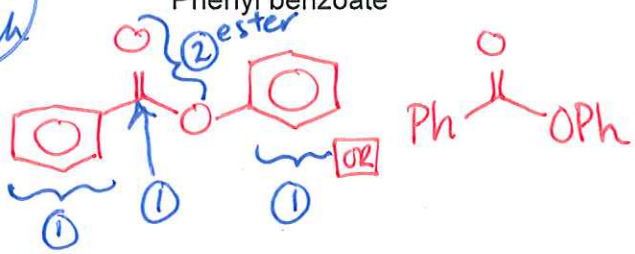
CHEM 108B, Exam 2A Last Name, First Initial Key

1. Nomenclature – suffixes for acyl derivatives on the cover page

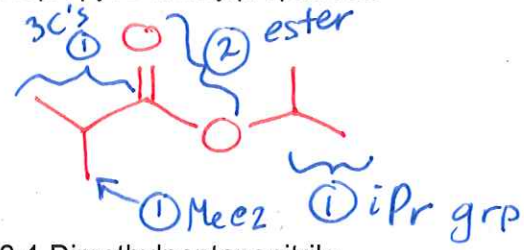
(a) (*15 points*) **Draw structures** corresponding to **any three** of the following names. *Put a large "X" over the name and space you don't want graded.*

5 pts each

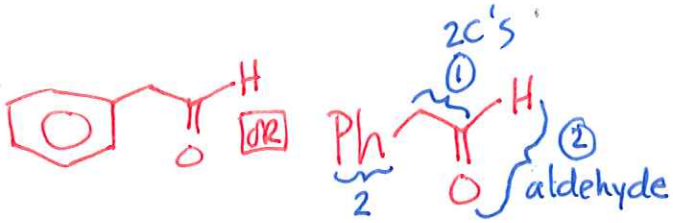
Phenyl benzoate



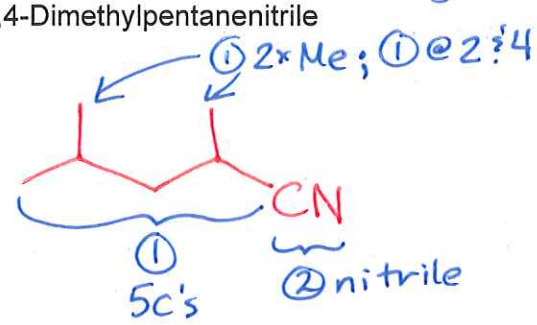
Isopropyl 2-methylpropanoate



Phenylacetaldehyde
(2-Phenylethanal)

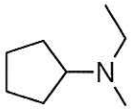


2,4-Dimethylpentanenitrile

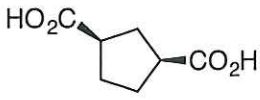


(b) (*15 points*) **Provide IUPAC names** for **any three** of the following compounds. *Draw a large "X" over the problems you do not want graded, otherwise the first three will be graded.*

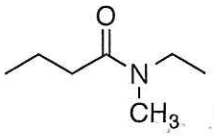
5 pts each



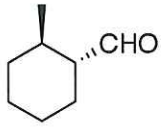
Cyclopentyl ethyl methyl amine
other order OK



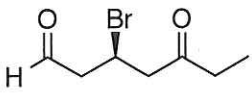
(R,S) or cis-1,3-cyclopentane dicarboxylic acid



N-Ethyl-N-methyl butanamide



(1R,2R)-2-Methyl cyclohexane carbaldehyde



R-3-Bromo-5-oxoheptanal
OK

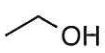
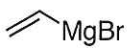
2. Miscellaneous Fundamentals

(a) (*5 points*) Fill in the blank.

