KWANTLEN UNIVERSITY COLLEGE

CHEMISTRY 2420 - R10

ORGANIC CHEMISTRY II

FINAL EXAM - April 18, 2002

NAME: _____

Time: 3 hours (180 minutes)

Budget your time carefully and good luck!!!

All the best for the future, I hope you enjoyed the course.

This paper consists of **13 pages** (**12 questions**) including this title page.

Molecular models may be used during this examination but not calculators.

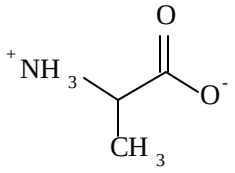
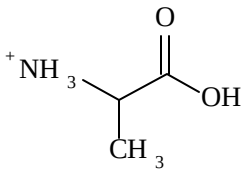
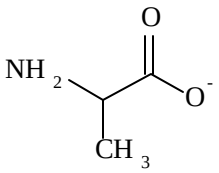
Place all your answers on this examination paper.

Grading Scheme For The Exam

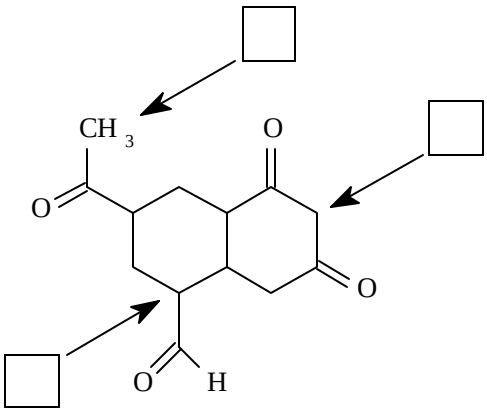
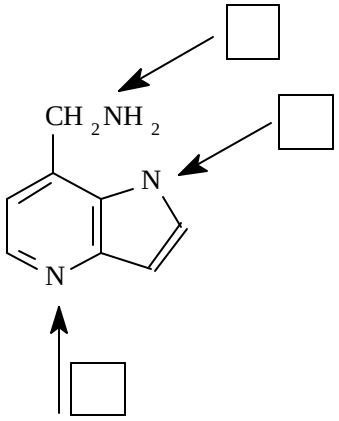
Question	1	2	3	4	5	6	7	8	9	10	11	12
Marks	15	30	8	12	20	27	23	18	18	18	12	16

Maximum	Total	Percent
217		%

Question 1. **(15 Marks)** a) In the boxes below the various forms of the amino acid alanine, place the pH (2, 6 or 12) at which the indicated structure would be the predominate form of the amino acid.

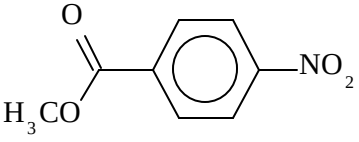
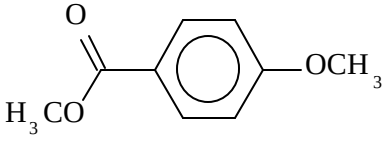
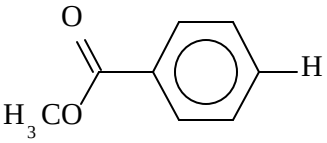




b) In the boxes place 1, 2 , 3 for the H atoms of increasing pK_a value for the compound on the left; for the structure on the right, place 1, 2 , 3 for the N atoms of increasing pK_b value. **(6)**

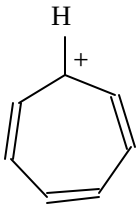
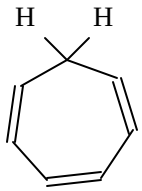
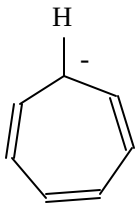



c) Circle the best answer for each of the following: **(6)**

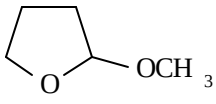
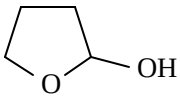
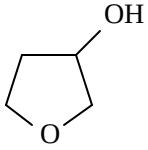
i) the compound most likely to undergo the slowest reaction with OH^-

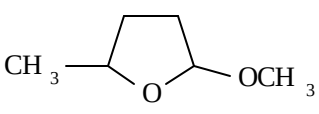
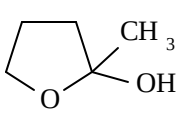
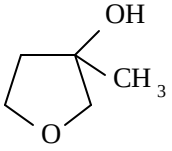
ii) the species most likely aromatic in its properties

