

NAME \_\_\_\_\_



Problem 1 10 pts \_\_\_\_\_

Problem 2 6 pts \_\_\_\_\_

Problem 3 10 pts \_\_\_\_\_

Problem 4 8 pts \_\_\_\_\_

Problem 5 24 pts \_\_\_\_\_

Problem 6 21 pts \_\_\_\_\_

Problem 7 21 pts \_\_\_\_\_

TOTAL 100 pts \_\_\_\_\_

Please read through each question carefully and answer in the spaces provided.

A good strategy is to go through the test and answer all the questions you can do easily. Then go back and tackle the more difficult problems.

Please make sure your structures are drawn clearly and indicate any stereochemistry with bold or dashed bonds.

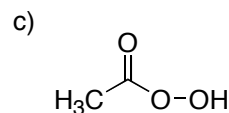
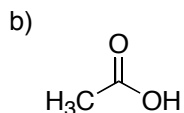
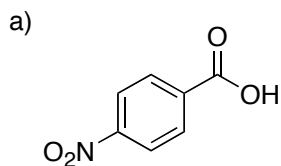
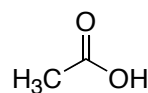
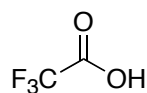
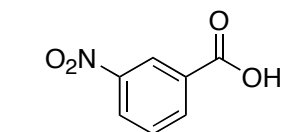
Finally, think about what you know. Reason and common sense can often help you out.

Note: Ph is an abbreviation for a phenyl group.

1. Place a check mark next to the functional group that best describes the following structures. (10 points).

		ketone hydrate	acetal	imine	ester	amide	anhydride
a)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

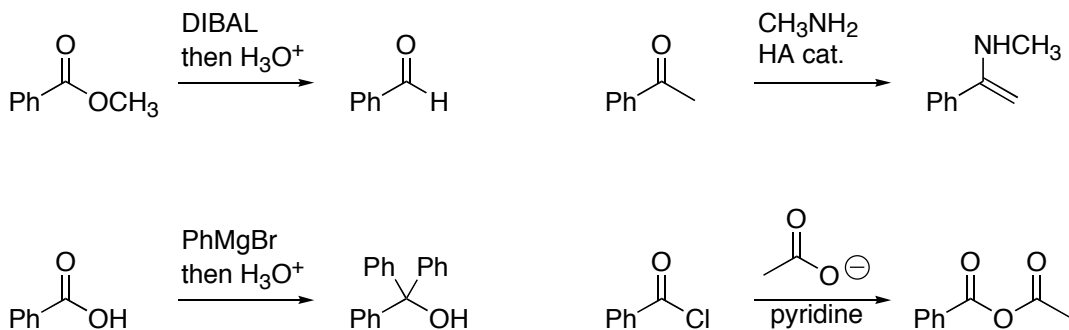
2. For each pair of molecules below, circle the one with the highest  $pK_a$  (weakest acid). (6 pts)



