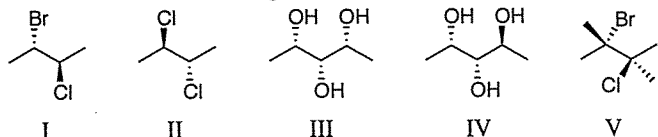


第一部分有機化學 (共 50 分)

單選題：第 1~17 題 (每題 2 分，共 34 分，請依題號順序於選擇題作答區內作答)

1. Which of the following molecules would demonstrate optical activity?

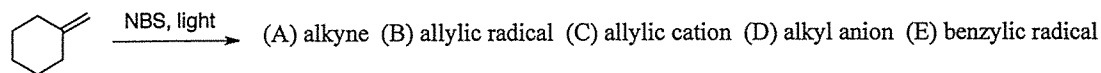


(A) II and V (B) II and III (C) only I (D) I and IV (E) I, IV and V

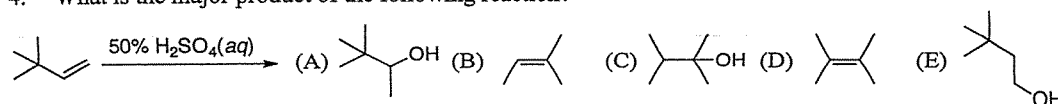
2. Which of the following alkyl halides can produce only a single alkene product from when treated with sodium ethoxide?

- (A) 2-chloro-2-methylpentane
(B) 3-chloro-3-ethylpentane
(C) 3-chloro-2-methylpentane
(D) 2-chloro-4-methylpentane
(E) 2-chloro-3-ethylpentane

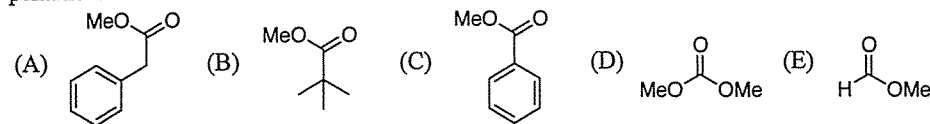
3. What kind of reactive intermediate is present in the mechanism of the following reaction?



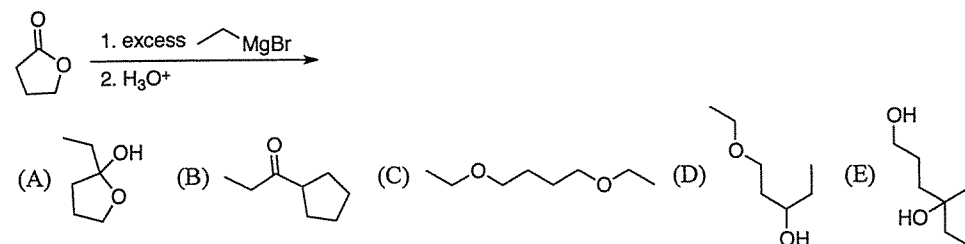
4. What is the major product of the following reaction?



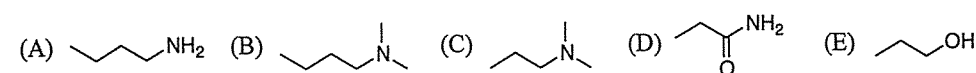
5. Which of the following is least likely to undergo a smooth crossed Claisen condensation with methyl pentanoate?



6. What is the major product of the following reaction?



7. What compound is produced when *N,N*-dimethylpropanamide is treated with LiAlH_4 ?



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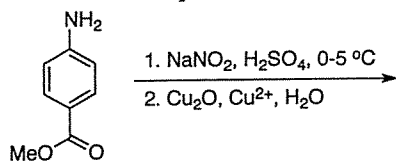
8. Which of the following conditions will drive the equilibrium of the Fischer esterification towards ester formation?