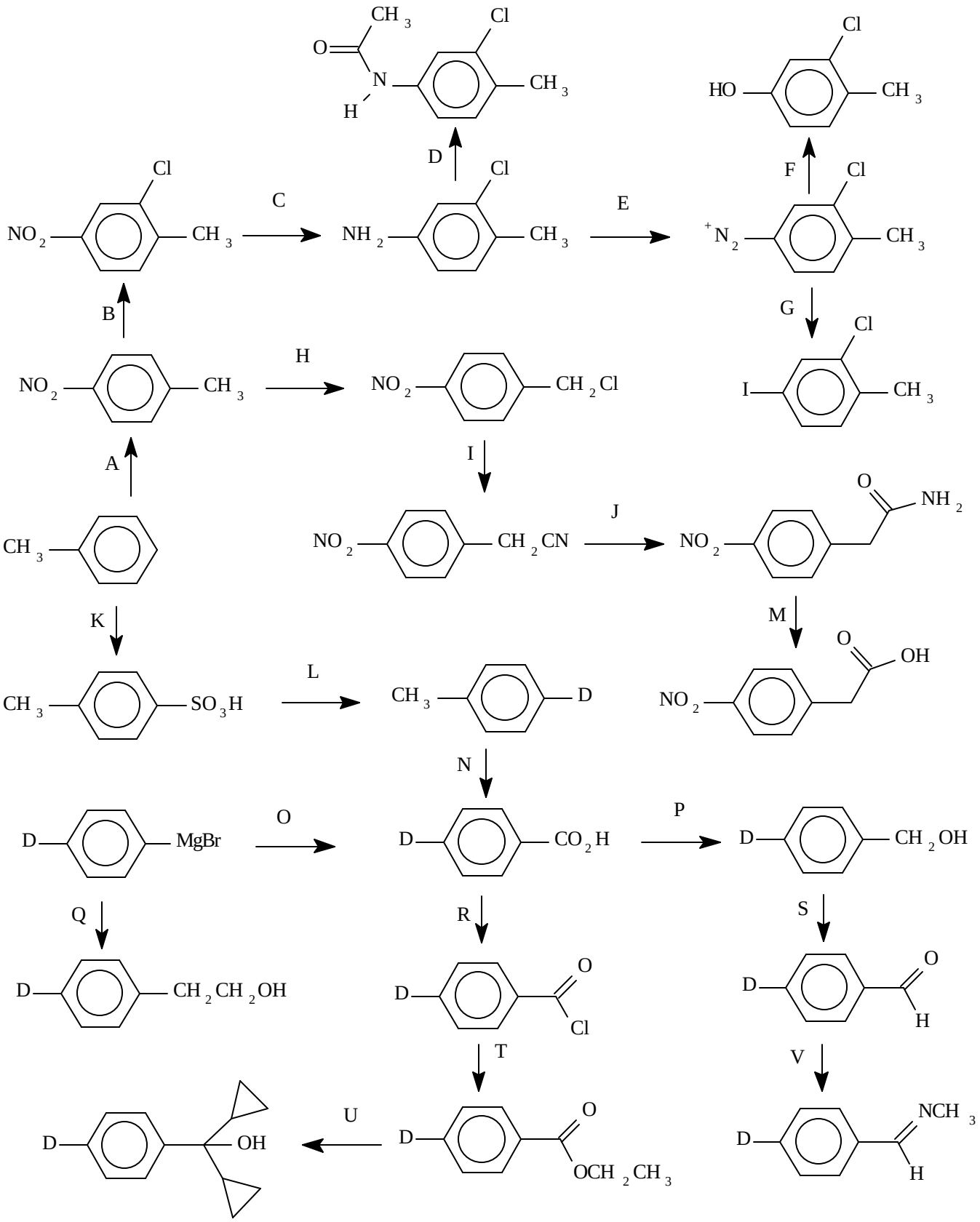
iii) the compound which would give a positive Tollens test

iv) the compound which would give a positive Iodoform test

Question 2. **(30 Marks)** Provide the identity of the unknown reagents in each of the following reactions (use the spaces provided on the next page). Indicate whether the reagents need to be used in 2 separate steps. Specify (where necessary) if acidic or basic conditions are necessary. **I'll count the best 20 of 22 answers.**


CH3
O
N
H
Cl
CH3
D
HO
CH3
Cl
F
Cl
NO2
CH3
C
NH2
CH3
E
+N2
CH3
G
B
Cl
NO2
CH3
H
NO2
CH2Cl
I
A
I
CH3
NO2
CH2CN
J
O
NH2
NO2
K
M
CH3
SO3H
L
CH3
D
O
OH
NO2
N
D
MgBr
O
D
CO2H
P
D
CH2OH
Q
R
S
D
CH2CH2OH
D
O
Cl
D
O
H
T
V
D
OH
U
D
O
OCH2CH3
D
NCH3
H

A: _____ B: _____ C: _____ D: _____

E: _____ F: _____ G: _____ H: _____

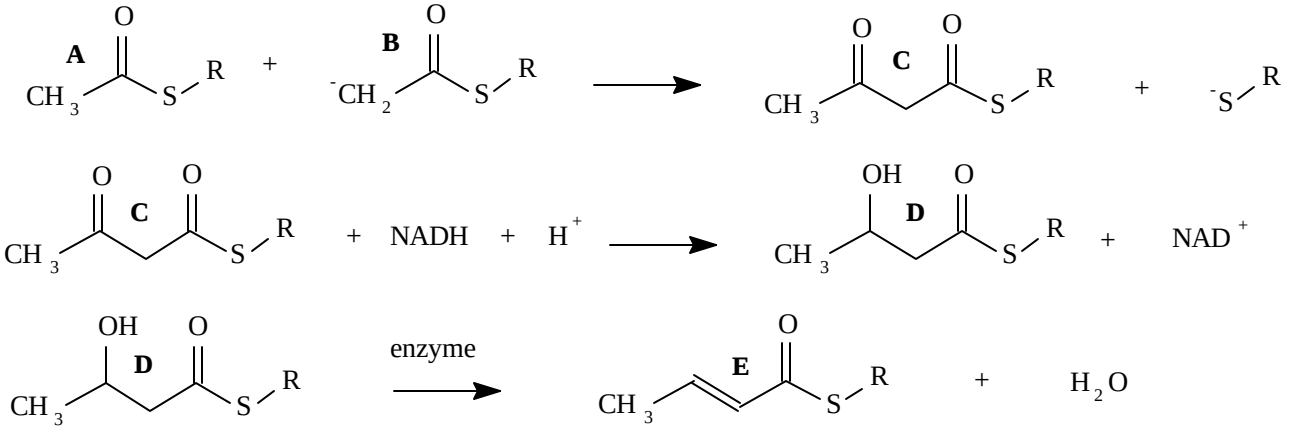
I: _____ J: _____ K: _____ L: _____

M: _____ N: _____ O: _____ P: _____

Q: _____ R: _____ S: _____ T: _____

U: _____ V: _____

Question 3. (8 Marks) Many of the reaction mechanisms that you have seen in **Chemistry 2320/2420** are the same ones found when biological chemical processes occur. The following reactions are important in the biosynthesis of fatty acids.



