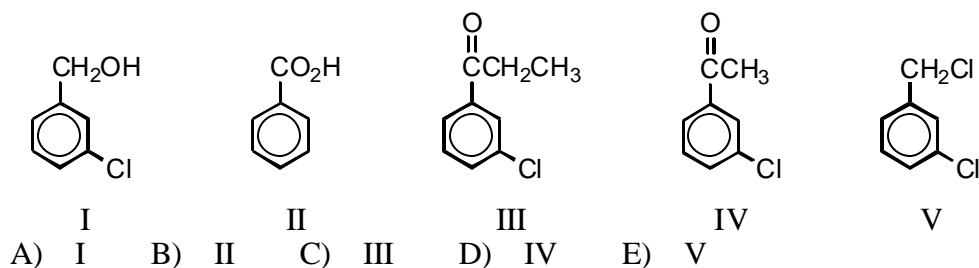


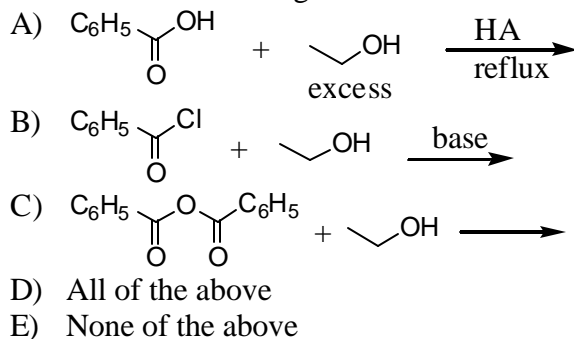
No electronic devices (calculators, cell phones, laptops, etc) may be used or consulted during the exam. All scrap work should be done on the extra page provided; no additional paper may be used. **Your name and Panther ID should be placed** at the end of this paragraph to indicate acceptance of all policies and on your answer sheet. Be sure to include **the form of your exam on the answer sheet.**

Name _____ Panther ID _____

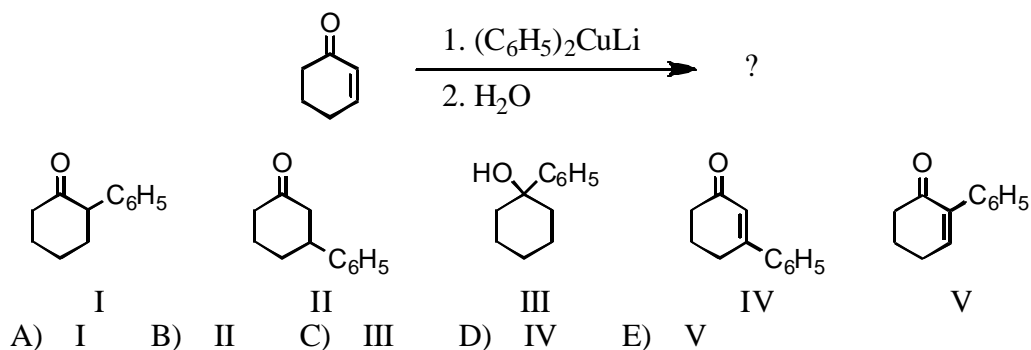
1. Which compound could be subjected to a haloform reaction to produce m-chlorobenzoic acid?



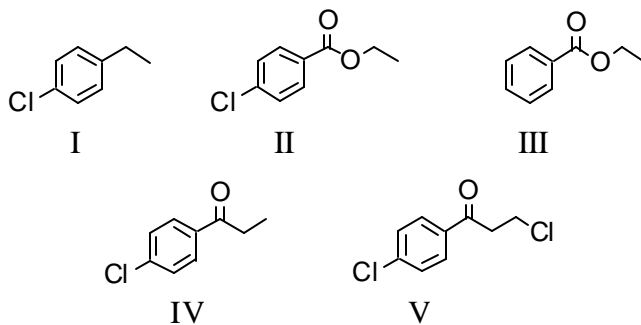
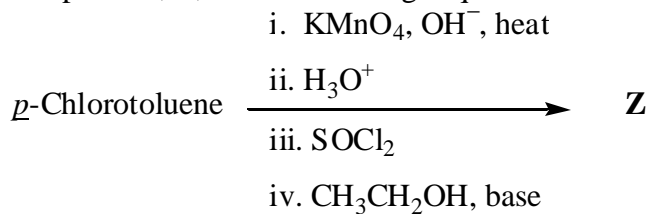
2. Which of the following would serve as a reasonable synthesis of ethyl benzoate?



