1) Which of the following is the most reactive carboxylic acid derivative?
A) ester
B) anhydride
C) nitrile
D) acid chloride
E) amide
Answer: D
Diff: 1

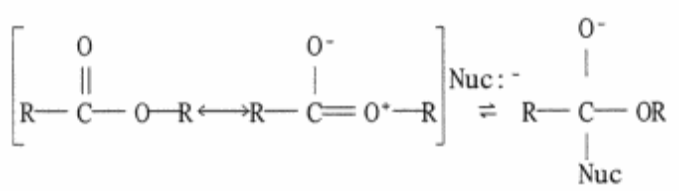
2) *N*-Methylacetamide is an example of:
A) a primary amide
B) a secondary amide
C) a tertiary amide
D) an *N*, *N*-disubstituted amide
E) an imine
Answer: B
Diff: 1

3) Which of the following are strongly hydrogen bonded in the liquid phase?
A) nitriles
B) esters
C) secondary amides
D) tertiary amides
E) acid chlorides
Answer: C
Diff: 2

9) In nucleophilic acyl substitution, :
A) protonation of the carbonyl is followed immediately by loss of the leaving group.
B) loss of the leaving group is followed by rearrangement of the carbocation.
C) addition to the carbonyl by a nucleophile is followed by loss of the leaving group.
D) ester hydrolysis is followed by deprotonation.
E) an S_N2 reaction occurs.
Answer: C
Diff: 2

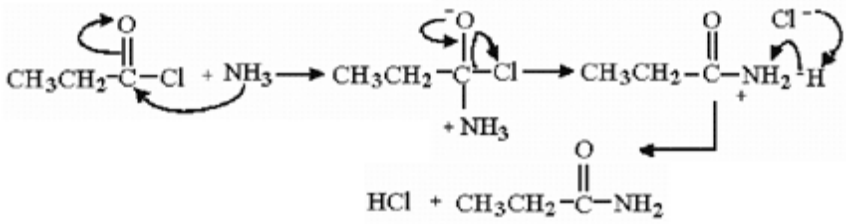
10) A correct order of reactivity of acid derivatives towards nucleophilic attack is:
A) esters > acid anhydrides > amides.
B) anhydrides > amides > esters.
C) carboxylates > esters > amides.
D) anhydrides > acids > acid chlorides.
E) anhydrides > amides > carboxylates.
Answer: E
Diff: 1

11) Using the two key resonance structures for an ester, show how resonance stabilization is lost when an ester is attacked by a nucleophile.
Answer:



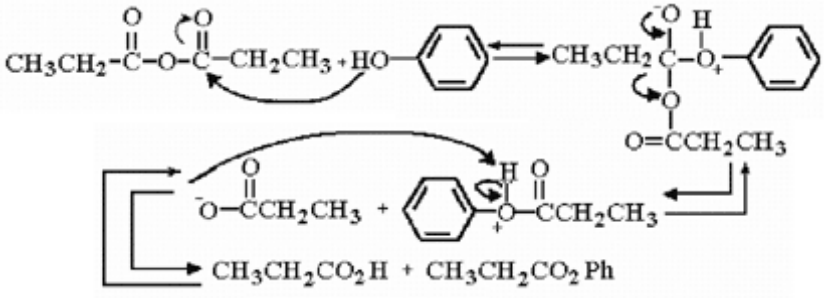
Diff: 3

12) Provide a detailed, stepwise mechanism for the reaction of propanoyl chloride with ammonia.
Answer:



Diff: 2

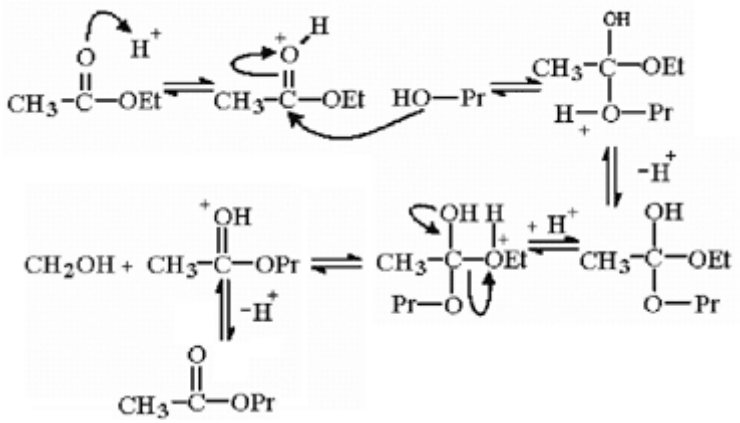
13) Provide a detailed, stepwise mechanism for the reaction of propanoic anhydride with phenol.
Answer:



Diff: 2

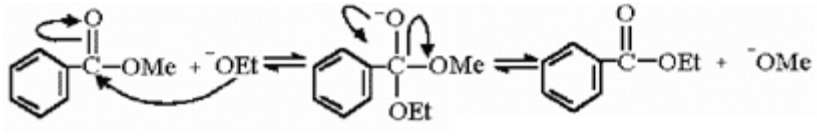
14) Using potential energy diagrams, explain why alkoxides act as leaving groups in nucleophilic acyl substitutions but not in S_N2 reactions.
Answer: See Figure 21-10, p.963
In nucleophilic acyl substitution, the leaving group is ejected in a separate exothermic step. The Hammond Postulate predicts that the transition state for this step resembles the tetrahedral intermediate. Therefore, in the transition state for this step minimal bond breaking has occurred, and the importance of the nature of the leaving group is diminished.
Diff: 3

15) Provide a detailed, stepwise mechanism for the acid-catalyzed transesterification of ethyl acetate with *n*-propanol.
Answer:



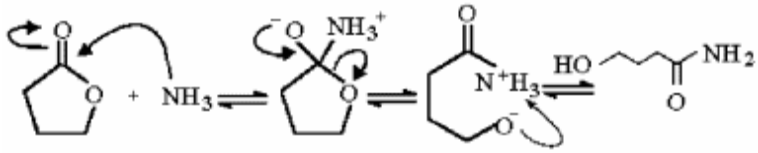
Diff: 3

16) Provide a detailed, stepwise mechanism for the base-mediated transesterification of methyl benzoate with sodium ethoxide.
Answer:



Diff: 2

17) Provide a detailed, stepwise mechanism for the reaction of γ-butyrolactone with ammonia.
Answer:



Diff: 3

18) The hydrolysis of esters in base is called:
A) the Fischer esterification.
B) the Hunsdiecker reaction.
C) the Dieckmann condensation.
D) transesterification.
E) saponification.
Answer: E
Diff: 1

19) Typically, amides will hydrolyze under _____ conditions than esters.
A) stronger
B) more dilute
C) milder
D) less vigorous
E) more saline
Answer: A
Diff: 1

20) The hydrolysis of esters, amides, and nitriles:
A) can be carried out under acidic or basic conditions.
B) must be acid-catalyzed.
C) must be base-catalyzed.
D) should be carried out at pH 7.0 for optimum efficiency.
E) is not pH dependent.
Answer: A
Diff: 1

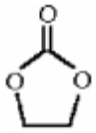
21) Lithium aluminum hydride reduces carboxylic acids, acid chlorides, and esters to:
A) aldehydes.
B) primary alcohols.
C) secondary alcohols.
D) tertiary alcohols.
E) ketones.
Answer: B
Diff: 1

22) Acids can be reduced to aldehydes by:
A) treatment with $LiAlH_4$.
B) conversion to the acid chloride followed by treatment with $LiAlH[OC(CH_3)_3]_3$.
C) conversion to the amide followed by treatment with $NaBH_4$.
D) conversion to the ester followed by treatment with $LiAlH_4$.
E) conversion to the anhydride followed by treatment with Mg and H_3O^+.
Answer: B
Diff: 2

23) Acids can be converted to primary amines by:
A) conversion to the nitrile followed by treatment with $LiAlH_4$.
B) conversion to the diazonium salt followed by treatment with $NaBH_4$.
C) conversion to the primary amide followed by treatment with $LiAlH_4$.
D) both A and B.
E) both A and C.
Answer: E
Diff: 2

.
33) What reagents are used to dehydrate amides to nitriles?
Answer: P_2O_5 or $POCl_3$
Diff: 3

40) Ethylene glycol will react with phosgene to produce what organic compound?
Answer:



Diff: 3

50) Cyclic amides are called:
A) lactones.
B) lactams.
C) aminals.
D) animals.
E) imines.
Answer: B
Diff: 1

51) Amides are less basic than amines because:
A) the carbonyl group donates electrons by resonance.
B) the carbonyl group withdraws electrons by resonance.
C) the nitrogen does not have a lone pair of electrons.
D) the nitrogen has a full positive charge.
E) amides do not contain nitrogen.
Answer: B
Diff: 1