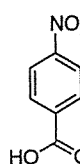
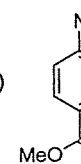
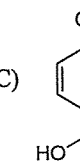
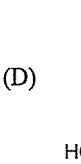
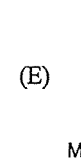
- (A) addition of water
- (B) removal of water as it is formed
- (C) addition of an inorganic acid as a catalyst
- (D) addition of alcohol
- (E) both B and D

9. Which of the following is the best method to convert *o*-xylene to *o*-phenylenediamine?

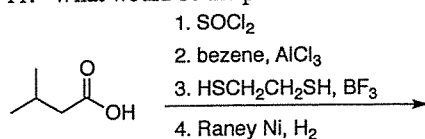
- (A) NaNH_2 and heat
- (B) KMnO_4 , OH^- , heat; then H_3O^+ ; then PCl_5 ; then NH_3 ; then Br_2/OH^-
- (C) NBS/CCl_4 ; then NH_3 ; then Br_2/OH^-
- (D) KMnO_4 , OH^- , heat; then H_3O^+ ; then SOCl_2 ; then NH_3 ; then LiAlH_4 ; then Br_2/OH^-
- (E) KMnO_4 , OH^- , heat; then H_3O^+ ; then NH_3 with H_2/Ni

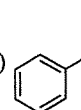
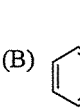
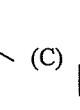
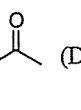
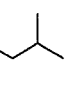
10. Which is the product of the following reaction?



- (A)  (B)  (C)  (D)  (E) 

11. What would be the product of the following reaction sequence?








- (A)  (B)  (C)  (D)  (E) 

12. A mixture of chlorobenzene (1 mol) and acetanilide (1 mol) is allowed to react with Br_2 (0.5 mol) in the presence of trace amounts of FeBr_3 . What is the principal product of the competing reactions?

- (A) 4-bromoacetanilide
- (B) 1-bromo-2-chlorobenzene
- (C) 1-bromo-3-chlorobenzene
- (D) 1-bromo-4-chlorobenzene
- (E) 3-bromoacetanilide

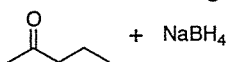
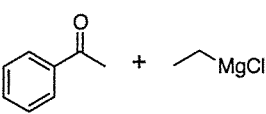
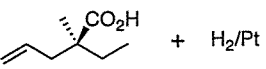
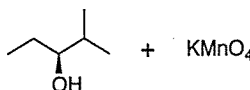
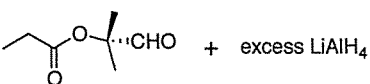
13. Which of the following molecules would you expect to be antiaromatic?

- (A)  (B)  (C)  (D)  (E) 

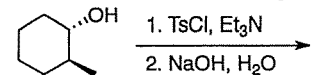
14. Which is the only compound which can be completely ruled out as a product of the reaction of 1,3-butadiene with HCl?

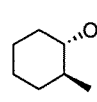
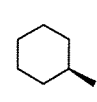
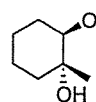
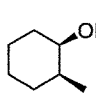
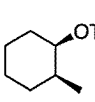
- (A) (*S*)-3-chloro-1-butene
- (B) (*R*)-3-chloro-1-butene
- (C) (*E*)-1-chloro-2-butene
- (D) (*Z*)-1-chloro-2-butene
- (E) (*Z*)-2-chloro-2-butene

15. Which of the following reactions would lead to an optically active product?

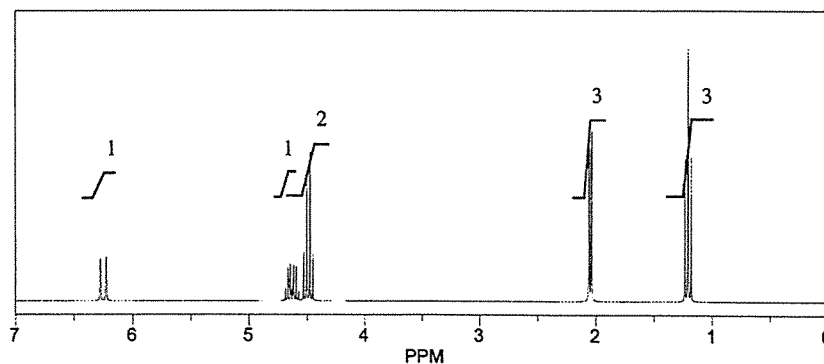
- (A)  + NaBH₄
- (B)  + MgCl
- (C)  + H₂/Pt
- (D)  + KMnO₄
- (E)  + excess LiAlH₄

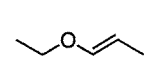


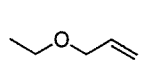
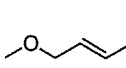
16. What would be the major product of the following reaction sequence?