3. What is the product of the reaction below?



4. The product, **Z**, of the following sequence of reactions is which compound?



A) I B) II C) III D) IV E) V

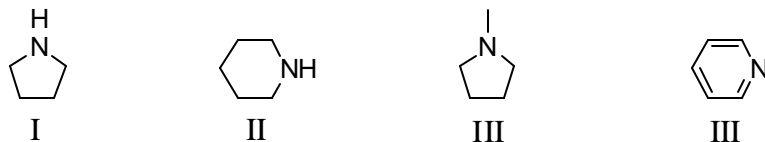
5. Which compound would be the strongest acid?

- | | |
|---|--|
| A) $\text{CHCl}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ | D) $\text{CH}_3\text{CHClCHClCO}_2\text{H}$ |
| B) $\text{ClCH}_2\text{CHClCH}_2\text{CO}_2\text{H}$ | E) $\text{CH}_3\text{CH}_2\text{CCl}_2\text{CO}_2\text{H}$ |
| C) $\text{CH}_3\text{CCl}_2\text{CH}_2\text{CO}_2\text{H}$ | |

6. Which reagent could be used to separate a mixture of aniline and toluene?

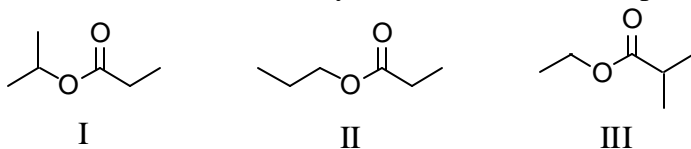
- | | |
|--|--|
| A) KMnO_4 in H_2O | D) $\text{Ag}(\text{NH}_3)_2\text{OH}$ |
| B) Dilute NaOH | E) Dilute HCl |
| C) Dilute NaHCO_3 | |

7. Which of these amines is/are used with aldehydes and ketones to form enamines?



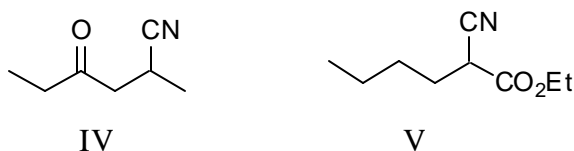
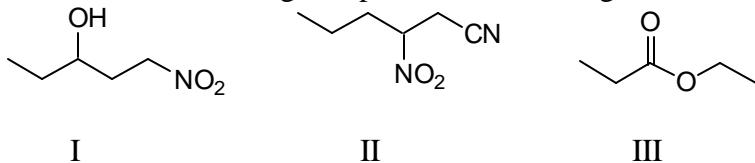
A) I B) II C) III D) IV E) Both I and II

8. A compound has the molecular formula, $C_6H_{12}O_2$. Its IR spectrum shows a strong absorption band near 1740 cm^{-1} ; its 1H NMR spectrum consists of two singlets, at δ 1.4 and δ 2.0. The most likely structure for this compound is:



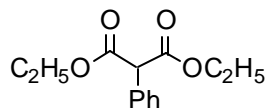
- A) I B) II C) III D) IV E) V

9. Which of the following compounds is the strongest acid?



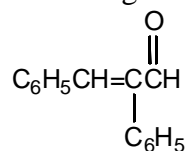
- A) I B) II C) III D) IV E) V

10. Which of the following would afford the best synthesis of diethyl phenylmalonate,



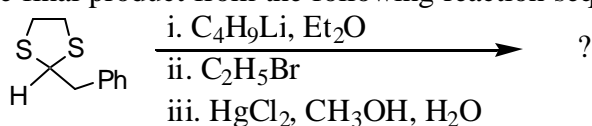
- A) $\text{Ph-Br} + \text{C}_2\text{H}_5\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\overset{\ominus}{\text{C}}(\text{OC}_2\text{H}_5)_2 + \text{Na}^+ \longrightarrow$
- B) $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\text{OC}_2\text{H}_5 + \text{C}_2\text{H}_5\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OC}_2\text{H}_5 \xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{NaOC}_2\text{H}_5} \xrightarrow{\text{H}_3\text{O}^+}$
- C) $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\text{OC}_2\text{H}_5 + \text{C}_2\text{H}_5\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OC}_2\text{H}_5 \xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{NaOC}_2\text{H}_5} \xrightarrow{\text{H}_3\text{O}^+}$
- D) $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\text{OC}_2\text{H}_5 + \text{C}_2\text{H}_5\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OC}_2\text{H}_5 \xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{NaOC}_2\text{H}_5} \xrightarrow{\text{H}_3\text{O}^+}$
- E) $\text{Ph-CHO} + 2 \text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OC}_2\text{H}_5 \xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{NaOC}_2\text{H}_5} \xrightarrow{\text{H}_3\text{O}^+}$

