

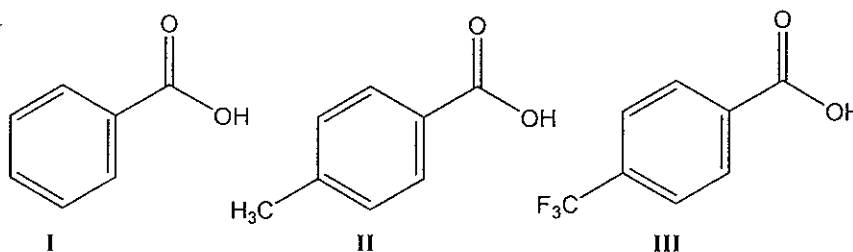
CHEM 256 – Phillips
Test 3, Version I

By signing below, I certify that I have neither given nor received any unauthorized help on this exam, and have followed good test-taking practices

Student Name: Key

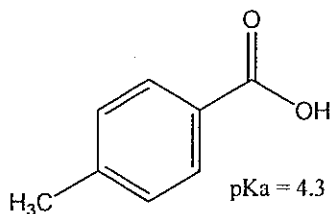
Lab TA: _____

1. Rank the following compounds in order of *increasing* acidity [Homework problem 19.37(c)]:



- A. I < II < III
B. II < III < I
C. III < I < II
D. II < I < III

2. Using the pKa table in Appendix A, indicate which of the following bases is strong enough to deprotonate the compound below [Homework problem 19.34(b)]:



I. OH^-

II. CH_3CH_2^-

III. NH_2^-

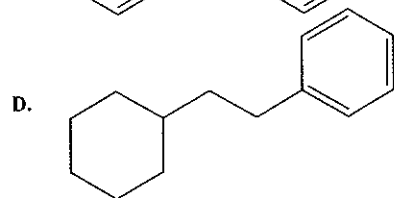
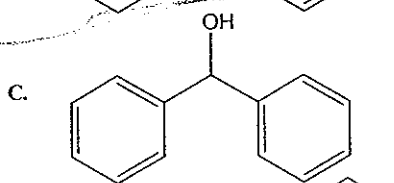
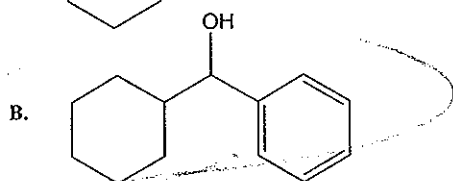
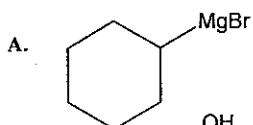
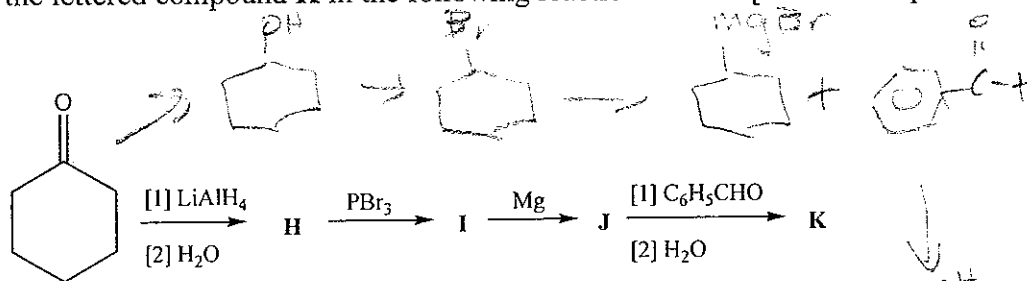
IV. NH_3

