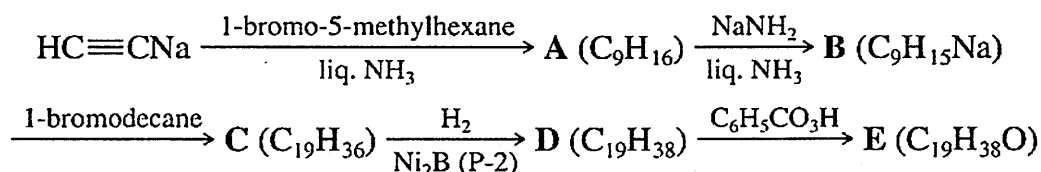


※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

I. Multiple-choice questions (10 pts)

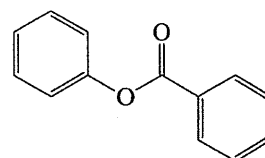
- [1] When a ketone and its enol are in equilibrium, under most conditions the concentration of the enol is _____ the concentration of the ketone.
 (A) slightly higher than (B) equal to (C) much higher than (D) much lower than
 (E) exactly half of
- [2] Which of the following compounds is(are) hydrolyzed to butanoic acid upon heating in H_2O , H_2SO_4 ?
 (A) ethyl butanoate (B) butyl acetate (C) *N*-methylbutanamide (D) both A and B
 (E) both A and C
- [3] What reagents can be used to convert 1-hexyne into 2-hexanone?
 (A) 1). SiA_2BH ; 2). H_2O_2 , NaOH (B) Hg^{2+} , H_2SO_4 , H_2O (C) 1). O_3 ; 2). $(\text{CH}_3)_2\text{S}$
 (D) 1). CH_3MgBr ; 2). CO_2 (E) 1). H_2 , Ni ; 2). $\text{Na}_2\text{Cr}_2\text{O}_7$, H_2SO_4
- [4] Which of the following alcohols will give a positive chromic acid test?
 (A) *tert*-butanol (B) cyclohexanol (C) pentan-3-ol (D) both A and B (E) both B and C
- [5] In addition to a carbonyl stretch, which of the following molecules exhibits two characteristic stretches at 2700 and 2800 cm^{-1} ?
 (A) $(\text{CH}_3\text{CH}_2)_2\text{CO}$ (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ (C) $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_3$
 (D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ (E) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCl}$

II. Outlined below is a synthesis of gypsy moth sex attractant **E** (a type of pheromone). Give the structures of **E** and the intermediates **A–D** in the synthesis. (10 pts)

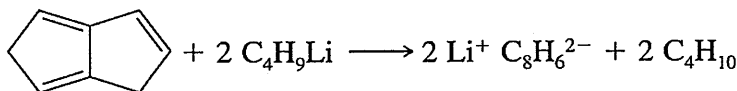


III. One ring of phenyl benzoate undergoes electrophilic aromatic substitution much more readily than the other.

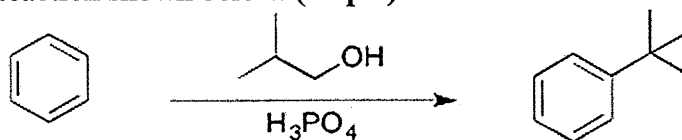
- (a) Which one is it? (b) Explain your answer. (10 pts)



IV. Removing two protons from the compound below (using butyllithium as the base) leads to the formation of a stable dianion with the formula $\text{C}_8\text{H}_6^{2-}$ (as the dilithium salt). Propose a reasonable structure of the product and explain why it is stable. (10 pts)



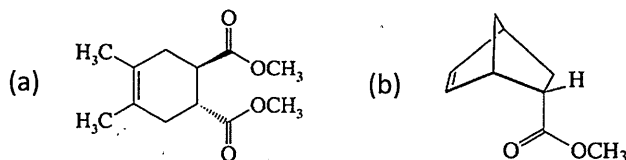
V. Draw a mechanism for the reaction shown below. (10 pts)



VI. Give structures of the products when 4-methylbenzaldehyde reacts with the following reagents (10 pts)

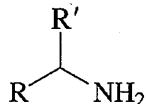
- (a) $\text{CH}_3\text{CH}_2\text{MgBr}$, then H_3O^+ (b) Hot KMnO_4 , OH^- , then H_3O^+ (c) $\text{CH}_3\text{COC}_6\text{H}_5$, OH^-
 (d) Cold dilute KMnO_4 , OH^- , then H_3O^+ (e) $^-:\text{CH}_2\text{-P}^+(\text{C}_6\text{H}_5)_3$

VII. Which diene and dienophile would you employ in a synthesis of each of the following? (10 pts)



VIII. When a Dieckmann condensation is attempted with diethyl succinate ($\text{EtOOCCH}_2\text{CH}_2\text{COOEt}$), the product obtained has the molecular formula $\text{C}_{12}\text{H}_{16}\text{O}_6$. What is the structure of this compound? (10 pts)

IX. Reductive amination of a ketone is almost always a better method for the preparation of amines of the type $\text{R}'\text{RCHNH}_2$ than the treatment of an alkyl halide with ammonia.



Why would this be true? (10 pts)

X. (a) Why do most long-chain fatty acids show a large peak in the mass spectrum at m/z 60? (4 pts)

(b) Use equations to explain the prominent peaks at m/z 74 and m/z 87 in the mass spectrum of 2-methylpentanoic acid. (6 pts)

