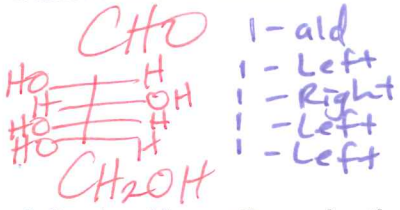
CHEM 8B W17, Final Exam B  Last Name, First Initial _____

**1. Nomenclature**

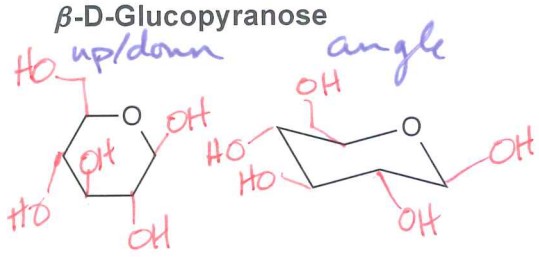
**(a)** (*5 points*) Draw the open chain form of **L-Glucose** below (Fischer projection).



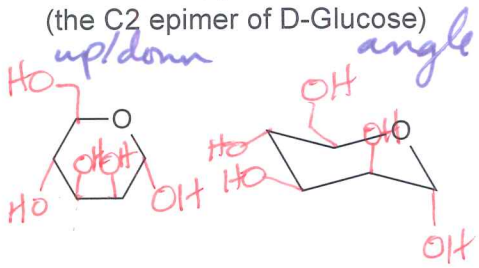

5 pts/ bond

**(b)** (*20 points*) Complete the following **Haworth projections** and **chair conformations**, being careful to clearly indicate proper directions (up or down) in the Haworth projections and bond angles in the chair conformations.

**β-D-Glucopyranose**

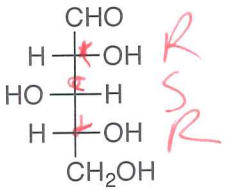



**α-D-Mannopyranose**
(the C2 epimer of D-Glucose)

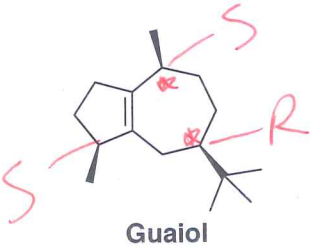



1pt/ center

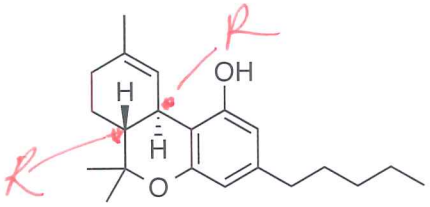
**(c)** (*8 points*) Draw an asterisk next to each chiral center on the molecules below and **clearly designate each chiral center as R or S**.




**D-Xylose**



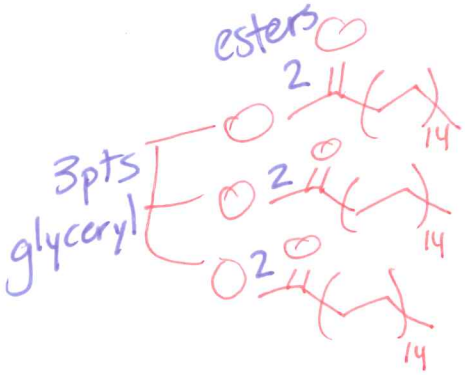

**Guaiol**




**Tetrahydrocannabinol (THC)**

-1 for each non-chiral atom assigned/ starred

**(d)** (*12 points*) Draw the structure of a **glyceryl trilaurate**, the product of the triesterification of glycerol with three lauric acid units. **Lauric acid** is a saturated fatty acid containing 16 carbons. **Glycerol** is a three-carbon triol, where each alcohol is on different a carbon.




3pts- correct chains

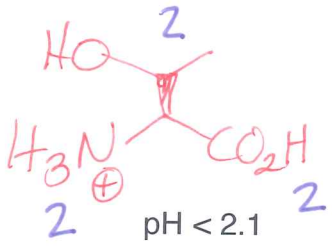
 Last Name, First Initial _____

**2. Acid-Base Chemistry**

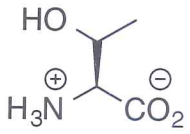
1pt - protonated/deprotonated
1pt - correct charge

The physiological form of each amino acid is given below. Draw the dominant ionic species of the amino acids at each of remaining indicated pH ranges based on the given pKa's. Indicate all charged atoms. Circle the charges as shown below.

**(a)** (*8 points*) **Titration of Threonine** – $pKa_1$ 2.1; $pKa_2$ 9.4



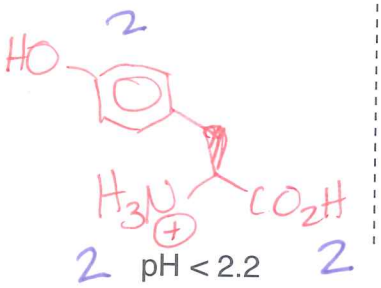
pH < 2.1



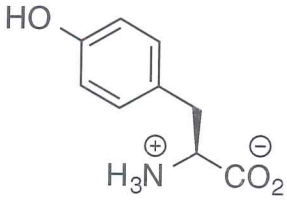
2.1 < pH < 9.4

pH > 9.4

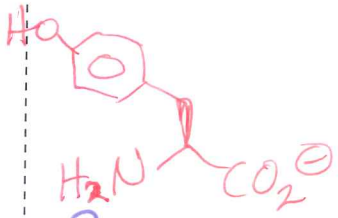
**(b)** (*10 points*) **Titration of Tyrosine** - $pKa_1$ 2.2; $pKa_2$ 9.11; $pKa_R$ 10.1