V. $\text{HC}\equiv\text{C}^-$

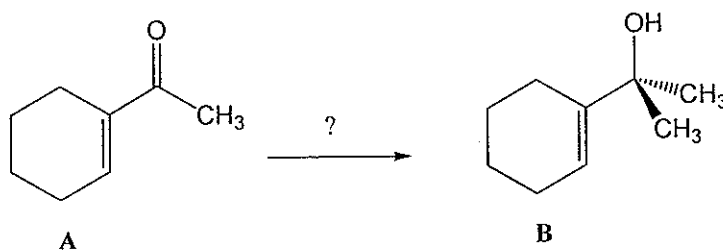
pKa
16
50
38
10
25

- A. I, II, III
B. III, VI
C. I, V
D. I, II, III, IV, V
E. II, V

3. Identify the lettered compound **K** in the following reaction scheme [Homework problem 20.51]



4. Choose the correct reagent to convert α,β -unsaturated ketone **A** into product **B** [Homework problem 20.43]:



A. $\text{NaBH}_4, \text{CH}_3\text{OH}$

B. H_2 (1 eq), Pd-C

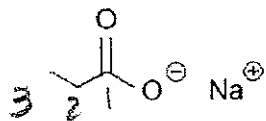
C. [1] CH_3Li ; [2] H_2O

D. [1] $\text{CH}_3\text{CH}_2\text{MgBr}$; [2] H_2O

E. H_2 (excess), Pd-C

5. Chapter 19 Practice Test, Question #5:

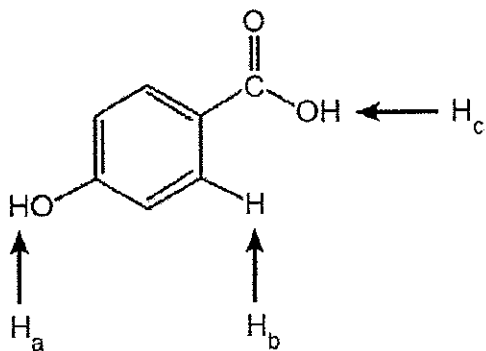
What is the IUPAC name of the following structure?



- A. Sodium ethanoic
- B. Propanoic sodium
- C. Sodium ethanoate
- D. Sodium propanoate

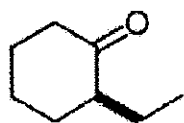
6. Chapter 19 Practice Test, Question #27:

Rank the labeled protons in order of *decreasing* acidity.

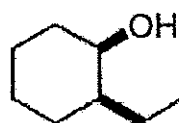


- A. $H_b > H_c > H_a$
- B. $H_b > H_a > H_c$
- C. $H_a > H_b > H_c$
- D. $H_a > H_c > H_b$
- E. $H_c > H_a > H_b$

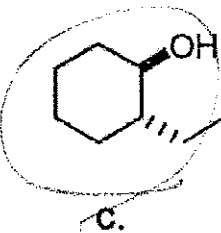
7. Chapter 20 Practice Test, Question #12:
What is the product of the following reaction?



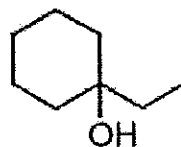
A.



B.



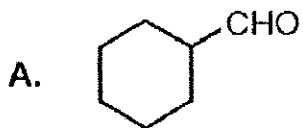
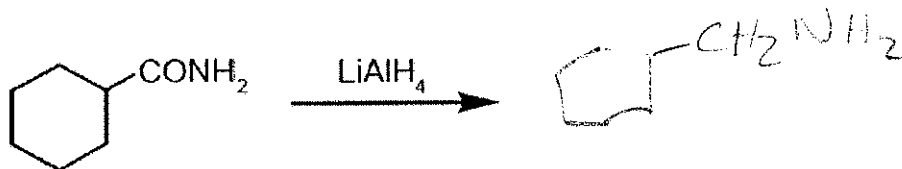
C.



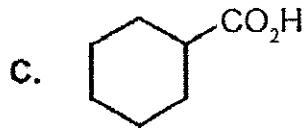
D.

- A. A
- B. B
- C. C
- D. D

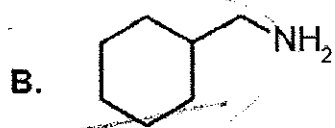
8. Chapter 20 Practice Test, Question #15
What is the product of the following reaction?



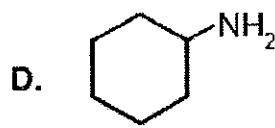
A.



C.



