

4) Which of the following is the strongest acid?

- A) chloroacetic acid
- B) dichloroacetic acid
- C) trichloroacetic acid
- D) acetic acid

Answer: C

Diff: 2

5) Draw an acetic acid dimer. Be sure to indicate the hydrogen bonds present.

Answer:



Diff: 2

6) At pH 4.5, which of the following acids would be most dissociated?

- A) *p*-nitrobenzoic acid ($pK_a = 3.41$)
- B) acetic acid (ethanoic acid) ($pK_a = 4.74$)
- C) hexanoic acid ($pK_a = 4.88$)
- D) octanoic acid ($pK_a = 4.89$)
- E) water

Answer: A

Diff: 3

8) What salt results from the reaction of benzoic acid with potassium hydroxide?

Answer: potassium benzoate

Diff: 1

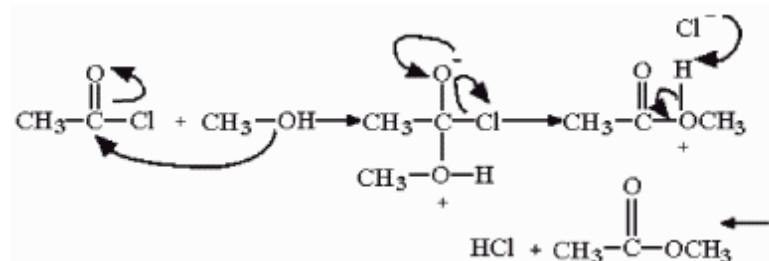
9) Name the salt formed from the reaction of acetic acid with ammonia.

Answer: ammonium acetate

Diff: 1

22) Provide a detailed, stepwise mechanism for the reaction of acetyl chloride with methanol to produce methyl acetate and HCl.

Answer:



Diff: 3

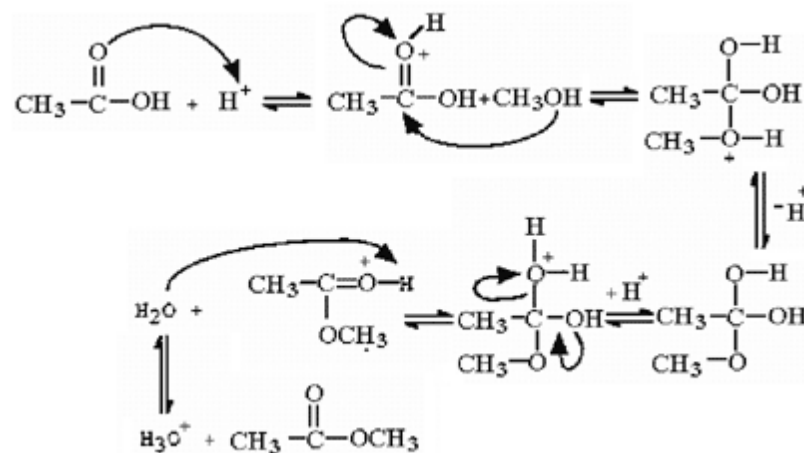
23) What are the products of the reaction of benzoic acid with thionyl chloride?

Answer: benzoyl chloride, $\text{SO}_2(\text{g})$, and $\text{HCl}(\text{g})$

Diff: 2

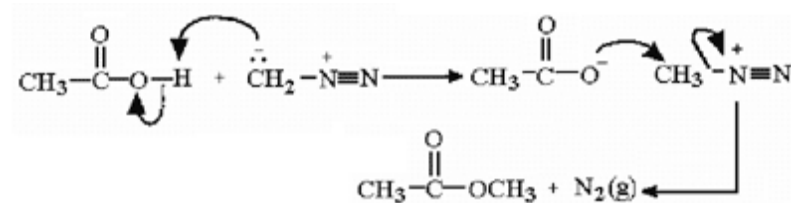
25) Give a detailed, stepwise mechanism for the Fischer esterification of acetic acid with methanol.

Answer:



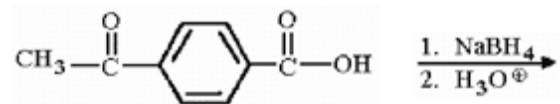
29) Provide a detailed, stepwise mechanism for the methylation of a carboxylic acid with diazomethane.

Answer:

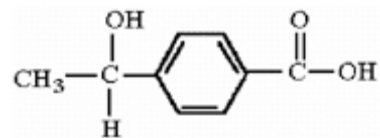


Diff: 3

32) Provide the major organic product for the following reaction.