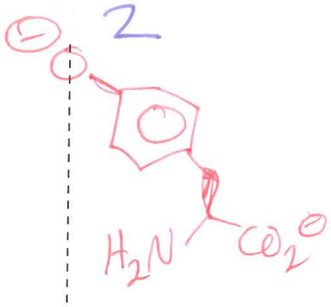
pH < 2.2



2.2 < pH < 9.11



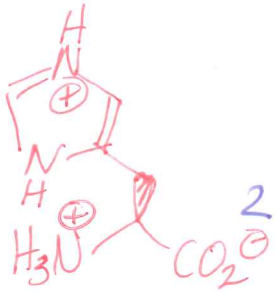
9.11 < pH < 10.1



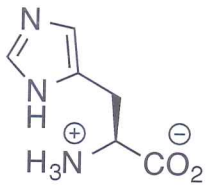
pH > 10.1

**(c)** (*10 points*) **Titration of Histidine** - $pKa_1$ 1.8; $pKa_2$ 9.2; $pKa_R$ 6.0

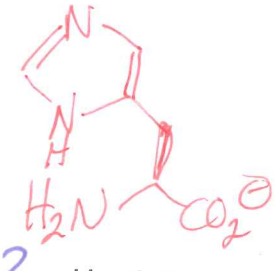
pH < 1.8



1.8 < pH < 6.0



6.0 < pH < 9.2



pH > 9.2

**3. Amino Acids & Peptides**
Use the structures from the previous page to answer the following.

1pt box

**(a)** (*12 points*) Indicate the **charge of the dominant form** of each amino acid at the indicated pH. Show the **setup for calculation of the isoelectric point (pI)** of each in the table.

3 extra possible

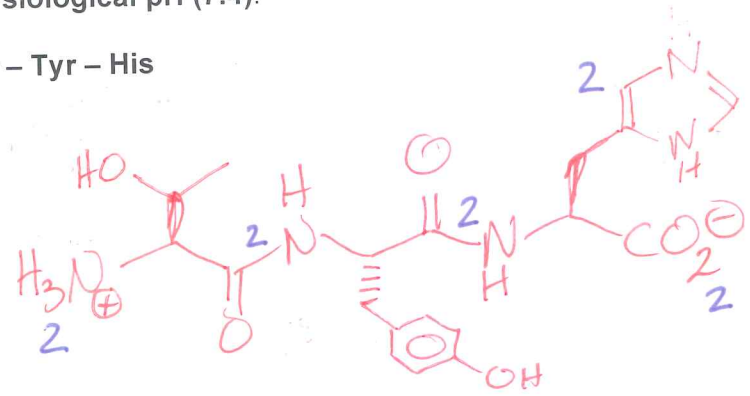
| | pH 1 | pH 4 | pH 7.4 | pH 11 | pI (Isoelectric Point) Calculation Setup |
|---|---|---|---|---|---|
| Threonine | +1 | Ø | Ø | −1 | 2.1+9.4/2 |
| Tyrosine | +1 | Ø | Ø | −2 | 2.2+9.11/2 |
| Histidine | +2 | +1 | Ø | −1 | 6+9.2/2 |

**(b)** (*4 points*) Why is **histidine** considered to be a **basic amino acid**? "*It can act as a base*" is not a sufficient answer!

Histidine is neutral under basic cond's/pH (net charge Ø) (has basic pI)

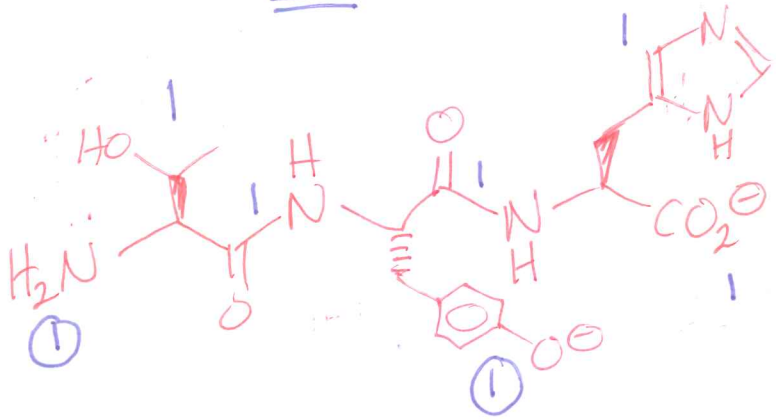
**(c)** (*14 points*) Draw the structure of a tripeptide containing threonine, tyrosine, and histidine at **physiological pH (7.4)**.

**Thr – Tyr – His**



side chains
-1 stereochem wrong/not shown
• correctly (de)protonated
• charges shown

**(c)** (*7 points*) Draw the structure of the **Thr – Tyr – His** tripeptide under highly basic conditions found in the intestines (**pH 11**).