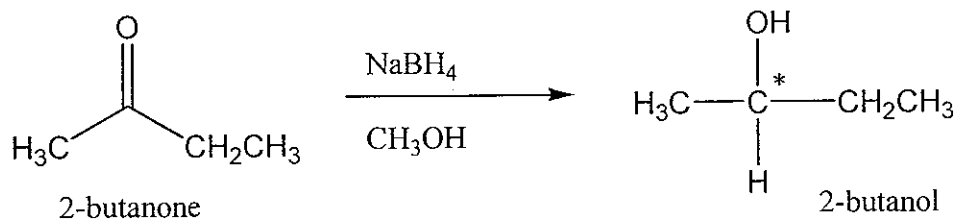
B.



D.

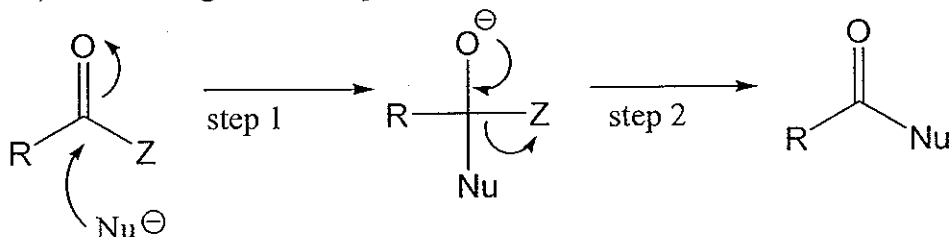
- A. A
- B. B
- C. C
- D. D

9. Which of the following statements regarding the transformation shown below is **FALSE**:

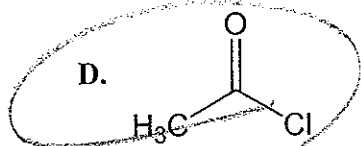


- ✓ A. Reaction occurs at the planar sp² hybridized carbonyl carbon
- ✓ B. A new stereogenic (chiral) center is formed in the product
- ✓ C. The hydride may approach the C=O double bond from either side with equal probability
- ✓ D. Methanol is used to protonate the alkoxide intermediate
- ✓ E. The reaction produces an excess of the (R) enantiomer

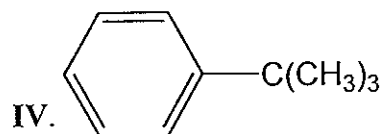
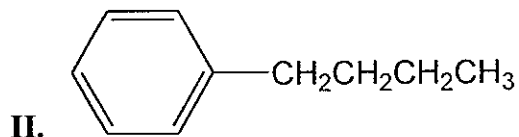
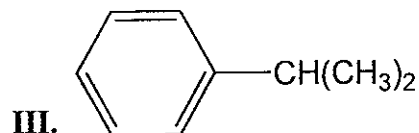
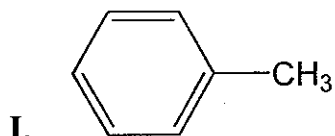
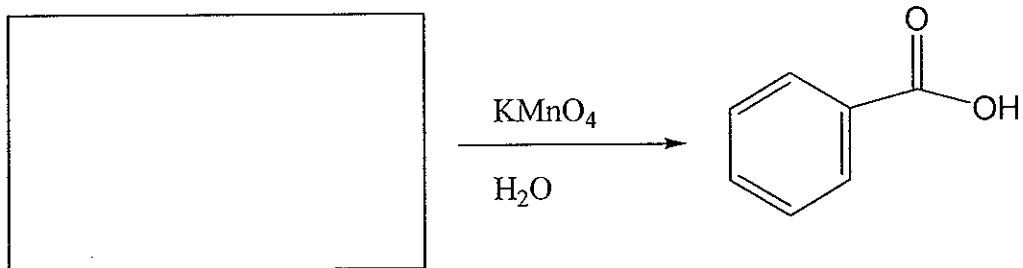
10. Which of the following compounds is the most reactive in a nucleophilic acyl substitution reaction, such as the general 2-step reaction shown?



