NAME (Print): _____

SIGNATURE: _____

Chemistry 310N
Dr. Brent Iverson
3rd Midterm
April 22, 2010

Please print the first three letters of your last name in the three boxes

Please Note: This test may be a bit long, but there is a reason. I would like to give you a lot of little questions, so you can find ones you can answer and show me what you know, rather than just a few questions that may be testing the one thing you forgot. **I recommend you look the exam over and answer the questions you are sure of first**, then go back and try to figure out the rest. Also make sure to **look at the point totals** on the questions as a guide to help budget your time.

You must have your answers written in PERMANENT ink if you want a regrade!!!! This means no test written in pencil or ERASABLE INK will be regraded.

Please note: We routinely xerox a number of exams following initial grading to guard against receiving altered answers during the regrading process.

FINALLY, DUE TO SOME UNFORTUNATE RECENT INCIDENCTS YOU ARE NOT ALLOWED TO INTERACT WITH YOUR CELL PHONE IN ANY WAY. IF YOU TOUCH YOUR CELL PHONE DURING THE EXAM YOU WILL GET A "0" NO MATTER WHAT YOU ARE DOING WITH THE PHONE. PUT IT AWAY AND LEAVE IT THERE!!!

Page	Points	
1		**(28)**
2		**(21)**
3		**(15)**
4		**(18)**
5		**(16)**
6		**(26)**
7		**(28)**
8		**(30)**
9		**(24)**
10		**(17)**
11		**(7)**
12		**(19)**
13		**(19)**
14		**(19)**
15		**(17)**
Total		**(304)**
%		
T Score		
HW		
Total Grade		

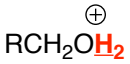
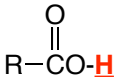
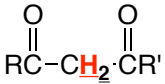
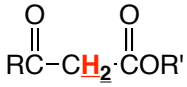
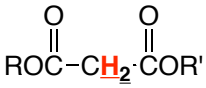
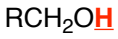
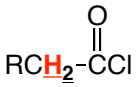
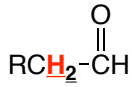
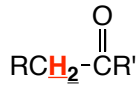
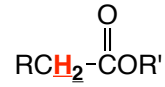
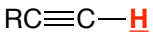
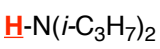
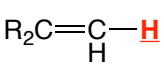
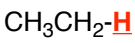
(HW score + Exam Grade) ⟹

Honor Code

The core values of the University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

_____

(Your signature)

Compound		pK_a
Hydrochloric acid		-7
Protonated alcohol		-2
Hydronium ion		-1.7
Carboxylic acids		3-5
Ammonium ion		9.2
β-Dicarbonyls		10
β-Ketoesters		11
β-Diesters		13
Water		15.7
Alcohols		15-19
Acid chlorides		16
Aldehydes		18-20
Ketones		18-20
Esters		23-25
Terminal alkynes		25
LDA		40
Terminal alkenes		44
Alkanes		51

Signature_____ Pg 1 _____(28)

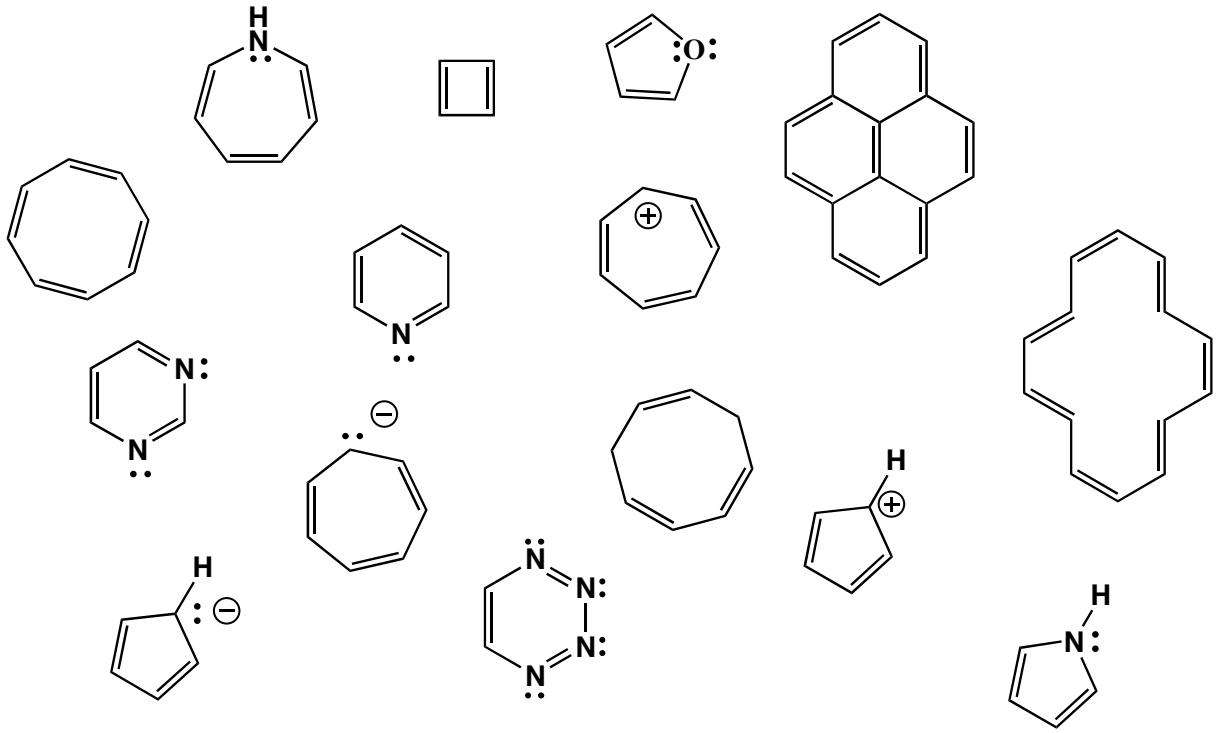
1. (18 points) Suppose a relative of yours is having an MRI. In no more than four sentences, explain to them what is happening when they have the MRI scan. We will be looking for a minumum of 7 key points here.