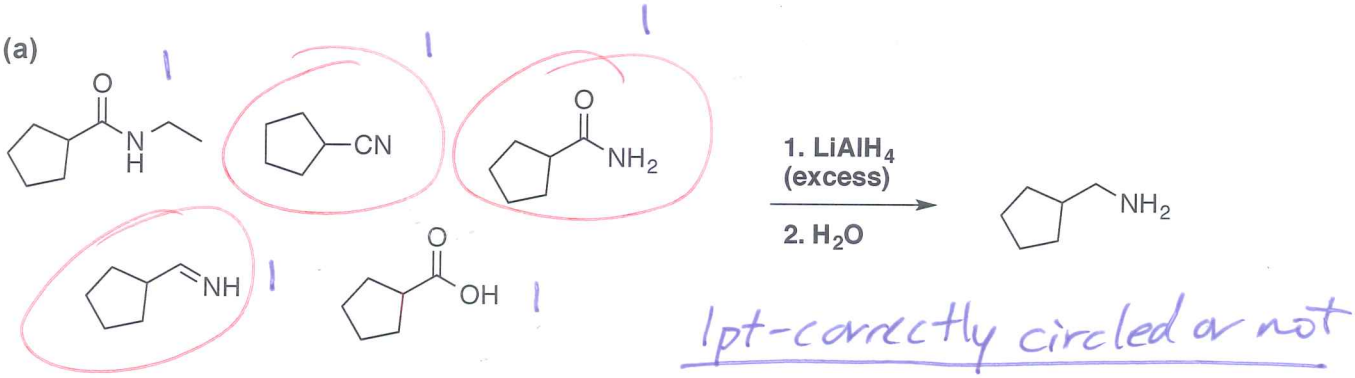


deprotonated grps circled

**4.** (*20 points*) **Single Step Reactions – Multiple Choice**  5 pts each

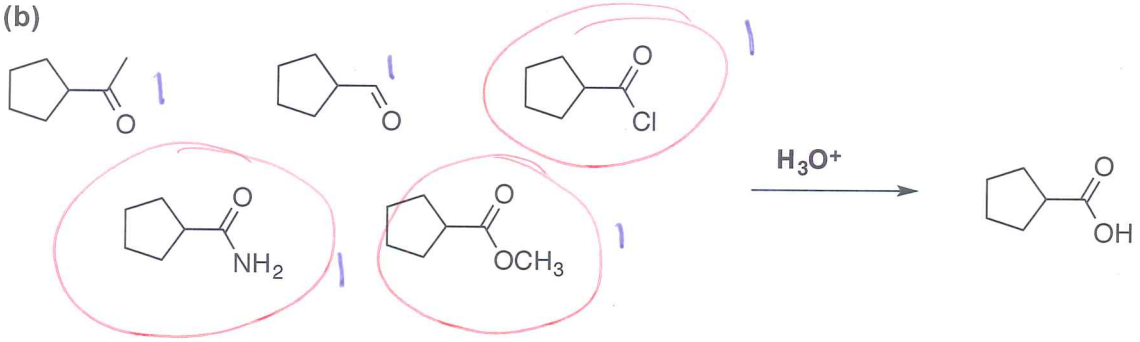
**For parts (a) & (b) below, circle the starting material(s)** that would give the indicated product. More than one answer is possible for each.