- A. CC(=O)N
- B. CC(=O)O
- C. CC(=O)OC



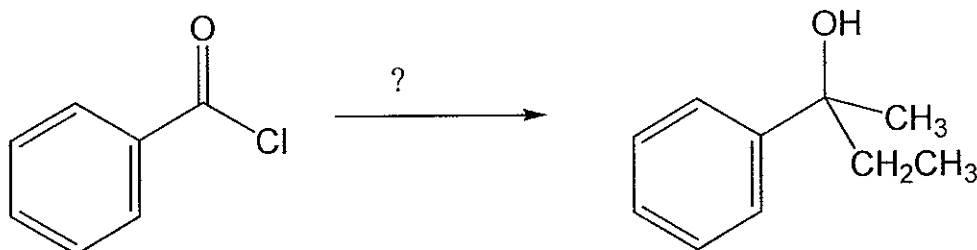
11. Which of the following alkyl-substituted benzene molecules will produce the carboxylic acid product shown after oxidation with KMnO₄ followed by H₂O?



- A. I only
 B. IV only
 C. I, II, and III
 D. I, II, III, and IV

12. Choose the best combination of reagents from the list provided to complete the following organic transformations [synthesis question #1]

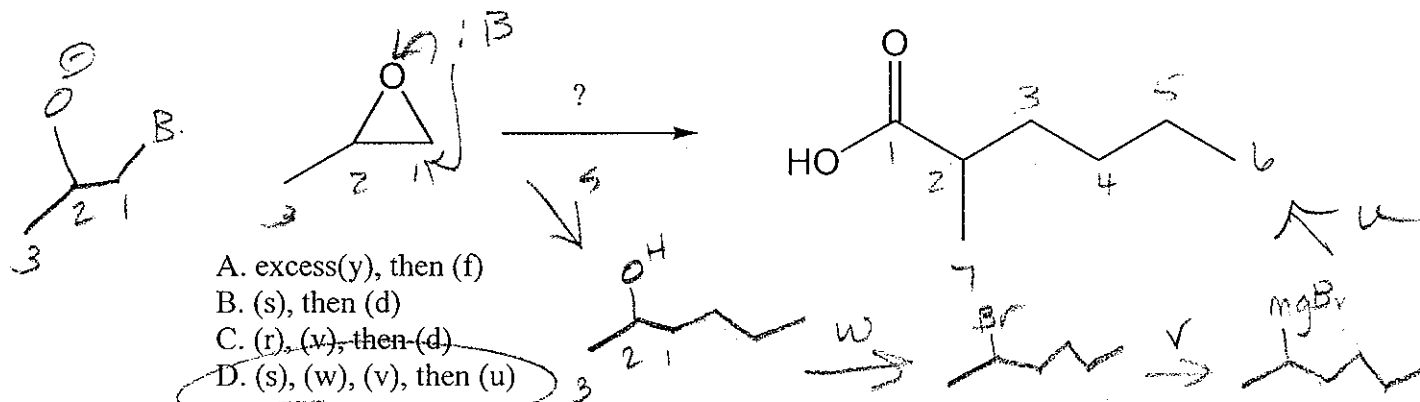
- (a) CH_3COOH ; (b) $\text{NaBH}_4/\text{CH}_3\text{OH}$; (c) Na_2CO_3 ; (d) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4, \text{H}_2\text{O}$; (e) NH_3 ; (f) KMnO_4 ; (g) $\text{BH}_3/\text{H}_2\text{O}_2, -\text{OH}$; (h) $\text{O}_3, \text{H}_2\text{O}$; (i) $\text{LiAlH}_4/\text{H}_2\text{O}$; (j) NaOH ; (k) NaH ; (l) $\text{H}_2/\text{Pd-C}$; (m) NaNH_2 ; (n) (S)-CBS reagent/ H_2O ; (o) DIBAL-H; (p) $\text{CH}_3\text{Li}/\text{H}_2\text{O}$; (q) $\text{LiAlH}[\text{OC}(\text{CH}_3)_3]_3$; (r) $\text{C}_6\text{H}_5\text{-Br}$; (s) $\text{CH}_3\text{CH}_2\text{CH}_2\text{-MgBr}/\text{H}_2\text{O}$; (t) $(\text{CH}_2=\text{CH})_2\text{CuLi}/\text{H}_2\text{O}$; (u) $\text{CO}_2/\text{H}_3\text{O}^+$; (v) Mg ; (w) PBr_3 ; (x) $(\text{CH}_3)_2\text{CHCl}/\text{AlCl}_3$; (y) $(\text{CH}_3\text{CH}_2)_2\text{CuLi}/\text{H}_2\text{O}$; (z) $\text{C}_6\text{H}_5\text{-Mg-Br}/\text{H}_2\text{O}$



