

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

I. Multiple-choice questions (10 pts)

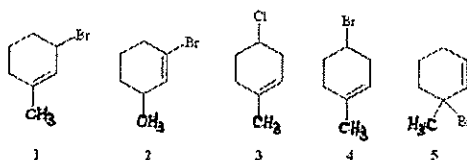
[1] When aldehydes are subjected to the same conditions that α -halogenate ketones (i.e., X_2 and aqueous acid or base), they are:

- (A) α -halogenated as well. (B) reduced to alcohols. (C) converted to the acid halide.
(D) oxidized to the acid or carboxylate. (E) esterified.

[2] What type of carbon environment does not generate a signal in the DEPT-90 spectrum and gives a positive peak in the DEPT-135 spectrum?

- (A) quaternary (B) methine (C) methylene (D) methyl (E) carbonyl

[3] Rank the following molecules in order of increasing relative rate of S_N1 solvolysis with methanol and heat (slowest to fastest reacting).



- (A) $3 < 2 < 4 < 5 < 1$ (B) $2 < 3 < 4 < 1 < 5$ (C) $5 < 4 < 3 < 2 < 1$
(D) $2 < 3 < 4 < 5 < 1$ (E) $1 < 2 < 5 < 4 < 3$

[4] In the addition of an electrophile to acetophenone, which of the following best describes the expected mode of reaction?

- (A) The *o,p*-positions are most activated to attack by the electrophile.
(B) The *m*-positions are most activated to attack by the electrophile.
(C) The *o,p*-positions are most deactivated to attack by the electrophile.
(D) The *m*-positions are most deactivated to attack by the electrophile.
(E) All positions (*o*, *m*, and *p*) are equally activated to attack by the electrophile.

[5] Which of the following statements is (are) true for the compound (3*R*, 4*R*)-3,4-dimethylhexane?

- (A) This compound is chiral. (B) The enantiomer of this compound is (3*S*, 4*S*)-3,4-dimethylhexane.
(C) This compound is a diastereomer of (3*R*, 4*S*)-3,4-dimethylhexane.
(D) all of the above (E) none of the above

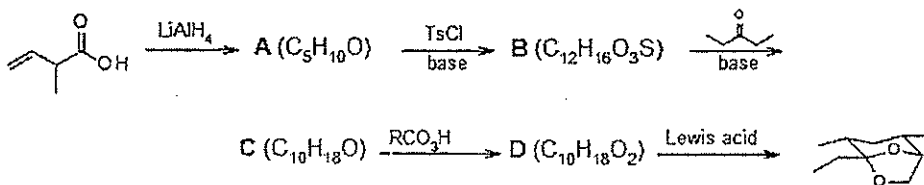
II. A newly isolated natural product was shown to be optically active. If a solution of 2.0 g in 10 mL of ethanol in a 50 cm tube gives a rotation of $+54.87^\circ$, what is the specific rotation of this natural product? (10 pts)

III. Describe the sources of angle strain and torsional strain present in cyclopropane. (10 pts)

IV. Explain the following facts: (10 pts)

- (a) Treating (*Z*)-2-butene with OsO_4 in pyridine and then $NaHSO_3$ in water gives a diol that is optically inactive and cannot be resolved.
(b) Treating (*E*)-2-butene with OsO_4 and then aqueous $NaHSO_3$ gives a diol that is optically inactive but cannot be resolved.

V. Shown below is a synthesis of the elm bark beetle pheromone, multistriatin. Give structures for compounds A, B, C, and D. (10 pts)



VI. Describe with equations how you might separate a mixture of aniline, *p*-cresol, benzoic acid and toluene using ordinary laboratory reagents. (10 pts)

VII. Draw a Newman projection down the C1–C6 bond in the equatorial conformation of methylcyclohexane. Show that the equatorial group is also anti to C5. (10 pts)

VIII. Predict the elimination products of the following reactions, and label the major products. (10 pts)

(a) *cis*-1-bromo-2-methylcyclohexane + NaOCH₃ in CH₃OH

(b) *trans*-1-bromo-2-methylcyclohexane + NaOCH₃ in CH₃OH

IX. Given that compound X has a molecular formula of C₆H₁₀O₂, gave three peaks in its ¹³C NMR spectrum (14, 63 and 158 ppm) and two peaks in its ¹H NMR spectrum (1.4 ppm, triplet and 4.3 ppm, quartet), provide a structure for compound X. (10 pts)

X. Propose structures for intermediates and products (A) through (L) (10 pts)