Choose the best answer for each of the following questions.

i) B is best described as a(n): **enol of a thioketone** **thioacetal** **enolate of a thioester**

ii) The process A + B --> C is best described as:
Aldol Condensation **Claisen Condensation** **S_N2 Substitution**

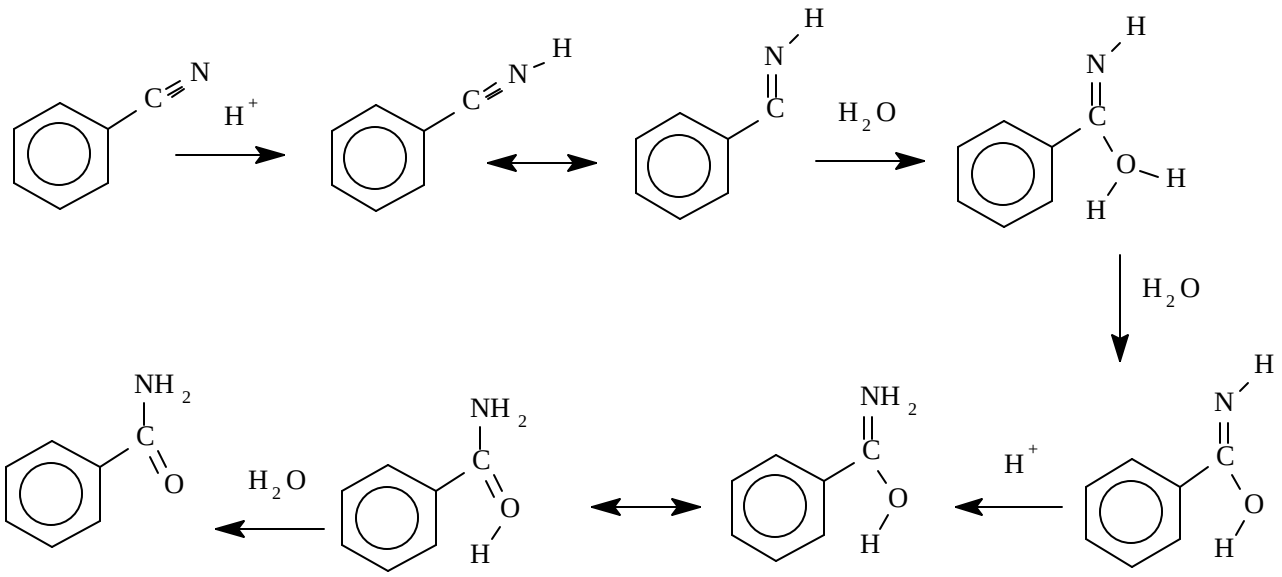
iii) In the process C --> D, compound C is being **{ oxidized / reduced / hydrated }** and NADH is acting as the **{ reducing / oxidizing / hydrating }** agent.

iv) The process D --> E is best described as a **{ dehydration / dehydrogenation / enolization }** and the most likely mechanism would be **{ elimination / substitution / rearrangement }**.

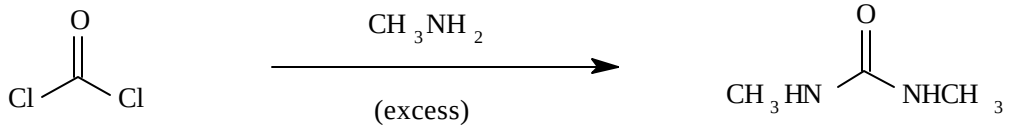
v) The process E --> D requires a different enzyme and would be best described as a **{ 1,2 / 1,3 / 1,4 }** **{ nucleophilic / electrophilic / radical }** addition of water to the α,β-unsaturated compound E.

Question 4. **(12 Marks)** This question deals with the wonderful world of arrows!!

a) Provide the necessary reaction arrows / charges / lone pairs of electrons in the following mechanism involving the conversion of a nitrile to an amide.

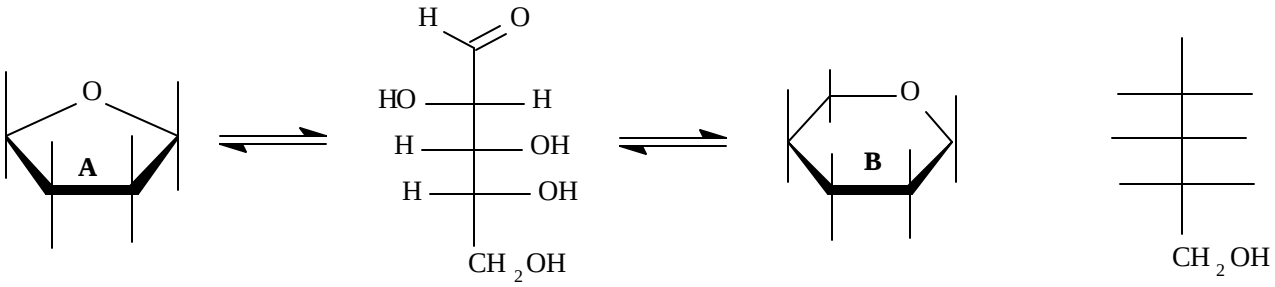


b) Supply a plausible mechanism for the following process. Indicate the flow of electrons using arrows and include all protonations and deprotonations. Provide any pertinent lone pairs of electrons and the location of any charges. Write resonance structures for any appropriate intermediates. Provide the structure of the other substance produced in the reaction.



Question 5. (20 Marks)

a) Complete the Haworth structures for two of the cyclic compounds A and B which are in equilibrium in an aqueous solution of the monosaccharide D-arabinose. Complete the Fischer Projection formula on the right for L-arabinose. **(4)**



D-arabinose L-arabinose

b) The structure in (a) which is a furanose is: **(1)** **A** **B**

c) The monosaccharide which is epimeric to D-arabinose at C#4 contains **{ 2 / 3 / 4 }** stereogenic carbon atoms and is best described as a(n): **{ D / L } { chiral / achiral } { non-reducing / reducing } { aldo / keto } { pentose / hexose }**. This monosaccharide would **{ undergo / not undergo }** mutarotation and would give a **{ positive / negative }** Tollens test. **(4)**

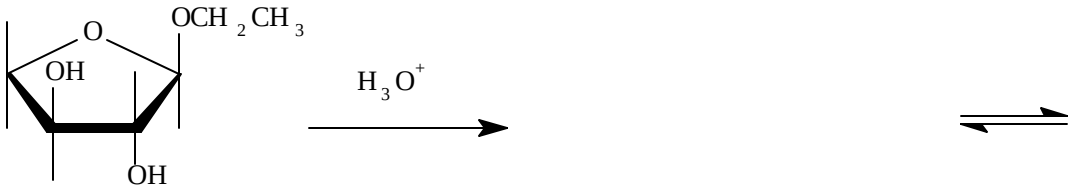
d) When D-arabinose is subjected to the series of reactions involved in the Kiliani-Fischer synthesis, two new monosaccharides (C and D) are isolated. Provide the Fischer Projection formulas below for monosaccharides (C and D) as well as the product from the HNO_3 reaction of compound C and the $NaBH_4$ reaction (after acidic workup) with compound D. **(6)**

