CHEM 3331, Professor M. Walczak, Spring 2015
Third hour exam, 7.00 PM, April 14th, 2015

Printed Name: Answer key

Student ID: _____ Recitation TA: _____

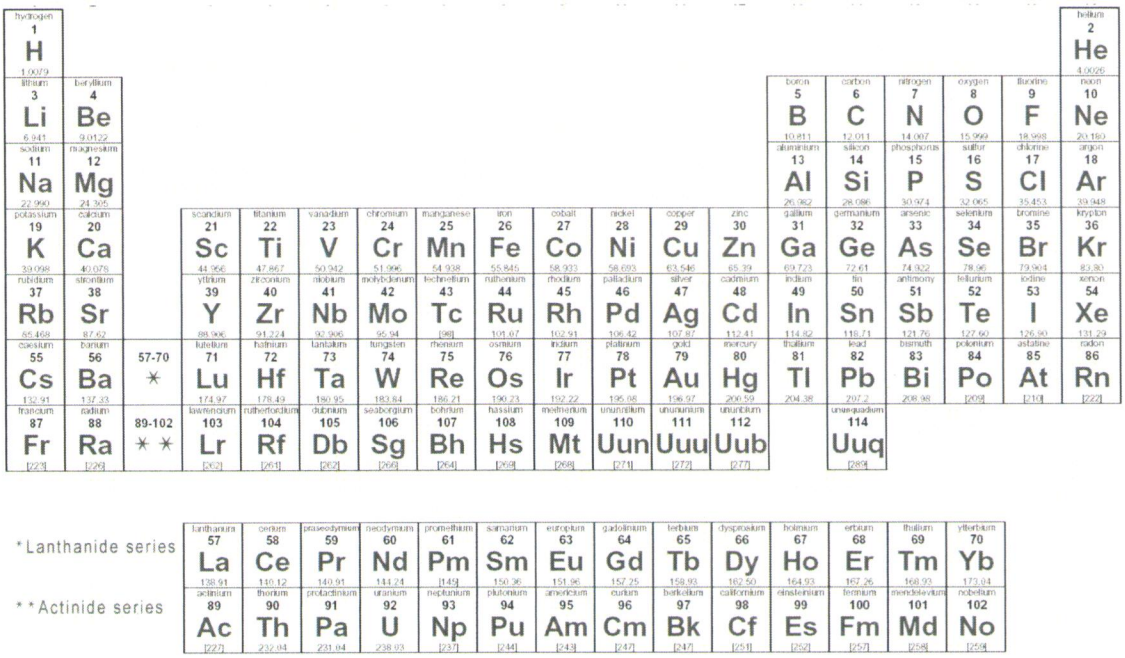
Recitation Day and Time: _____ Signature: _____

1. _____ / 11
2. _____ / 32
3. _____ / 15
4. _____ / 15
5. _____ / 15
6. _____ / 12

Total: _____ / 100

This is a closed-book exam. You are not allowed to use molecular models, lecture notes, personal class notes, textbooks, and electronic copies of the above materials on mobile devices. Use the backs of the pages for scratch notes.

Honor Code: All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion).



1.

(a) Unlike $LiAlH_4$, the following reagent - $HAl[OC(CH_3)_3]_3$ - selectively reduces acyl halides to aldehydes. The reason(s) for the reduced acitvity of this reagent is/are (3 points):

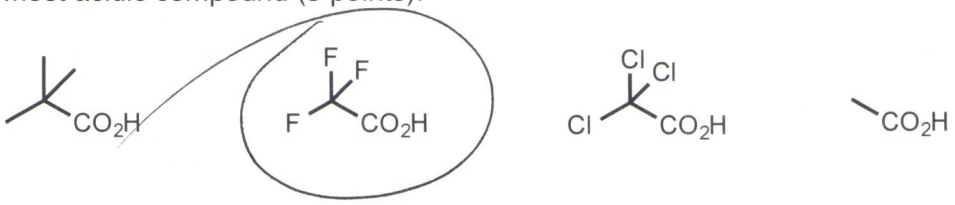
(a) the hydride ion is less nucleophilic;

(b) it is sterically hindered;

(c) both (a) and (b) are correct;

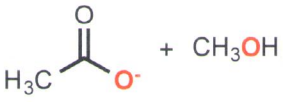
(e) both (a) and (b) are incorrect.

