

Chemistry Department

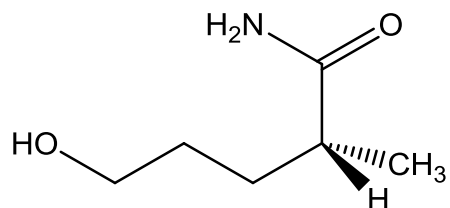
University of Alberta

CHEM 263  
Final Exam

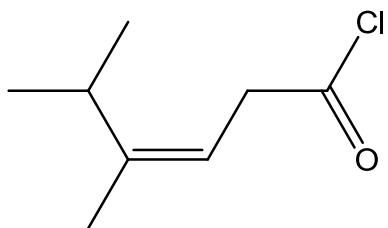
April 21, 2010

1. Name five (5) of the following structures: (15 points)

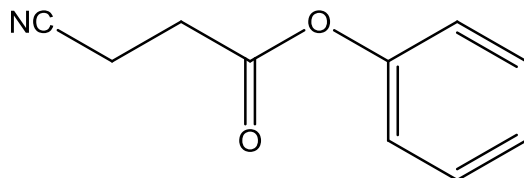
a.

**(R)-5-hydroxy-2-methylpentanamide**

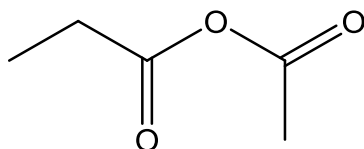
b.

**(Z)-4,5-dimethyl-3-hexenoyl chloride**

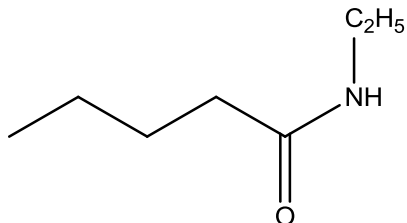
c.

**phenyl 3-cyanopropanoate**

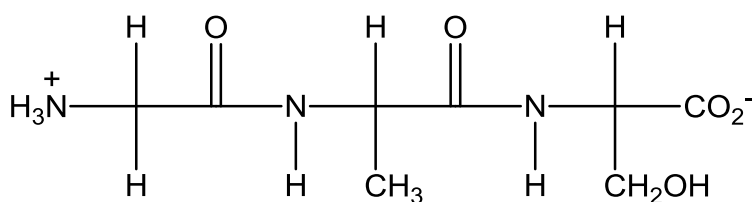
d.



e.

*N*-ethylpentanamide

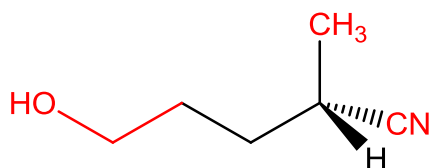
f.



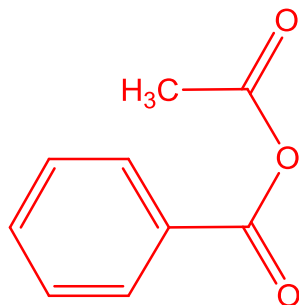
glycylalanylserine

2. Give the structural formula of five (5) of the following compounds. Where given, complete the partial structures: (15 points)

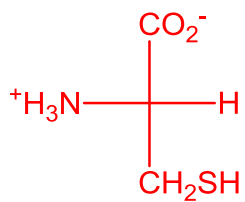
a. (S)-5-hydroxy-2-methylpentanenitrile



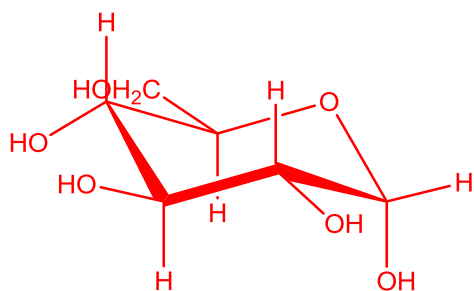
b. acetic benzoic anhydride



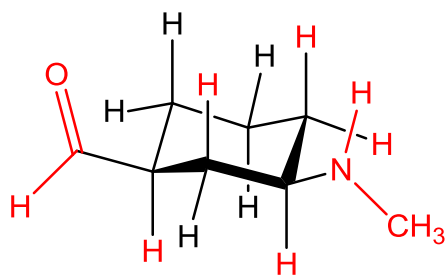
c. L-Cysteine (as a zwitterion)



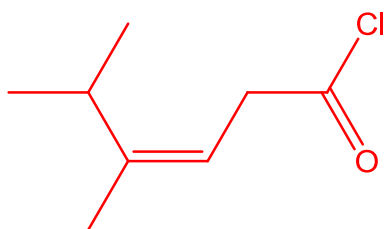
d.  $\alpha$ -D-glucopyranose



e. *cis*-3-methylaminocyclohexancarbaldehyde

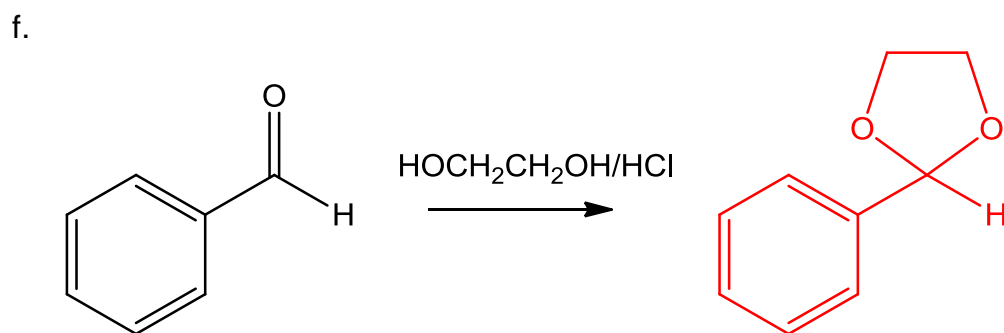
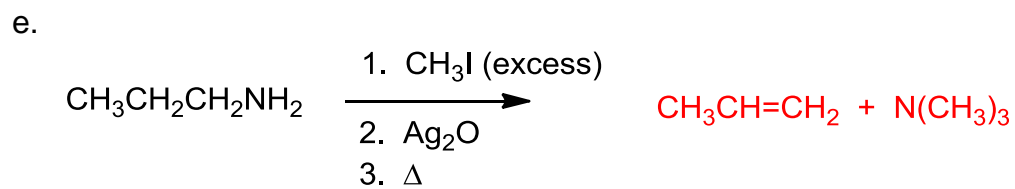
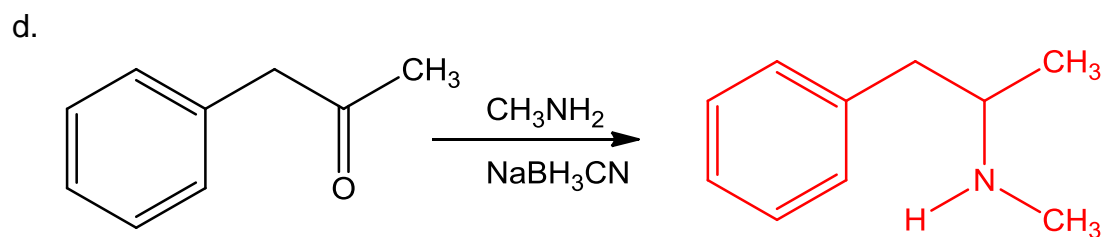
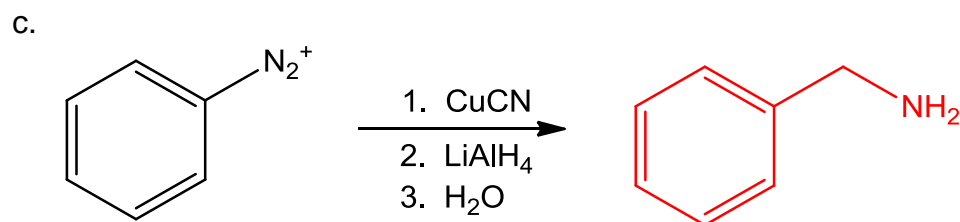
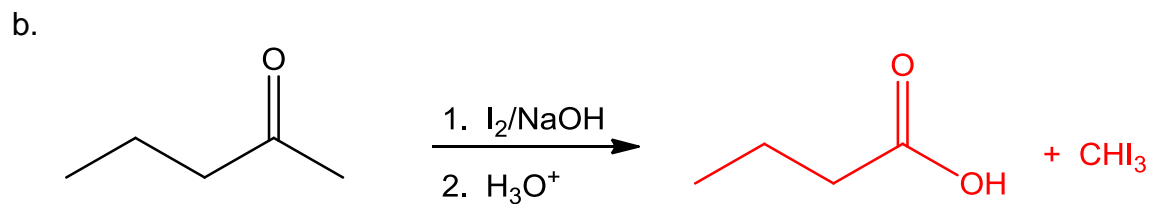
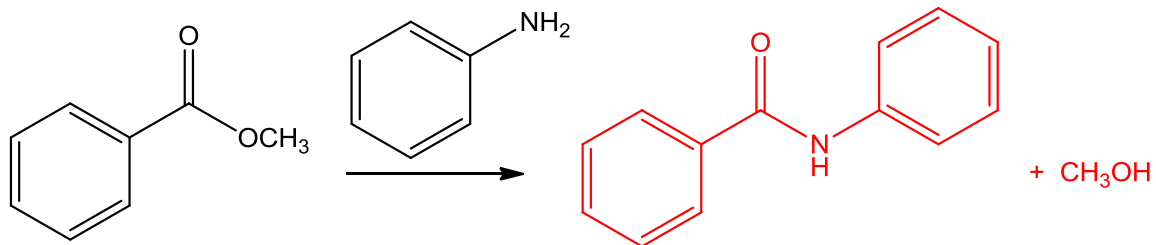