HNO_3 product compound C compound D $NaBH_4$ product

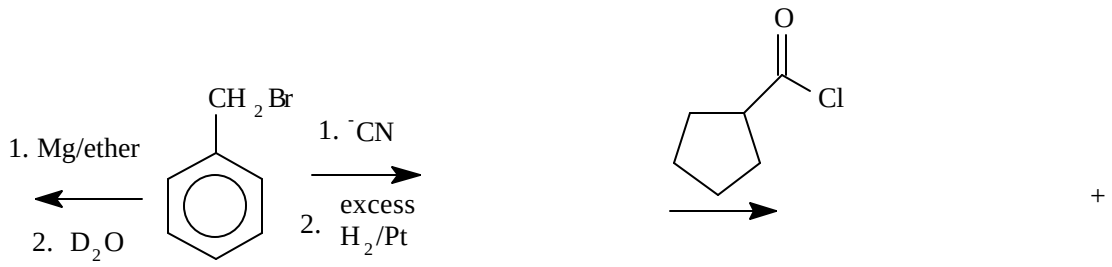
The HNO_3 product is an: **aldonic acid** **aldaric acid** **uronic acid** **alditol** **(1)**

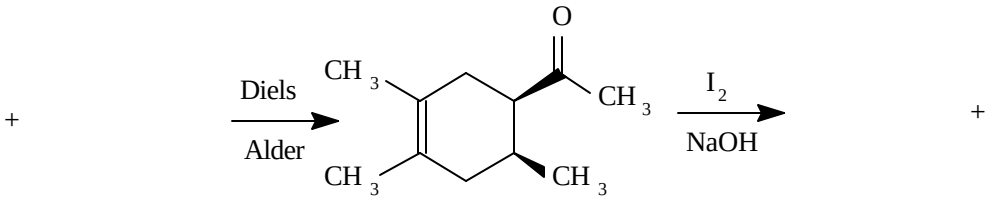
The $NaBH_4$ product is an: **aldonic acid** **aldaric acid** **uronic acid** **alditol** **(1)**

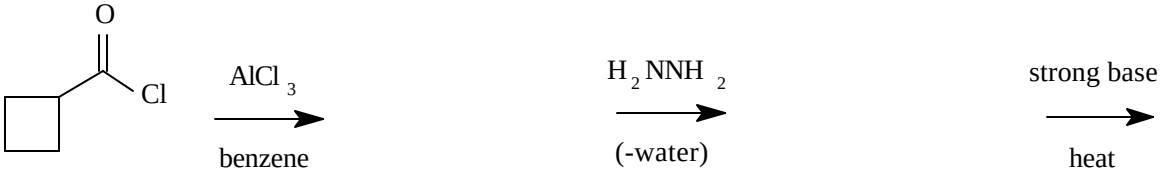
e) Give the Haworth and Fischer Projection formula of the monosaccharide formed from: **(3)**



Question 6. (27 Marks) Provide the structures of the organic compounds involved in the following sequences of reactions. **I'll count the best 18 of 20 answers.**

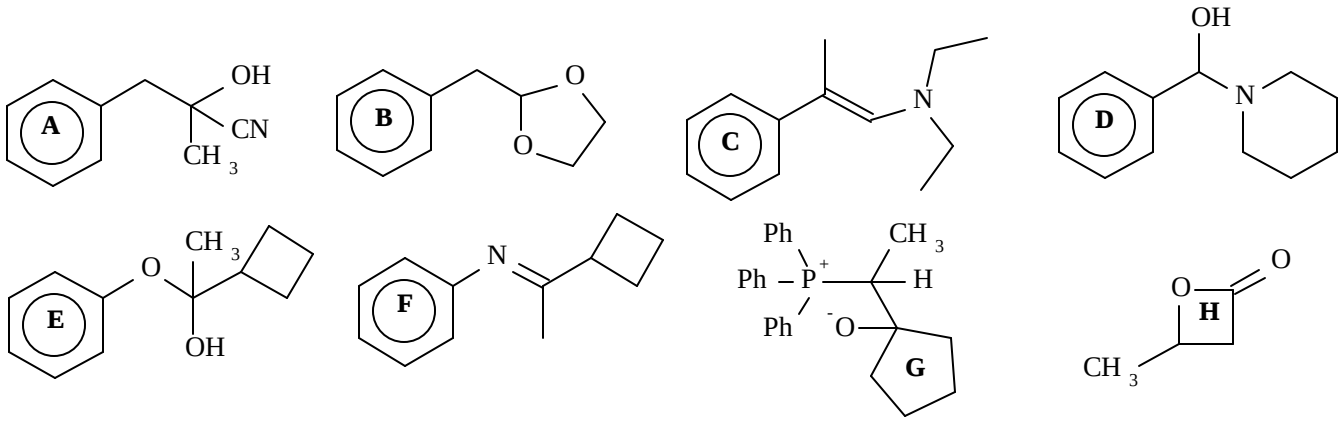






Question 7. (23 Marks) As you have seen during the past 14 weeks, the chemistry of the C=O group makes a very interesting story. Match the following structures with the correct term.

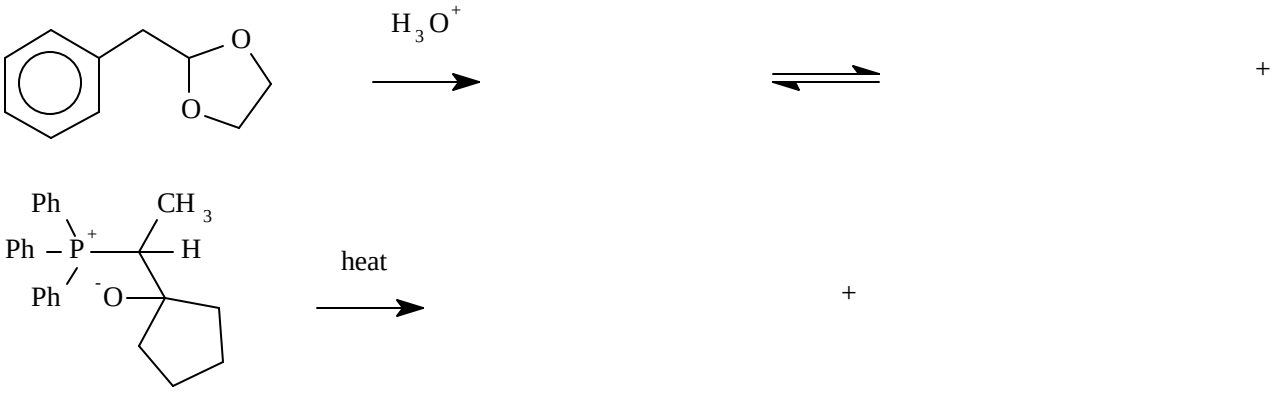
NOTE: There are more terms than structures!! (8)

