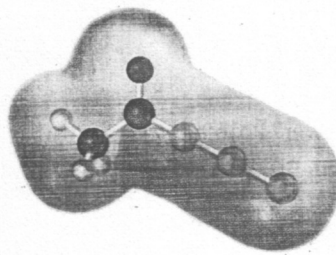
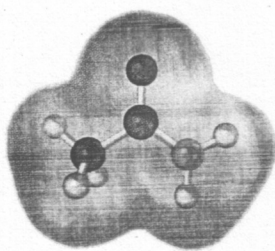
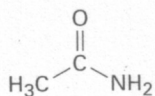


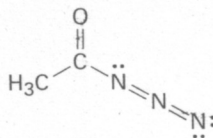
- 21.30 Electrostatic potential maps of a typical amide (acetamide) and an acyl azide (acetyl azide) are shown. Which of the two do you think is more reactive in nucleophilic acyl substitution reactions? Explain.



Acetamide



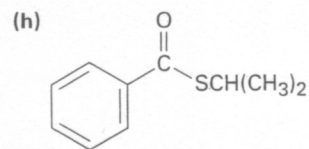
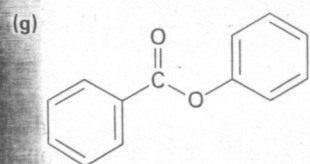
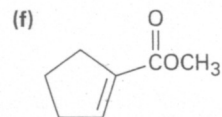
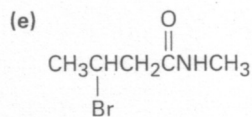
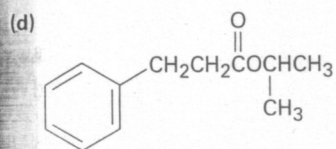
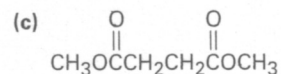
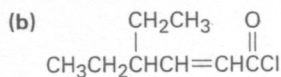
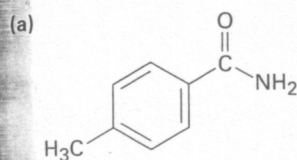
Acetyl azide



Additional Problems

Naming Carboxylic Acid Derivatives

- 21.31 Give IUPAC names for the following compounds:



- 21.32 Draw structures corresponding to the following names:

- (a) *p*-Bromophenylacetamide (b) *m*-Benzoylbenzamide
 (c) 2,2-Dimethylhexanamide (d) Cyclohexyl cyclohexanecarboxylate
 (e) Ethyl 2-cyclobutenecarboxylate (f) Succinic anhydride

- 21.33 Draw and name compounds that meet the following descriptions:

- (a) Three acid chlorides having the formula $\text{C}_6\text{H}_9\text{ClO}$
 (b) Three amides having the formula $\text{C}_7\text{H}_{11}\text{NO}$

Nucleophilic Acyl Substitution Reactions

21.34 Predict the product, if any, of reaction between propanoyl chloride and the following reagents:

- (a) $\text{Li}(\text{Ph})_2\text{Cu}$ in ether (b) LiAlH_4 , then H_3O^+
 (c) CH_3MgBr , then H_3O^+ (d) H_3O^+
 (e) Cyclohexanol (f) Aniline
 (g) $\text{CH}_3\text{CO}_2^- + \text{Na}^+$