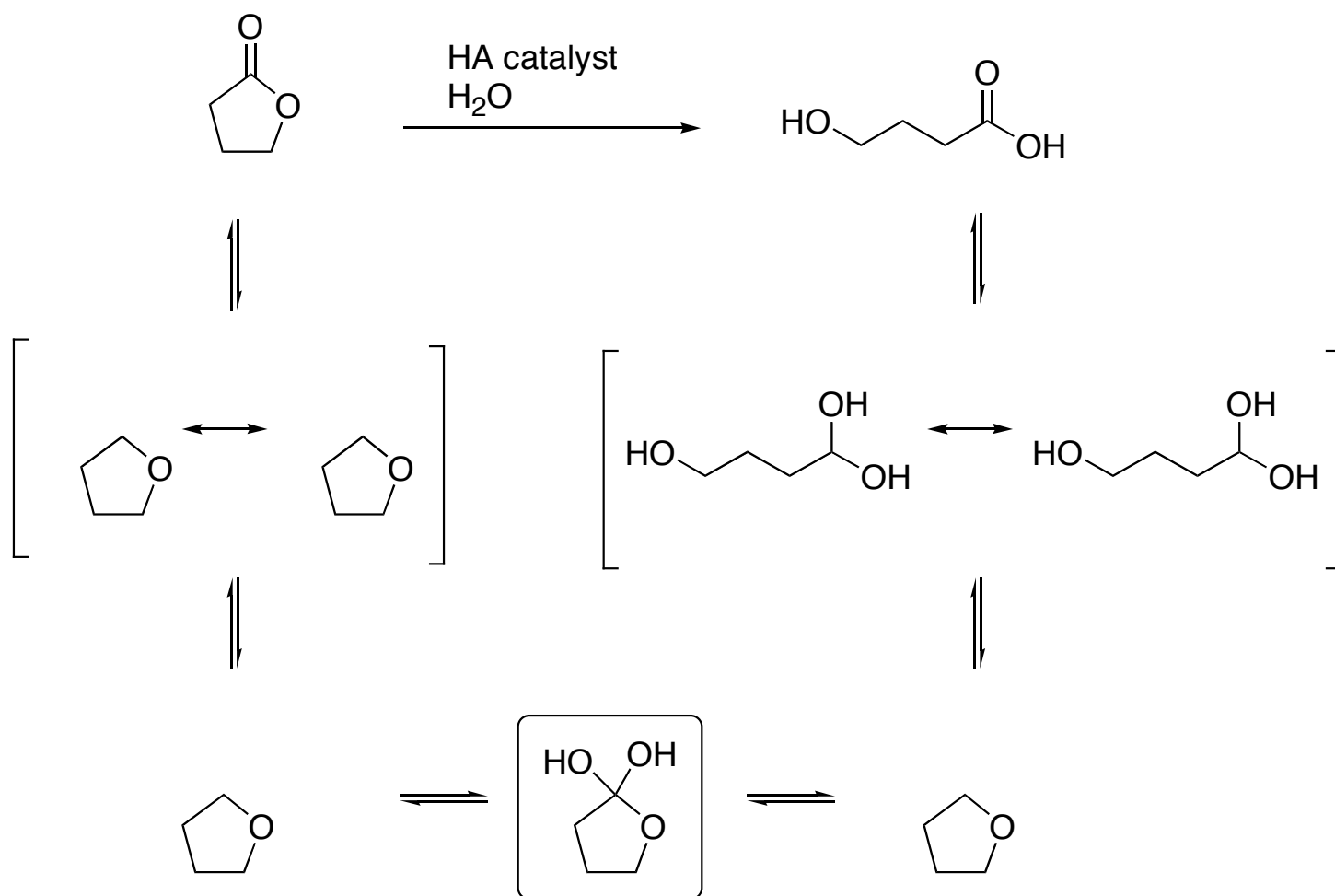
3. Indicate whether the following statements are true or false. (10 pts)

- Acid-catalyzed hydrolysis of esters is usually better than base-catalyzed hydrolysis.
- Borane selectively reduces a carboxylic acid while it leaves an ester alone.
- Grignard reagents add to give 1,4-products upon reaction with  $\alpha,\beta$ -unsaturated ketones.
- Enamines are prepared from aldehydes or ketones and secondary amines.
- Acetals are relatively stable and are used as carbonyl protecting groups.