f. (Z)-4,5-dimethyl-3-hexenoyl chloride

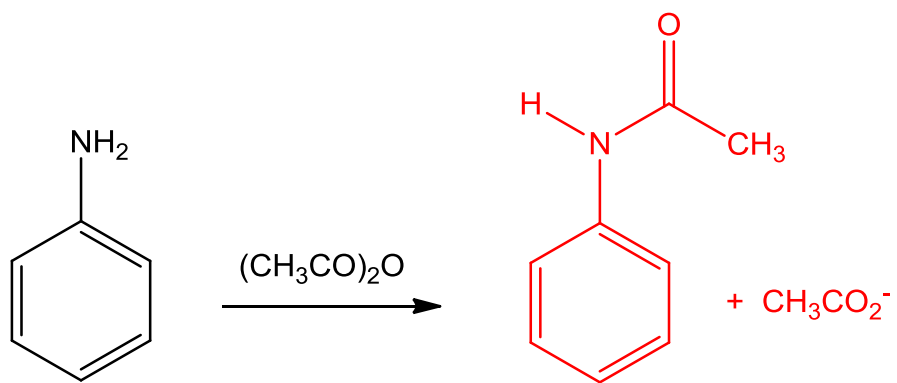


3. Give the structure(s) of the principle organic products of ten (10) of the following reactions: (30 points)

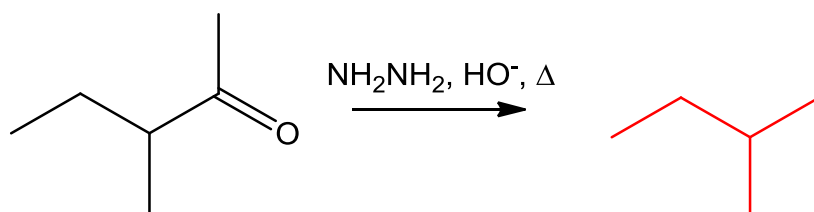
a.



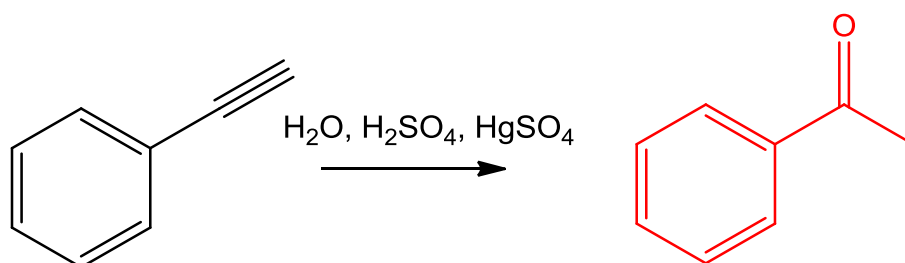
g.



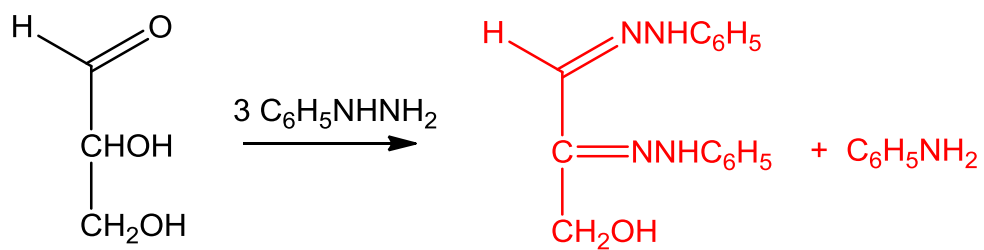
h.



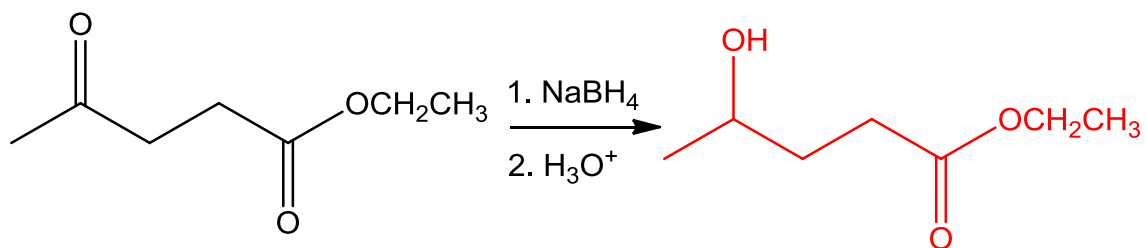
i.



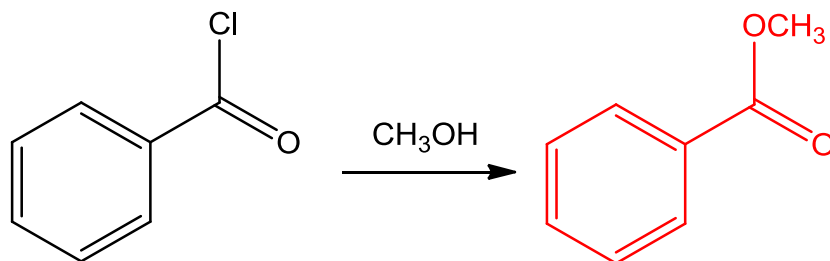
j.



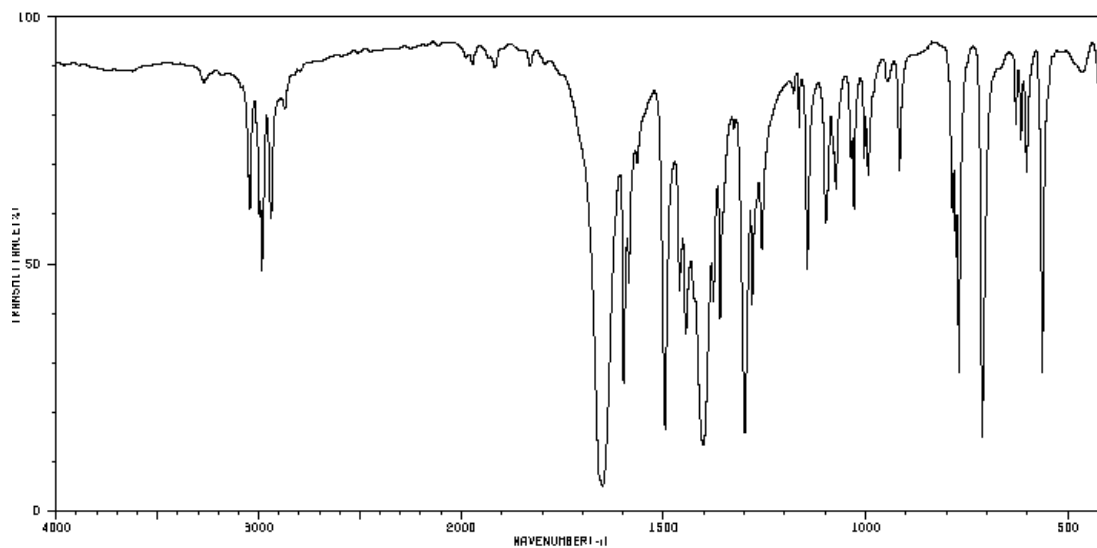
k.