11. Which reagents would you use to synthesize this compound by an aldol condensation?



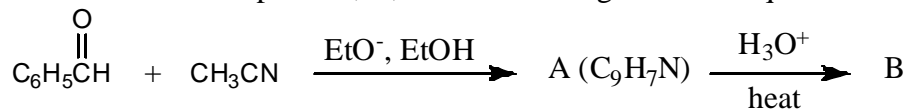
- A) $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CH} \end{array}$ and $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CH}_2\text{CH} \end{array}$ D) $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CCH}_3 \end{array}$ and $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CH} \end{array}$
- B) $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CH}_2\text{CH} \end{array}$ and $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CCH}_3 \end{array}$ E) $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$ and $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CHCH} \\ | \\ \text{ONa} \end{array}$
- C) $\text{C}_6\text{H}_5\text{CH}=\text{CHCH}=\text{O}$ and $\text{C}_6\text{H}_5\text{OH}$

12. What is the final product from the following reaction sequence?



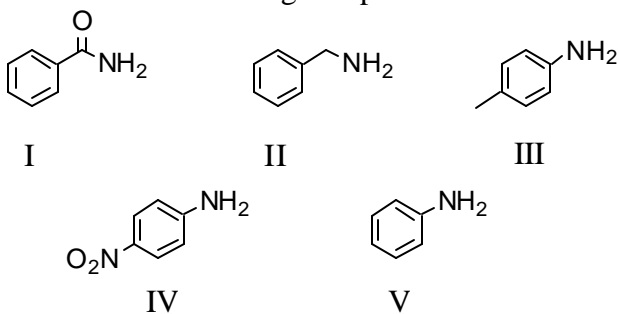
- I: $\begin{array}{c} \text{S} \quad \text{S} \\ \diagdown \quad / \\ \text{C} \\ / \quad \backslash \\ \text{Et} \quad \text{Ph} \end{array}$ II: $\begin{array}{c} \text{S} \quad \text{S} \\ \diagdown \quad / \\ \text{C} \\ / \quad \backslash \\ \text{H} \quad \text{Ph} \\ | \\ \text{Et} \end{array}$ III: $\text{Ph}-\text{CH}(\text{Et})-\text{CH}_2-\text{S}-\text{CH}_2-\text{SH}$
- IV: $\text{Ph}-\text{CH}_2-\text{C}(=\text{O})-\text{CH}_2-\text{Et}$ V: $\text{Ph}-\text{CH}(\text{Et})-\text{CHO}$
- A) I B) II C) III D) IV E) V

13. What would be the product, B, of the following reaction sequence?



- A) $\text{C}_6\text{H}_5\text{CH}=\text{CHCO}_2\text{H}$ D) $\begin{array}{c} \text{OH} \\ | \\ \text{C}_6\text{H}_5\text{CHCH}_2\text{CO}_2\text{H} \end{array}$
- B) $\begin{array}{c} \text{O} \\ \parallel \\ \text{C}_6\text{H}_5\text{CCH}_2\text{CO}_2\text{H} \end{array}$ E) $\begin{array}{c} \text{OH} \\ | \\ \text{C}_6\text{H}_5\text{CHCH}_2\text{CN} \end{array}$
- C) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$

14. Which of the following compounds would be the strongest base?

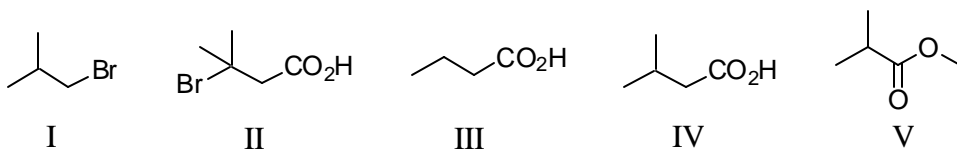
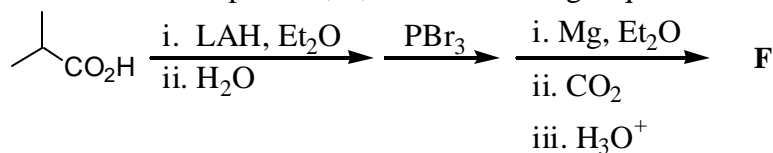


