

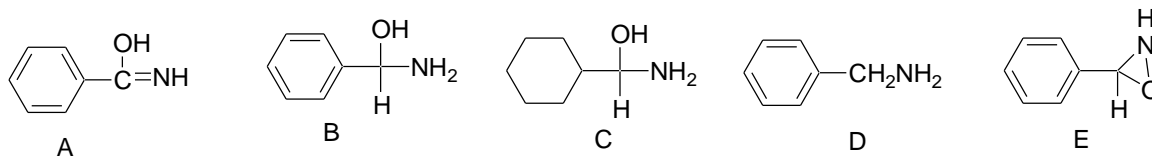
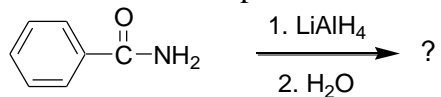
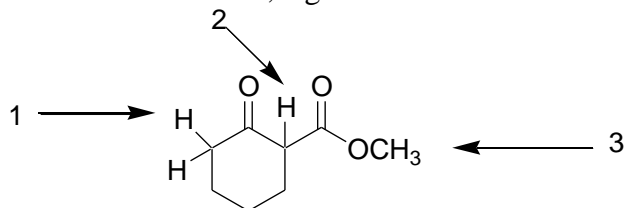
B

Student ID _____

1. What is the molecular formula of diethyl oxalate?

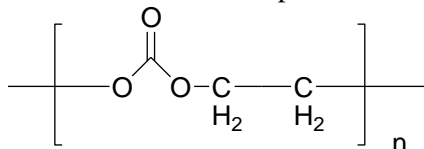
- A. $C_4H_{10}O_3$ B. $C_4H_8O_4$ C. $C_5H_{10}O_4$ D. $C_7H_{12}O_4$ E. $C_6H_{10}O_4$

2. What is the most probable outcome of the following reduction?

3. For the compound below, rank the indicated protons according to DECREASING acidities, most acidic to least acidic, e.g. $1 > 2 > 3$.

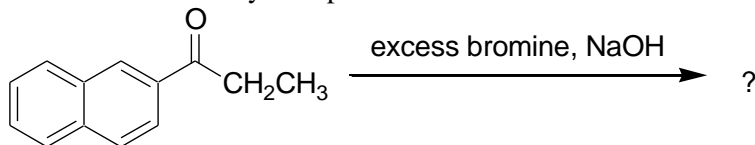
- A. $1 > 2 > 3$ B. $1 > 3 > 2$ C. $3 > 1 > 2$ D. $3 > 2 > 1$ E. $2 > 1 > 3$

4. Show below is the repeat unit of a polyester. From which acid and which alcohol is it derived?



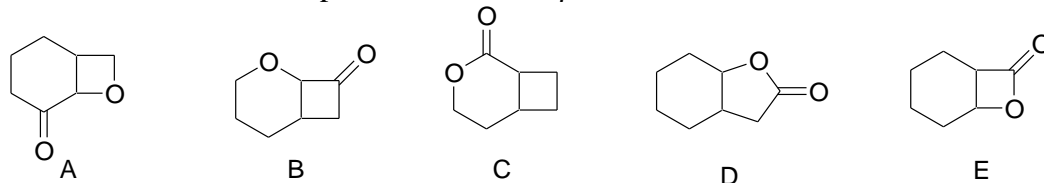
- A. From 2-hydroxyethanol and carbonic acid
 B. From ethanediol and acetic acid
 C. From ethanediol and carbonic acid
 D. Both the acid and alcohol component are part of the same molecule, 2-hydroxypropanoic acid
 E. From ethanediol and hydroxyacetic acid

5. What outcome do you expect for the reaction below?

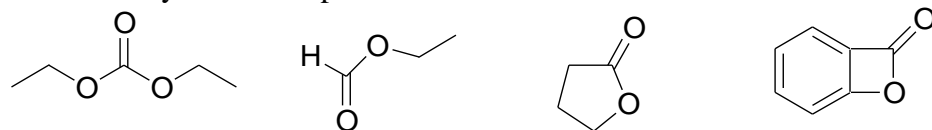


- A. This is a haloform reaction and will generate tribromoethane and 2-bromonaphthalene
 B. This is a haloform reaction and will generate tribromomethane and sodium 2-naphthalenecarboxylate
 C. This is a haloform reaction and will generate tribromoethane and naphthalene
 D. This is a haloform reaction and will generate chloroform and 2-naphthalenecarbaldehyde
 E. No haloform reaction is possible for this ketone