**(a)**



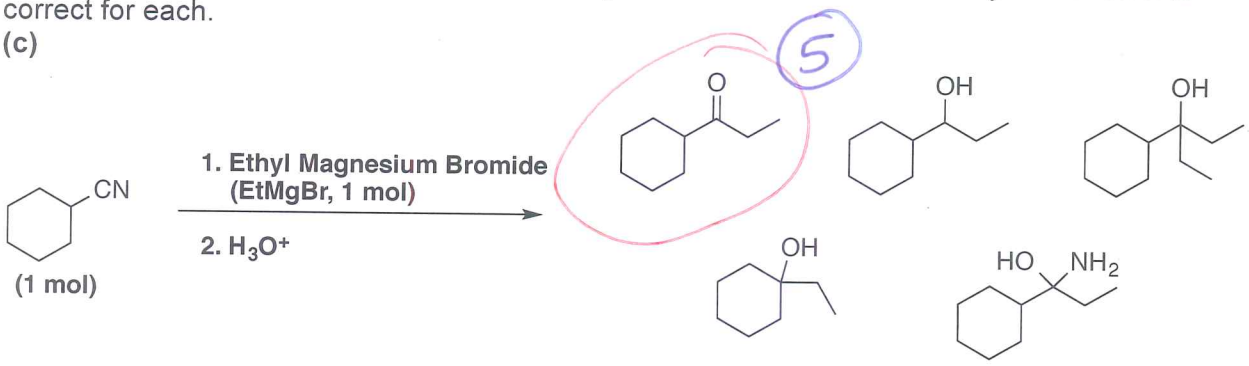

1pt-correctly circled or not

**(b)**



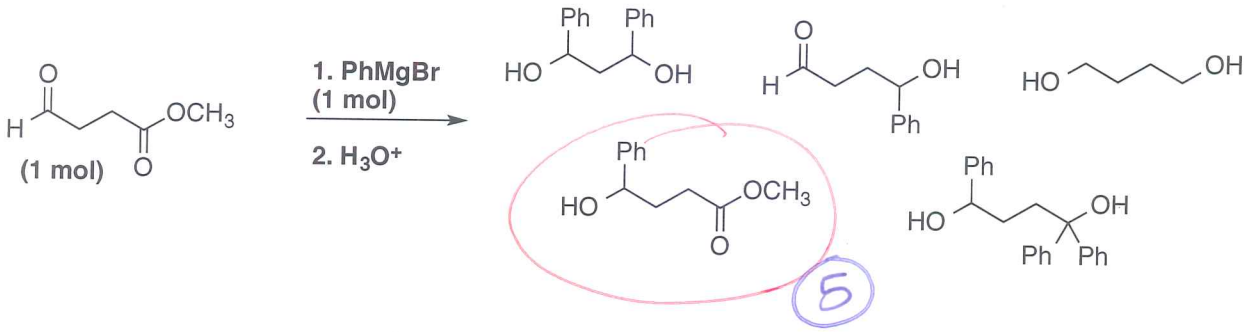

**For parts (c) & (d) below, circle the correct product** in each reaction. Only one answer is correct for each.

**(c)**




5

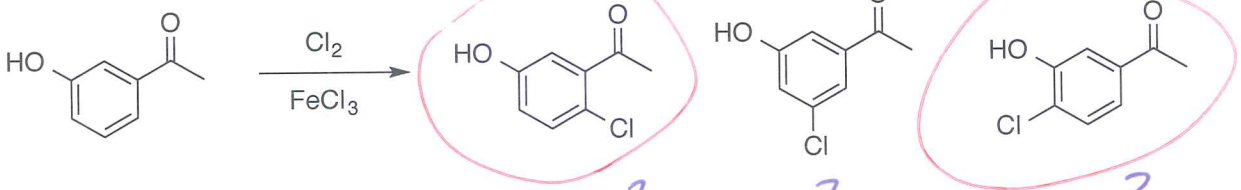
**(d)**




5

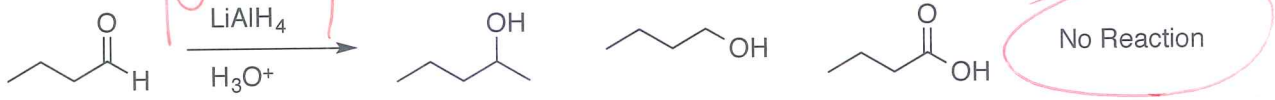
**5.** (*30 points*) **Single Step Reactions, Multiple Choice** 6pts each

**(a) Circle the major products** in the reaction below.




2 circled  2 not  2 circled

**(b) Circle the product** in the following reaction or **circle "No Reaction"** if the aldehyde does not react as written.

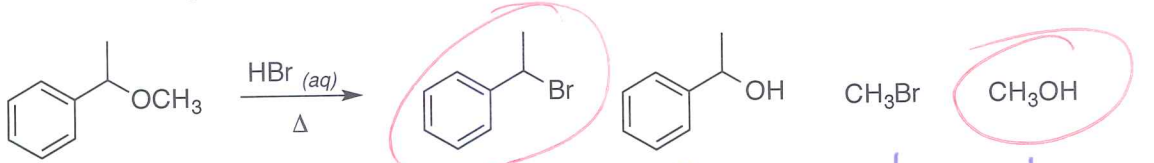



4

If "No Reaction", briefly explain:

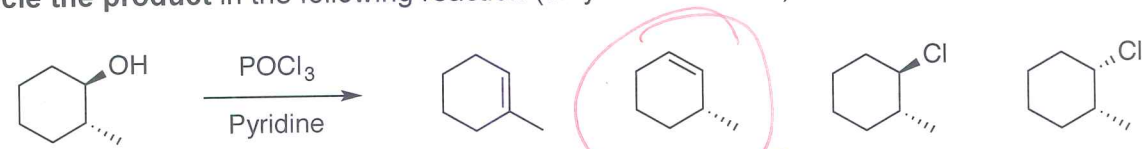
2 LAH quenched by $H_3O^+$ (not separated into steps). Fireballs 😮