What is the most important question in chemistry?

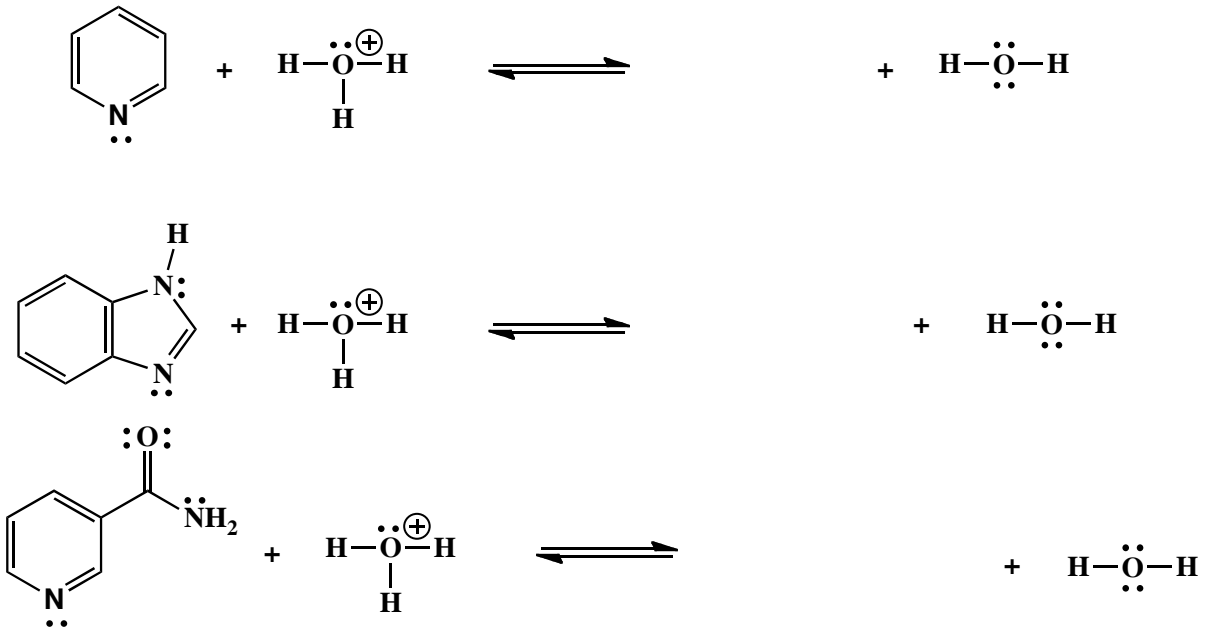
2. (1 pt. each) Here are a number of statements regarding aromaticity or other general aspects of organic chemistry. Do not second guess yourself, this is not meant to be tricky! **Check the appropriate box to indicate whether the statement is true or false.**

	True	False
A. When using molecular orbital theory, it is best to think of electron density as being like waves, since it is described mathematically using wave equations.	☐	☐
B. According to Huckel's rule, aromatic molecules are flat, monocyclic, all ring atoms have a 2p orbital (no sp3 ring atoms) and there are 4n + 2 pi electrons (i.e. 2, 6, 10, 14.....).	☐	☐
C. Most reactions you have learned in this class involve nucleophiles reacting with electrophiles.	☐	☐
D. Electrophiles are usually descibed as having relatively high electron density.	☐	☐
E. Nucleophiles are usualy described as having relatively low electron density.	☐	☐
F. When drawing mechanisms, arrows are used to indicate the flow of electrons from electrophiles to nucleophiles.	☐	☐
G. A strong resonance effect due to aromaticity can stabilize a postive charge, negative charge, or unpaired electron density on atoms attached to an aromatic ring.	☐	☐
H. Aromaticity makes pi electron density more reactive compared to simple alkenes	☐	☐
I. When molecules absorb light, electrons are excited into antibonding molecular orbitals.	☐	☐
J. An object has the color of the wavelengths of light that are reflected, not absorbed, by the molecules on its surface.	☐	☐