- (A) 
- (B) 
- (C) 
- (D) 
- (E) 

17. What is the structure of the compound in the following ¹H-NMR spectrum with the molecular formula C₅H₁₀O? The IR spectrum does not show any characteristic stretches around 1700 cm⁻¹. Relative integration is shown.

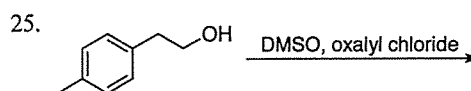
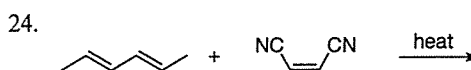
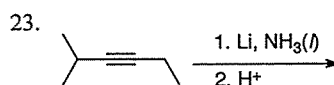
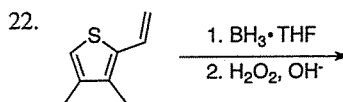
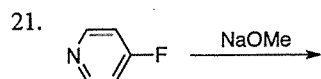
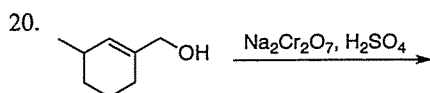
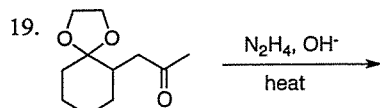
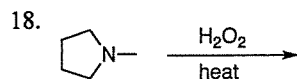


- (A) 
- (B) 
- (C) 
- (D) 
- (E) 

見背面

問答題：第 18~25 題（每題 2 分，共 16 分，請標明題號依順序於非選擇題作答區內作答）

Give the major product in line-angle structures for each of the following reactions and include stereochemistry where appropriate.



※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之部份及題號。

Inorganic Chemistry

(50%)

- (I) Determine the point group of the following eight molecules: (a) cis- and trans- $\text{CHCl}=\text{CHCl}$ (b) $(\eta^6\text{-C}_6\text{H}_6)_2\text{Cr}$ (ring-eclipsed and staggered) (c) $(\text{C}_6\text{H}_5)_2\text{Cr}$ (two rings are coplanar and perpendicular) (d) cis- and trans- $\text{Co}(\text{NH}_3)_4\text{Cl}_2$. (II) Give all symmetry operations and use the great orthogonality theorem to derive the character table of C_{2v} . (10%)
- (I) Use molecular orbital theory to explain why oxygen (O_2) and B_2 molecules are paramagnetic and C_2 molecule is diamagnetic. (II) Find the spectroscopic terms (term symbol) of C atom and the number of total microstates for each of them. Among those terms, give the ground state. (10%)
- (I) Determine the packing efficiency of (a) a cubic, (b) a body-centered cubic and (c) a face-centered cubic structure. (II) In a face-centered cubic structure if all octahedral holes are filled by a smaller atom, what is the total packing efficiency? (10%)
- (I) For transition metal carbonyl (M-CO), metal carbene (M=CR_2) and metal ethylene ($\text{M}-(\eta^2\text{-C}_2\text{H}_4)$) complexes, describe all possible bonding modes between metal and the ligand. (II) Write a catalytic cycle for an olefin metathesis using propene $\text{CH}_3\text{CH}=\text{CH}_2$ as a starting material and appropriate Ru complex as catalyst, give possible products at the initial stage. (10%)
- (I) In coordination complexes of transition metal, how five d-orbitals are separated in octahedral, tetrahedral and square planar fields (draw the energy levels and denote the orbitals). (II) Explain the following terms: strong and weak field, high and low spin complex, spectrochemical series, Orgel diagram. (10%)

試題隨卷繳回