonate is treated successively with NaOEt (1 eq.), EtBr, potassium *t*-butoxide, isobutyl chloride, hot aqueous NaOH, HCl, and heat. What is the final product?

- (A) 4-Ethyl-2-methylpentanoic acid (B) 6-Methylheptanoic acid
 (C) 2-Ethyl-3-methylpentanoic acid (D) 2-Ethyl-4-methylpentanoic acid
 (E) Ethyl 2-methylheptanoate

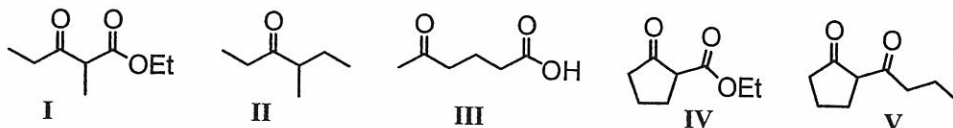
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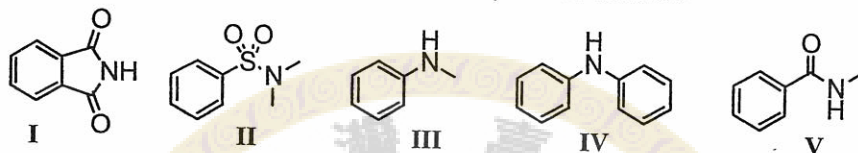
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24. Which compound could be prepared via Dieckmann condensation?



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

25. Which of these compounds is soluble in dilute sodium hydroxide solution?



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

26. What final product is expected when toluene is subjected to the following reaction sequence?

(i) KMnO_4 , NaOH ; (ii) H_3O^+ ; (iii) SOCl_2 ; (iv) NaN_3 ; (v) heat

- (A) $\text{C}_6\text{H}_5\text{CONH}_2$ (B) $\text{C}_6\text{H}_5\text{NH}_2$ (C) $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$
 (D) $p\text{-CH}_3\text{C}_6\text{H}_4\text{SO}_2\text{NH}_2$ (E) $p\text{-CH}_3\text{C}_6\text{H}_4\text{NH}_2$

27. The reaction of which of these compounds with nitrous acid results in a stable N-nitroso compound?

- (A) $\text{C}_6\text{H}_5\text{NH}_2$ (B) $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2$ (C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$
 (D) $\text{C}_6\text{H}_5\text{NHCH}_3$ (E) $\text{CH}_3\text{CH}_2\text{CONH}_2$

28. The best synthesis of 3,5-dibromotoluene would be:

- (A) Toluene, Br_2 , Fe and heat
 (B) $p\text{-CH}_3\text{C}_6\text{H}_4\text{NH}_2$, Br_2 , H_2O ; then HONO , $0\text{-}5^\circ\text{C}$; then H_3PO_2
 (C) Toluene, fuming HNO_3 , H_2SO_4 ; then NH_3 , H_2S ; then HONO , $0\text{-}5^\circ\text{C}$; then CuBr
 (D) *m*-Dibromobenzene, CH_3Cl , AlCl_3 , heat
 (E) *m*-Bromotoluene, HNO_3 , H_2SO_4 ; then NH_3 , H_2S ; then HONO , $0\text{-}5^\circ\text{C}$; then CuBr

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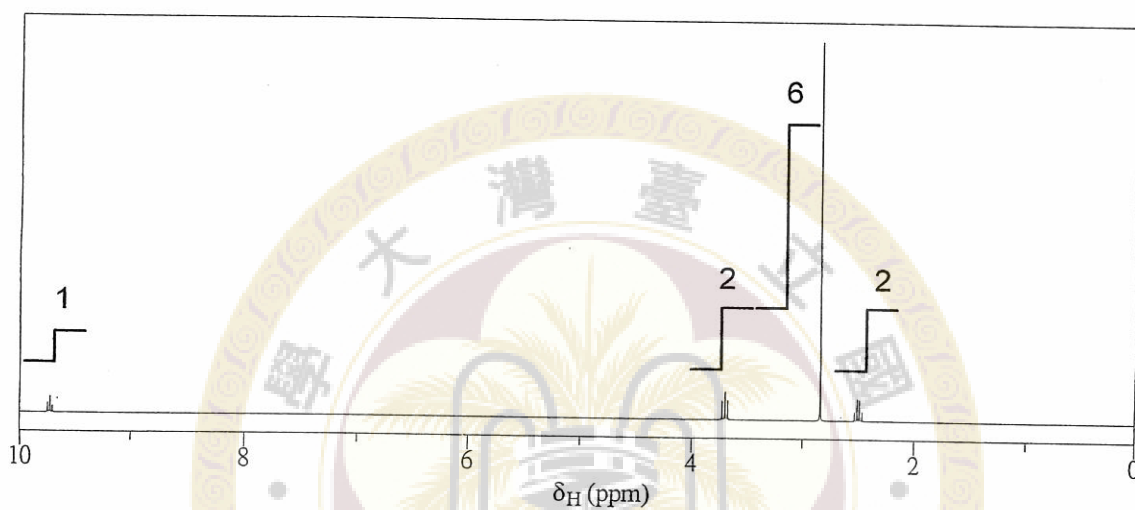
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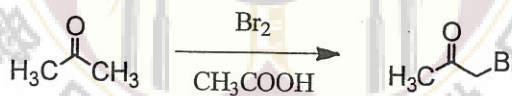
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Part II. 問答題 (2 題, 16 分)

1. Perform structural determination for compounds X ($C_5H_{11}NO$), which shows a characteristic peak at 202 ppm in the ^{13}C NMR. Its 1H NMR spectrum with relative integration is shown below. Please (a) calculate the IHD, (b) assign as many partial structures as possible, (c) propose the complete structure. **For any assignments, you must provide explanations.** (10 points)



2. Give a detailed reaction mechanism for the following reaction. (6 points)



試題隨卷繳回