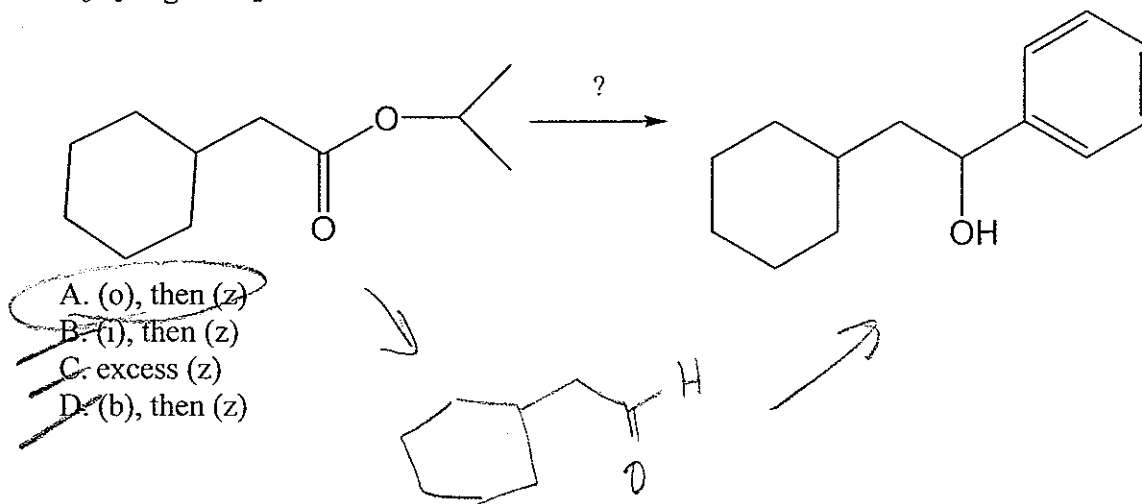
- A. (p), then (y)
 B. (y), then (p)
 C. (g), (y), then (p)
 D. (v), then (p)

$\text{R}'_2\text{CuLi}$ are less reactive and
 they add 1 eq of R' to an
 $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl}$ to form a ketone

13. Choose the best combination of reagents from the list provided to complete the following organic transformations [synthesis question #2]
- (a) CH_3COOH ; (b) $\text{NaBH}_4/\text{CH}_3\text{OH}$; (c) Na_2CO_3 ; (d) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4, \text{H}_2\text{O}$; (e) NH_3 ; (f) KMnO_4 ; (g) $\text{BH}_3/\text{H}_2\text{O}_2, -\text{OH}$; (h) $\text{O}_3, \text{H}_2\text{O}$; (i) $\text{LiAlH}_4/\text{H}_2\text{O}$; (j) NaOH ; (k) NaH ; (l) $\text{H}_2/\text{Pd-C}$; (m) NaNH_2 ; (n) (S)-CBS reagent/ H_2O ; (o) DIBAL-H; (p) $\text{CH}_3\text{Li}/\text{H}_2\text{O}$; (q) $\text{LiAlH}[\text{OC}(\text{CH}_3)_3]_3$; (r) $\text{C}_6\text{H}_5\text{-Br}$; (s) $\text{CH}_3\text{CH}_2\text{CH}_2\text{-MgBr}/\text{H}_2\text{O}$; (t) $(\text{CH}_2=\text{CH})_2\text{CuLi}/\text{H}_2\text{O}$; (u) $\text{CO}_2/\text{H}_3\text{O}^+$; (v) Mg ; (w) PBr_3 ; (x) $(\text{CH}_3)_2\text{CHCl}/\text{AlCl}_3$; (y) $(\text{CH}_3\text{CH}_2)_2\text{CuLi}/\text{H}_2\text{O}$; (z) $\text{C}_6\text{H}_5\text{-Mg-Br}/\text{H}_2\text{O}$