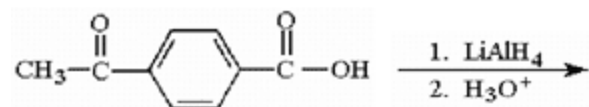


Answer:

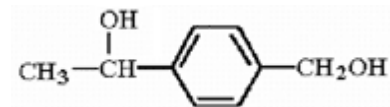


Diff: 2

33) Provide the major organic product for the following reaction.



Answer:



Diff: 2

34) $\text{LiAl}[\text{O}(\text{CH}_3)_3]_3\text{H}$ will reduce an acid chloride to an:

- A) alcohol
- B) alkane
- C) acid
- D) aldehyde
- E) acetal

Answer: D

Diff: 1

35) Suggest a sequence of synthetic steps through which *p*-toluic acid can be prepared from toluene.

Answer: 1. Br_2 , FeBr_3

2. Mg, ether

3. CO_2

4. H_3O^+

Diff: 3

36) Suggest a sequence of synthetic steps through which 2-phenylethanol can be prepared from toluene. One of your intermediates must be a carboxylic acid.

Answer: 1. Br_2 , hv or NBS

2. NaCN, acetone

3. H^+ , H_2O

4. LiAlH_4

or

1. Br_2 , hv or NBS

2. Mg, ether

3. CO_2

4. H^+ , H_2O

5. LiAlH_4

Diff: 3

45) Provide the structure of pent-3-ynoic acid.

Answer: $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{CO}_2\text{H}$

Diff: 1

47) The strongest dichlorobutanoic acid is:

- A) 2,2-dichlorobutanoic acid
- B) 2,3-dichlorobutanoic acid
- C) 3,3-dichlorobutanoic acid
- D) 3,4-dichlorobutanoic acid
- E) 4,4-dichlorobutanoic acid

Answer: A

Diff: 2

48) Which of the following compounds is the strongest acid?

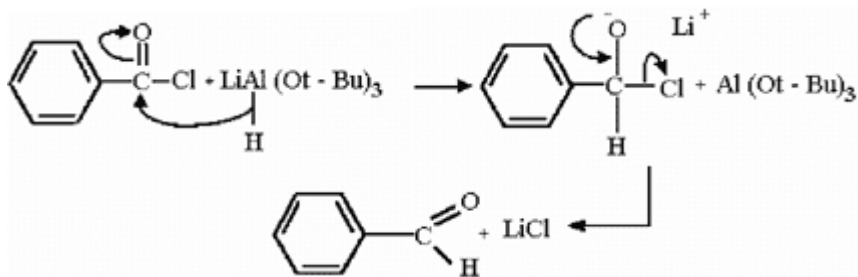
- A) *p*-nitrobenzoic acid
- B) *p*-bromobenzoic acid
- C) *m*-methylbenzoic acid
- D) *m*-methoxybenzoic acid
- E) water

Answer: A

Diff: 2

54) Provide a detailed, stepwise mechanism to show how PhCHO is formed by the reaction of PhCOCl with $\text{LiAlH}[\text{O}(\text{CH}_3)_3]_3$.

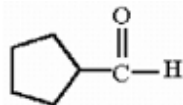
Answer:



Diff: 1

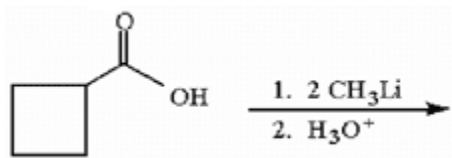
55) Provide the structure of the major organic compound which results when cyclopentanecarboxylic acid is treated with thionyl chloride and the resulting product is treated with $\text{LiAlH}_4[\text{OC}(\text{CH}_3)_3]_3$.

Answer:

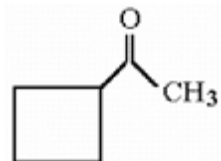


Diff: 2

59) Provide the structure of the major organic product of the reaction sequence shown.



Answer:



Diff: 2

65) Which of the following is the strongest acid?

- A) $(\text{CH}_3)_2\text{CHCO}_2\text{H}$
- B) $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$
- C) $\text{CH}_3\text{OCH}_2\text{CO}_2\text{H}$
- D) $\text{PhCH}_2\text{CO}_2\text{H}$
- E) $\text{O}_2\text{NCH}_2\text{CO}_2\text{H}$

Answer: E

Diff: 2

67) What compound is produced when cyclohexene is treated with concentrated KMnO_4 ?