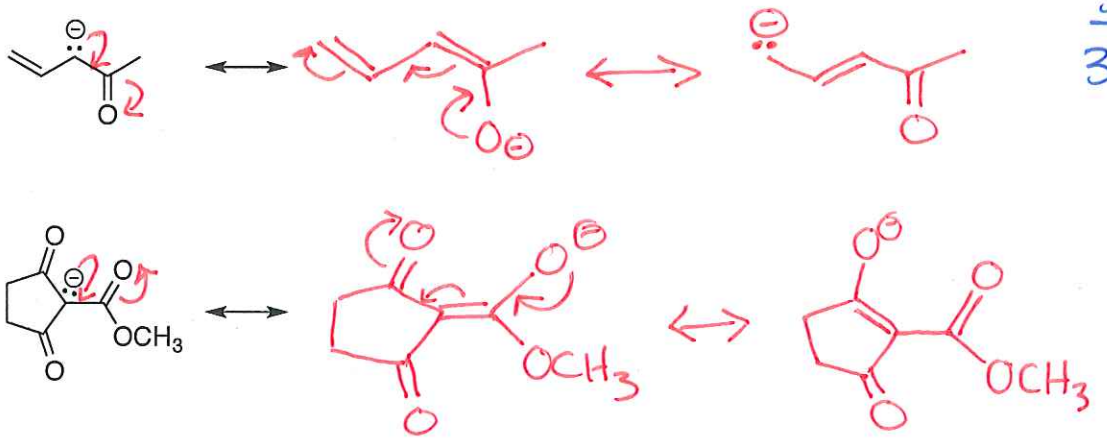
Electronegativity / Polarity (one word) **is the underlying principle that explains most, if not all, of the reactivity patterns in organic chemistry.**

(b) (*10 points*) **Nucleophile vs. Electrophile.** Indicate whether the following functional group, type of compound, or reagent most often acts as nucleophile (N) or electrophile (E) in the reactions covered in this class.

1pt each

Methoxide ion	Acids	Bases	Carbocations	Cyanide ion
N	E	N	E	N
				
E	E	N	E	N

(c) (*10 points*) **Resonance.** Use *curved arrow* notation to indicate electron movement and draw *two non-equivalent* resonance structures of the compound below.

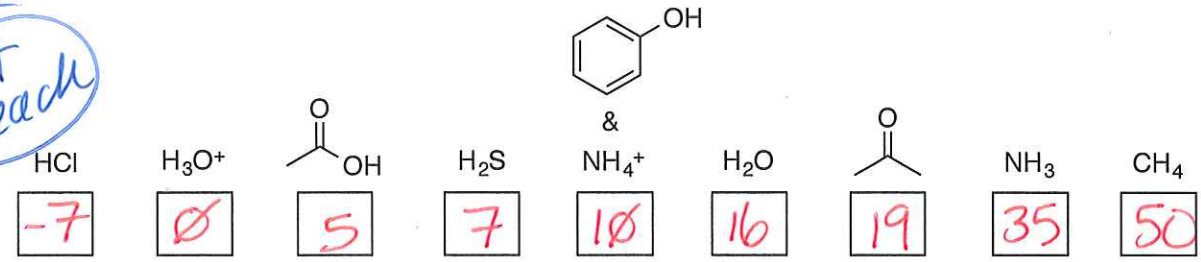


5pts each
3 pts - correct structures w/ charge
2pts - correct arrows

3. Acid-Base Chemistry

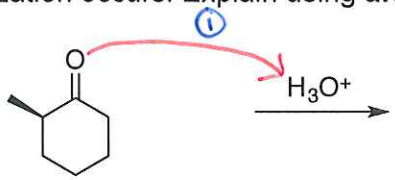
(a) (*9 points*) The following compounds are arranged from most to least acidic (left to right). Fill in the **pKa** values of each in the boxes provided.

1pt each

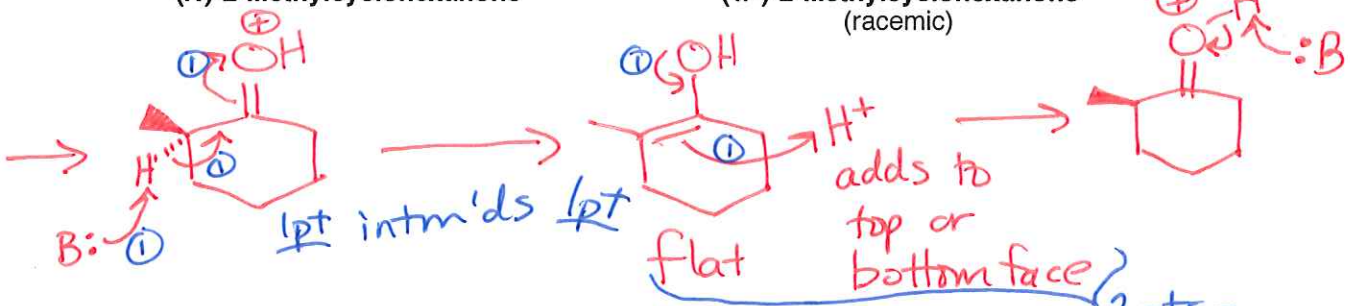


HCl	H_3O^+	OH	H_2S	& NH_4^+	H_2O		NH_3	CH_4
-7	Ø	5	7	10	16	19	35	50

(b) (*11 points*) **Tautomers.** When optically active (*R*)-2-methylcyclohexanone is treated with aqueous acid, racemization occurs. Explain using **arrow pushing, intermediates, *and* <u>less than ten words</u>**.