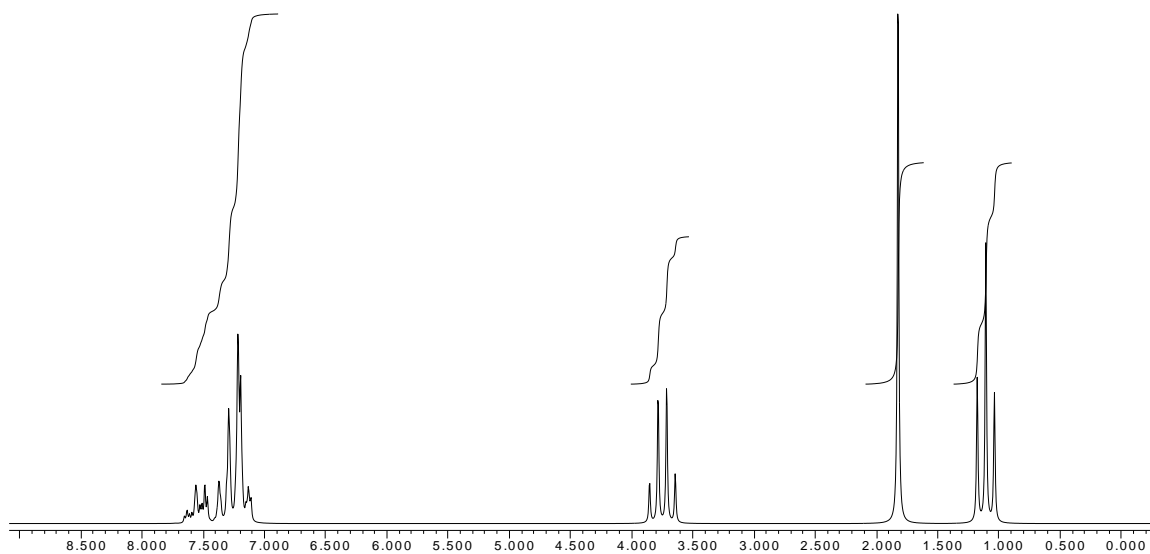


I.



4. The IR and <sup>1</sup>H NMR spectra of a compound of molecular formula C<sub>10</sub>H<sub>13</sub>NO are given below.





a. Calculate the degree of unsaturation. (1 point)

$$(2 \times 10 + 1 - 13 + 2)/2 = 5$$

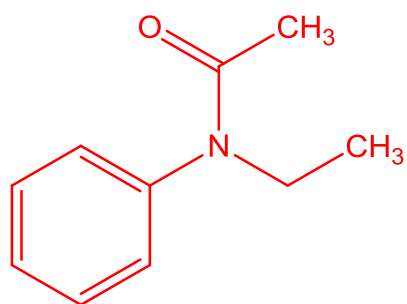
b. List the possible non-hydrocarbon functional groups using the molecular formula and your calculated degree of unsaturation. (2 points)

Alcohol  
Aldehyde  
Ether  
Ketone  
Phenol  
Amide  
Nitrile  
Primary amine  
Secondary amine  
Tertiary amine

c. What are the functional groups listed in your answer to part "b" that the IR spectrum does not show to be absent in the unknown? (1 point)

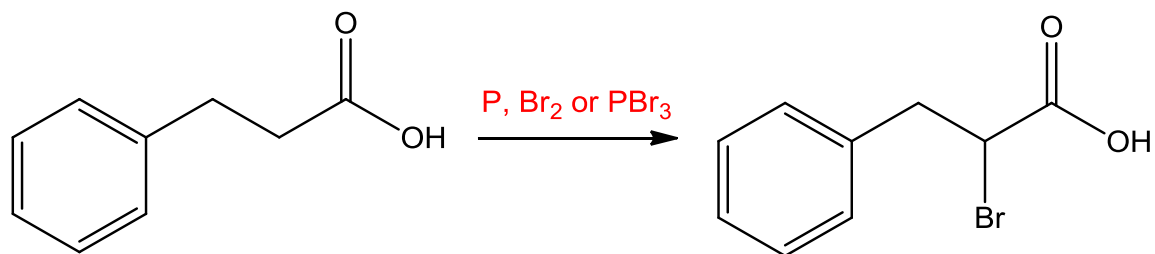
Ketone  
Amide  
Tertiary amine

d. Draw a table that lists chemical shifts and multiplicity. Then propose a structure for this compound. (11 points)

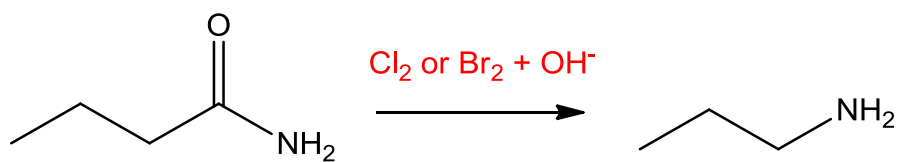


5. What reagent(s) would you use to effect ten (10) of the following conversions? (30 points)

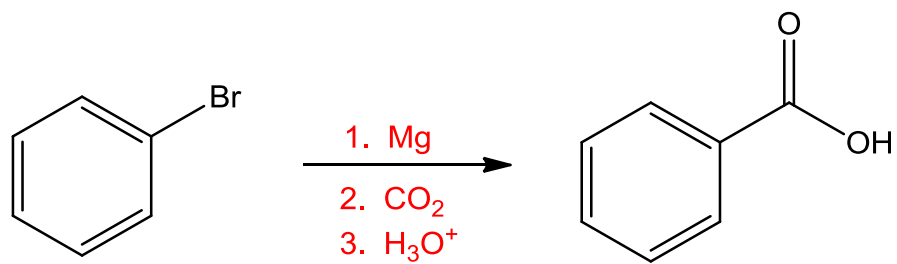
a.



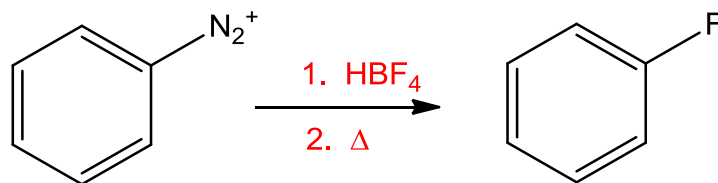
b.

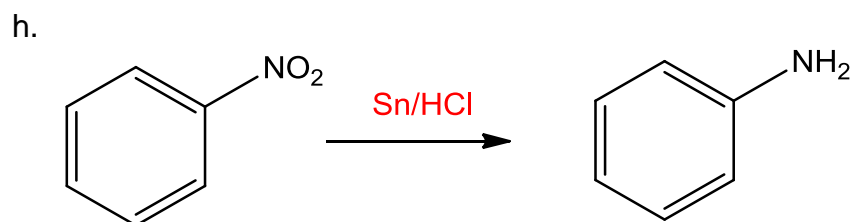
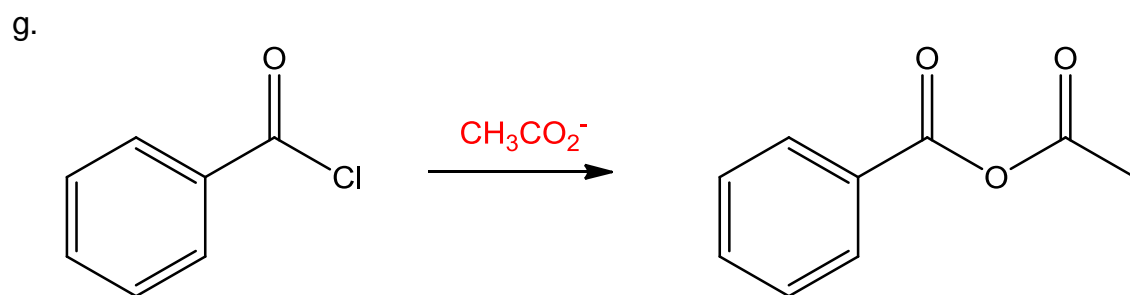
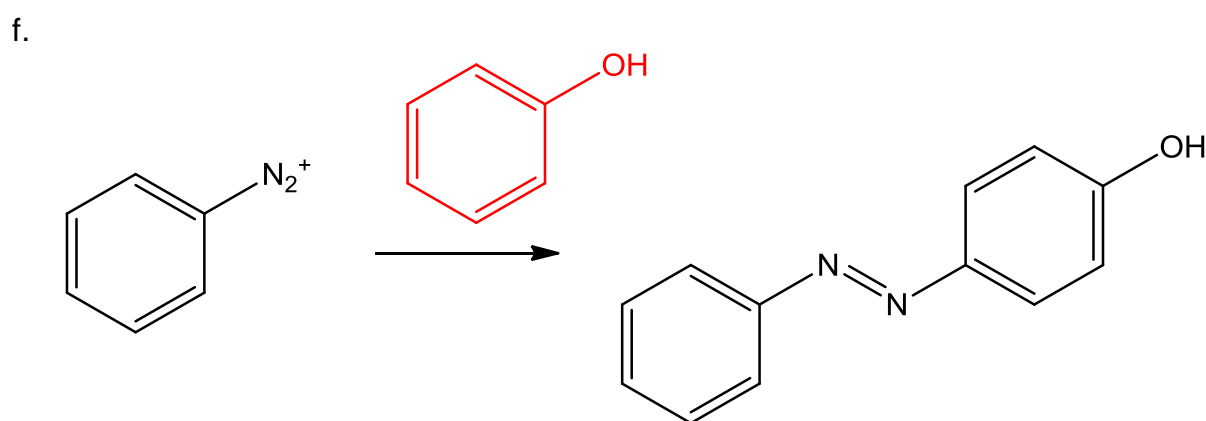
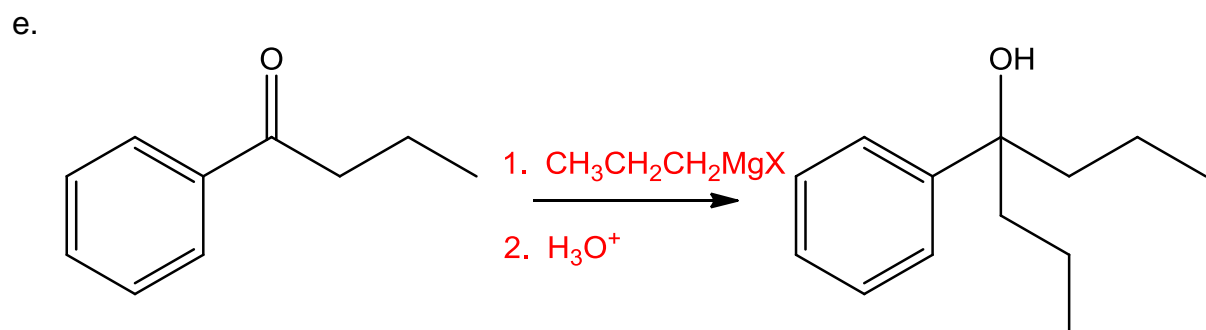


c.

