Name: _____

Chem 12B
March 5, 2012

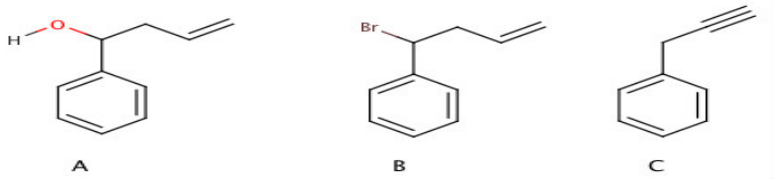
Exam 1
show all work!!

Exam 1 is worth 10% of your grade. You are allowed to use one 3" x 5" index card for notes. Show all work for full credit. Write your answers legibly. You may ask me for a hint; however, each hint will cost you 1 point.

1. (1 unit) a. Fill in the blanks. A carbon-bromine bond is _____. The carbon behaves like a _____ because the carbon is _____ _____ than bromine.

b. What is the effect on the carbon when Mg is inserted between the C and Br?

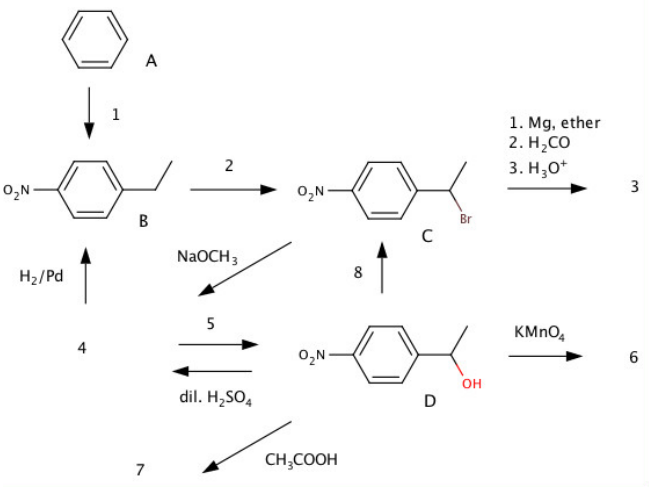
2. (4 units) So far, we have studied four reaction types: acid-base, addition, elimination, and substitution reactions.
a. Of the three compounds shown below, which compound can undergo all four types of reactions? Circle the atom or bond at which each type of reaction occurs. Write the name of the reaction type next to your circle.



b. For the compound you chose in part a, suggest an efficient synthesis starting from benzene and any necessary organic and inorganic reagents.

3. (5 units) Simple alkenes undergo addition reactions whereas aromatic compounds undergo electrophilic aromatic substitution reactions. Consider the two reactions:
(i) 4-methylcyclohexene + Br_2 →
(ii) toluene + Br_2 →
a. Why does Reaction (ii) require $FeBr_3$?
b. Show the mechanism of each reaction. In each step, use curved arrows to show bonds breaking and forming, and identify the nucleophile and electrophile. For Reaction (ii), your mechanism should show the regioselectivity of the product.

4. (10 units) Compounds A, B, C, and D are shown below.
a. Identify the reaction conditions or draw the structure for (1) through (8).



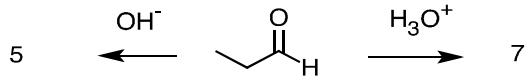
b. For the reaction to convert A to B, explain your substitution sequence (-NO_2 followed by –C_2H_5 or vice versa).
c. For the reaction to convert B to C, which structural characterization method (MS, IR, H NMR, or C NMR) would you use to determine whether you made C? Briefly describe how the spectrum looks.
d. Alcohols are used to make alkyl halides (D → C). Why aren't alkyl halides used to make alcohols?
e. Compound 4 is used to make Compound D. Briefly describe another method to make Compound D.

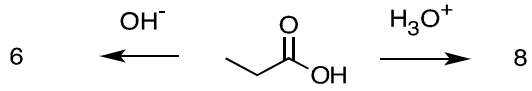
Name: _____

Chem 12B
April 23, 2012

Exam 2
show all work!!

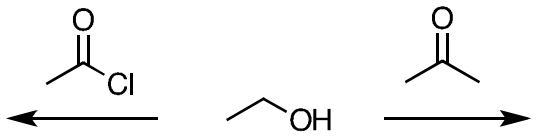
Exam 2 is worth 10% of your grade. You are allowed to use one 3" x 5" index card for notes. Show all work for full credit. Write your answers legibly. You may ask me for a hint; however, each hint will cost you 1 point.
Many functional groups react with acids and bases. Protonating or deprotonating a group can be part of a synthetic strategy.
1. (3 units) Carbonyl compounds react with acids and bases.
a. Draw the structure of (5) through (8).