(b) Identify the most acidic compound (3 points).

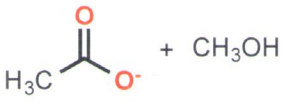


(c) Methyl acetate (shown below) was reacted with a hydroxide anion labeled with a heavy isotope of oxygen (oxygen-18, shown in red). Based on your understanding of the saponification reaction, predict the location of the labeled oxygen atom in the products (5 points).

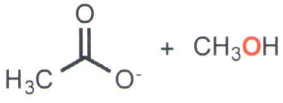
(a)



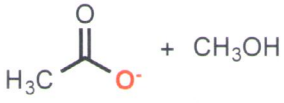
(b)



(c)

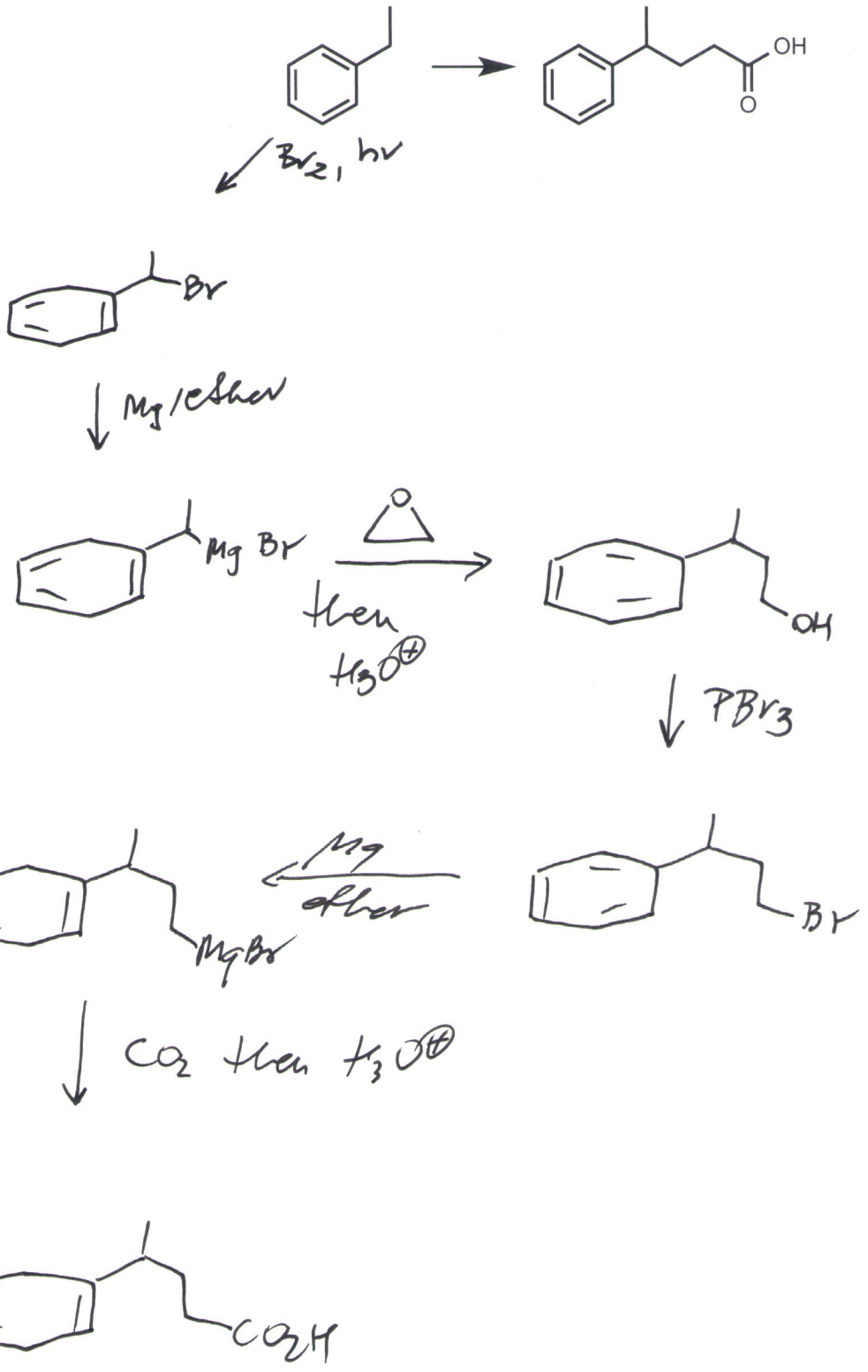


(d)



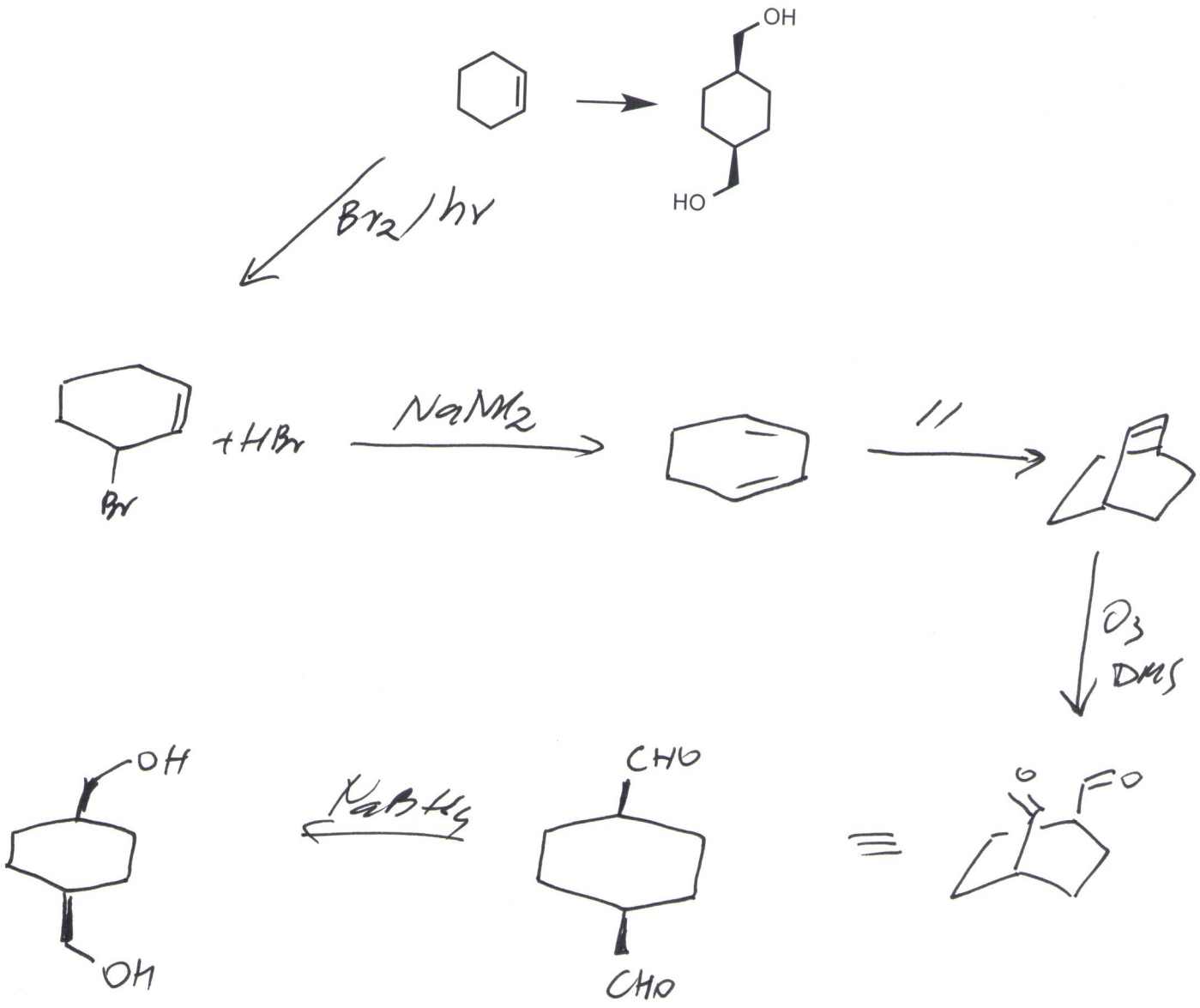
2. Provide a reasonable synthesis of the following two compounds using provided starting materials. More than one step may be required to complete the synthesis. The products are racemic but pay close attention to relative stereochemistry (32 points).