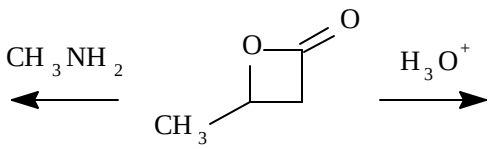


Ketal ___ Acetal ___ Hemiketal ___ Hemiacetal ___ Imine ___ Enamine ___

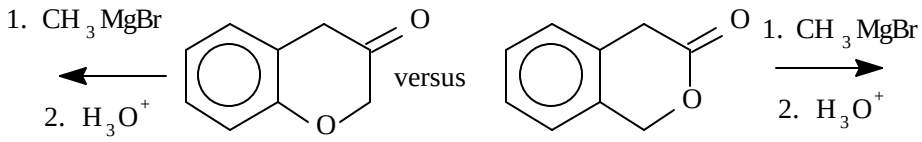
Ylid ___ Betaine ___ Lactam ___ Lactone ___ Carbinolamine ___ Cyanohydrin ___

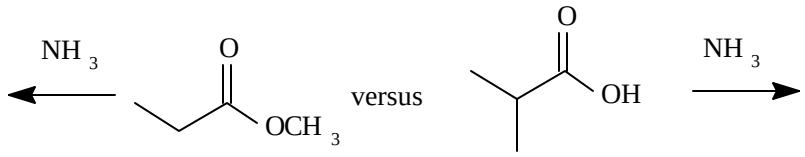
Provide the structure of all organic compounds formed in each of the following reactions. **(15)**

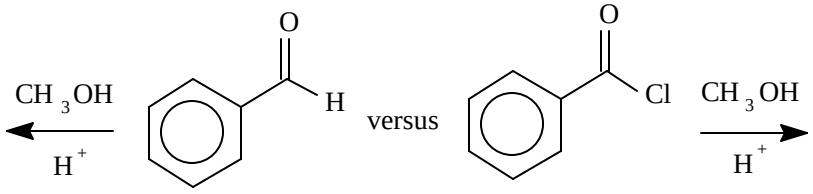


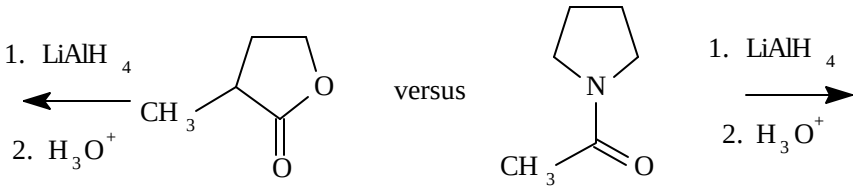


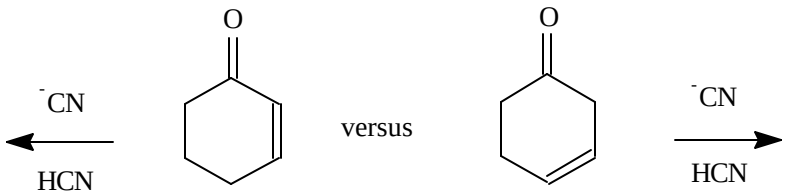
Question 8. (18 Marks) Making a small change in the structure of the starting material can result in a significant change in the structure of the products isolated in a chemical reaction. Provide the structures of the expected carbon-containing products in the following reactions. You may assume that you have **as much reagent as necessary to make the reactions go to completion.**

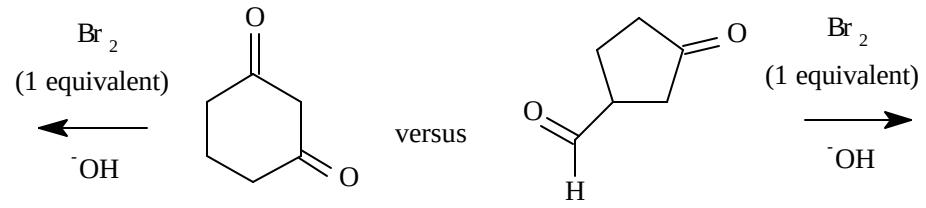






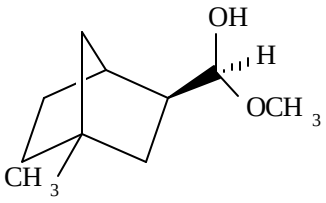




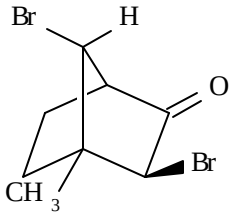


Question 9. (18 Marks) Provide a brief description of what each term means, and then provide another structure to illustrate your description. **I'll count the best 6 of 7 answers.**

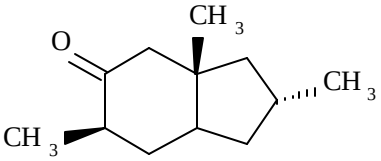
a) Anomers



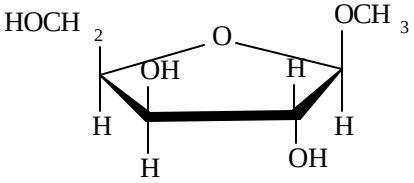
b) Diastereomers (not epimers)