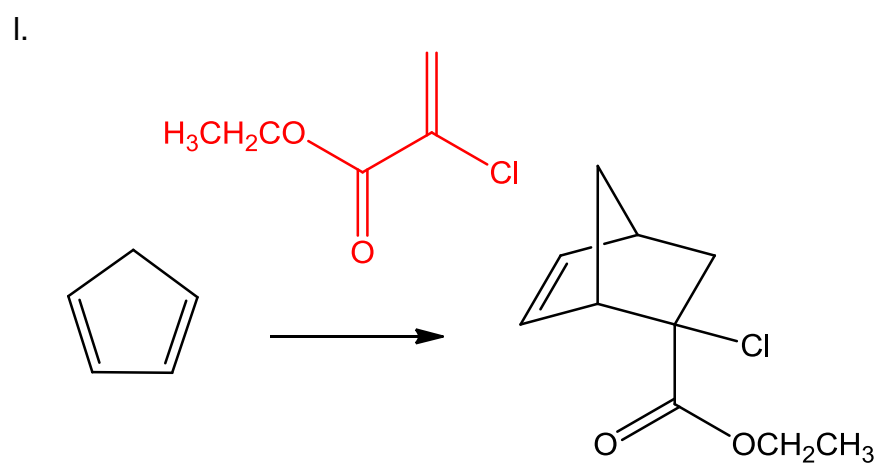
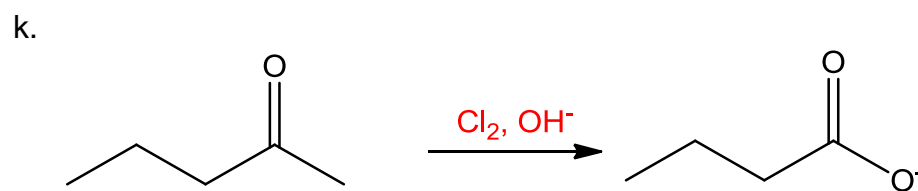
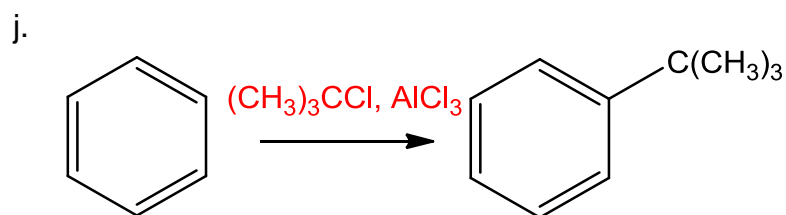
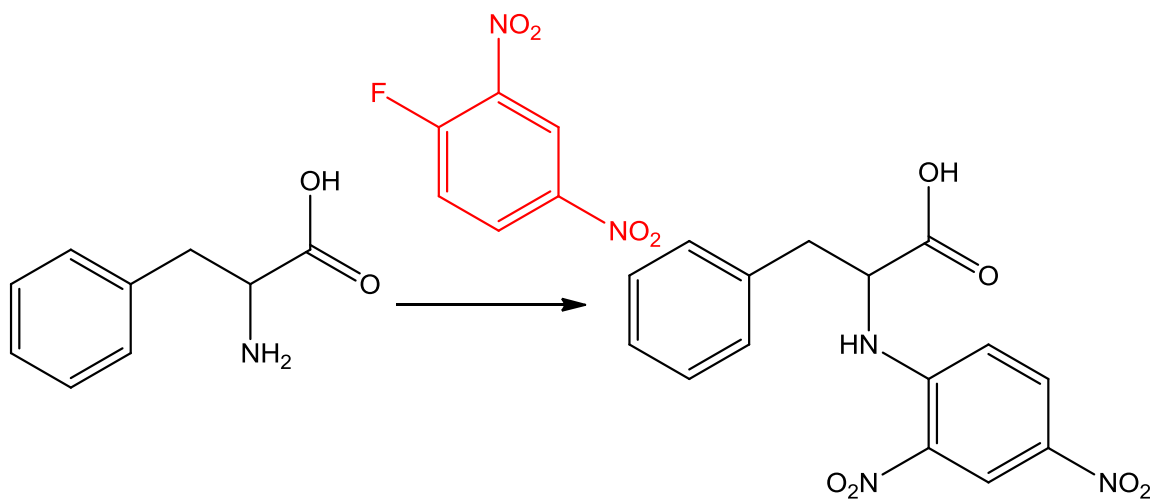


d.



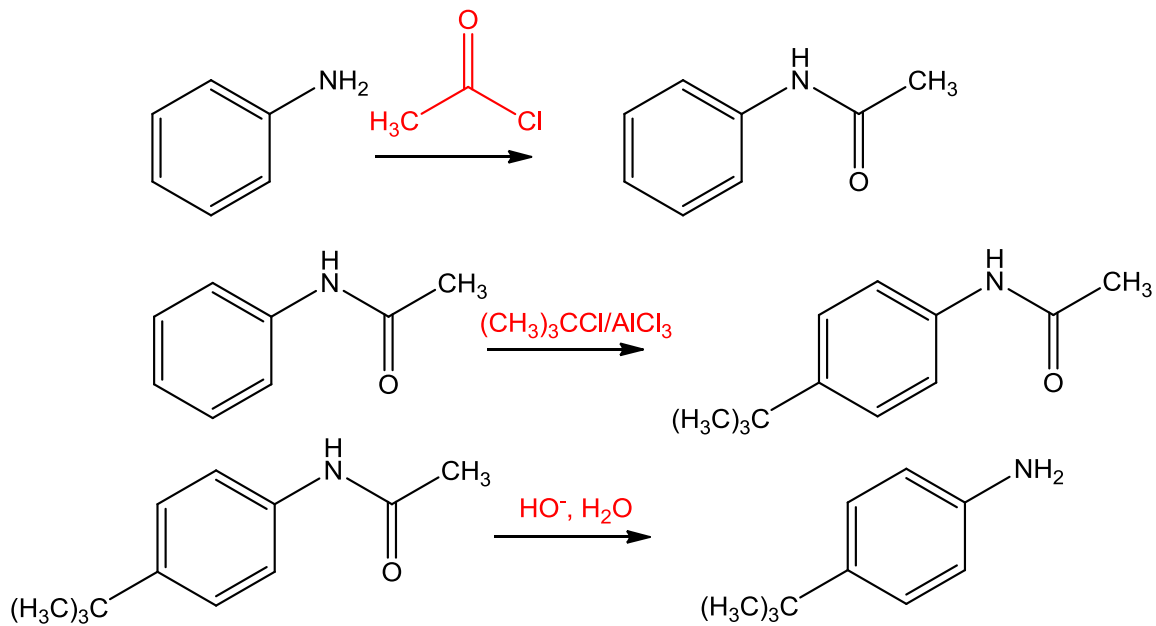


i.