(a)



18 points

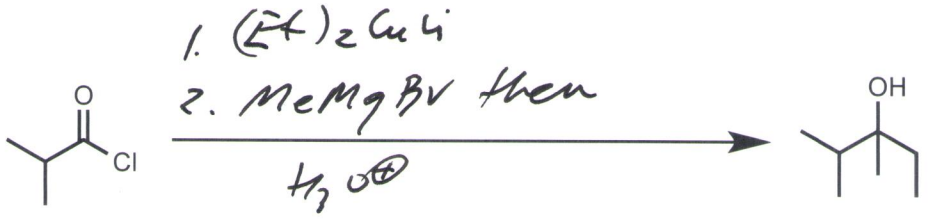
(b)



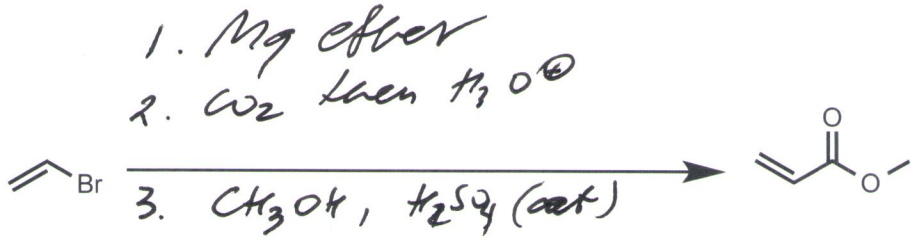
14 points

3. Complete the following syntheses using any reagents you need. You do not have to show the synthesis of the reagents you use, but you must use the starting material indicated. All chiral products are racemic mixtures (3 points each, 15 points total).

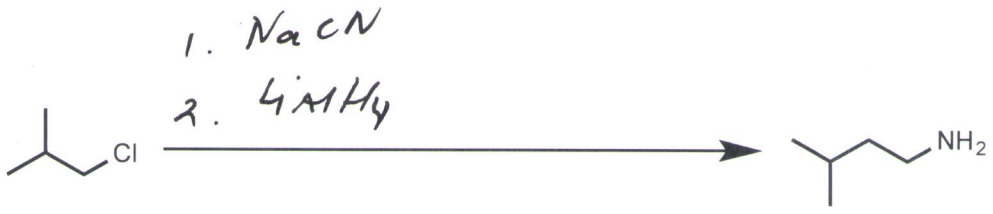
(a)



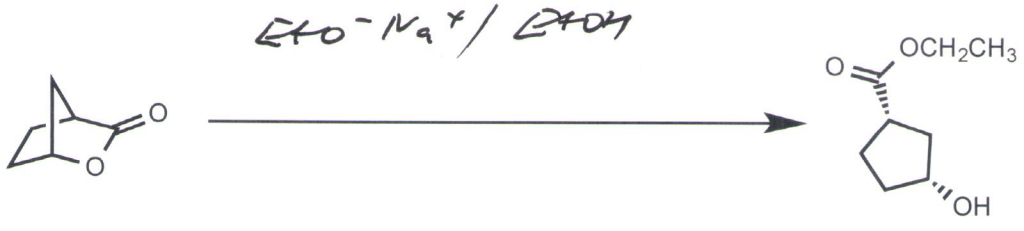
(b)