21.35 Answer Problem 21.34 for reaction of the listed reagents with methyl propanoate.

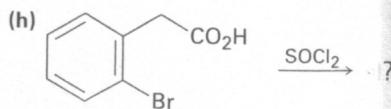
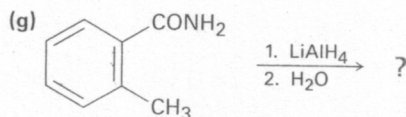
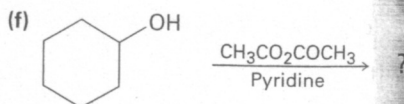
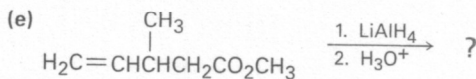
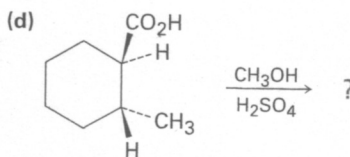
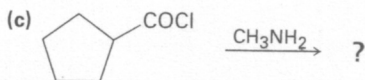
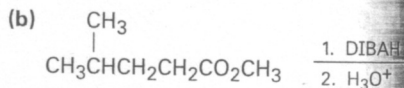
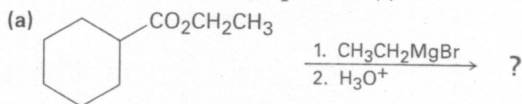
21.36 Answer Problem 21.34 for reaction of the listed reagents with propanamide.

21.37 What product would you expect to obtain from Grignard reaction of an excess of phenylmagnesium bromide with dimethyl carbonate, $\text{CH}_3\text{OCO}_2\text{CH}_3$?

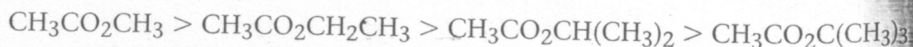
21.38 How might you prepare the following compounds from butanoic acid?

- (a) 1-Butanol (b) Butanal (c) 1-Bromobutane
 (d) Pentanenitrile (e) 1-Butene (f) *N*-Methylpentanamide
 (g) 2-Hexanone (h) Butylbenzene (i) Butanenitrile

21.39 Predict the product(s) of the following reactions:



21.40 The following reactivity order has been found for the saponification of alkyl acetates by aqueous NaOH. Explain.



21.41 Explain the observation that attempted Fischer esterification of 2,4,6-trimethylbenzoic acid with methanol and HCl is unsuccessful. No ester is obtained, and the acid is recovered unchanged. What alternative method of esterification might be successful?

21.42 Outline mechanism for starting from (a) Benzene (d) Benzene

21.43 Treatment of yields a lactone reaction.

When ethyl HCl, methanol

21.45 *tert*-Butoxide treating the mechanism for

H_3C

H_3C

Step-Growth P

21.46 The step-growth involves open-chain mechanism

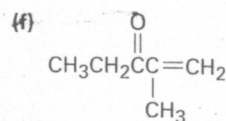
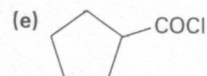
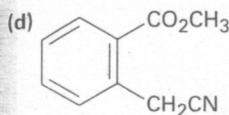
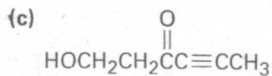
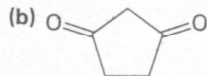
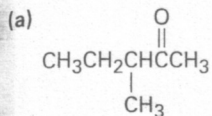
21.47 Qiana, What are

21.48 What is lactone

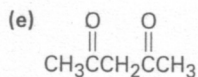
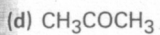
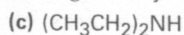
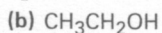
Additional Problems

Acidity of Carbonyl Compounds

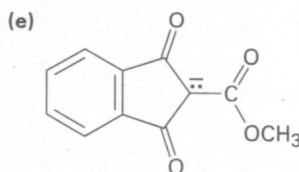
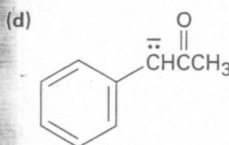
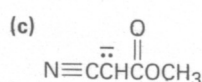
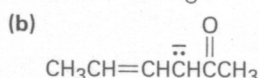
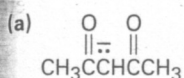
22.20 Identify all the acidic hydrogens ($pK_a < 25$) in the following molecules:



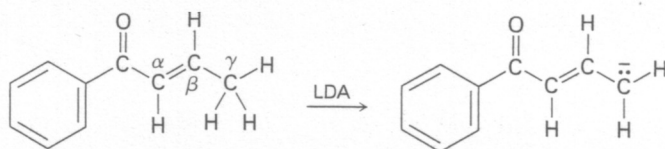
22.21 Rank the following compounds in order of increasing acidity:



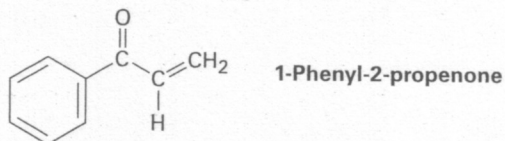
22.22 Write resonance structures for the following anions:



22.23 Base treatment of the following α,β -unsaturated carbonyl compound yields an anion by removal of H^+ from the γ carbon. Why are hydrogens on the γ carbon atom acidic?

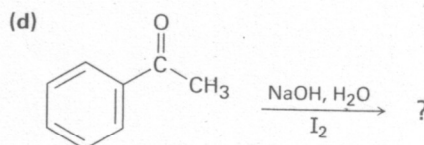
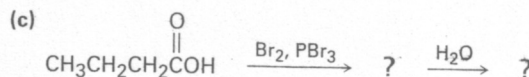
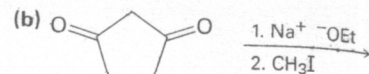
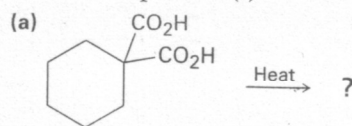


22.24 Treatment of 1-phenyl-2-propenone with a strong base such as LDA does not yield an anion, even though it contains a hydrogen on the carbon atom next to the carbonyl group. Explain.



α -Substitution Reactions

22.25 Predict the product(s) of the following reactions:

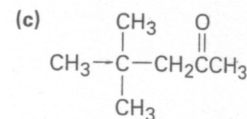
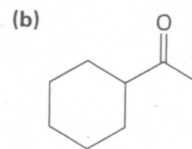
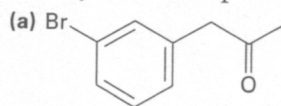


MALONIC

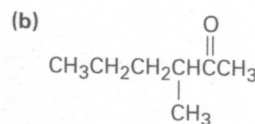
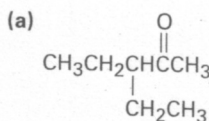
22.26 Which, if any, of the following compounds can be prepared by a malonic ester synthesis? Show the alkyl halide you would use in each case.

- (a) Ethyl pentanoate (b) Ethyl 3-methylbutanoate
(c) Ethyl 2-methylbutanoate (d) Ethyl 2,2-dimethylpropanoate

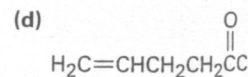
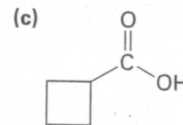
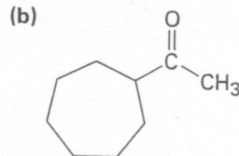
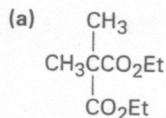
22.27 Which, if any, of the following compounds can be prepared by an acetoacetic ester synthesis? Explain.



22.28 How would you prepare the following ketones using an acetoacetic ester synthesis?



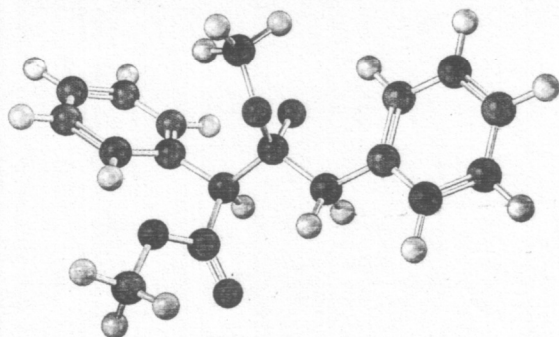
22.29 How would you prepare the following compounds using either an acetoacetic ester synthesis or a malonic ester synthesis?