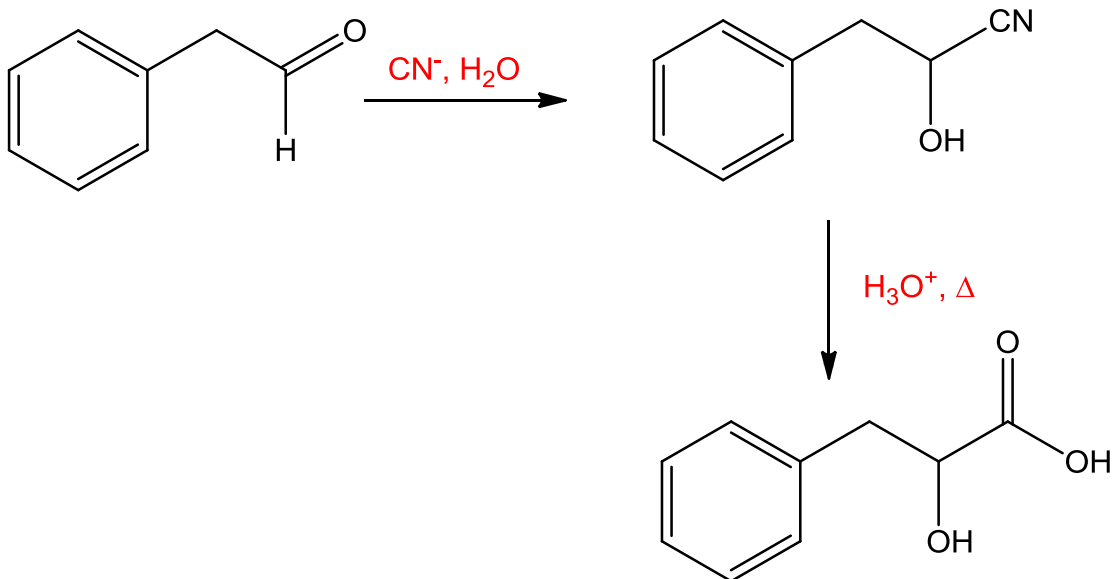
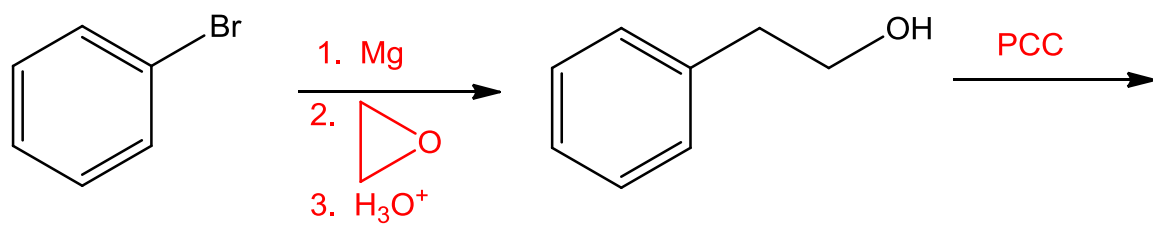


6. Provide synthetic pathways for three (3) of the following transformations (30 points):

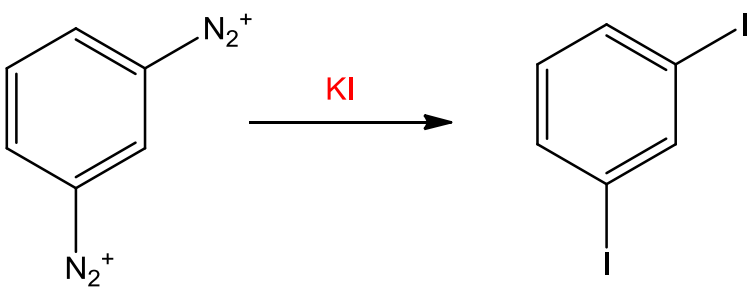
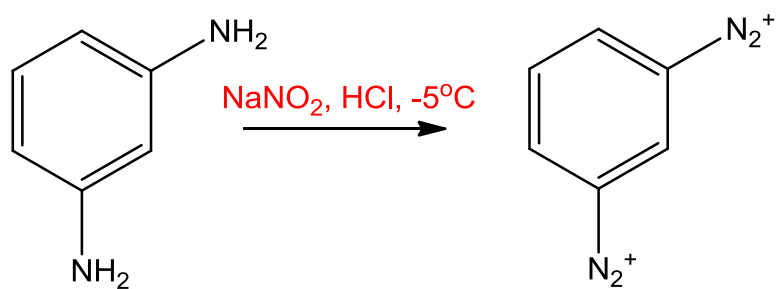
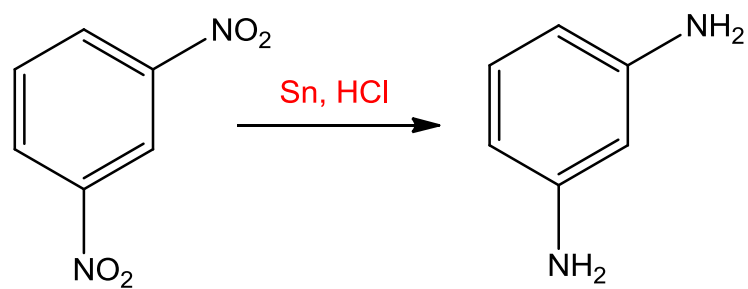
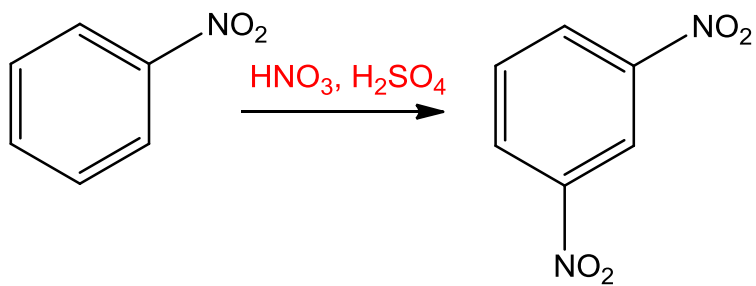
a.



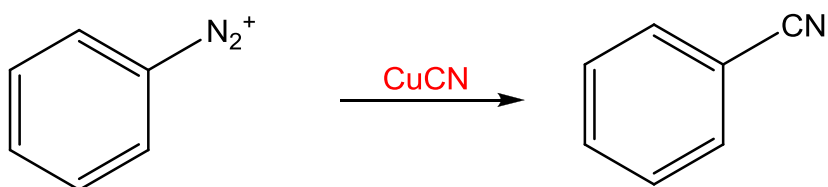
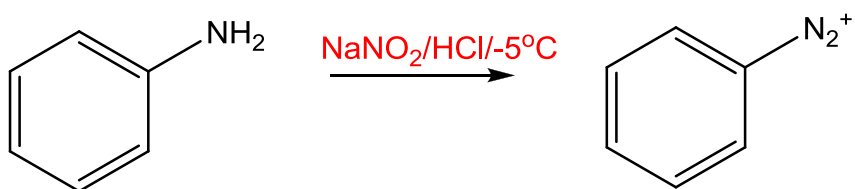
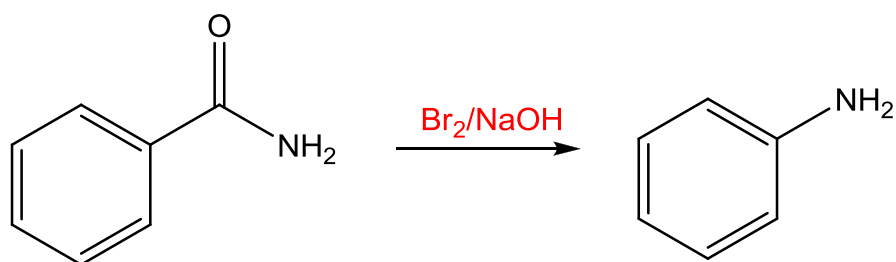
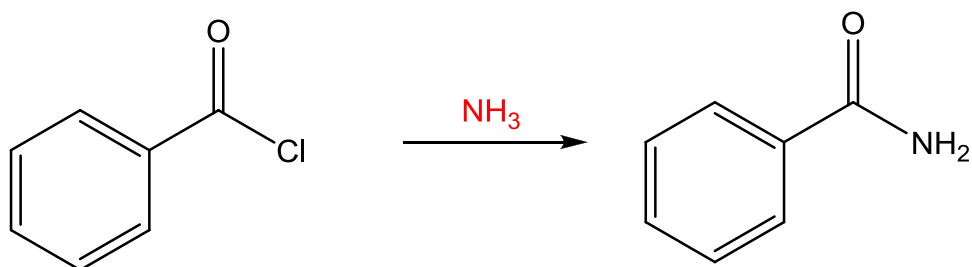
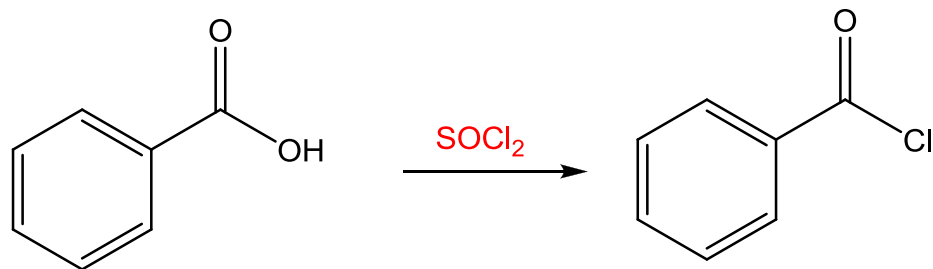
b.