53) Cyclic esters are called:
A) lactones.
B) lactams.
C) lacrimals.
D) imides.
E) enamines.
Answer: A
Diff: 1

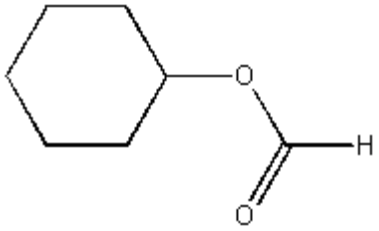
61) List the following four carboxylic acid derivatives, ester, anhydride, amide, and acid halide, in order of increasing reactivity in nucleophilic acyl substitution reactions. Start with the least reactive derivative.
Answer: amide < ester < anhydride < acid halide
Diff: 2

62) What compound results when benzoic acid reacts with methylamine, and what compound ultimately results when the initially formed compound is heated at 140°C?
Answer: $PhCO_2^-$ $CH_3NH_3^+$; $PhCONHCH_3$
Diff: 2

69) What compound is produced when *N*,*N*-dimethylpropanamide is treated with $LiAlH_4$?
A) $CH_3CH_2CONH_2$
B) $CH_3CH_2CH_2NH_2$
C) $CH_3CH_2CH_2OH$
D) $CH_3CH_2CH_2N(CH_3)_2$
E) $CH_3CH_2N(CH_3)_2$
Answer: D
Diff: 2

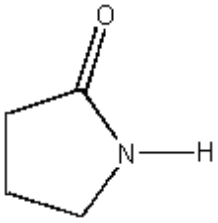
70) Which of the following reagents convert(s) benzoyl chloride to phenyl propyl ketone?
A) $CH_3CH_2CH_2MgBr$
B) $CH_3CH_2CH_2Li$
C) $(CH_3CH_2CH_2)_2CuLi$
D) both A and B
E) both A and C
Answer: C
Diff: 2

71) Provide the structure of cyclohexyl formate.
Answer:



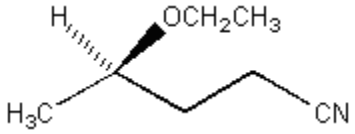
Diff: 2

72) Provide the structure of γ-butyrolactam.
Answer:



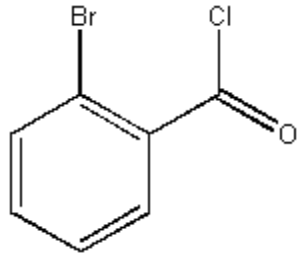
Diff: 2

73) Provide the structure of (*R*)-4-ethoxypentanenitrile.
Answer:



Diff: 2

74) Provide the structure of *o*-bromobenzoyl chloride.
Answer:

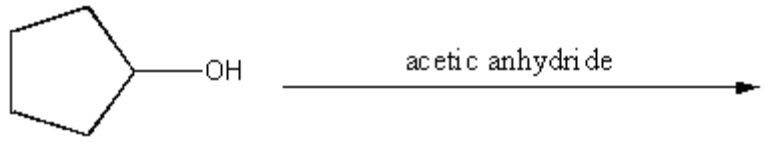


Diff: 2

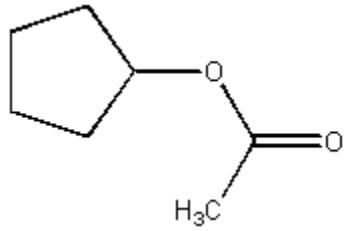
75) What type of compound results from the reaction of an acid chloride and a 2° amine?
A) amide
B) 1° amine
C) ester
D) nitrile
E) carboxylate
Answer: A
Diff: 2

76) What type of compound results from the reaction of ethyl formate with cyclohexylamine?
A) amide
B) 1° amine
C) acid anhydride
D) nitrile
E) carboxylate
Answer: A
Diff: 2

77) Provide the major organic product of the following reaction.

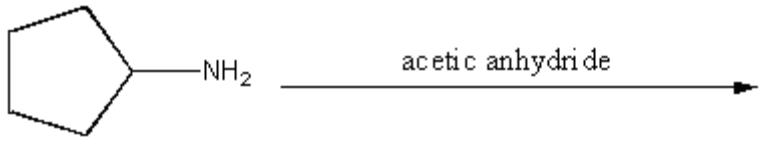


Answer:

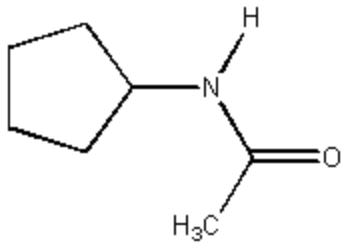


Diff: 2

78) Provide the major organic product of the following reaction.