**(c) Circle the two major products** in the reaction below.



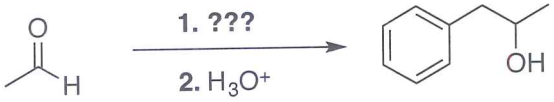

2 circled  2 not  1 not  1 circled

**(d) Circle the product** in the following reaction (only one is formed).




6

**(e) Circle the appropriate reagent** to complete the transformation below (what is **???**).




6

Benzyl magnesium bromide

Phenyl magnesium bromide

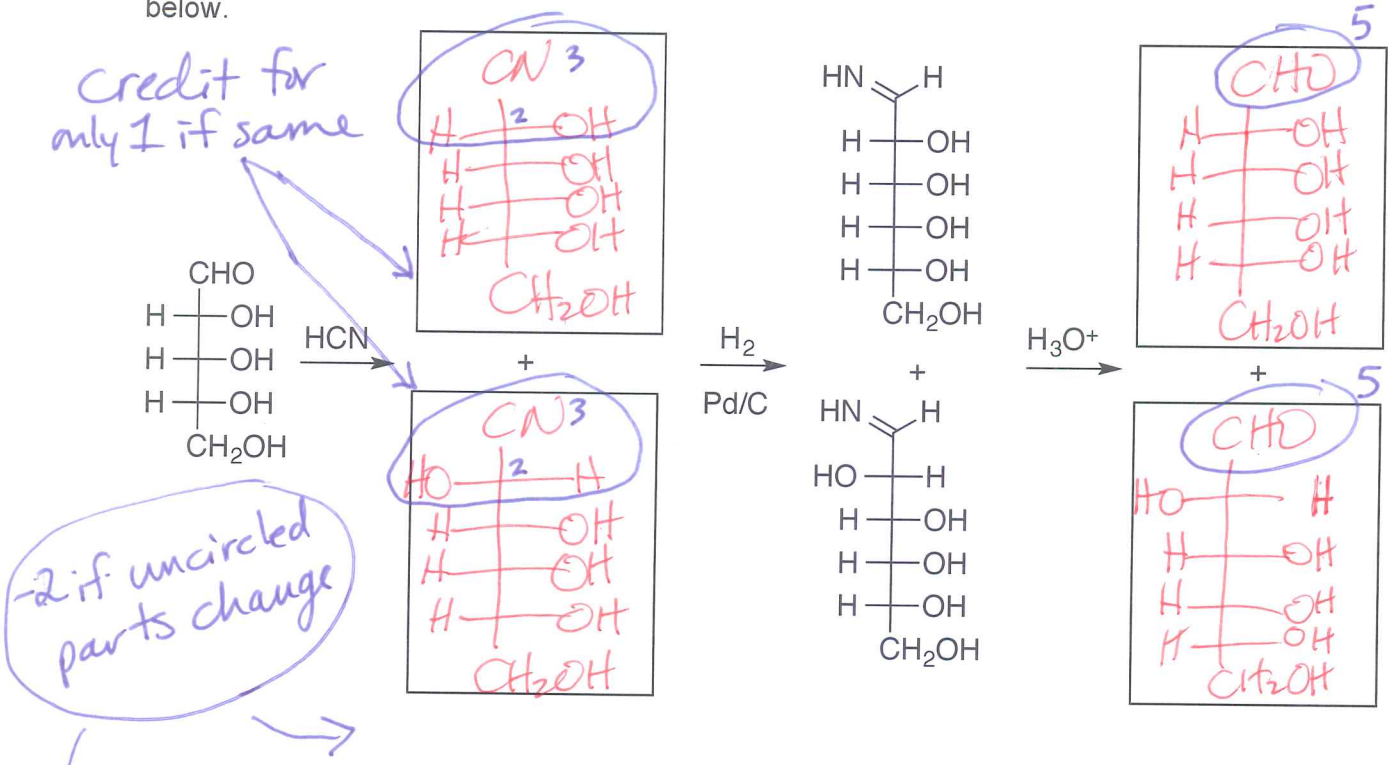
Methyl magnesium bromide

Bromobenzene

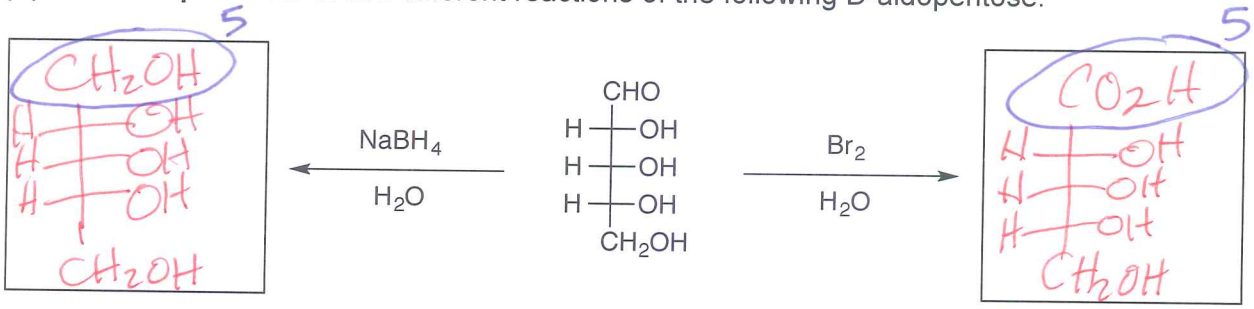
5 pts/box

**6.** (*40 points*) **Mini-Puzzles with Biomolecules**

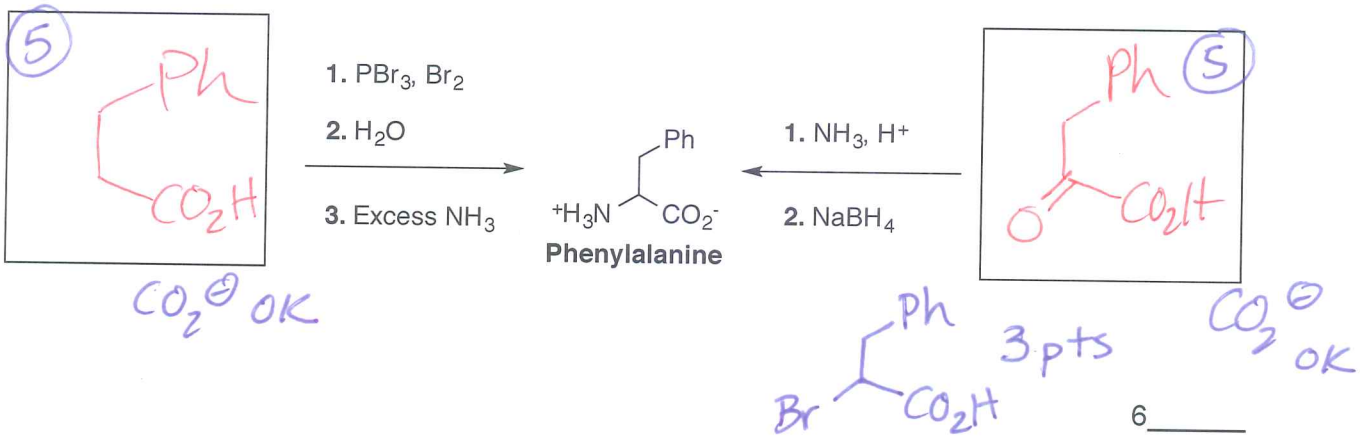
**(a)** Indicate the products in the first and last steps of the **Kiliani-Fischer synthesis** outlined below.