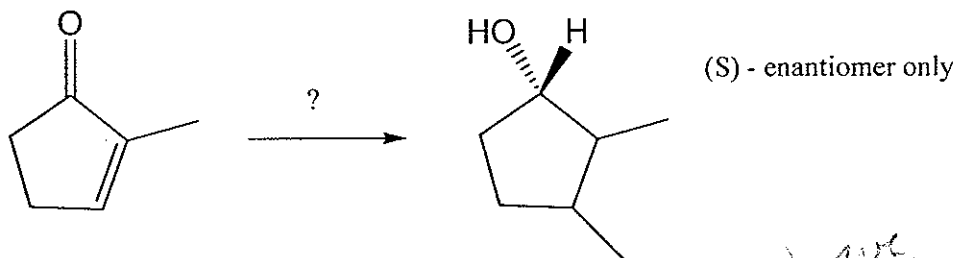


14. Choose the best combination of reagents from the list provided to complete the following organic transformations [synthesis question #3]
- (a) CH_3COOH ; (b) $\text{NaBH}_4/\text{CH}_3\text{OH}$; (c) Na_2CO_3 ; (d) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4, \text{H}_2\text{O}$; (e) NH_3 ; (f) KMnO_4 ; (g) $\text{BH}_3/\text{H}_2\text{O}_2, -\text{OH}$; (h) $\text{O}_3, \text{H}_2\text{O}$; (i) $\text{LiAlH}_4/\text{H}_2\text{O}$; (j) NaOH ; (k) NaH ; (l) $\text{H}_2/\text{Pd-C}$; (m) NaNH_2 ; (n) (S)-CBS reagent/ H_2O ; (o) DIBAL-H; (p) $\text{CH}_3\text{Li}/\text{H}_2\text{O}$; (q) $\text{LiAlH}[\text{OC}(\text{CH}_3)_3]_3$; (r) $\text{C}_6\text{H}_5\text{-Br}$; (s) $\text{CH}_3\text{CH}_2\text{CH}_2\text{-MgBr}/\text{H}_2\text{O}$; (t) $(\text{CH}_2=\text{CH})_2\text{CuLi}/\text{H}_2\text{O}$; (u) $\text{CO}_2/\text{H}_3\text{O}^+$; (v) Mg ; (w) PBr_3 ; (x) $(\text{CH}_3)_2\text{CHCl}/\text{AlCl}_3$; (y) $(\text{CH}_3\text{CH}_2)_2\text{CuLi}/\text{H}_2\text{O}$; (z) $\text{C}_6\text{H}_5\text{-Mg-Br}/\text{H}_2\text{O}$



15. Choose the best combination of reagents from the list provided to complete the following organic transformations [synthesis question #4]