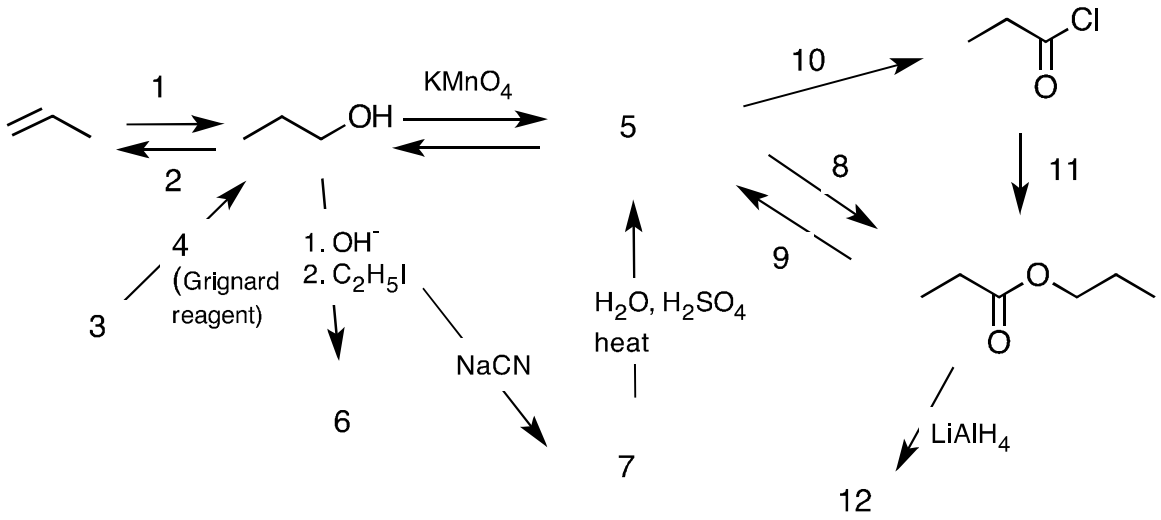
b. For what reason is a carbonyl compound treated with an acid?
c. How can you get a base (nucleophile) to react at the carbonyl carbon of an acid?

2. (3 units) a. Draw the structure of the product of each reaction:

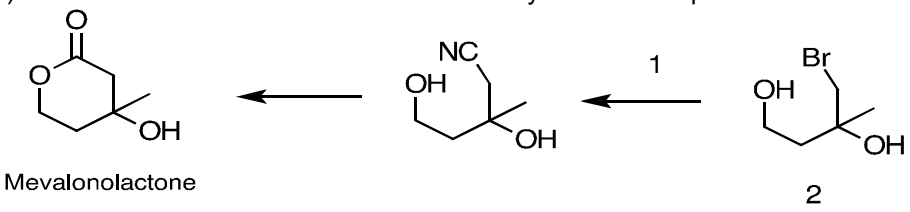


b. Identify the reaction type (acid-base, addition, elimination, or substitution) for each reaction.
c. In part (b), the reaction types are different. Draw the structure of the tetrahedral intermediate in each reaction. Explain why the reaction types are different based on the tetrahedral intermediate structure. (Hint: think mechanism.)

3. (6 units) Identify the reaction conditions or draw the structure for (1) through (12).



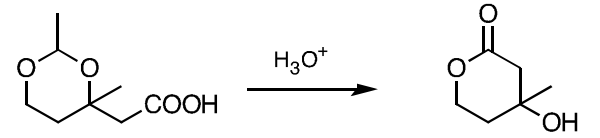
4. (8 units) Mevalonolactone is an intermediate in the synthesis of terpenes and steroids.



Mevalonolactone

2

a. For (1), would you use HCN or NaCN? Give reasons.
b. Suggest a synthesis of (2). Use ethylene or propylene as your source of carbon atoms and any necessary inorganic reagents.
c. On standing in dilute aqueous acid, Compound A is smoothly converted to Mevalonolactone. Suggest a reasonable mechanism for this reaction. For each step, use curved arrow to show bonds breaking and forming. What other organic product is formed?