**(b)** Show the **products** of two different reactions of the following D-aldopentose.



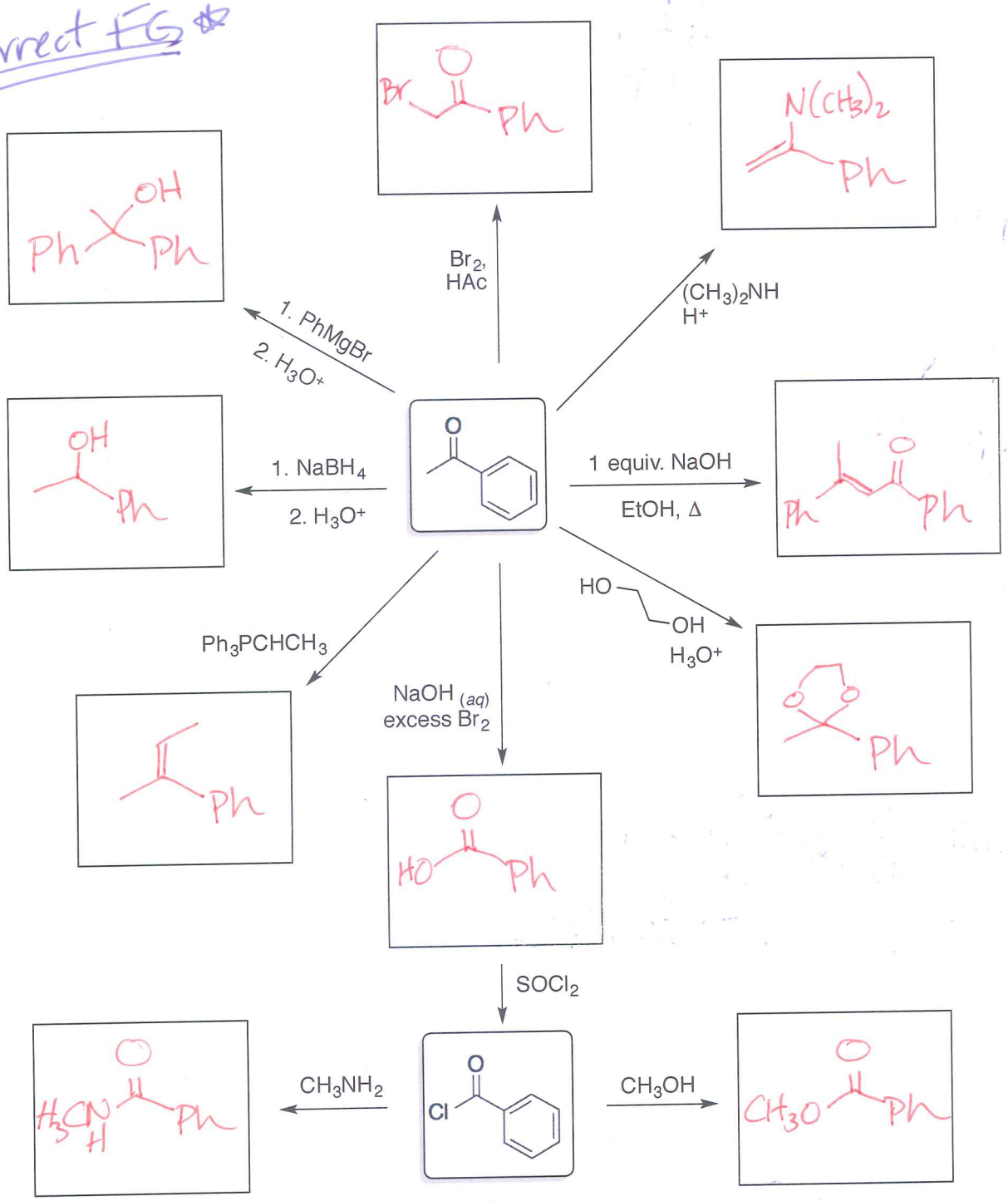

**(c)** Show the **starting materials** for two different methods for synthesizing **phenylalanine.**



**7.** (*40 points*) **Reaction Puzzle / Starburst**
Aldehydes and ketones were major focal points of this course. Over the past 10 weeks, you learned over 10 reactions of aldehydes and ketones. Acid chlorides were also found to be a useful synthetic tool, opening up possibilities of making any acyl derivative.

Convey your knowledge of ketone and acid chloride chemistry by **drawing the products of the reactions in the boxes** below. It's not uncommon to forget a few things on an exam so please **SKIP ANY TWO by drawing a LARGE X over the boxes to skip, otherwise the top eight reactions in the starburst will be graded.**