- A) hexanoic acid
- B) adipic acid
- C) cyclohexanecarboxylic acid
- D) benzoic acid
- E) succinic acid

Answer: B

Diff: 2

68) What compound is produced when $(\text{CH}_3)_2\text{CHCH}_2\text{Br}$ is subjected to the following sequence of steps:

1. Mg , Et_2O , 2. CO_2 , 3. H_3O^+ ?

- A) 2-methylpropanoic acid
- B) 3-methylpropanoic acid
- C) 2-methylbutanoic acid
- D) 3-methylbutanoic acid
- E) 2-methylhexanoic acid

Answer: D

Diff: 2

69) Acid chlorides can be prepared from carboxylic acids by treatment with:

- A) $(\text{COCl})_2$
- B) SOCl_2
- C) KCl
- D) both A and B
- E) both B and C

Answer: D

Diff: 2

70) How can one prepare ethyl cyclohexyl ketone from cyclohexanecarboxylic acid?

Answer: 1. $\text{CH}_3\text{CH}_2\text{Li}$ (2 eq.)

2. H_3O^+

Diff: 2

71) Provide the structure of glutaric acid.

Answer:

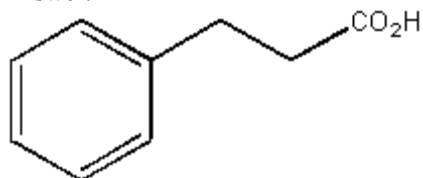


Diff: 2

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

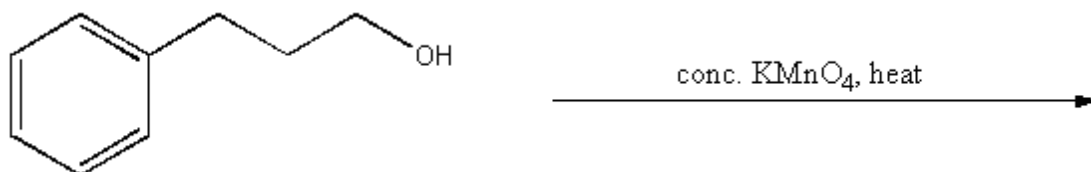


Answer:

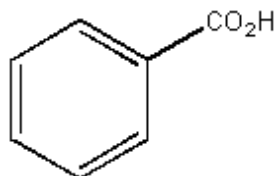


Diff: 2

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

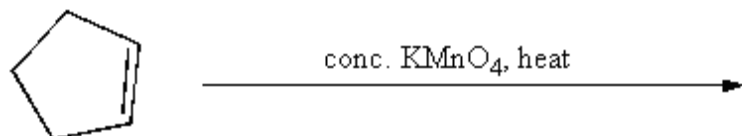


Answer:



Diff: 3

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

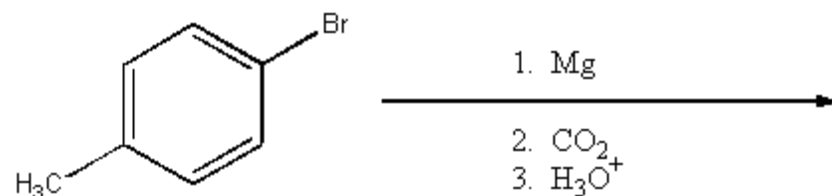


Answer:

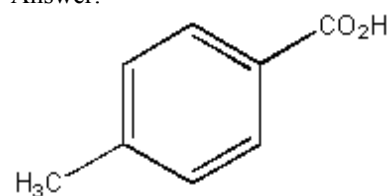


Diff: 2

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

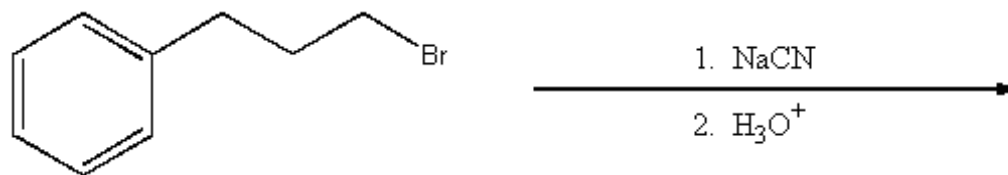


Answer:

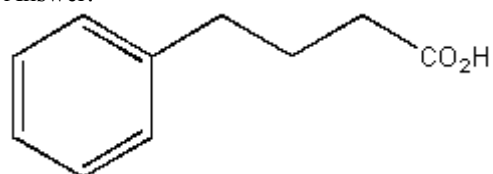


Diff: 2

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

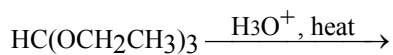


Answer:



Diff: 2

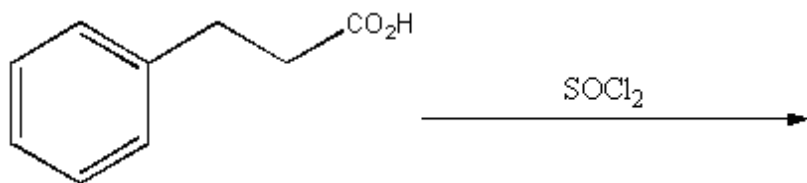
77) Provide the major organic product of the following reaction.