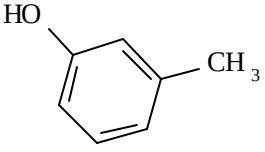
c) Epimers



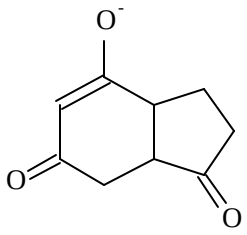
d) Enantiomers



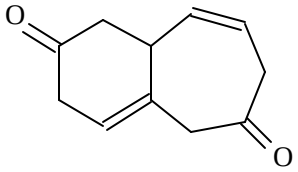
e) Tautomers



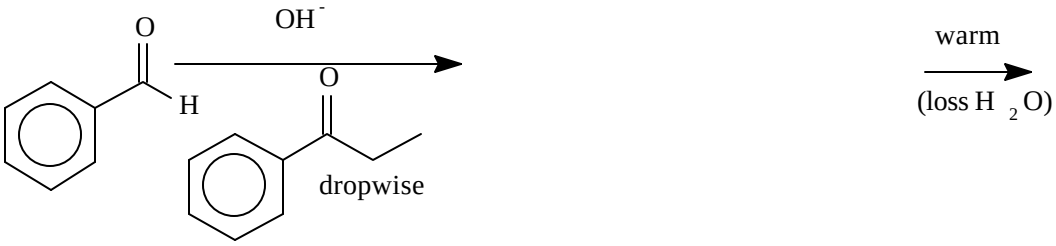
f) Resonance Structures

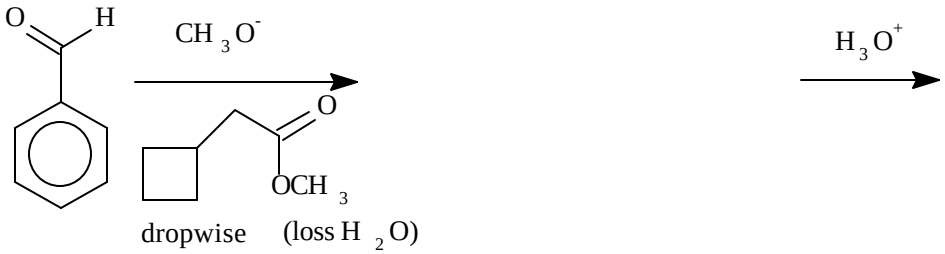


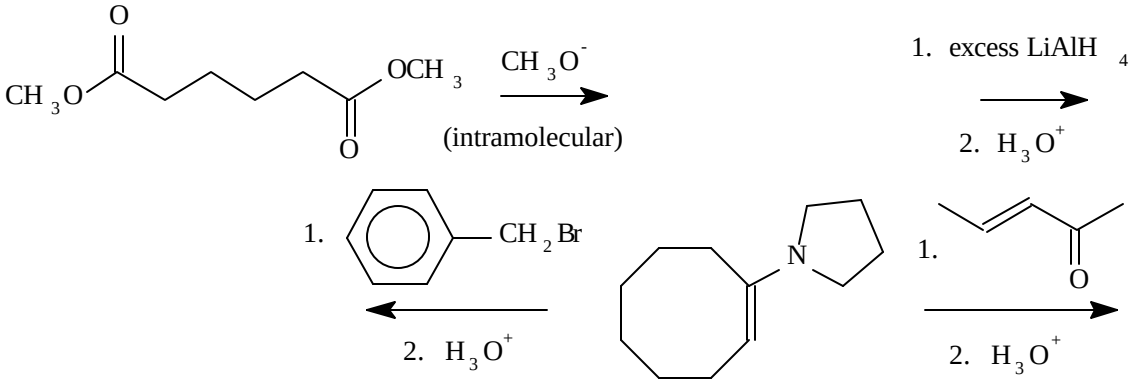
g) Conjugated Compound



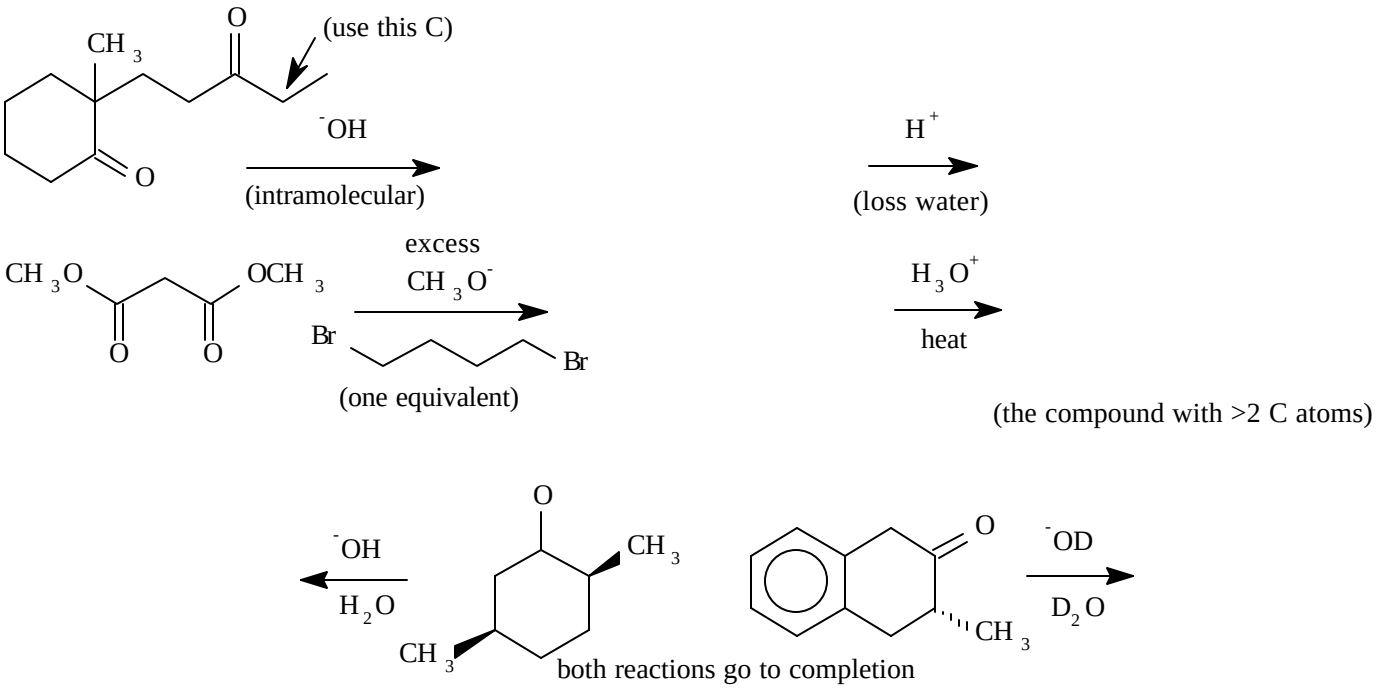
Question 10. (18 Marks) Provide the structure of the compounds formed in the following enolate reactions. **I'll count the best 12 of 14 answers.**