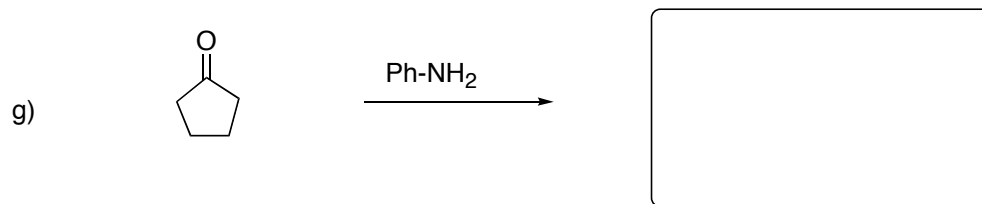
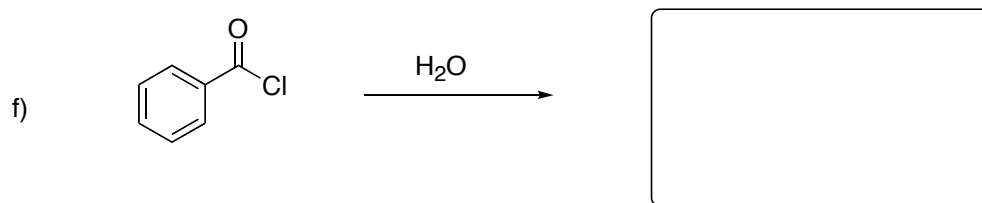
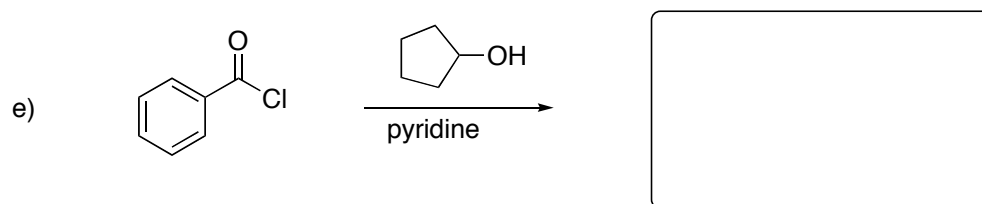
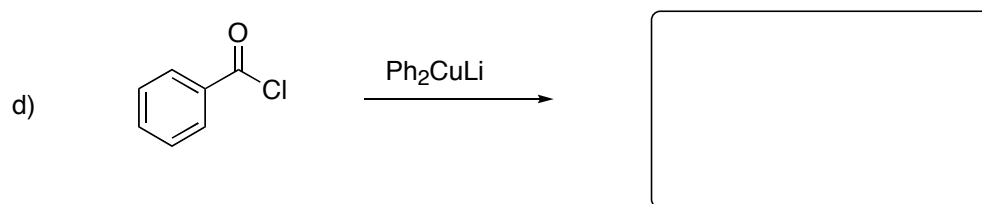
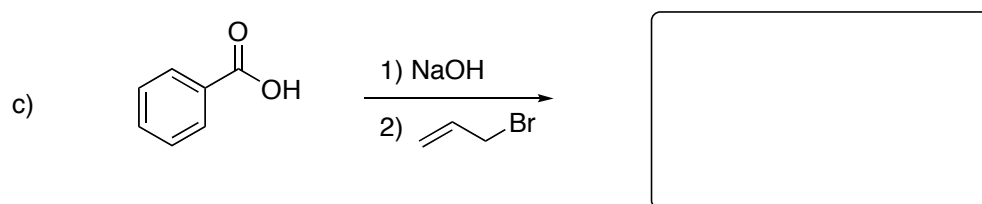
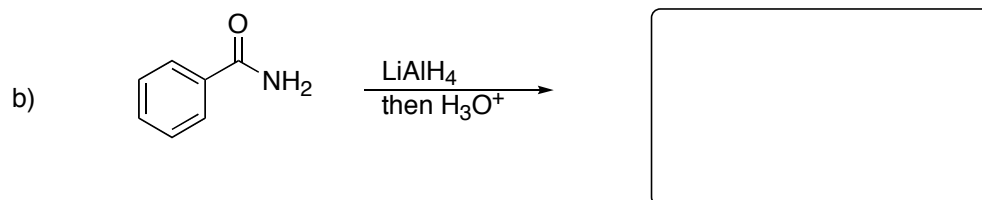
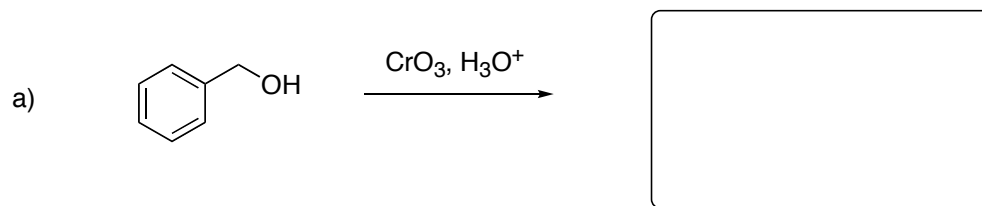
4. Below are several reactions. Circle the ones that would NOT proceed as shown. (8 pts)



5. Shown below is an acid-catalyzed hydrolysis of a lactone ester. Complete the mechanism for this reaction by showing all arrows for electron movements and filling out the partially drawn structures. Make sure to place the appropriate formal charges where necessary. Include any additional acid or conjugate base necessary for the mechanism. (24 pts)



6. Draw the structure of the product for the following reactions. (21 pts)



7. Fill in the missing reagents and products in the following multistep syntheses. (21 pts)