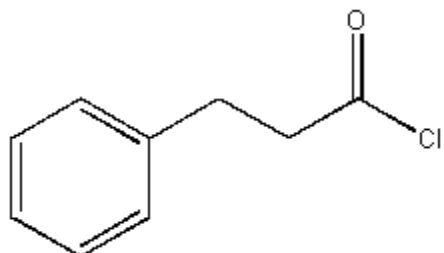
Answer: $\text{HCO}_2\text{H} + \text{CH}_3\text{CH}_2\text{OH}$

Diff: 3

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

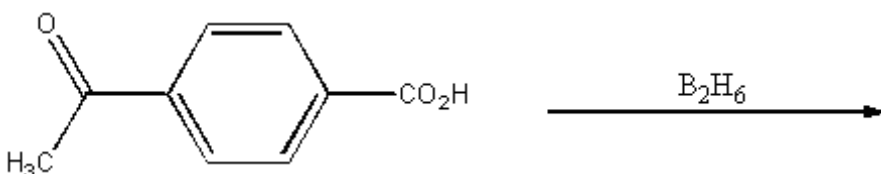


Answer:

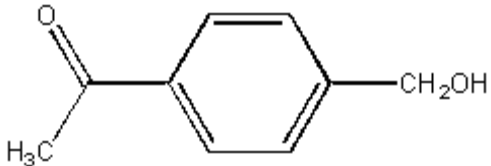


Diff: 1

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



Answer:



Diff: 2

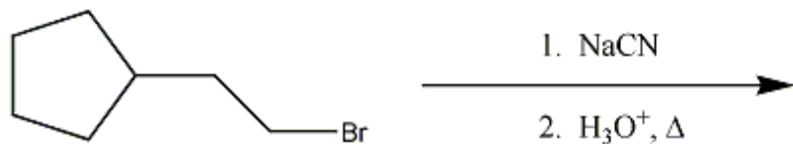
80) Which of the following reagents can be used to convert a carboxylic acid directly into its corresponding acid chloride derivative?

- A) $(\text{COCl})_2$
- B) HCl
- C) CH_3Cl
- D) NaOCl
- E) CH_3COCl

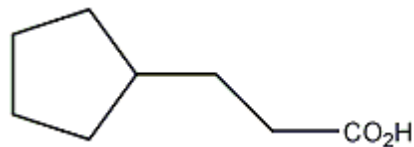
Answer: A

Diff: 2

81) Provide the major organic product of the following reaction sequence.

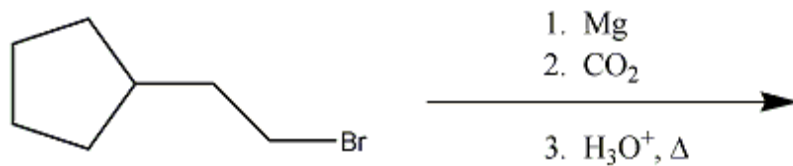


Answer:

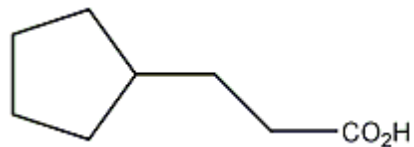


Diff: 2

82) Provide the major organic product of the following reaction sequence.

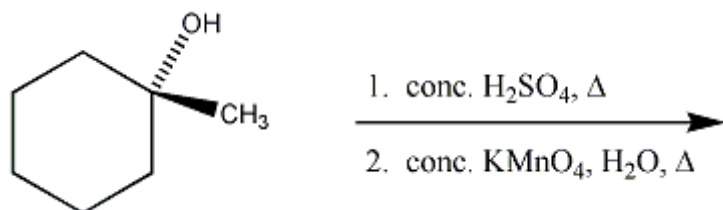


Answer:

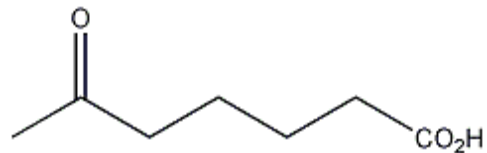


Diff: 2

83) Provide the major organic product of the following reaction sequence.