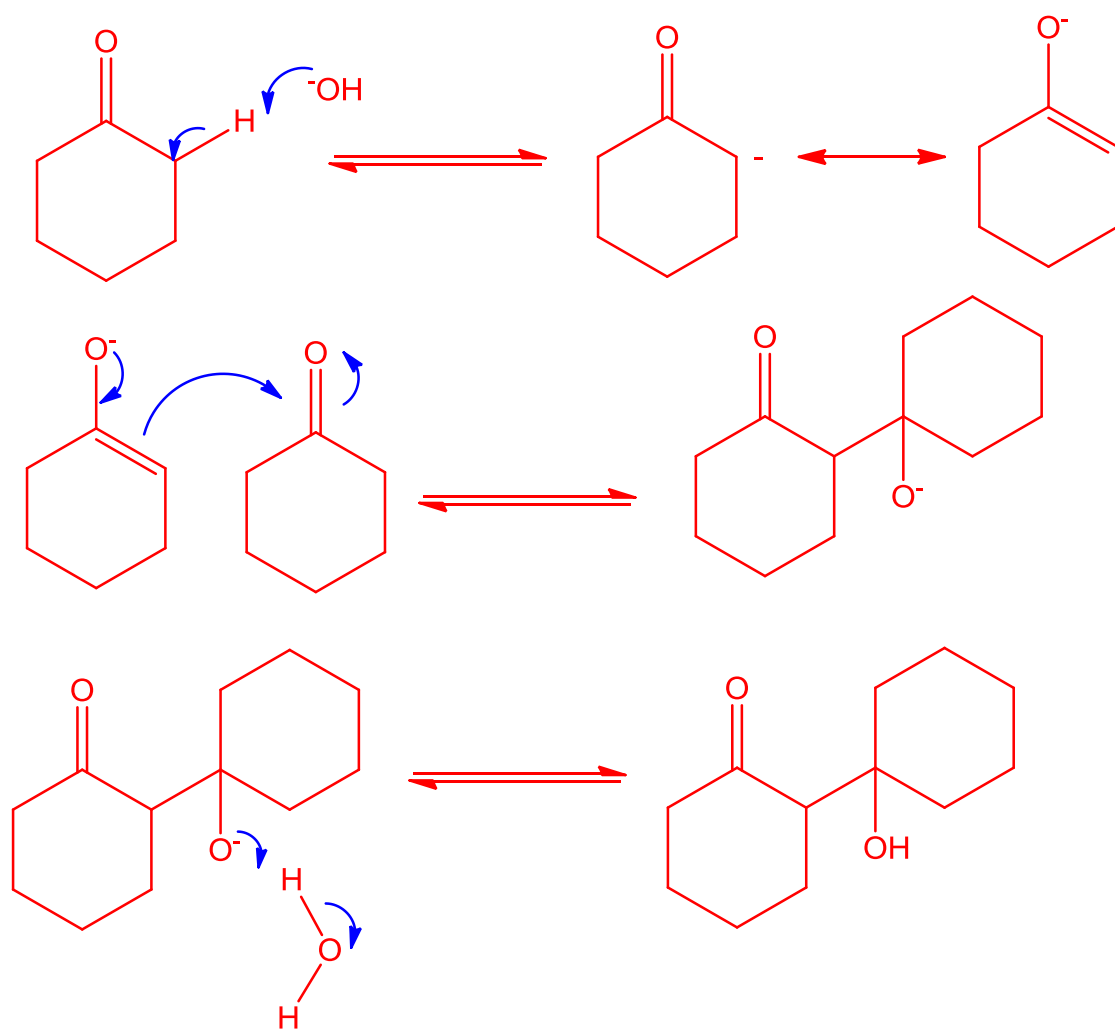
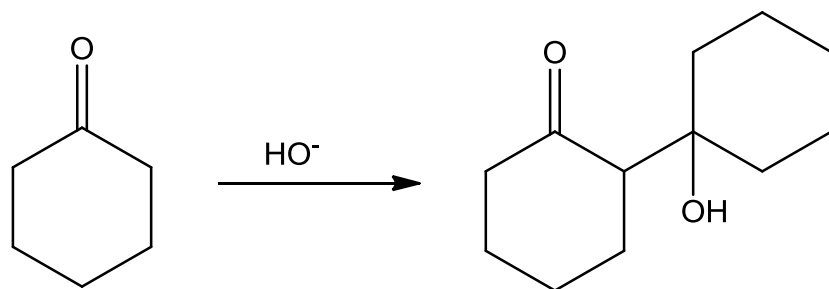
c.



d.



7. Propose a mechanism that accounts for the following reaction: (9 points)

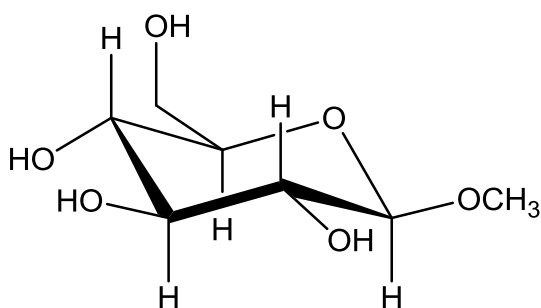


8.

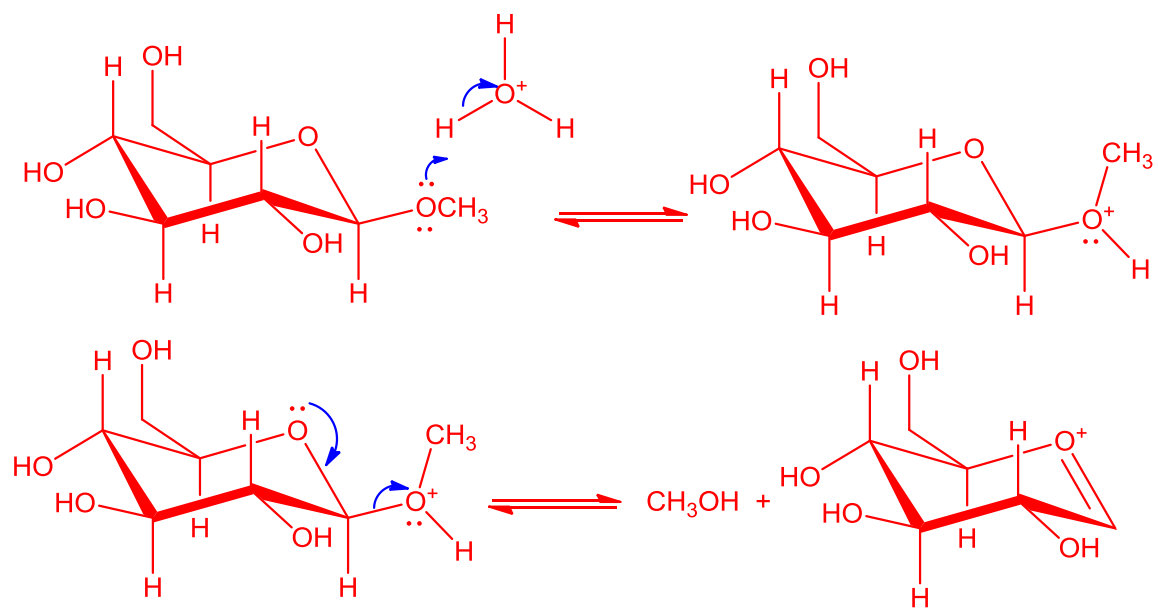
- a. What term refers to two diastereomers that differ in the configuration around only one stereogenic centre. (1 points)