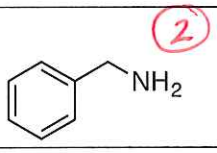
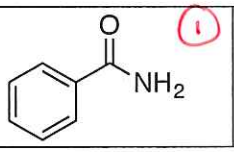
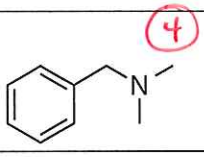
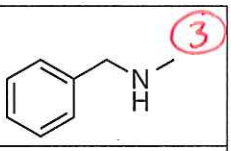
(*R*)-2-Methylcyclohexanone **(+/-)-2-Methylcyclohexanone** (racemic)



2pts - explanation

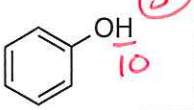
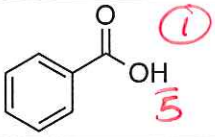
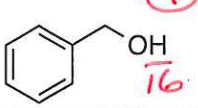
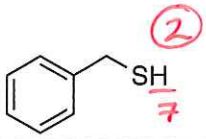
(c) (*8 points*) **Rank** the following sets in terms of acidity where **1 is the most acidic.**

Set 1

Circle your answer below ↓				
I	2	4	1	3
II	2	1	4	3
III	4	1	2	3
IV	1	4	3	2

4pts

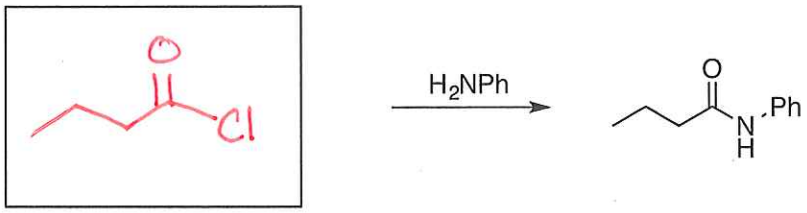
Set 2

Circle your answer below ↓				
I	1	2	3	4
II	2	1	3	4
III	3	1	4	2
IV	3	2	4	1

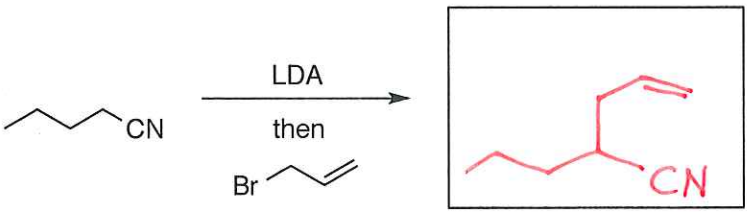
4pts

4. (*25 points*) **Single Step Reactions** – Fill in the box with the reactant, reagent(s), or product. *SKIP ANY ONE REACTION with big "X" over the entire reaction, otherwise the first five (a-e) will be graded.*

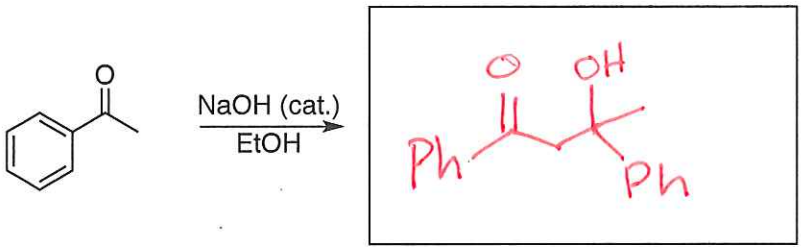
(a)



(b)

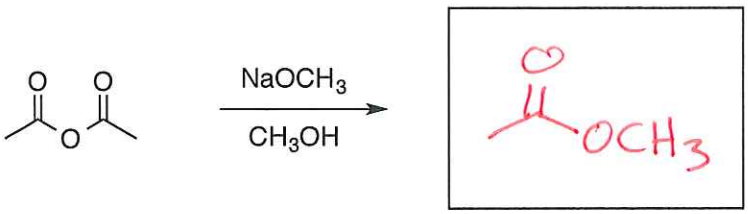


(c)