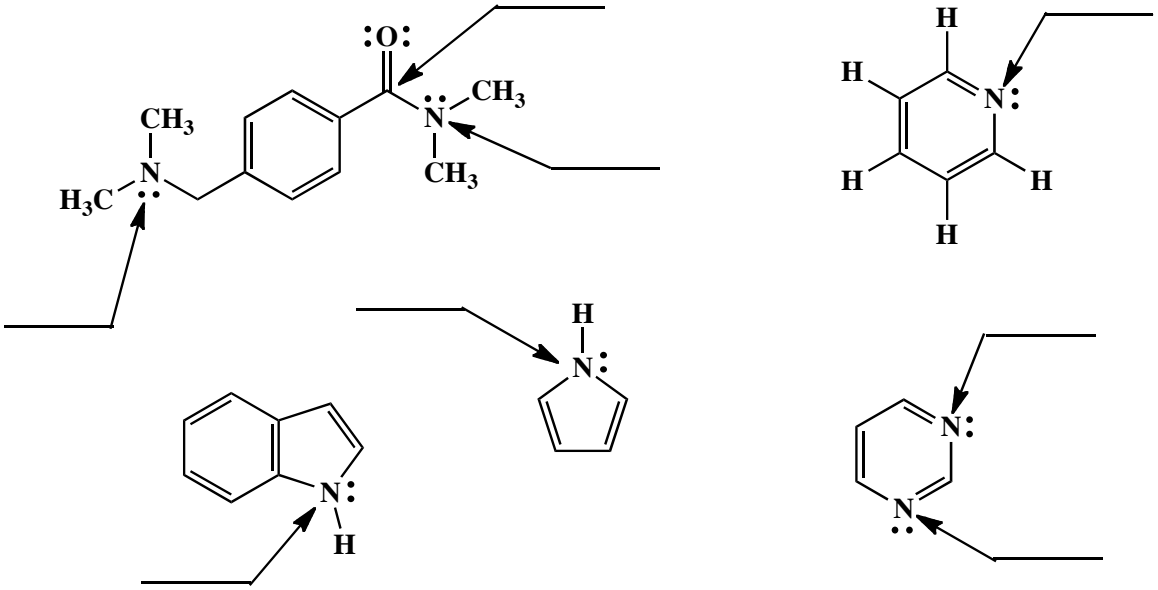
3. (15 points) **Draw a circle around** all of the molecules below that **can be considered aromatic.**



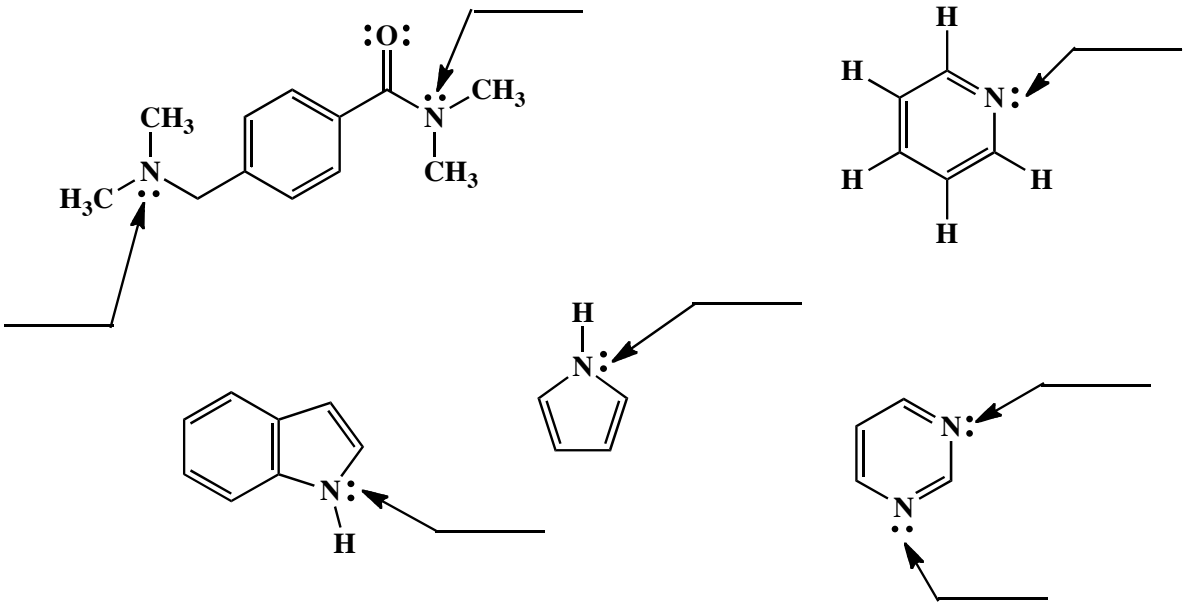
4. (6 points) **In strong acid, the following molecules will become protonated. Draw the protonated form of each.**



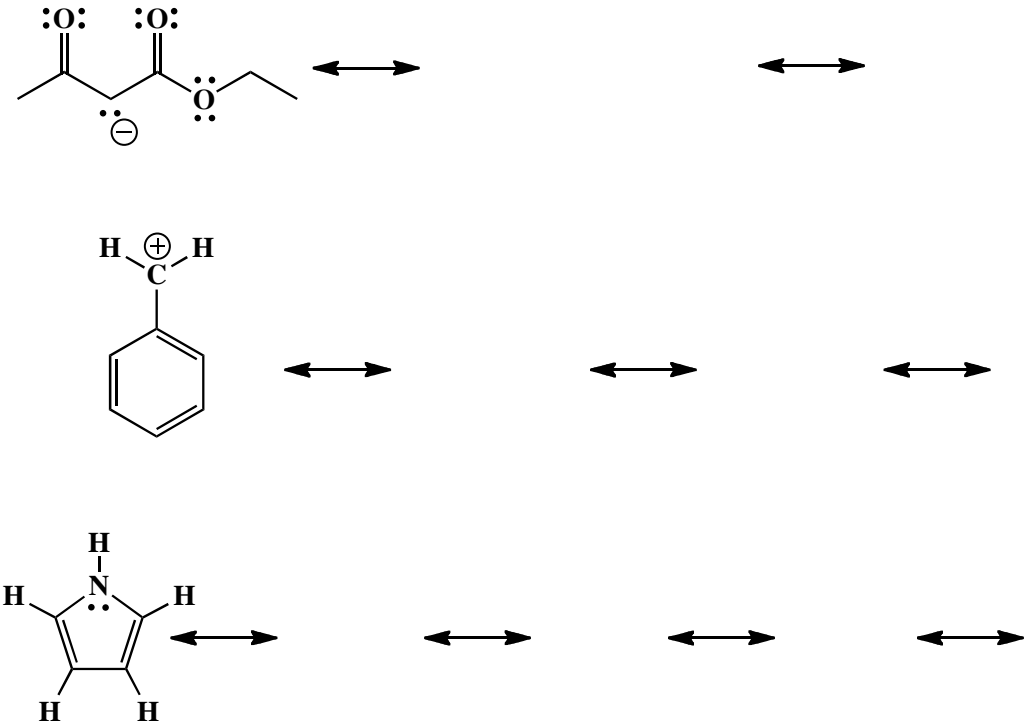
5. (8 pts) On the lines provided, state the **hybridization state of the atom** indicated by the arrow.