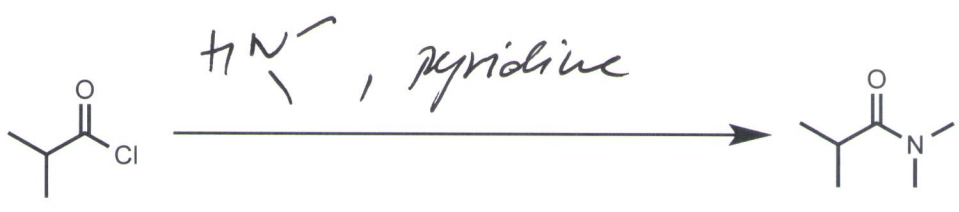
(c)



(d)

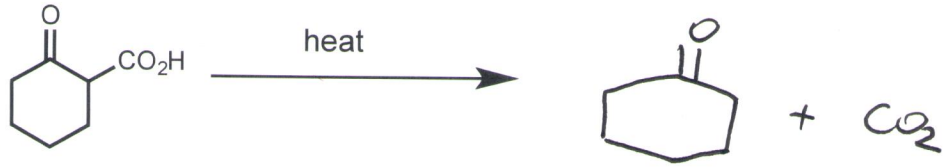


(e)

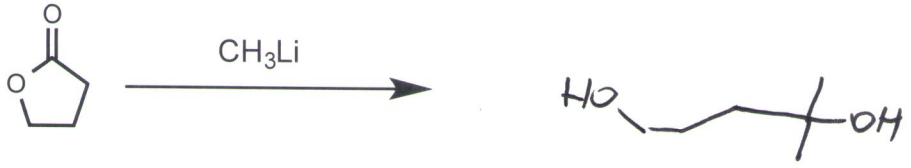


4. Provide the products of the following reactions (all reactions have an appropriate aqueous work up). If no reaction would occur, write NR. Ignore stereochemistry in the products (3 points each, 15 points total).

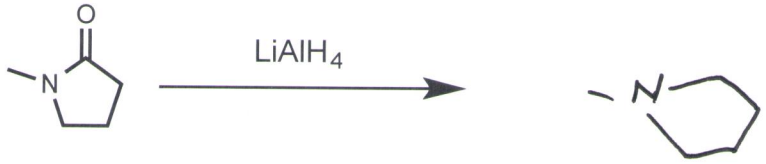
(a)



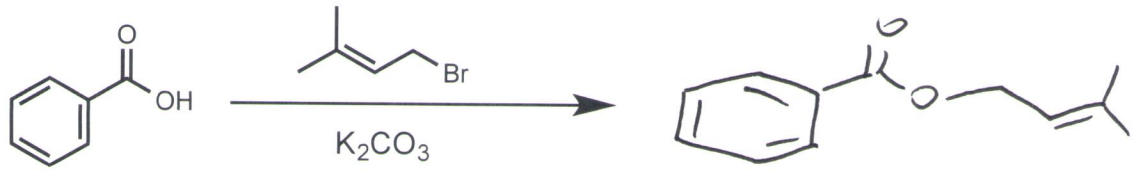
(b)



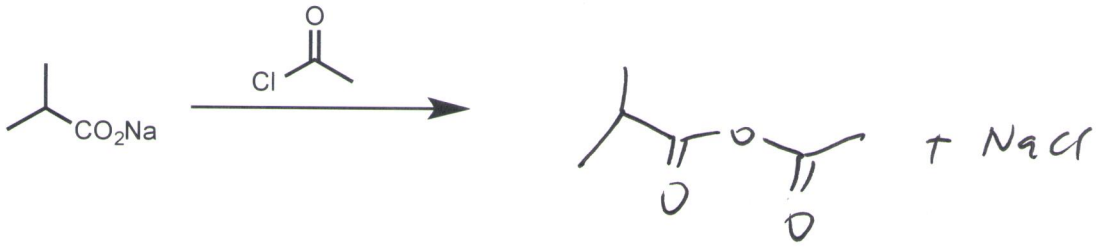
(c)



