

Name: _____

Grade: _____

Please use a **non-red** pen. Answer questions in the provided space. If you write any answers on the back of the page, indicate this on the **front** of that page. Points appear in parentheses (). **Good Luck!**

Question	Max. Pts.	Pts	Question	Max. Pts	Points
1. 6+6	= 12		4. 4+4+7+4	= 19	
2. 6+6+3+3+3+2	= 23		5. 3+(4+5)+4	= 16	
3. 4+4+4+4	= 16		6. 4+3+3+2+2	= 14	
				Total	= 100

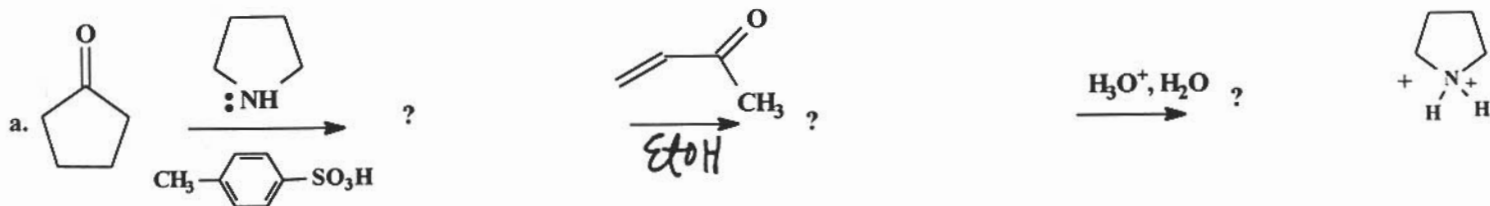
1. (12) a. Write a detailed step-by-step mechanism and fill in the reagents and synthetic steps necessary to complete the following reaction. Use arrows to show electron flow.

6

- b. Write a detailed step-by-step mechanism for the following conversion. Use arrows to show electron flow. Show the structure of the intermediate.

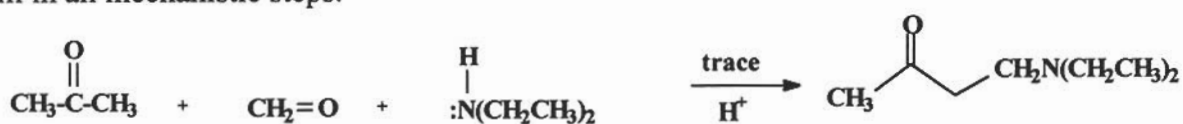
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2. (23) Fill in the missing reagents, intermediates, and/or products for the following reaction sequences:

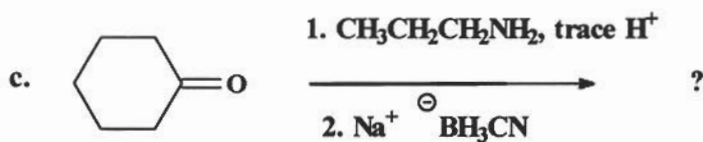


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b. Fill in all mechanistic steps.

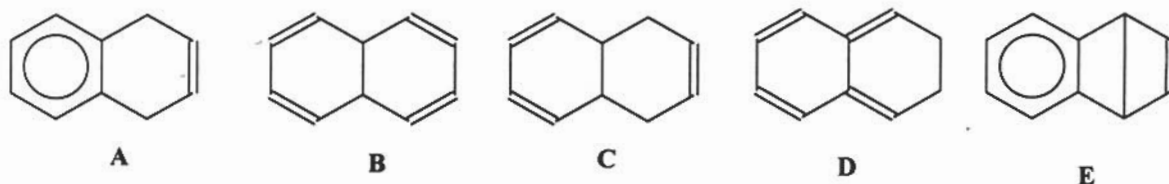


6



3

d. Circle the correct product if benzyne is generated in the presence of 1,3-butadiene:



3

e. Which one of the following compounds would you expect to be the strongest acid?

1. CH₃OH
2. C₆H₅CH₂OH
3. para-CH₃-C₆H₄-OH
4. C₆H₅OH
5. Para-NO₂-C₆H₄-OH

3

f. Explain your answer, using structures and resonance and/or inductive effects

2

- 3 (16) a. Rank the following compounds in order of decreasing basicity (most basic compound first) *in the gas phase*.



1



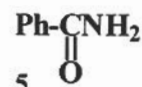
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3



4



5

4

Rank: _____

- b. Explain your answer for the **strongest base** and for the **weakest base** using structures involving resonance and/or inductive effects.