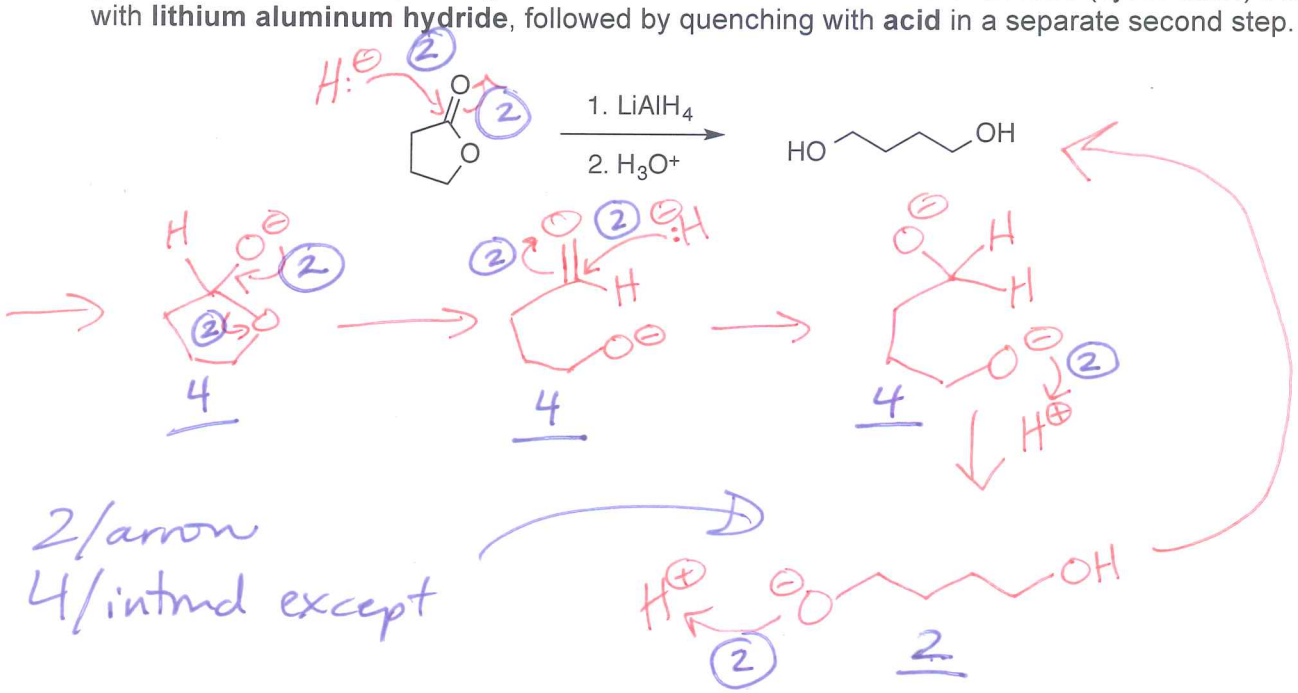
*Correct FG*



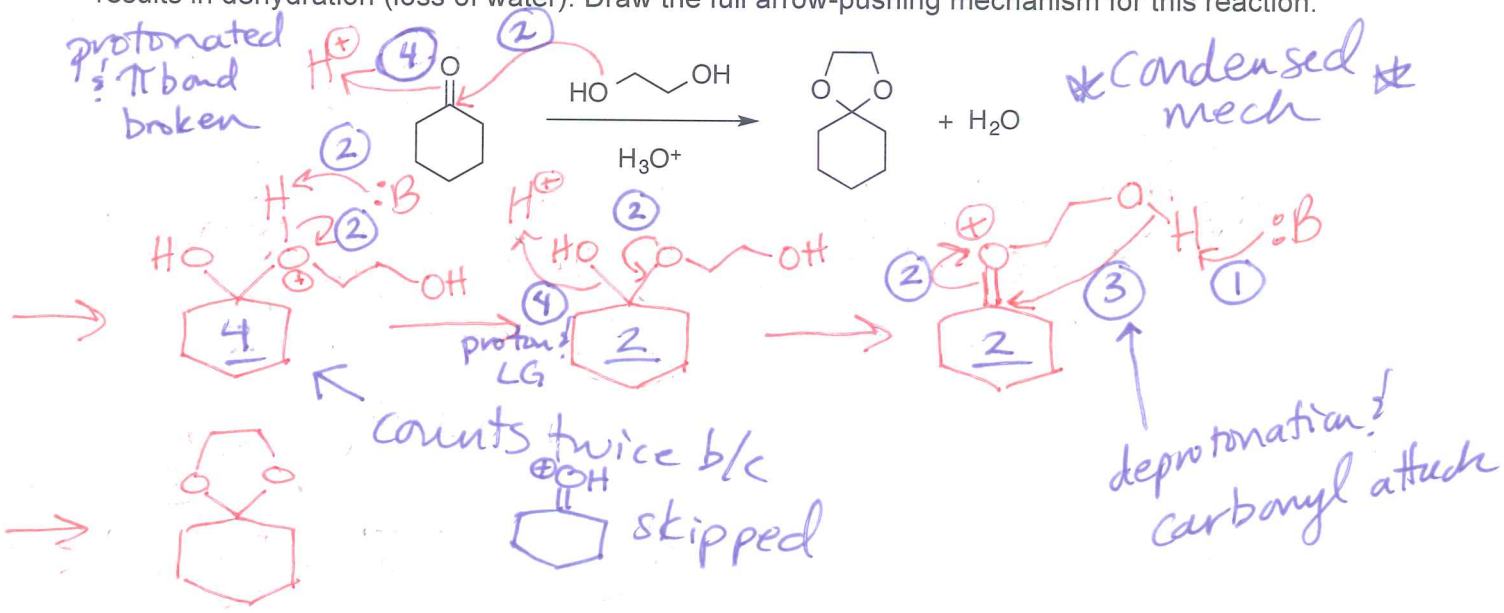
**8.** (*30 points*) **Mechanisms** – Draw the full arrow-pushing mechanism for **one of the reactions** below, including all arrows for acid-base reactions (no "PT"). Include all intermediates with proper charges circled for each step.

**CIRCLE THE REACTION TO BE GRADED. DRAW A LARGE "X" OVER THE REACTION YOU DO NOT WANT GRADED, OTHERWISE (a) WILL BE GRADED.**

**(a)** Draw the full arrow-pushing mechanism for the reduction of the **lactone** (cyclic ester) below with **lithium aluminum hydride**, followed by quenching with **acid** in a separate second step.