A) I B) II C) III D) IV E) V

15. Which of the following is a tertiary amine?

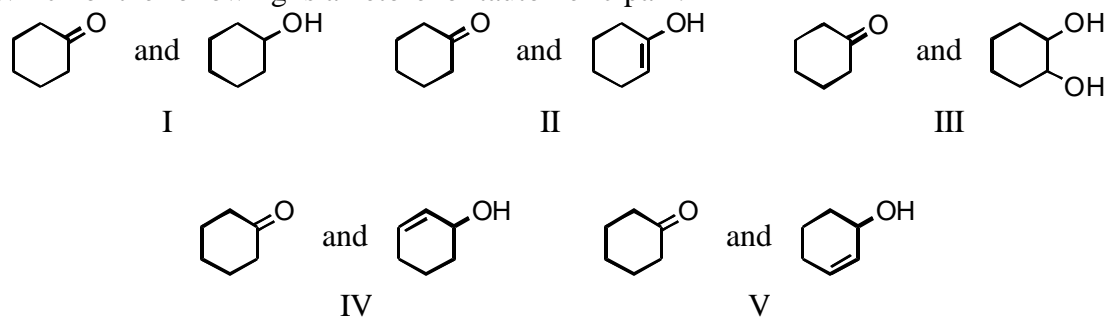
- A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ D) $(\text{CH}_3\text{CH}_2)_4\text{N}^+\text{OH}^-$
 B) $\text{CH}_3\text{CH}_2\text{NHCH}_2\text{CH}(\text{CH}_3)_2$ E) $(\text{CH}_3\text{CH}_2)_3\text{CNH}_2$
 C) $(\text{CH}_3\text{CH}_2)_2\text{NCH}_2\text{CH}(\text{CH}_3)_2$

16. What would be the final product, **F**, of the following sequence of reactions?



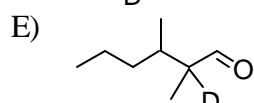
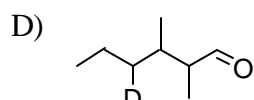
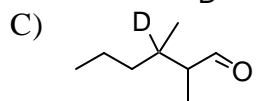
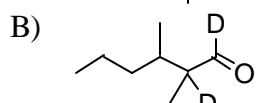
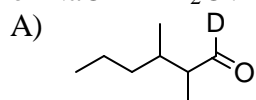
A) I B) II C) III D) IV E) V

17. Which of the following is a keto-enol tautomeric pair?



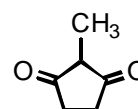
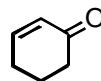
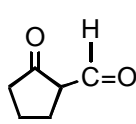
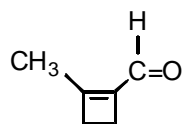
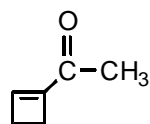
A) I B) II C) III D) IV E) V

18. Which compound would be formed when 2,3-dimethylhexanal is treated with a solution of NaOD in D₂O?



19.

The aldol cyclization of $\text{CH}_3\overset{\text{O}}{\parallel}\text{CCH}_2\text{CH}_2\text{CH}_2\overset{\text{H}}{\parallel}\text{C}=\text{O}$ produces which of these?



I

II

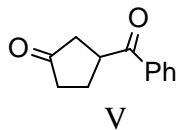
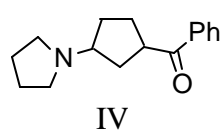
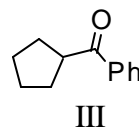
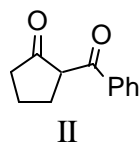
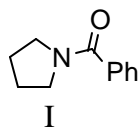
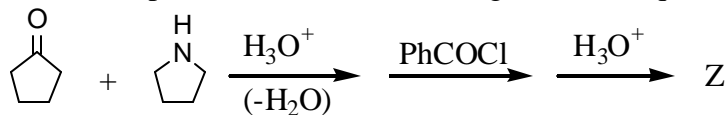
III

IV

V

A) I B) II C) III D) IV E) V

20. What is the product, **Z**, of the following reaction sequence?



A) I B) II C) III D) IV E) V

Answer Key

1. D
2. D
3. B
4. B
5. E
6. E
7. E
8. D
9. E
10. B
11. A
12. D
13. A
14. B
15. C
16. D
17. B
18. E
19. D
20. B