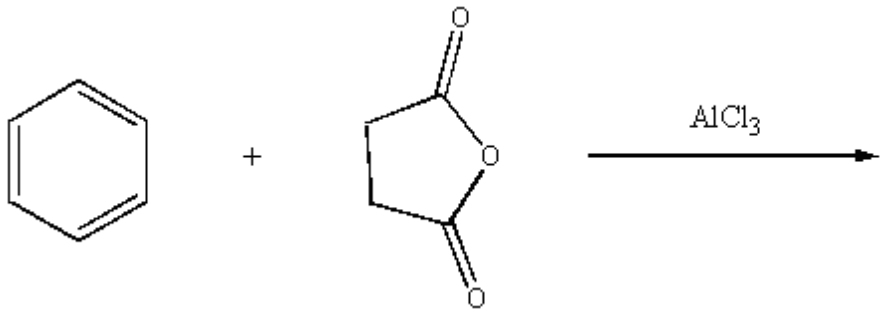


Answer:

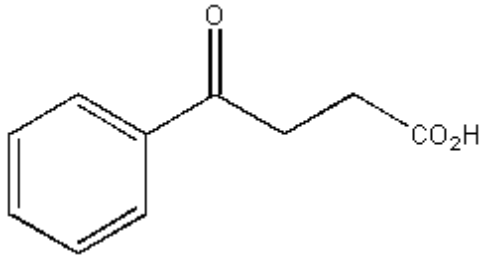


Diff: 2

79) Provide the major organic product of the following reaction.

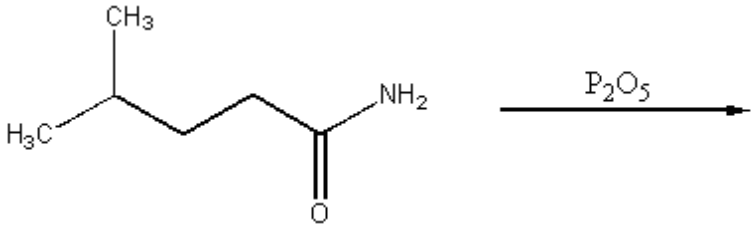


Answer:

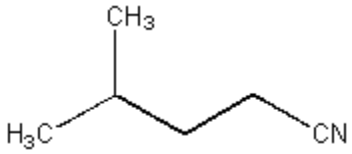


Diff: 2

80) Provide the major organic product of the following reaction.



Answer:



Diff: 2

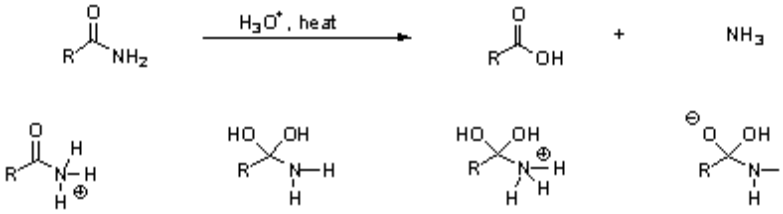
84) Arrange the following three amides in order of increasing boiling point: propanamide, N-methylacetamide, and N,N-dimethylformamide.
Answer: N,N-dimethylformamide < N-methylacetamide < propanamide
Diff: 2

85) Arrange the following compounds in order of increasing boiling point: acetic acid, propanenitrile, butane, and acetamide.
Answer: butane < propanenitrile < acetic acid < acetamide
Diff: 2

89) What compound results when ethyl benzoate is stirred in methanol containing a trace of HCl and by what name is this process known?
Answer: methyl benzoate; transesterification
Diff: 2

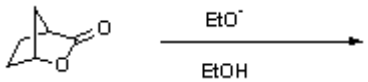
90) What reagent is used to convert pentanamide to 1-pentanamine?
A) $POCl_3$
B) CuCN
C) CH_3MgBr
D) $SOCl_2$
E) $LiAlH_4$
Answer: A
Diff: 2

94) Which of the following are intermediates in the acid hydrolysis of an amide?

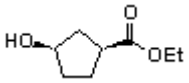


A) 1
B) 2
C) 2 & 3
D) 4
E) 1, 2, & 3
Answer: C
Diff: 3

95) Draw the product resulting from the following reaction. Indicate any relevant stereochemistry.



Answer:



Diff: 3