6. Which one of the compounds below is a β -lactone?



7. How many of the compounds below can enolize?

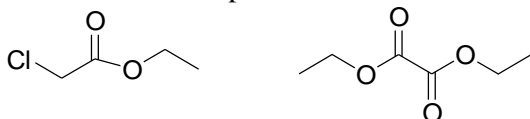


A. none can enolize B. one of them C. two of them D. three of them E. all of them

8. How could you convert acetic acid to chloroacetic acid?

- A. by shaking with hydrochloric acid
- B. with the Hell-Vollard-Zelinsky reaction
- C. with the haloform reaction
- D. by treatment with NBS (N-bromosuccinimide)
- E. by treatment with m-chloroperoxybenzoic acid

9. Which two compounds are shown?

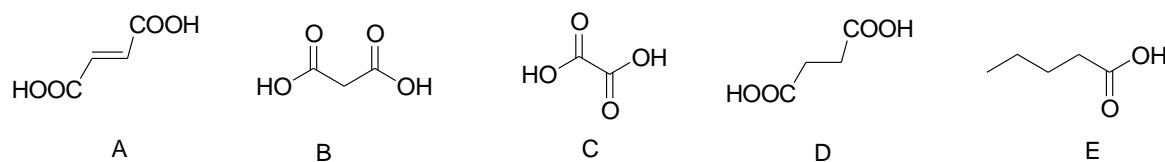


- A. two esters, ethyl chloroformate and diethyl malonate
- B. two esters, ethyl chloroacetate and diethyl oxalate
- C. two esters, ethyl chloroformate and diethyl carbonate
- D. two esters, ethyl chloroacetate and diethyl carbonate
- E. one ester and one acid anhydride

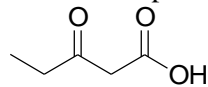
10. The reaction of primary amides with thionyl chloride constitutes a good method to prepare a class of compounds. Which one?

- A. carboxylic acid chlorides B. amines C. ketones D. nitriles E. ureas

11. Only one of the dicarboxylic acids below will spontaneously lose water and form an acid anhydride when heated. Which one?

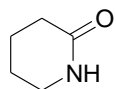


12. The compound below readily decarboxylates when heated. To what (in addition to CO_2)?



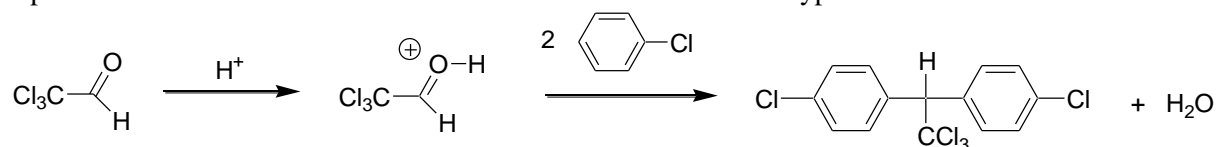
- A. butanol B. butanoic acid C. butanal
- D. butanone E. propanoic acid

13. Like other amides, the one shown below hydrolyzes with heated with aqueous sodium hydroxide. To what?



- A. ammonia and the sodium salt of pentanoic acid
- B. methylamine and the sodium salt of butanoic acid
- C. ammonia and pentanal
- D. the sodium salt of 5-aminopentanoic acid
- E. the sodium salt of 4-aminopentanoic acid

14. The insecticide DDT was manufactured from trichloroacetaldehyde and chlorobenzene under acid-catalyzed conditions. There can be little doubt that the first step is a protonation of the aldehyde. Consider a plausible mechanism for its reaction with chlorobenzene: What type of reaction is this?