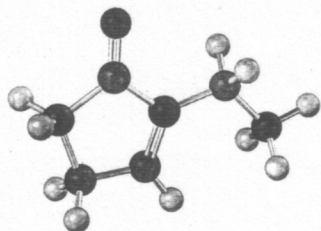
22.30 Which of the following substances would undergo the haloform reaction?

- (a) CH_3COCH_3 (b) Acetophenone (c) $\text{CH}_3\text{CH}_2\text{CHO}$
(d) $\text{CH}_3\text{CO}_2\text{H}$ (e) $\text{CH}_3\text{C}\equiv\text{N}$

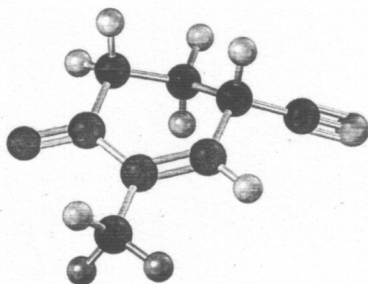
- 23.24 The following structure represents an intermediate formed by addition of an ester enolate ion to a second ester molecule. Identify the reactant, the leaving group, and the product.



- 23.25 The following molecule was formed by an intramolecular aldol reaction. What dicarbonyl precursor was used for its preparation?



- 23.26 The following molecule was formed by a Robinson annulation reaction. What reactants were used?



Additional Problems

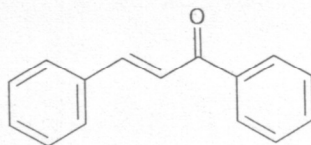
Aldol Reactions

- 23.27 Which of the following compounds would you expect to undergo aldol self-condensation? Show the product of each successful reaction.
- | | |
|------------------------------------|-------------------------|
| (a) Trimethylacetaldehyde | (b) Cyclobutanone |
| (c) Benzophenone (diphenyl ketone) | (d) 3-Pentanone |
| (e) Decanal | (f) 3-Phenyl-2-propenal |

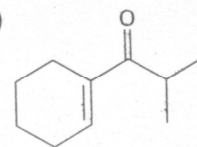
ALDOL

23.28 How might you synthesize each of the following compounds using an aldol reaction? Show the structure of the starting aldehyde(s) or ketone(s) you would use in each case.

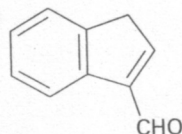
(a)



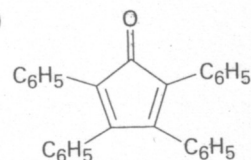
(b)



(c)



(d)



23.29 What product would you expect to obtain from aldol cyclization of hexanedial, $\text{OHCCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$?

23.30 Intramolecular aldol cyclization of 2,5-heptanedione with aqueous NaOH yields a mixture of two enone products in the approximate ratio 9:1. Write their structures, and show how each is formed.

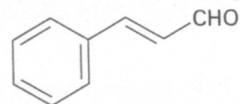
23.31 The major product formed by intramolecular aldol cyclization of 2,5-heptanedione (Problem 23.30) has two singlet absorptions in the ^1H NMR spectrum, at 1.65 δ and 1.90 δ , and has no absorptions in the range 3 to 10 δ . What is its structure?

23.32 Treatment of the minor product formed in the intramolecular aldol cyclization of 2,5-heptanedione (Problems 23.30 and 23.31) with aqueous NaOH converts it into the major product. Propose a mechanism to account for this base-catalyzed isomerization.

23.33 How can you account for the fact that 2,2,6-trimethylcyclohexanone yields no detectable aldol product even though it has an acidic α hydrogen?

23.34 The aldol reaction is catalyzed by acid as well as by base. What is the reactive nucleophile in the acid-catalyzed aldol reaction? Propose a mechanism.

23.35 Cinnamaldehyde, the aromatic constituent of cinnamon oil, can be synthesized by a mixed aldol condensation. Show the starting materials you would use, and write the reaction.



Cinnamaldehyde