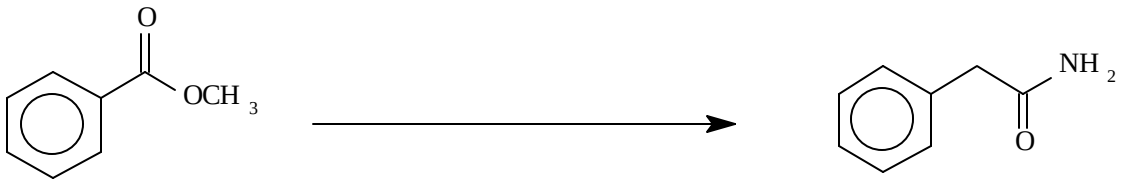
for these 2 reactions I only want
the product that doesn't contain N



both reactions go to completion

specify any pertinent stereochemistry in the products

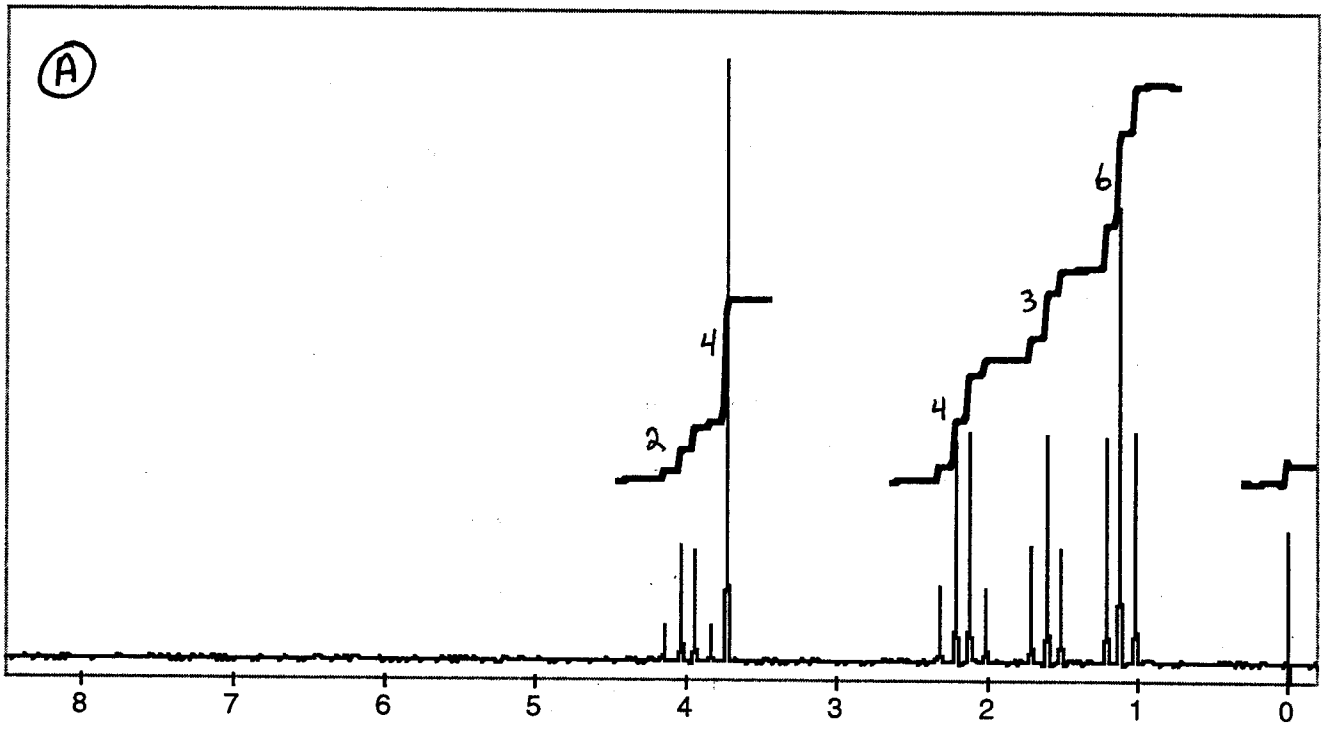
Question 11. (12 Marks) Provide a possible sequence of reactions for each of the following transformations. Make certain to show the structure of the major product isolated after each step.