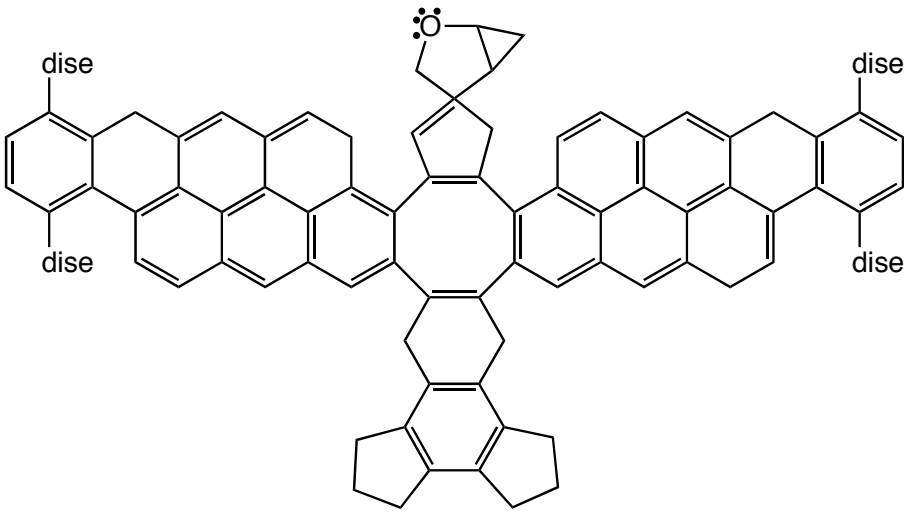
6. (7 pts) On the lines provided, state the **atomic orbital that contains the lone pair** of electrons indicated by the arrow.



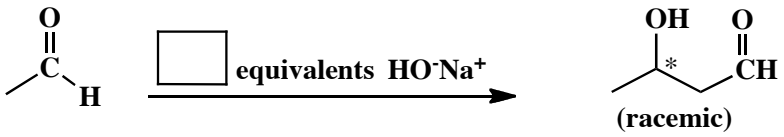
7. (18 points) **In the spaces provided, draw all the important resonance contributing structures of the indicated species.** We have provided template molecules to help you do this more quickly. You must draw all pi bonds, lone pairs of electrons and all formal charges on each of your structures. You DO NOT need to draw arrows to show electron movement.

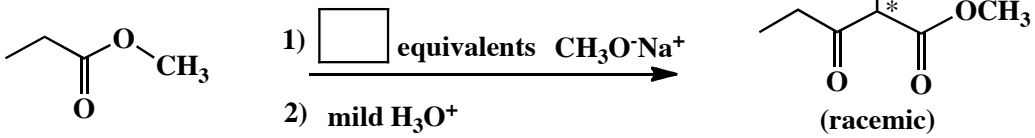


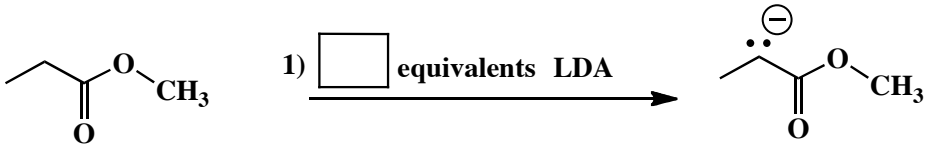
Molecule of the day: The rare central Texas bird of Paradise.

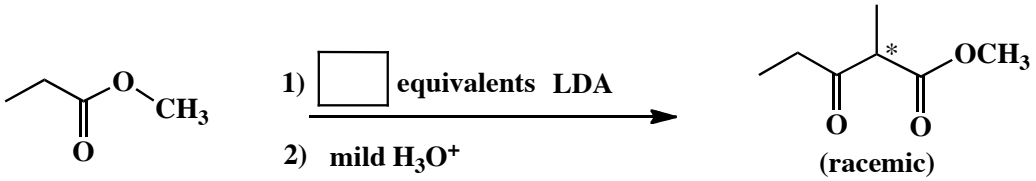


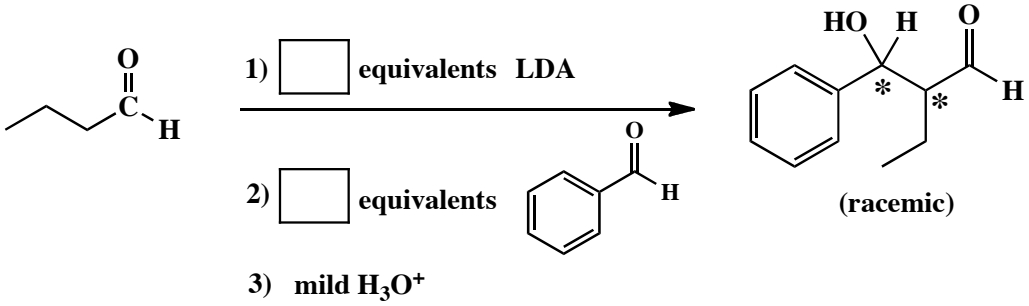
8. (2 pts each) In each of the boxes over an arrow, **write the minimum number of equivalents** of the specified reagent required to carry out the reaction shown **to completion**. If only a catalytic amount is needed, write **"CAT"**. Note: **You must assume the carbonyl compound starting material is initially present in an amount of 1.0 equivalent.**