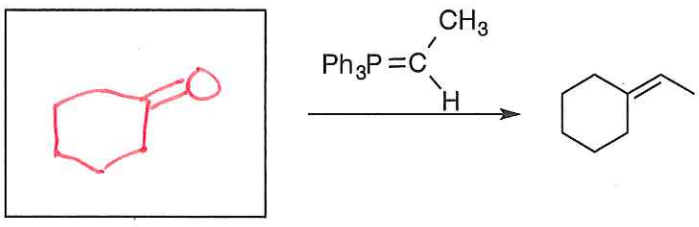


(d)

(e)



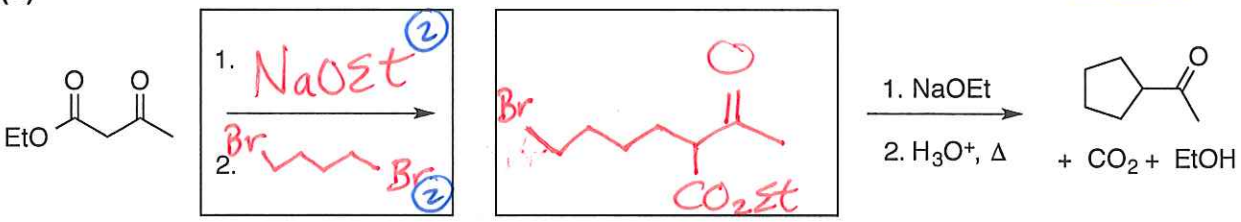
(f)



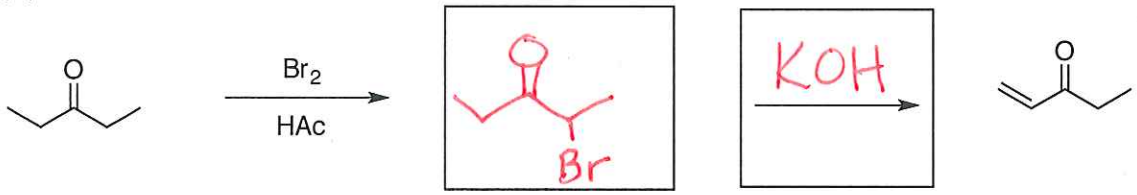
5. (*32 points*) **Mini Reaction Puzzles** - Fill in the box with the reactant, reagent(s), or product. *SKIP ANY ONE PUZZLE with big "X" over the entire reaction, otherwise the first four (a-d) will be graded.*

4pts/box

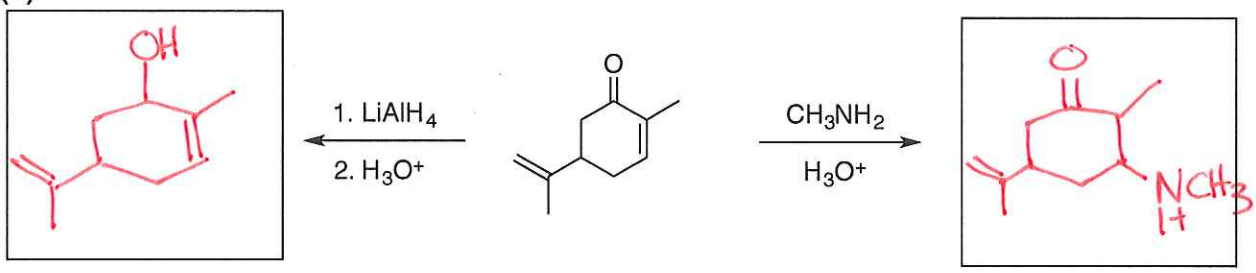
(a)



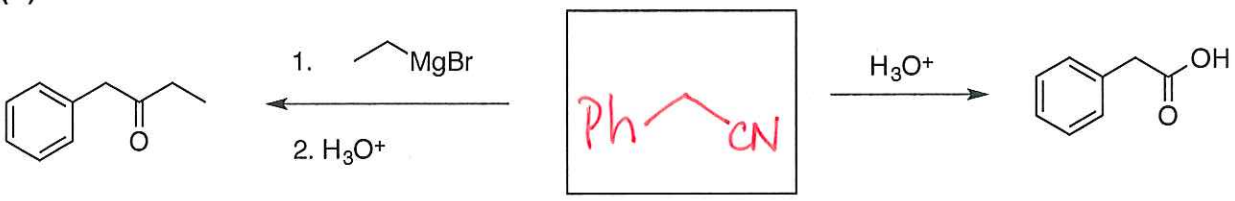
(b)