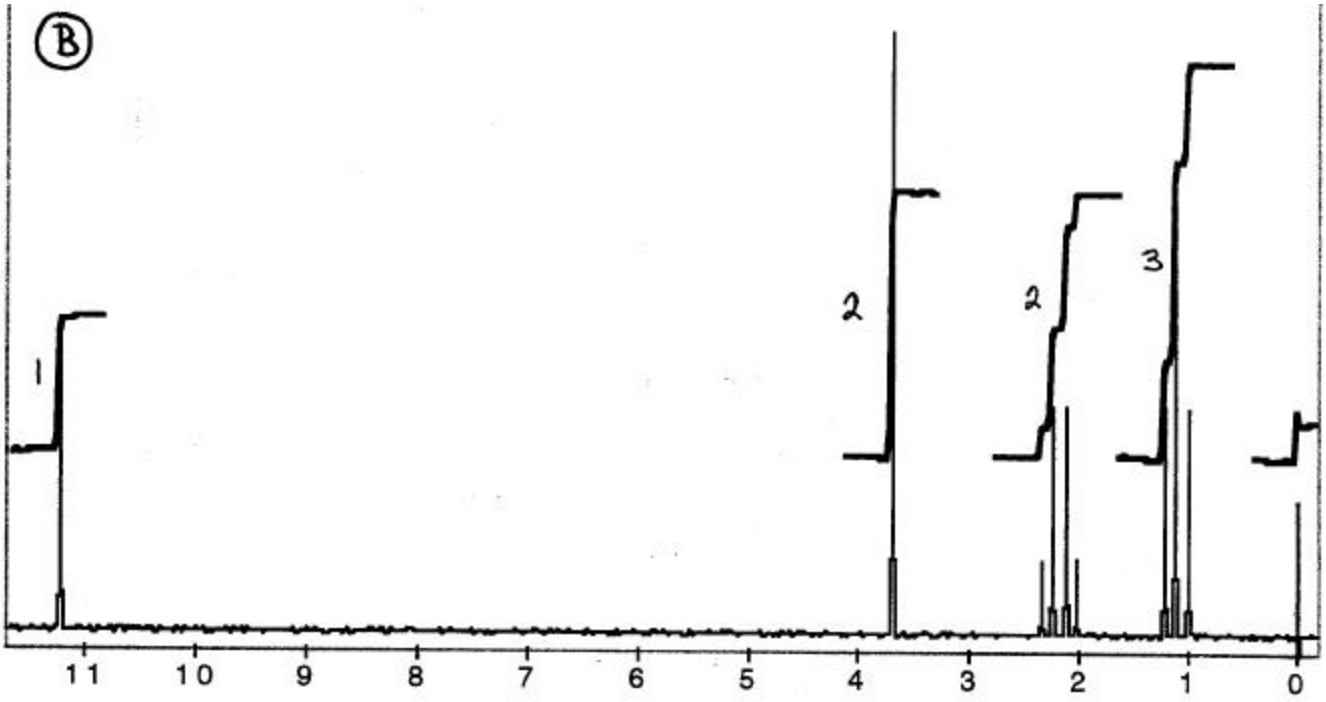


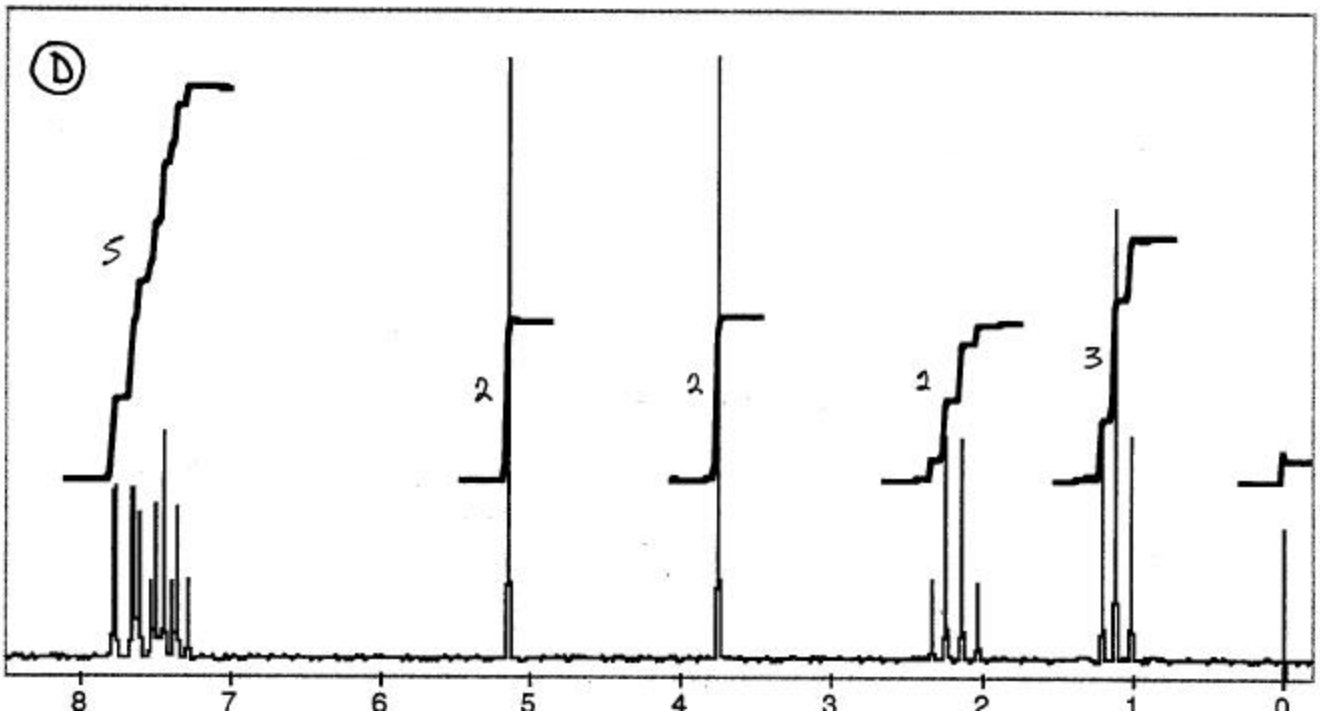
Question 12. (16 Marks) That wacky CHEM 2420 graduate I.M. Smart is in trouble at ACME Pharaceuticals again. He has been given the task of identifying some compounds left behind by a former research chemist. Compound A ($C_{11}H_{19}NO_2$, strong IR band at ~1700 cm^{-1}, ^1H NMR provided below) has been be isolated from a reaction sequence. Compound B ($C_9H_{16}O_4$, strong IR band at ~1700 cm^{-1}, broad IR band from 2800 cm^{-1} to 3300 cm^{-1}, ^1H NMR provided below) was isolated from the acidic hydrolysis of compound A. Treatment of the aqueous filtrate from the conversion of compound A to B with NaOH(aq) resulted in the formation of compound C (C_2H_7N) which had a strong fishy aroma. Treatment of compound B with benzyl alcohol (C_6H_5-CH_2OH) in the presence of a catalytic amount of concentrated H_2SO_4 resulted in the formation of compound D ($C_{23}H_{28}O_4$, strong IR band at ~1700 cm^{-1}, ^1H NMR provided below). Help I.M. Smart out by providing the structures of A, B, C and D.

A: _____ B: _____

C: _____ D: _____




B
1
2
2
3
11
10
9
8
7
6
5
4
3
2
1
0


D
5
2
2
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3
8
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