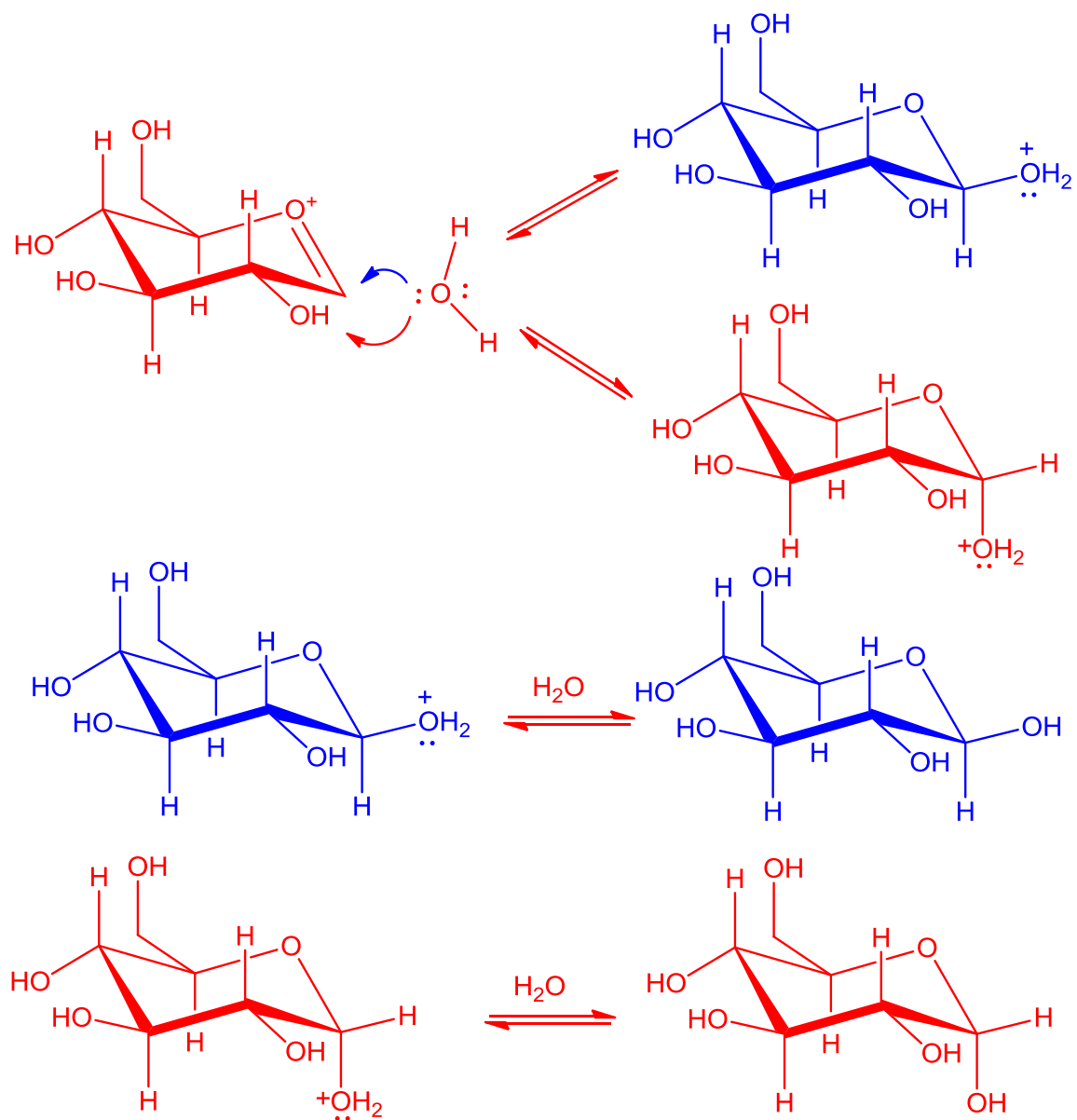
epimer

- b. When an aqueous solution of methyl  $\beta$ -D-glucopyranoside is made acidic, the glycoside undergoes hydrolysis to produce D-glucose as a mixture of the two pyranose forms and methanol. Propose a mechanism that accounts for this reaction. (15 points)

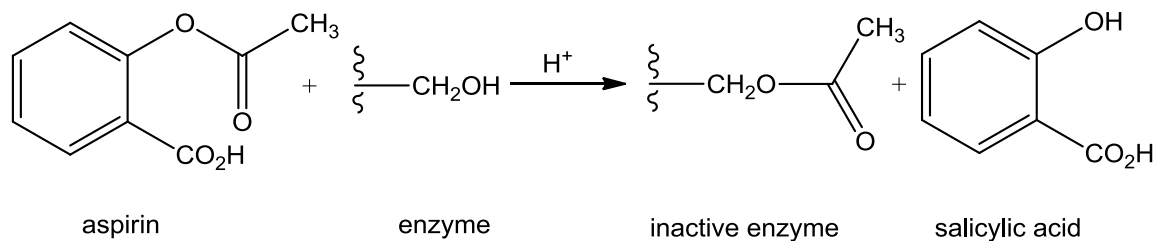


Methyl  $\beta$ -D-glucopyranoside

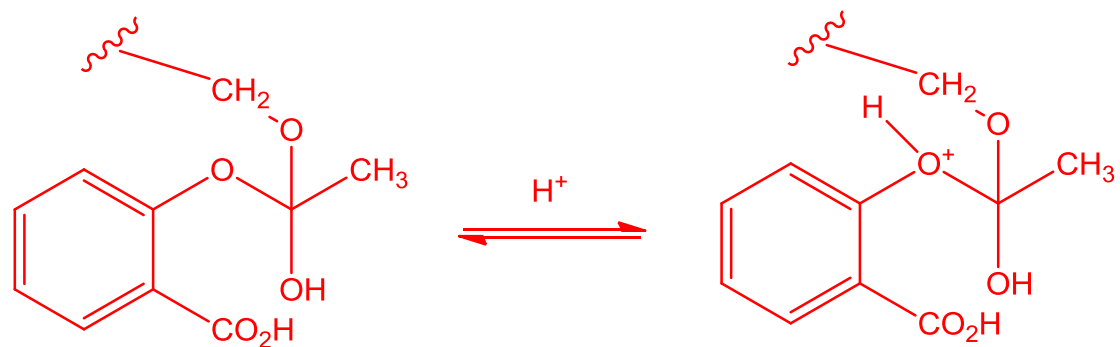
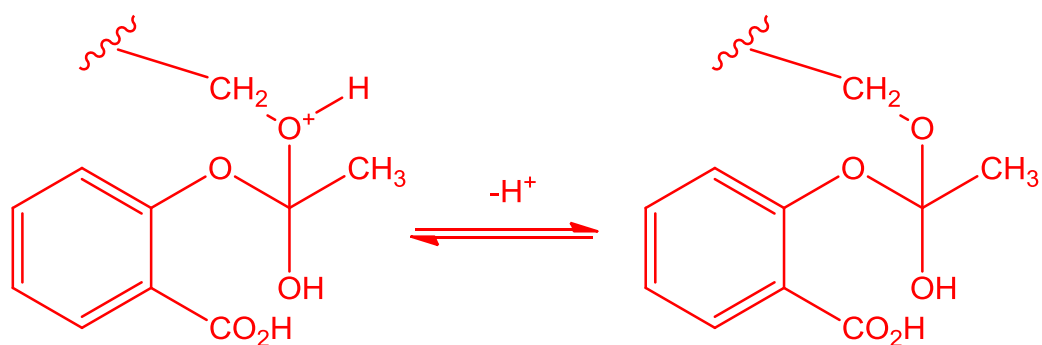
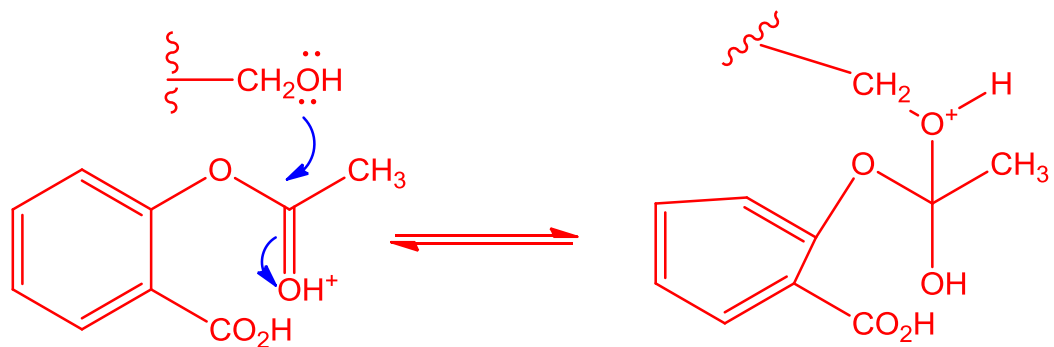
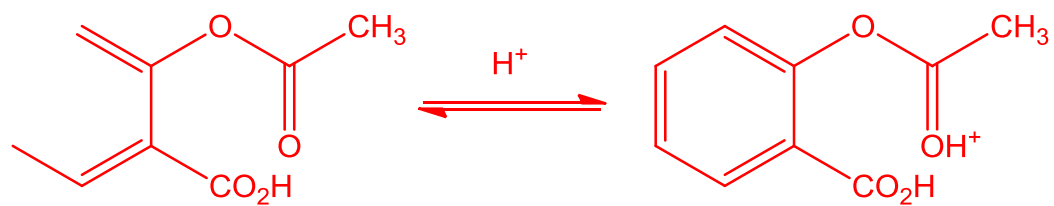


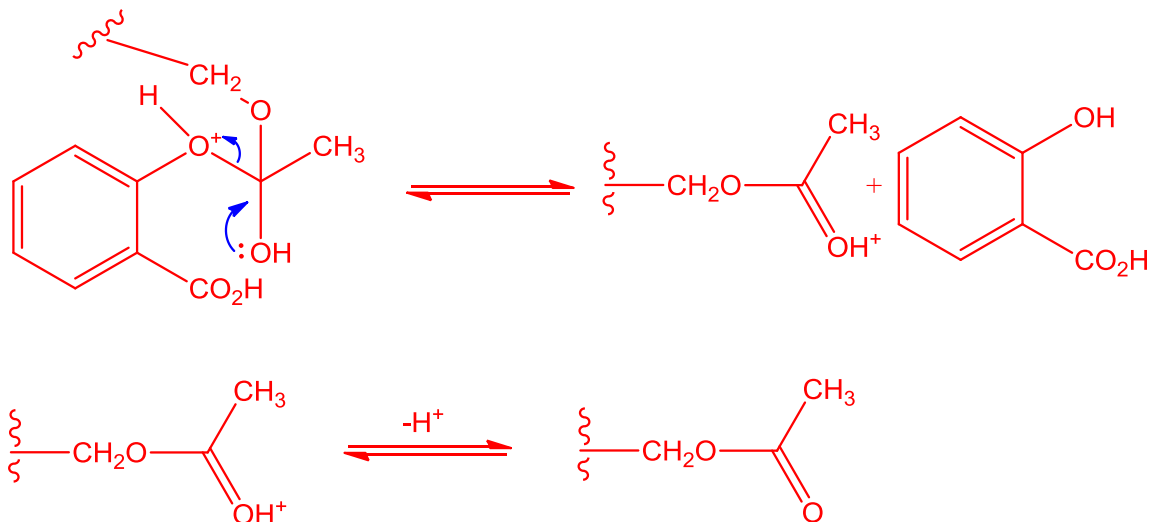


9. Aspirin is an anti-inflammatory agent that inhibits the conversion of arachidonic acid to prostaglandins by the transfer of its  $\text{CH}_3\text{CO}-$  group to an OH group at the active site of the enzyme:



Draw a mechanism for this reaction. (12 points)





10.