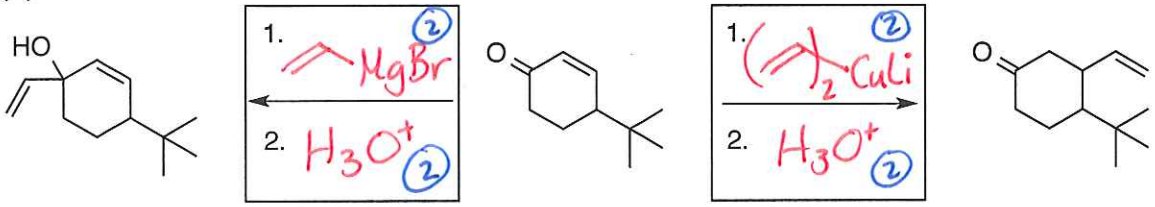
(c)



(d)

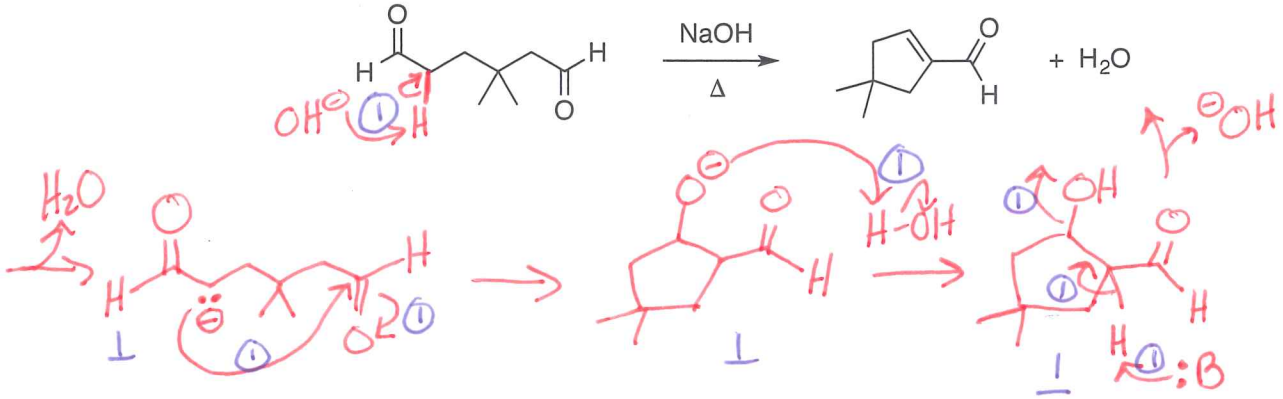


(e)