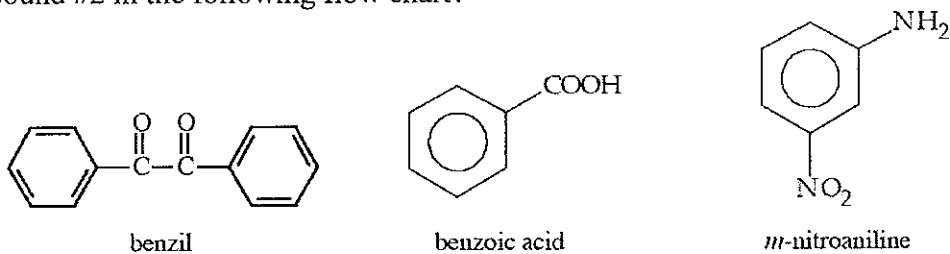
(a) CH_3COOH ; (b) $\text{NaBH}_4/\text{CH}_3\text{OH}$; (c) Na_2CO_3 ; (d) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4, \text{H}_2\text{O}$; (e) NH_3 ; (f) KMnO_4 ; (g) $\text{BH}_3/\text{H}_2\text{O}_2, -\text{OH}$; (h) $\text{O}_3, \text{H}_2\text{O}$; (i) $\text{LiAlH}_4/\text{H}_2\text{O}$; (j) NaOH ; (k) NaH ; (l) $\text{H}_2/\text{Pd-C}$; (m) NaNH_2 ; (n) (S)-CBS reagent/ H_2O ; (o) DIBAL-H; (p) $\text{CH}_3\text{CH}_2\text{Li}/\text{H}_2\text{O}$; (q) $\text{LiAlH}[\text{OC}(\text{CH}_3)_3]_3$; (r) $\text{C}_6\text{H}_5\text{-Br}$; (s) $\text{CH}_3\text{CH}_2\text{CH}_2\text{-MgBr}/\text{H}_2\text{O}$; (t) $(\text{CH}_2=\text{CH})_2\text{CuLi}/\text{H}_2\text{O}$; (u) $\text{CO}_2/\text{H}_3\text{O}^+$; (v) Mg ; (w) PBr_3 ; (x) $(\text{CH}_3)_2\text{CHCl}/\text{AlCl}_3$; (y) $(\text{CH}_3\text{CH}_2)_2\text{CuLi}/\text{H}_2\text{O}$; (z) $\text{C}_6\text{H}_5\text{-Mg-Br}/\text{H}_2\text{O}$