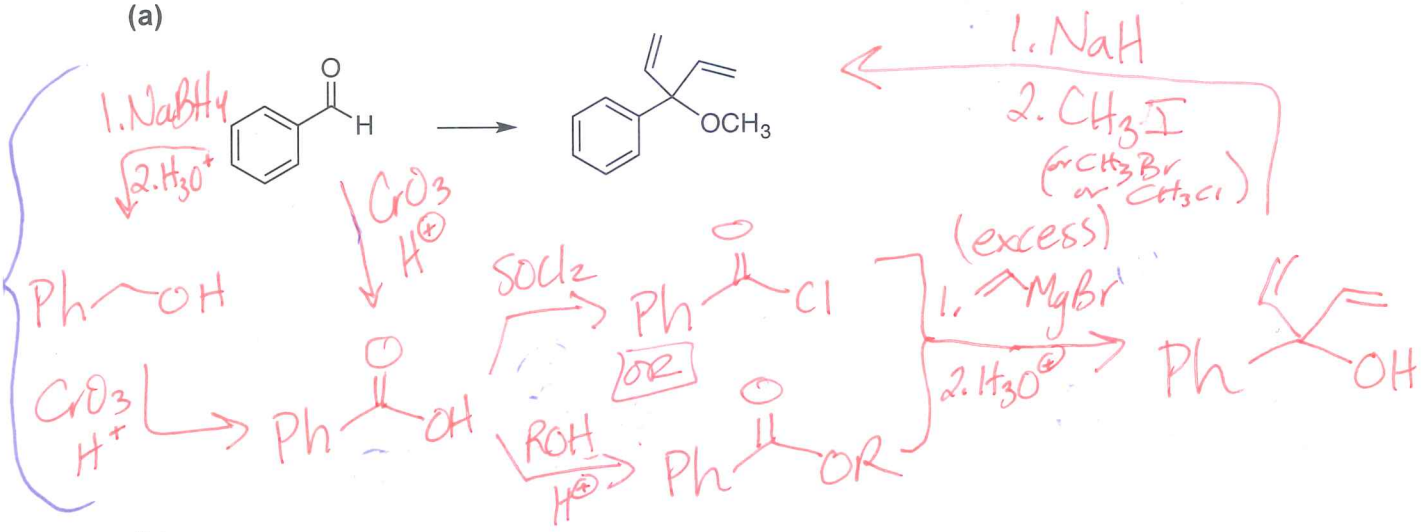

**(b)** The following **acetal** is synthesized from **cyclohexanone** and **1,2-ethanediol** under acidic condition. This mechanism takes places *via* two nucleophilic addition reactions, one of which results in dehydration (loss of water). Draw the full arrow-pushing mechanism for this reaction.



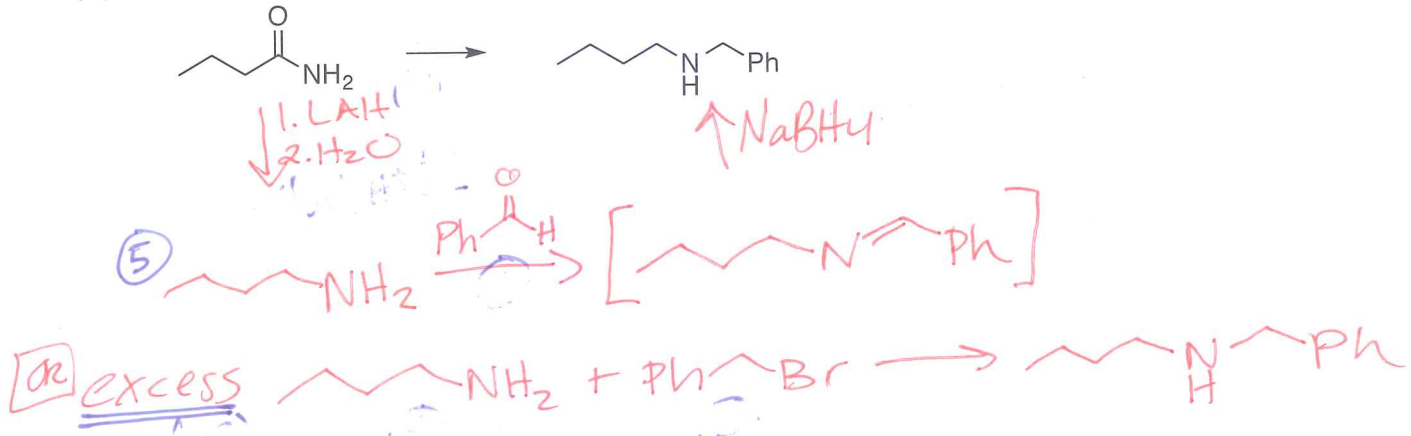
 15pts each

**9.** (*30 points*) **Multi-Step Synthesis – CHOOSE TWO**
Carry out the syntheses of the indicated target molecules using the starting material provided and any other reagents or carbon sources needed. Draw the **product after each synthetic step. No mechanisms.**

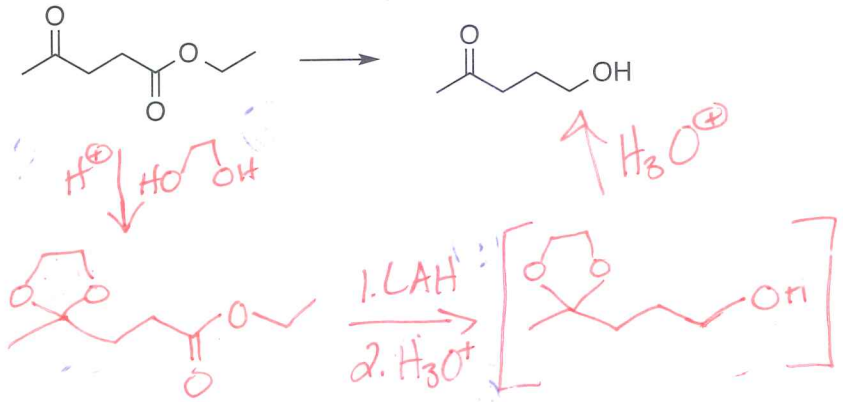
**(a)**




**(b)**




**(c)**




**PUT A LARGE "X" OVER THE ENTIRE REACTION & SPACE YOU ARE SKIPPING.**
**OTHERWISE THE TOP TWO REACTIONS WILL BE GRADED, EVEN IF THEY ARE BLANK!**