A) 

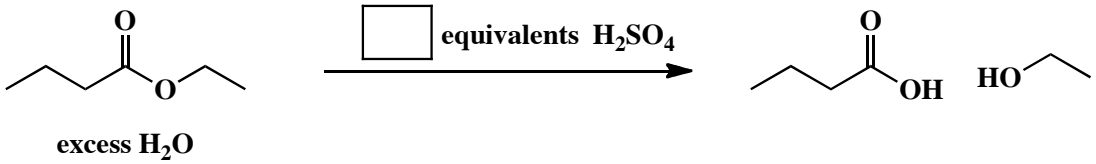
B) 

C) 

D) 

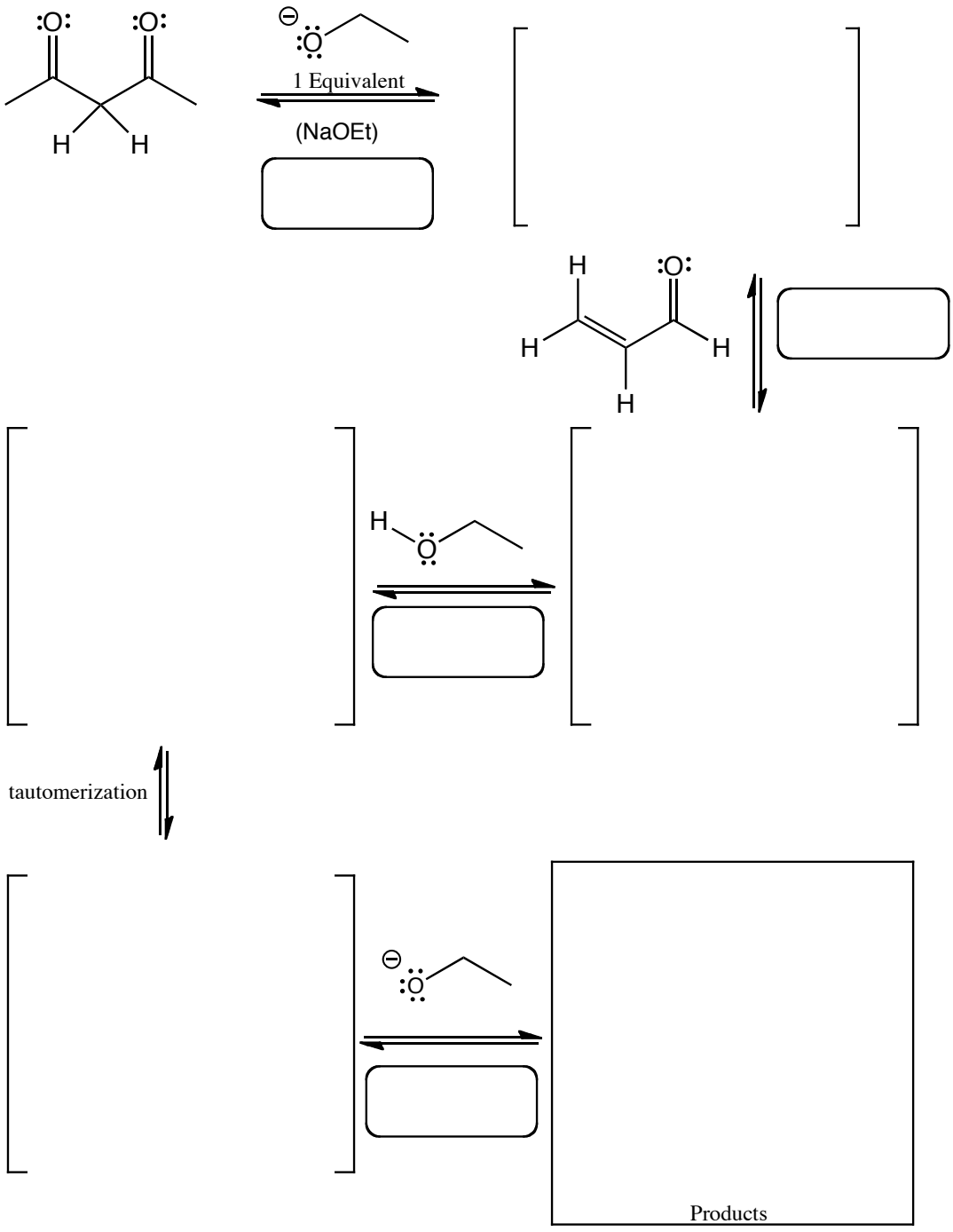
E) 

F) 