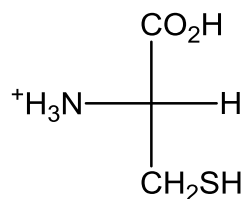
- a. Give an example of an essential amino acid. (1 point)

Val, Leu, Ile, Phe, Trp, Thr, Met, or Lys

- b. Explain the term isoelectric point. (1 point)

The pH at which the number of positive and negative charges on an amino acid or protein are equal.

- c. The isoelectric point of cysteine is 5.0. This is its structure in a buffer of a certain pH. Is this pH lower or higher than the isoelectric point? (1 point)



Lower

- d. Secreted by the pituitary gland, corticotrophin is a hormone that stimulates the adrenal cortex. Determine its structure from the following information: (6 points)

Trypsin, a digestive enzyme of intestinal liquids, cleaves polypeptides only at the carboxy (acid) end of arginine (Arg) and Lysine (Lys).  
Chymotrypsin which is also found in mammalian intestines, cleaves the

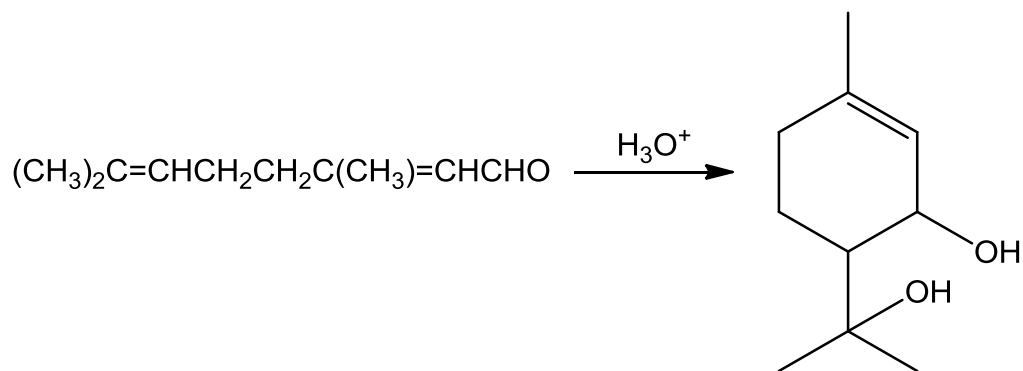
carboxy end of phenylalanine (Phe), tryptophan (Trp) and tyrosine (Tyr).

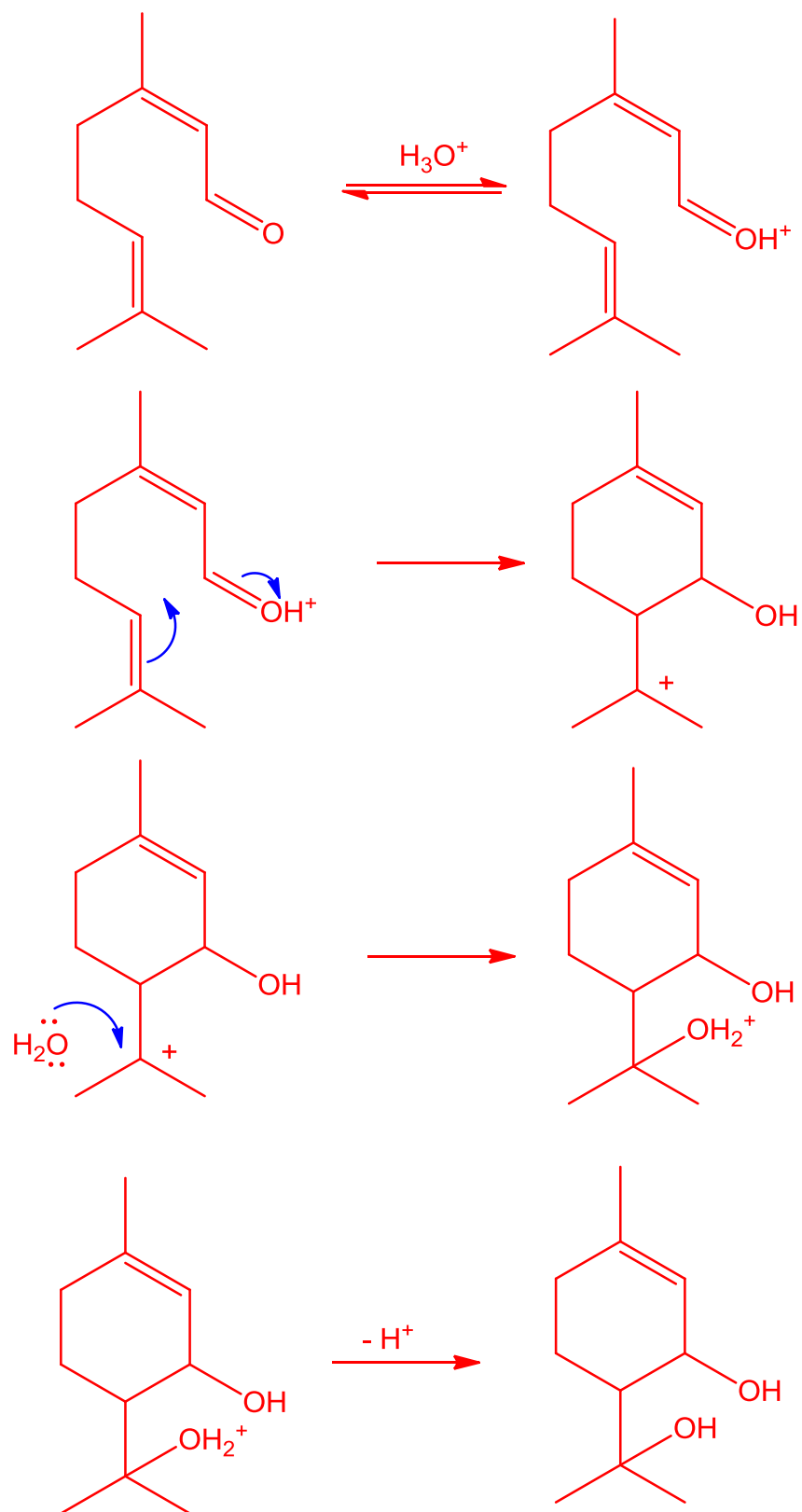
Hydrolysis by trypsin produces free lysine, free arginine, Trp-Gly-Lys, Pro-Val-Lys, Pro-Val-Gly-Lys, Ser-Tyr-Ser-Met-Glu-His-Phe-Arg, and Val-Tyr-Pro-Asp-Ala-Gly-Glu-Asp-Gln-Ser-Ala-Glu-Ala-Phe-Pro-Leu-Glu-Phe.

Hydrolysis by chymotrypsin produces Arg-Trp, Ser-Tyr, Pro-Leu-Glu-Phe, Ser-Met-Glu-His-Phe, Pro-Asp-Ala-Gly-Glu-Asp-Gln-Ser-Ala-Glu-Ala-Phe, and Gly-Lys-Pro-Val-Gly-Lys-Lys-Arg-Arg-Pro-Val-Lys-Val-Tyr.

Ser-Tyr-Ser-Met-Glu-His-Phe-Arg-Trp-Gly-Lys-Pro-Val-Gly-Lys-Lys-Arg-Arg-Pro-Val-Lys-Val-Tyr-Pro-Asp-Ala-Gly-Glu-Asp-Gln-Ser-Ala-Glu-Ala-Phe-Pro-Leu-Glu-Phe

11. Propose a mechanism to explain the following transformation: (12 points)

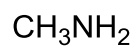




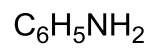
12. Match the  $pK_b$  values, 3.66, 4.74, 8.92, 9.42, and 13.0, to the appropriate structure:



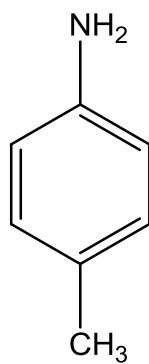
4.74



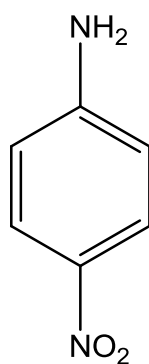
3.66



9.42



8.92



13.0