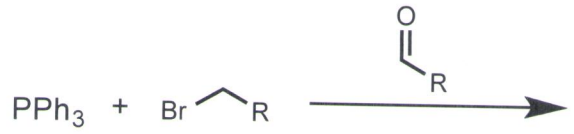
(d)

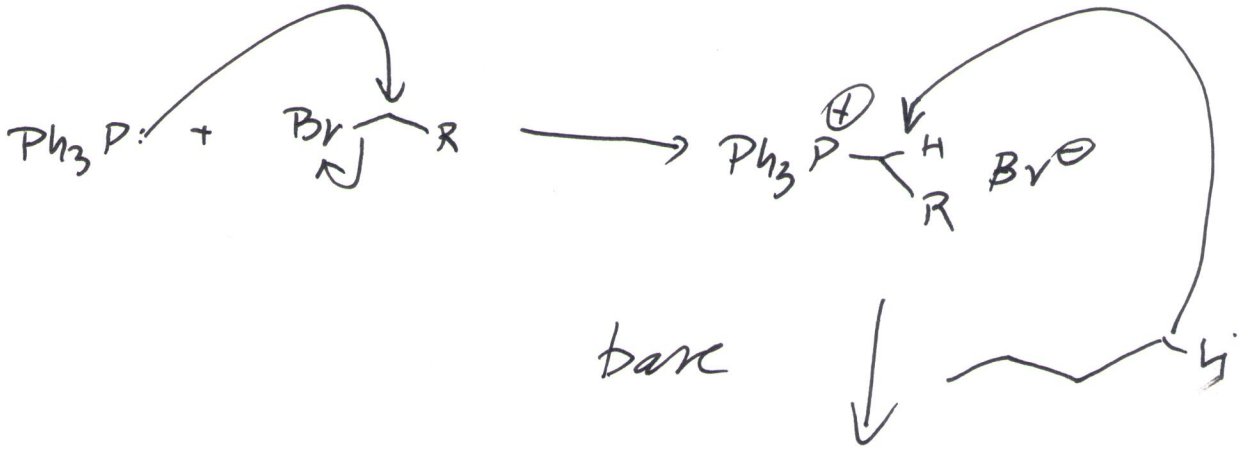


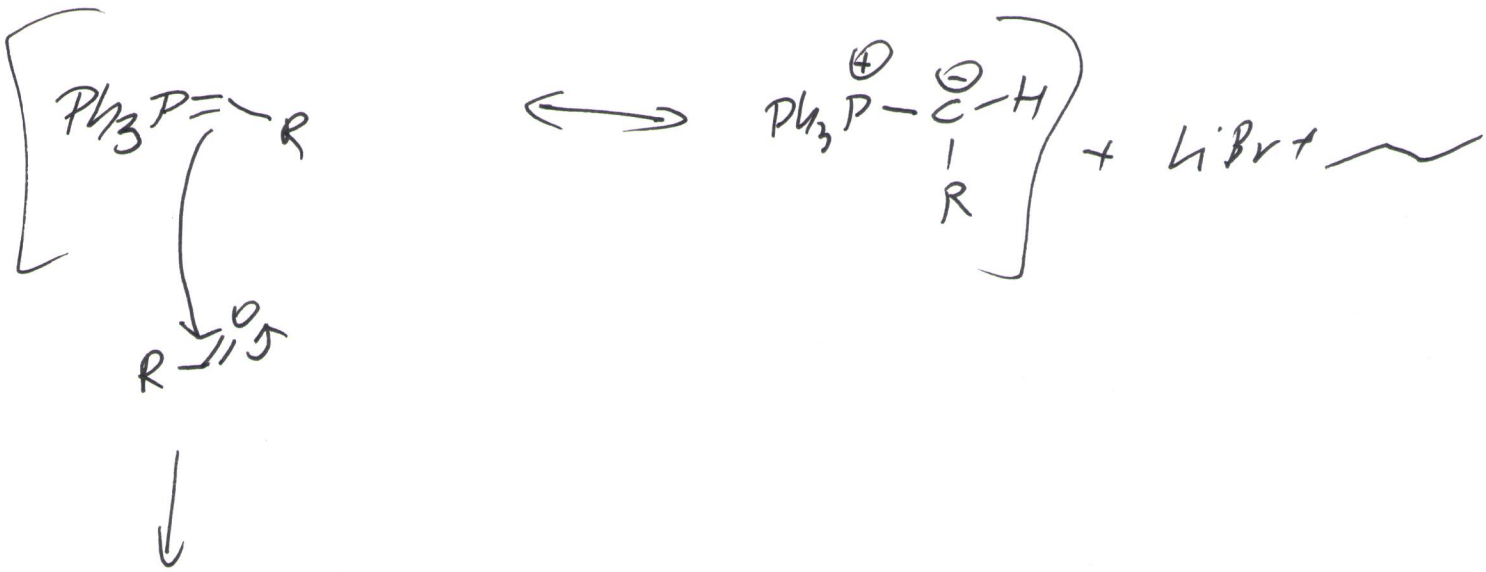
(e)