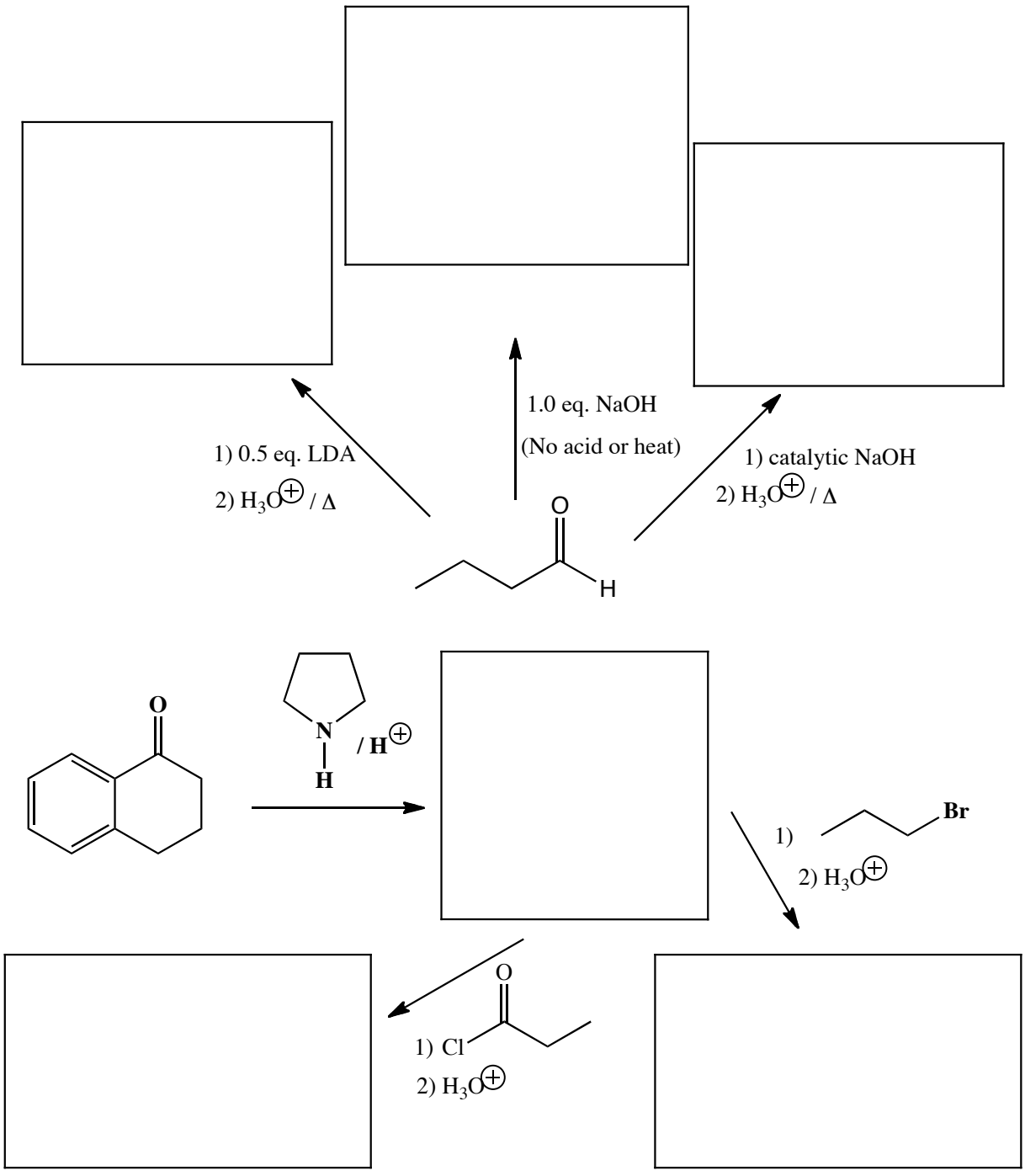
G) 

9. (22 pts total) Complete the following mechanism for the Michael reaction. Make sure to show all lone pairs, all formal charges and use arrows to indicate the flow of all electrons. You must draw all products that are made in each step. This should look familiar, as it is identical to the mechanism sheet handed out in class. IN THE SPACES PROVIDED, DESCRIBE EACH STEP AS ONE OF THE FOUR MECHANISTIC ELEMENTS SUCH AS "MAKE A BOND", "TAKE A PROTON AWAY", ETC.

Michael Reaction



10. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration step, write E,Z mixture, but you only have to draw one isomer, not both.** These directions are different than you may have seen before, and are intended to make it easier for you. You should read them again so you know what we want.