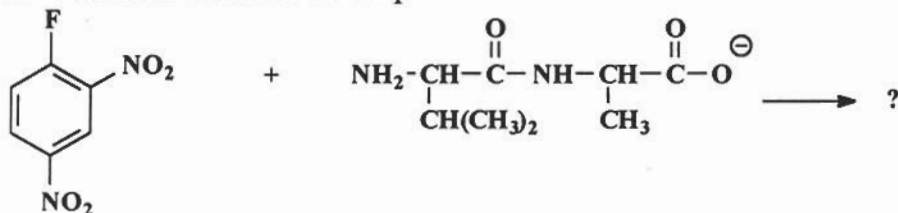
Strongest Base Rationale:

2

Weakest Base Rationale:

2

- c. Fill in the structure of the product. State the name of the mechanism.



3

Mechanism Name: _____

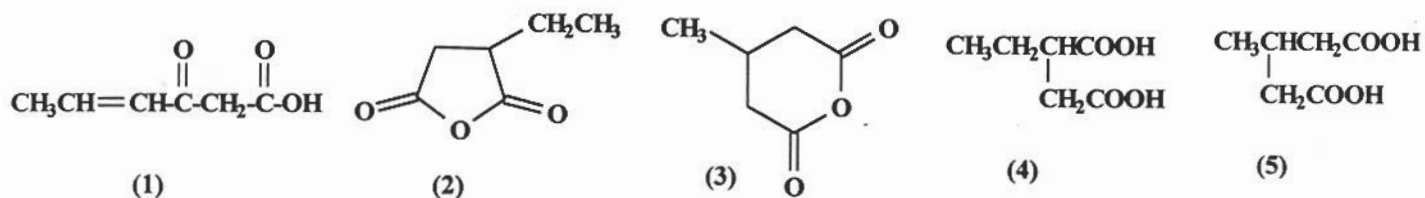
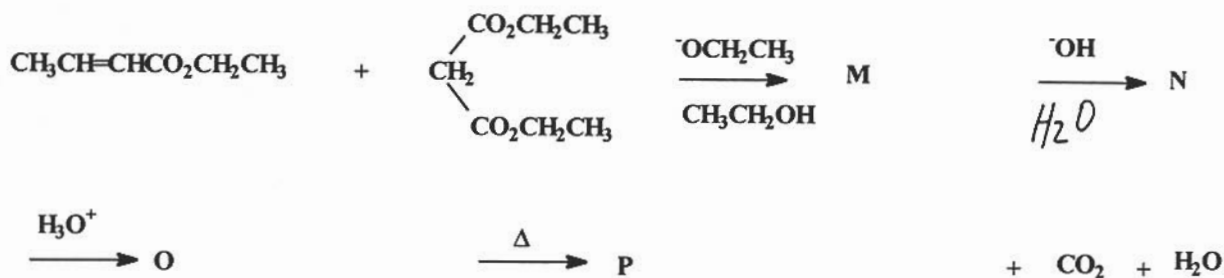
1

- d. Why is CH_3ONa **not used** in the Claisen condensation of ethyl acetate with itself?

1. CH_3ONa is a weaker base than the $\text{CH}_3\text{CH}_2\text{ONa}$ (EtONa) that is used
2. CH_3ONa is more difficult to prepare than is EtONa.
3. CH_3O^- would abstract a proton from the ethyl group of the ester
4. Use of CH_3ONa would result in transesterification in the product

4

4. (19) a. Predict the product, **P**, of the following reaction sequence.

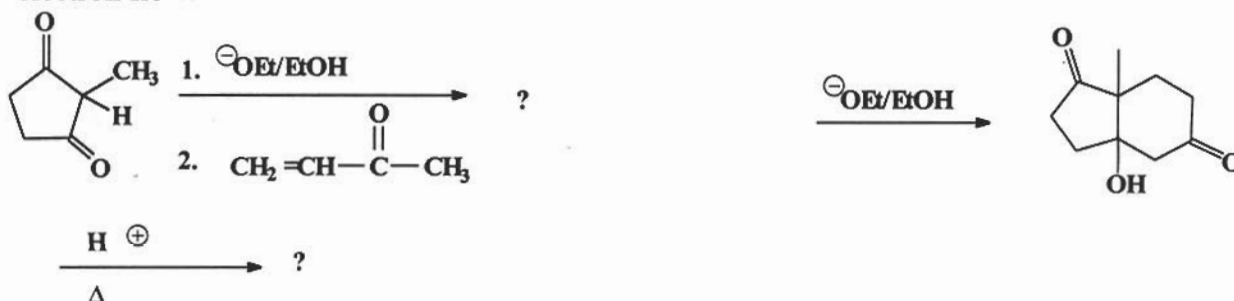


4

b. Show the structure of **O** and the mechanism of the conversion of **O** to **P**. Note that more than 1 step may be required.