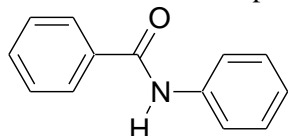


- A. an electrophilic aromatic substitution
- B. a haloform reaction
- C. a nucleophilic aromatic substitution
- D. a Hell-Vollard-Zelinski reaction
- E. a saponification reaction

15. As we discussed, fats are esters of various carboxylic acids and a specific alcohol. Which alcohol?

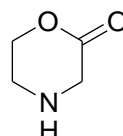
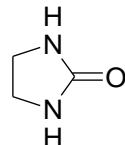
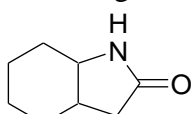
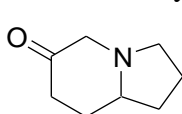
- A. ethanol
- B. 1,2-ethanediol
- C. 1,2-propanediol
- D. propanetriol
- E. 1,3-propanediol

16. Consider the compound below and select the best name:



- A. N-phenylcarbamide
- B. N-phenylbenzeneamide
- C. phenylbenzoic acid amide
- D. N-phenylbenzenecarboxamide
- E. N-benzylcarboxamide

17. How many of the following are amides?



- A. none
- B. one of them
- C. two of them
- D. three of them
- E. all of them

18. Only one of the compounds listed can undergo a haloform reaction. Which one?

- A. acetone
- B. benzaldehyde
- C. butanal
- D. 3-pentanone
- E. cyclohexanone

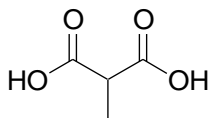
19. How could you prepare acetic anhydride?

- A. by heating acetic acid to eliminate water
- B. by reacting sodium acetate with acetyl chloride
- C. by treating acetic acid with thionyl chloride
- D. by heating acetic acid with phosphorous tribromide
- E. by treating acetyl chloride with DIBAL (DIBAL = diisobutylaluminum hydride)

20. How is acetic acid most commonly manufactured industrially?

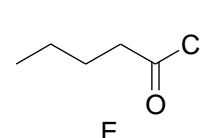
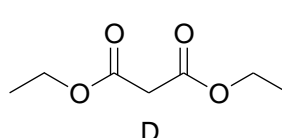
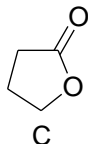
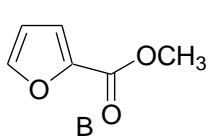
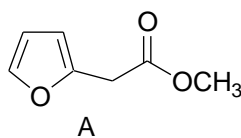
- A. from carbon monoxide and ethane
- B. by oxidizing ethene with hydrogen peroxide
- C. from carbon monoxide and methanol
- D. by reacting formic acid with formaldehyde
- E. by fermenting honey

21. Like many other β -dicarbonyl compounds, the one below decarboxylates at elevated temperature. To what does this compound decarboxylate?

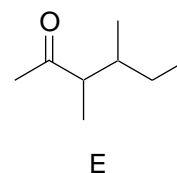
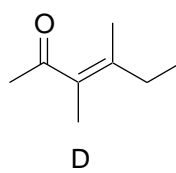
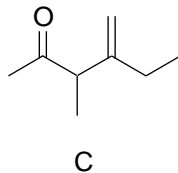
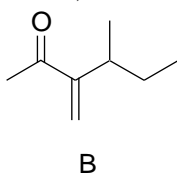
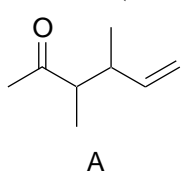


- A. carbon dioxide and propanoic acid
- B. carbon dioxide and 3-methylbutanone
- C. carbon dioxide and 3-hexen-2-one
- D. carbon dioxide and butanal
- E. carbon dioxide and butanone

22. Only one of the compounds below can **NOT** form an enol. Which one can **NOT** enolize?



23. Like other enolizable ketones, butanone can undergo aldol condensation with a second molecule of butanone (autocondensation). To what product?



24. Grignard reagents react with carbon dioxide. Usually, the resulting products are worked up by treatment with dilute mineral acids. (As an example, you could treat phenylmagnesium bromide with CO_2 , followed by dilute hydrochloric acid). What class of products is obtained?

- A. aldehydes
- B. ketones
- C. carboxylic acids
- D. alcohols
- E. esters

25. Acid halides react with Gilman reagents. Thus, benzoyl chloride (the chloride of benzoic acid) reacts with lithium dimethyl cuprate. To what?

- A. a ketone B. an alcohol C. an ester D. an aldehyde E. an acetal

26. This is exam version B. Please mark B on your scantron!

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2. D
3. E
4. C
5. E
6. E
7. B (third from left)
8. B
9. B
10. D
11. D
12. D
13. D
14. A
15. D
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17. B
18. A
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23. D
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