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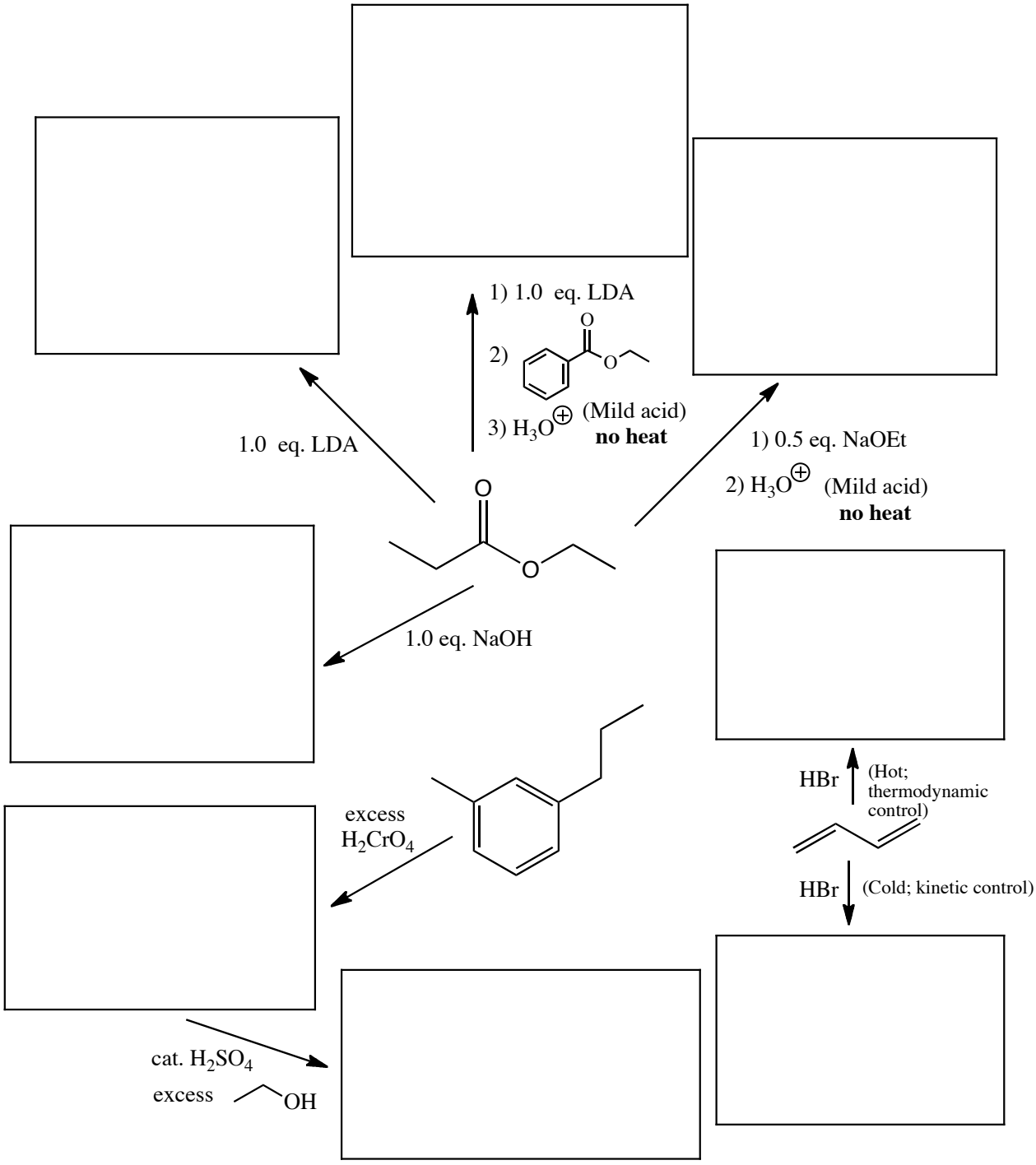

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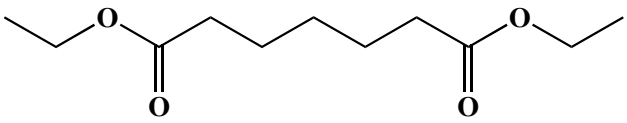
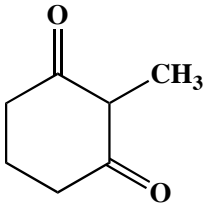
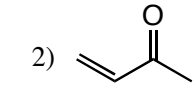


1) 1.0 eq.NaOEt
2) $H_3O^{\oplus}$
(mild acid, no heat)

1) excess $LiAlH_4$
2) H_2O



1) 1.0 eq.NaOEt
2)



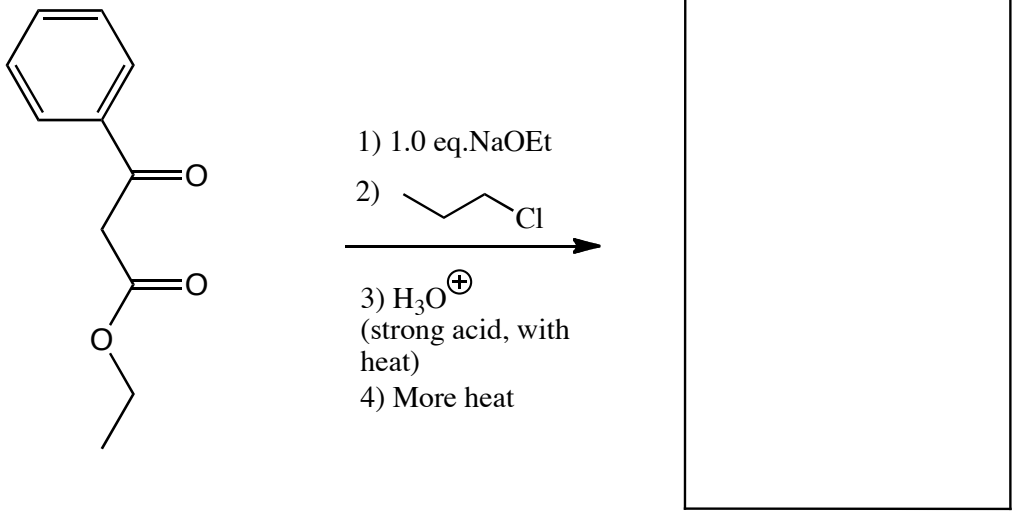
3) $H_3O^{\oplus}$
(stronger acid, with heat)