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c. Fill in the missing intermediates and product. Indicate the mechanism by arrows showing the direction of electron flow.



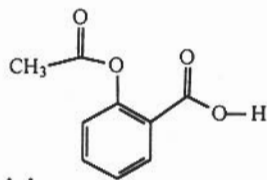
7

d. Circle which of the following reactions are not reversible processes?

1. Claisen condensation
2. Aldol condensation
3. Conversion of chlorobenzene to phenol with (a) NaOH, H₂O at 350°C, (b) acidification
4. Acetal formation
5. Base catalyzed ester hydrolysis

4

5. (16) a. Choose the best method to synthesize aspirin:



aspirin

- (1) CH_3COOPh , CO_2 , Δ ; then H^+
- (2) Ph-COOH , CH_3COOH , AlCl_3 , Δ ; then H_2O
- (3) PhOH , OH^- , CO_2 , Δ , pressure; then H_3O^+ ; then $(\text{CH}_3\text{C})_2\text{O}$
- (4) Ph-OH , CO_2 , H_3O^+ ; separate isomers; then CH_3COOH , AlCl_3
- (5) CH_3COOPh , HCOOEt , EtO^- ; then H_3O^+ ; then OH^-

3

b. Using any necessary reagents, do the following conversions: Show all intermediate, reagents.

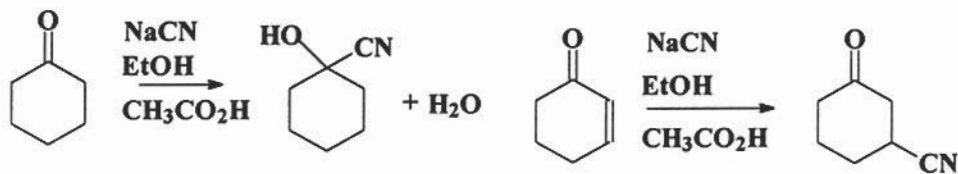
(1) 1-butanol \longrightarrow pentyamine

4

(2) $\text{PhCH=O} \longrightarrow \text{PhC(=O)C}_2\text{H}_5$

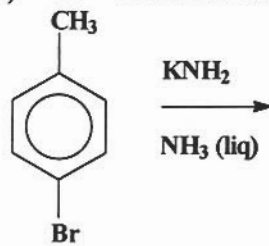
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c. Why does cyclohexanone give 1,2 addition with cyanide while cyclohexenone gives 1,4 addition? Explain with words and the mechanisms involved.



4

6. (14) a. Write the expected products in the following reaction:



4

b. Explain your answer in 6a by writing and naming the mechanism of the reaction involved and any important intermediate:

3

c. Which reagent(s) will distinguish between PhNH_2 and $(\text{Ph})_2\text{NH}$?

1. conc. HNO_3
2. H-O-N=O
3. $\text{PhSO}_2\text{Cl} / \text{OH}^-$, then H_3O^+
4. KMnO_4
5. $\text{Br}_2 / \text{CCl}_4$

3

d. Refluxing anisole ($\text{CH}_3\text{OC}_6\text{H}_5$) with **excess HCl** will yield which one of the following product mixtures:

1. $\text{C}_6\text{H}_5\text{Cl} + \text{CH}_3\text{OH}$
2. $\text{C}_6\text{H}_5\text{OH} + \text{CH}_3\text{OH}$
3. $\text{C}_6\text{H}_5\text{Cl} + \text{CH}_3\text{Cl}$
4. $\text{C}_6\text{H}_5\text{OH} + \text{CH}_3\text{Cl}$
5. No reaction

2

e. Circle the one or more compounds below that readily lose CO_2 at 25°C or upon some warming:

1. $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CO}_2\text{H}$
2. $(\text{CH}_3)_2\text{NCO}_2\text{H}$
3. $\text{C}_6\text{H}_5\text{CH}_2\text{CO}_2\text{H}$
4. $\text{CH}_2=\text{CHCO}_2\text{H}$
5. $\text{CH}_3\overset{\text{O}}{\parallel}\text{CCH}_2\text{CO}_2\text{H}$

2