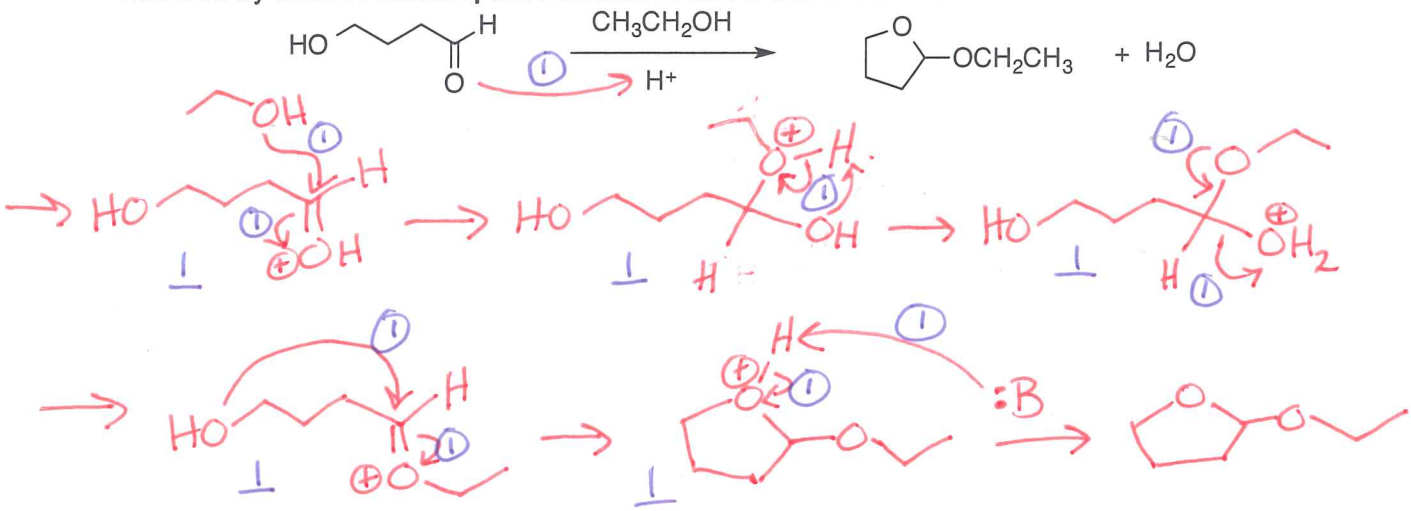


6. Mechanisms – Draw the full arrow-pushing mechanism for **all three reactions** below, including all arrows for acid-base reactions (no "PT"). Include all intermediates with proper charges circled for each step.

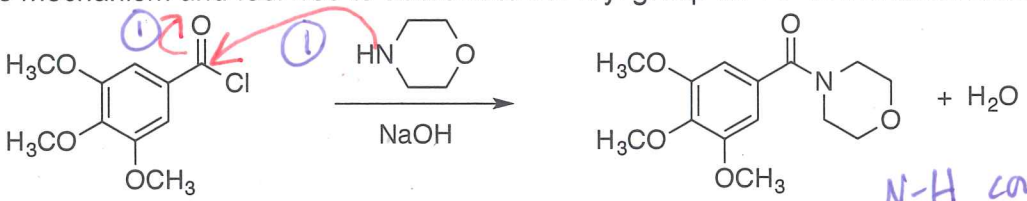
(a) (*10 points*) 4,4-Dimethyl-1-cyclopentene carbaldehyde is made through a **base-promoted intramolecular aldol cyclization** of the dialdehyde below. Show this mechanism.
Pro tip: number the carbons in the starting material & product.



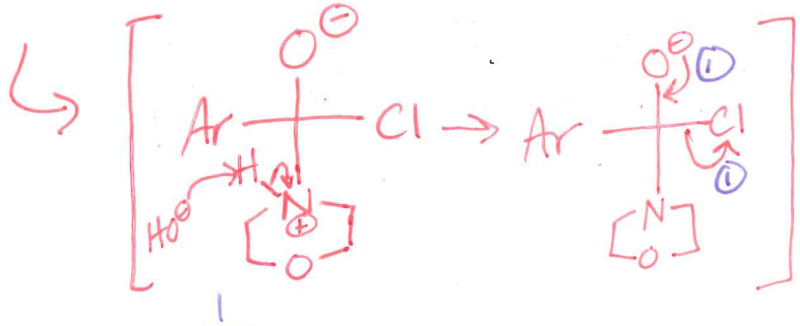
(b) (*15 points*) The following **acetal** is made through an **acid-catalyzed intramolecular cyclization** reaction. The mechanism proceeds by **nucleophilic addition and dehydration** followed by second **nucleophilic addition**. Show this mechanism.



(c) (*5 points*) Trimetozine, a sedative, is prepared commercially through a **base-catalyzed nucleophilic acyl substitution** reaction between morpholine and the following acid chloride. Show the mechanism and feel free to abbreviate the aryl group as "Ar" in the intermediate(s)!



-1 if N-H not addressed at all



N-H could be lost earlier (see 2B key)

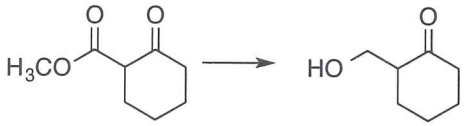
7. (*30 points*) **Multi-Step Synthesis** - Carry out any two of the syntheses below using the starting material provided and any other reagents or carbon sources needed. Draw the product after each synthetic step. No mechanisms.