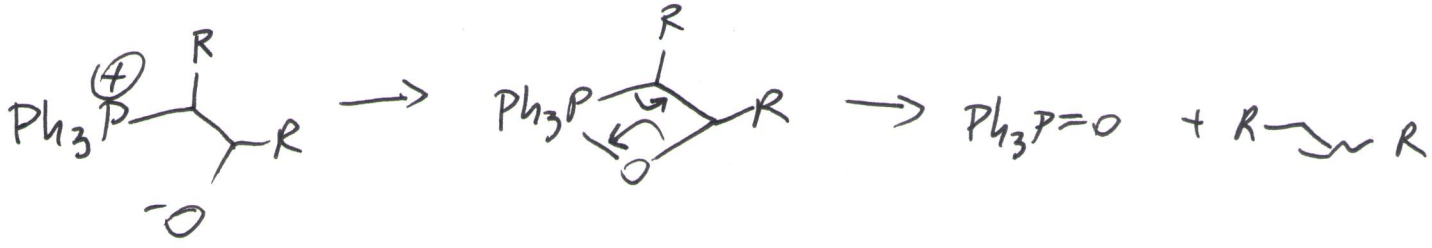


5. Draw a plausible mechanism of the Wittig reaction (15 points).







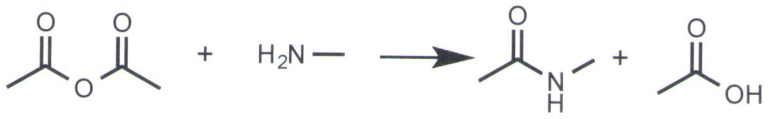


6. In the following questions, please circle only the correct answer (3 points each, 12 points total):

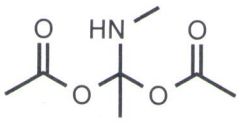
(a) Among the following choices, which group is the least reactive in a reaction with $LiAlH_4$?

(a) $-CO_2H$ (b) $-CN$ (c) $-CO_2CH_3$ (d) $-CO_2CH_2CH_3$ (e) $-COCl$

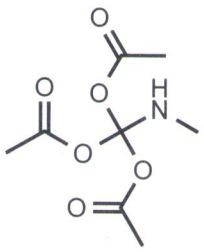
(b) Which structure represents a tetrahedral intermediate involved in acylation of metylamine with acetic anhydride?



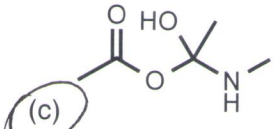
(a)



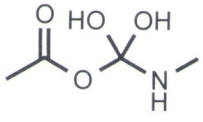
(b)



(c)



(d)



(c) In acylation reaction of an alcohol with acyl chloride, tertiary amine (Et_3N) or pyridine are added. Which statement about these additives is *incorrect*?

(a) they act as a Lewis base; (b) they deprotonate the alcohol to form an alkoxide;

(d) they scavenge HCl; (e) they can be used as a solvent.

(d) Which statement about transesterification reaction is correct?

(a) only stoichiometric amounts of acid can be used; (b) can be catalyzed by a base;

(c) works only with aliphatic alcohols; (d) can occur under acidic or basic conditions.