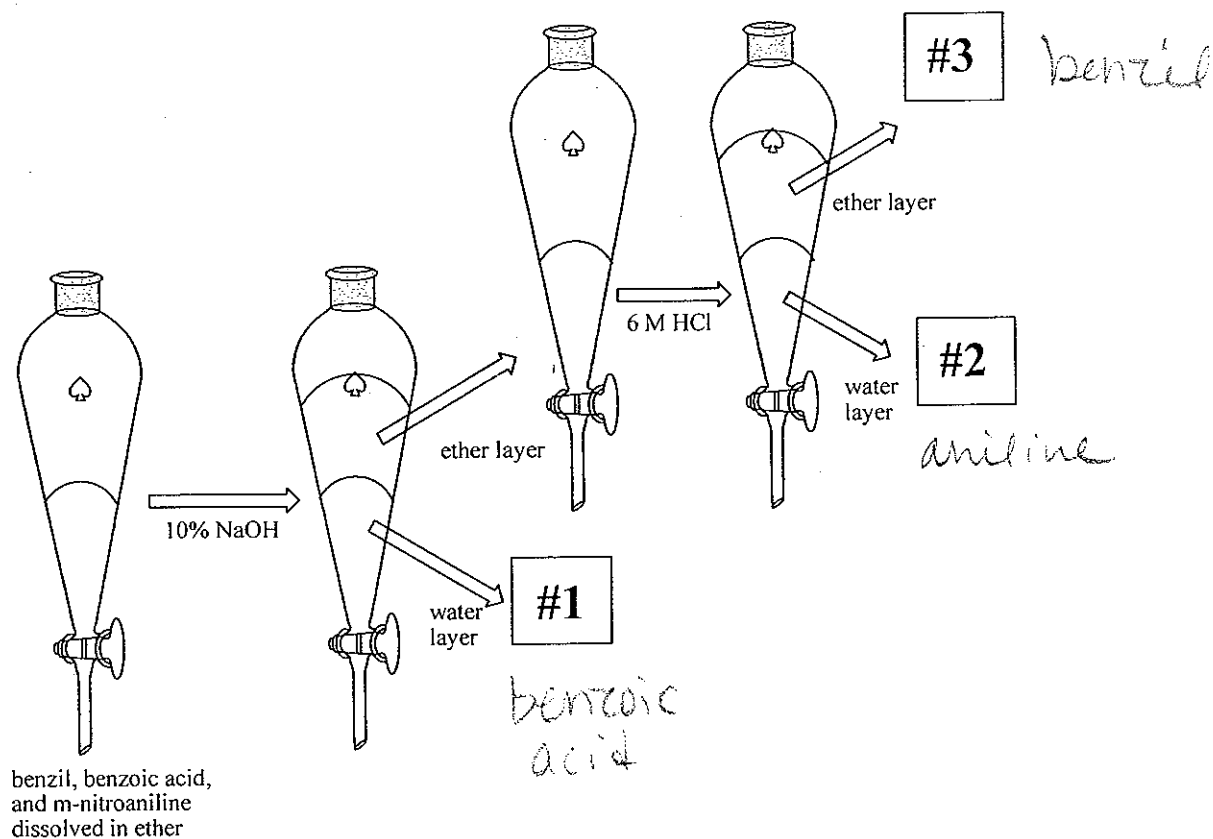


- A. (p), then (l)
- B. (i), then (l)
- C. (y), then (n)
- D. (y), then (b)

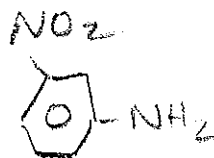
*you did not have (S)-CBS reagent
H⁻ from top face only*

16. A mixture of equal masses of benzil, benzoic acid, and m-nitroaniline were dissolved in ether and subjected to the following extraction procedure. What is the structure of compound #2 in the following flow chart?





- A. benzil
B. benzoic acid
C. *m*-nitroaniline



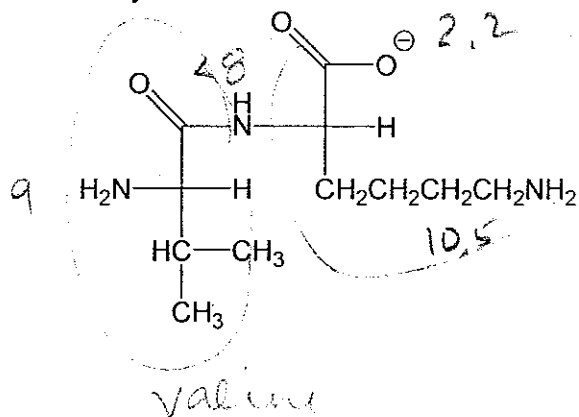
17. In comparing the chemical structure of *m*-nitroaniline in question #16 to aniline, $C_6H_5-NH_2$, which statement is FALSE?

- A. you can draw resonance structures for both *m*-nitroaniline and aniline, which illustrate the ability to stabilize the nitrogen lone pair throughout the aromatic ring and increasing stability
- B. *m*-nitroaniline is a weaker base than aniline due solely to resonance effects
- C. the pK_a of the conjugate acid of *m*-nitroaniline is less than that for aniline of 4.6
- D. the nitro group is a strong electron withdrawing group

18. Using the pK_a table of select amino acids provided with your test material, identify which one of the following statements is FALSE:

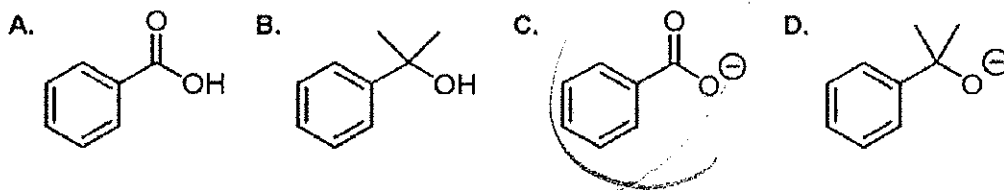
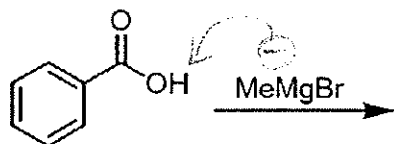
- ✓ A. the pK_a of the carboxylic acid functional group of glutamine is 2.17
- ✓ B. lysine contains two basic groups
- ✓ C. the isoelectric point of an amino acid is the point where it exists exclusively in its neutral zwitterionic form
- D. at $pH = 1$, alanine will exist exclusively in its negatively charged form

19. Using the pKa table of select amino acids provided to you with your test material, determine the pH value where this structure would exist. The following dipeptide is a combination of valine and lysine.



- A. 0-1
 B. 3-4
 C. 6-7
 D. 8-9
 E. 11-12

20. What will be the product of the following reaction (before any aqueous work-up)?



- A. A
 B. B
 C. C
 D. D