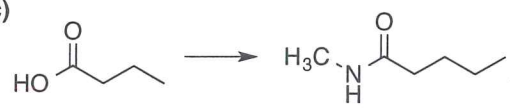
15 pts each

Grade breakdown subjective ← partial credit awarded where possible

CHOOSE ANY TWO

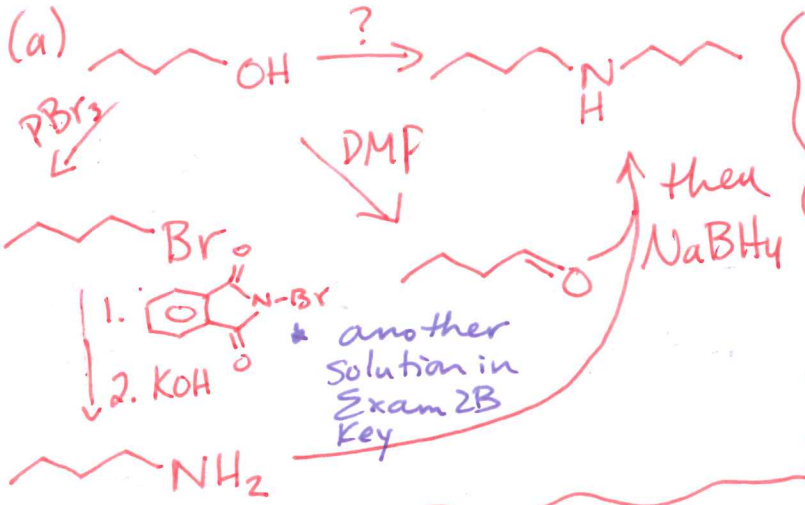
(a) 2 x  (butanol is your only source of carbon!)

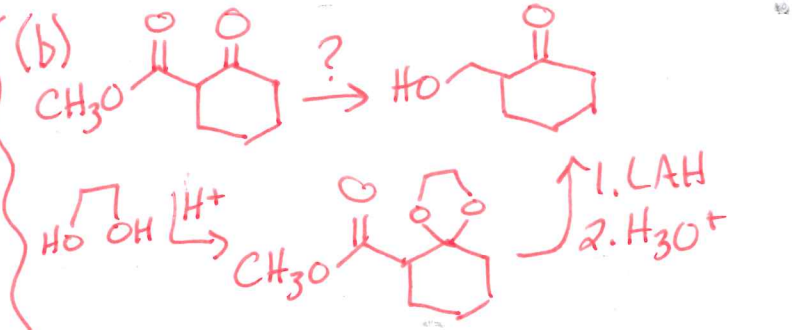
(b) 

(c) 

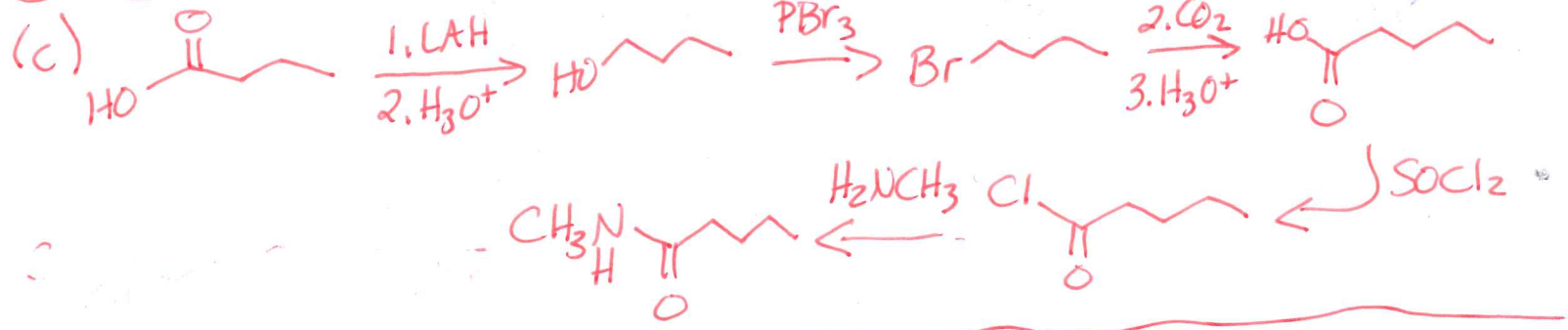
(d) 

PUT A LARGE "X" OVER THE REACTIONS YOU ARE SKIPPING & DO NOT WANT GRADED

(a) 

(b) 

another solution in 2B Key

(c) 

(d)