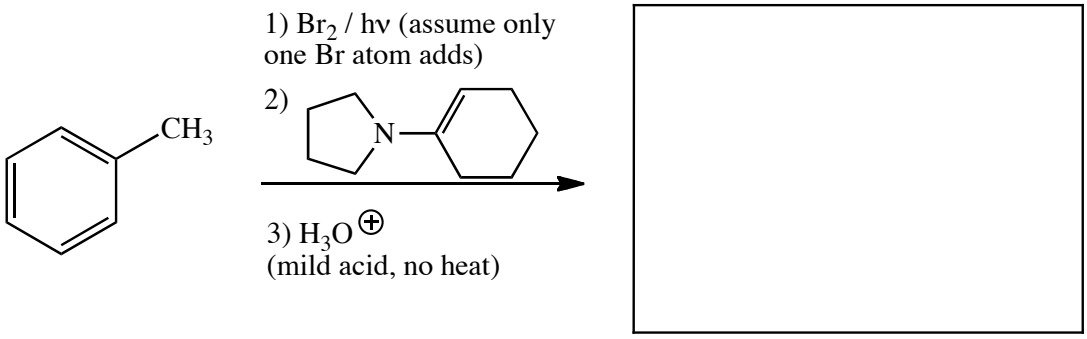
1) excess $LiAlH_4$
2) H_2O

Hardest problem on the test: How many different stereoisomers are created in this reaction?

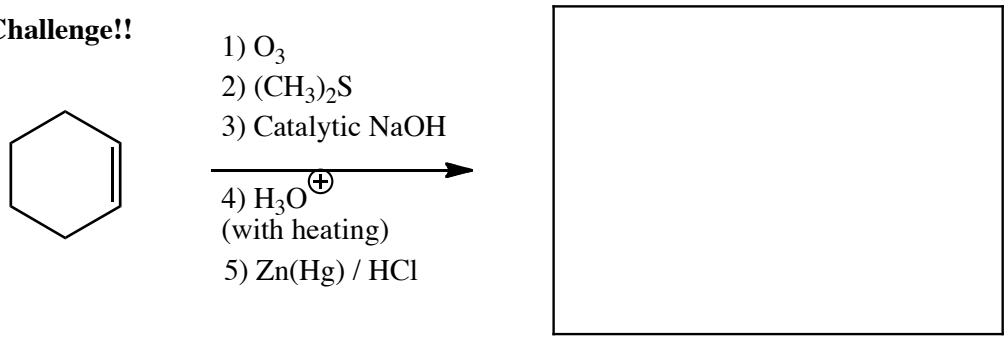
_____

11. (5 or 7 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration step, write "E,Z mixture", but you only have to draw one isomer, not both.** These directions are different than you may have seen before, and are intended to make it easier for you. You should read them again so you know what we want.



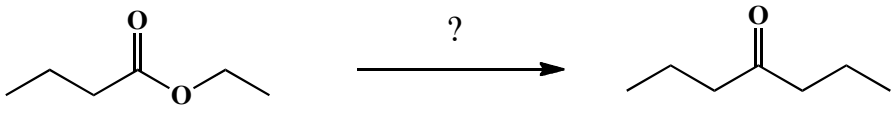


Challenge!!



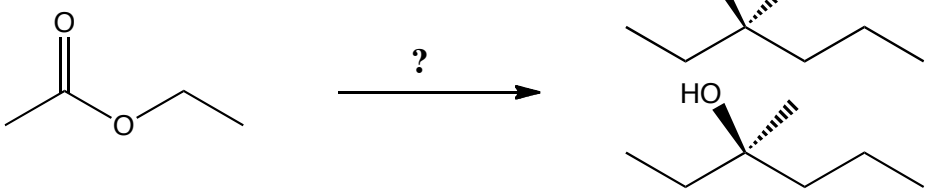
12. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

A) (7 pts)



12. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

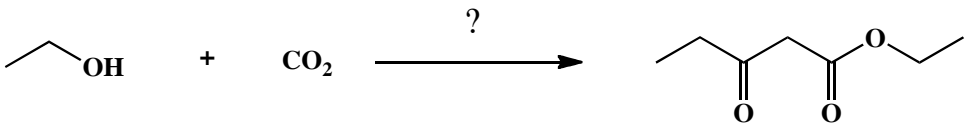
B) (19 pts)



(racemic)

12. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

C) (19 pts)



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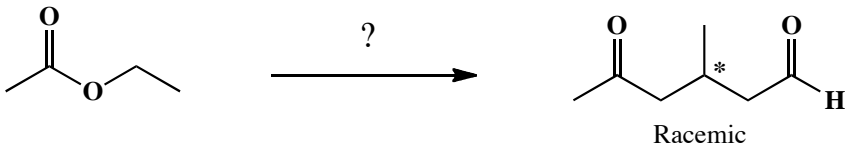
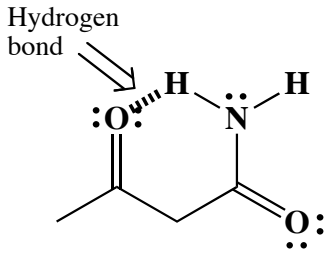
D) (19 pts)



Racemic

13. Here is the first of two apply what you know problems. Acetoacetamide is a molecule with an interesting structure. The molecule is drawn as one tautomer, and in fact the less stable tautomer. Notice the hydrogen bond in the conformation shown. In the space provided, draw the more stable tautomer, and include a key hydrogen bond in the structure you draw.

(6 pts)



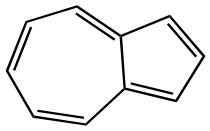
Acetoacetamide

tautomerization

More stable tautomer

(5 pts) In no more than two sentences, explain why the structure you drew is the more stable tautomer.

(6 pts) Here is the second apply what you know problem. Azulene is an amazing aromatic molecule with two notable features. It is blue and it has a very strong dipole moment of 0.8 D.



Azulene

Based on what you know about aromatic rings and the Hückel rules, explain the large dipole moment of azulene. You can draw a structure if you like to help describe your answer.