Answer:



Diff: 2

84) Provide the sequence of reagents needed to accomplish the conversion below.

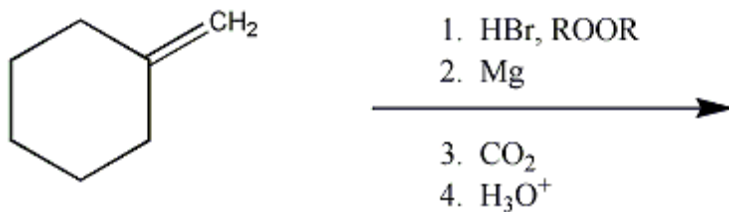


Answer:

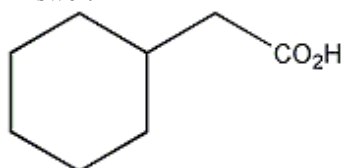
1. $\text{BH}_3 \cdot \text{THF}$
2. $\text{H}_2\text{O}_2, \text{HO}^-$
3. $\text{Na}_2\text{Cr}_2\text{O}_7$

Diff: 2

85) Provide the major organic product of the following reaction sequence.

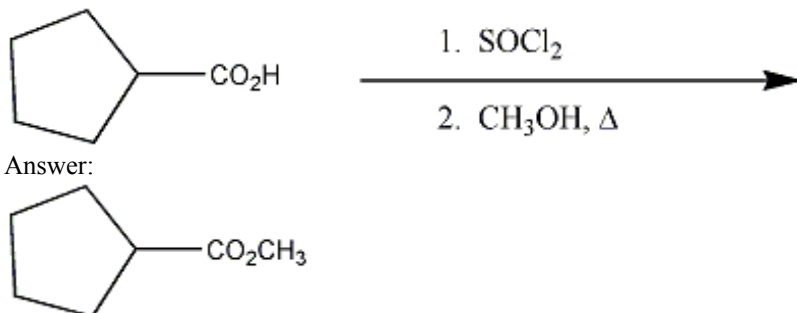


Answer:

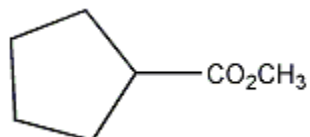


Diff: 2

86) Provide the major organic product of the following reaction sequence.

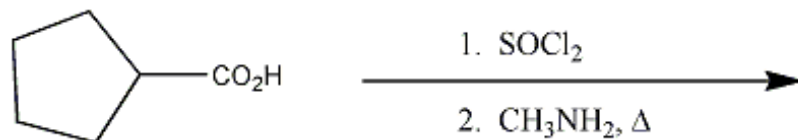


Answer:

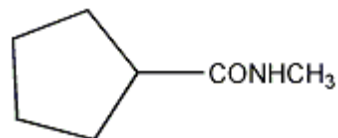


Diff: 2

87) Provide the major organic product of the following reaction sequence.

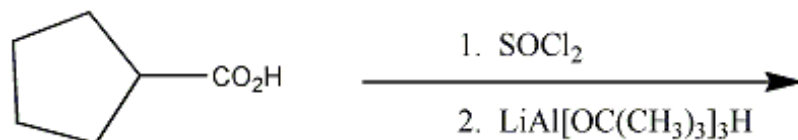


Answer:

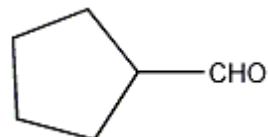


Diff: 2

88) Provide the major organic product of the following reaction sequence.

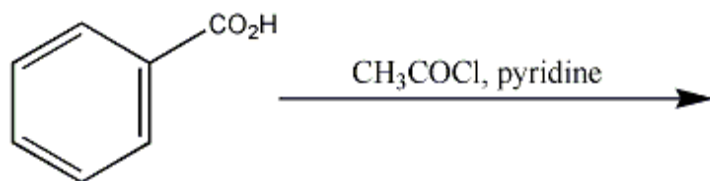


Answer:

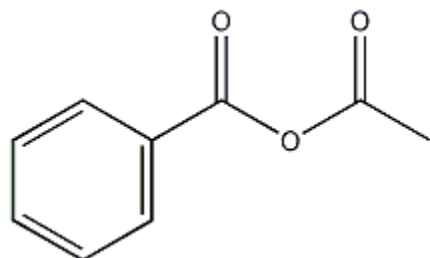


Diff: 2

89) Provide the major organic product of the following reaction sequence.



Answer:



Diff: 2