Compound A

Mevalonolactone

Chem 12B, FINAL EXAM - TAKE-HOME PART
due Wednesday, May 30, 2012 at 3 pm

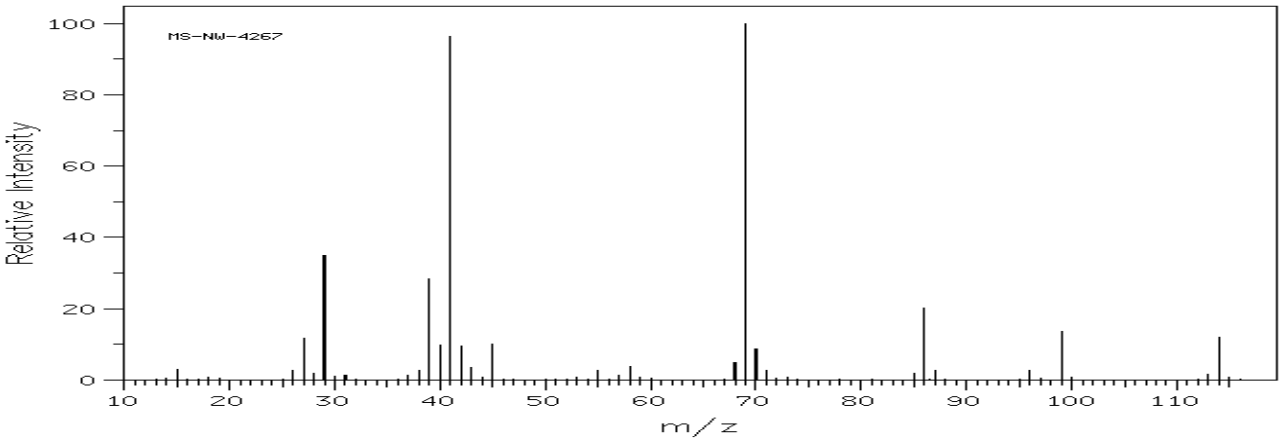
The Take Home Part of the Final Exam is worth 10% of your grade. For full credit, show all work in a logical and legible sequence. Clearly underline or circle your final answer. Include units where needed. You may work in a group with other students on Questions 1 – 4 of the Final Exam. **You must do Question 5 on your own.** If you work in a group, make sure every member contributes to the solutions. Turn in one set of solutions with the names of each member of your group. If you discuss any question or part of a question with another student, you are working in a group.

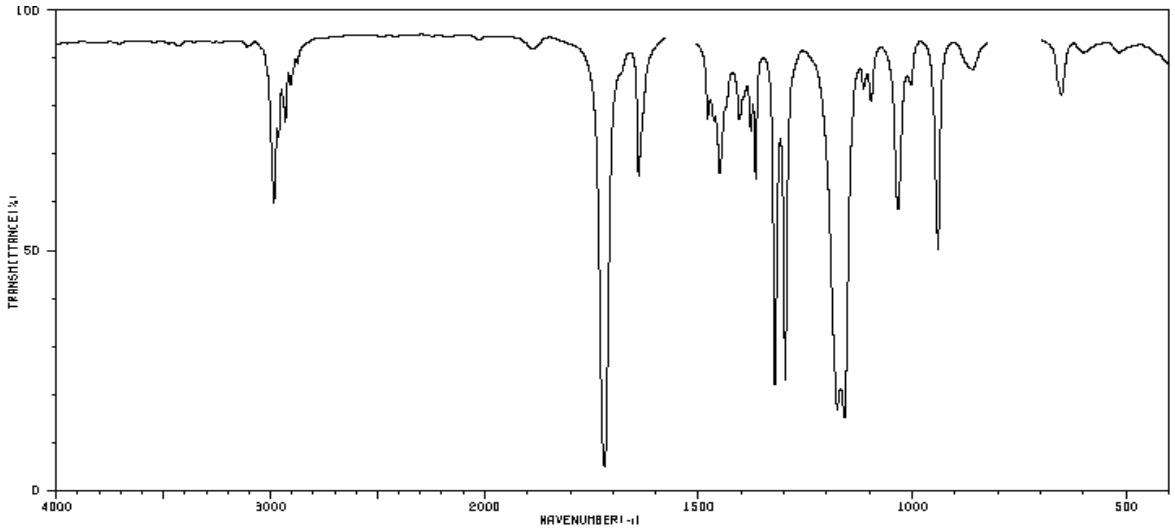
1. (8 units) Organic chemistry involves the conversion of one functional group to another. Many organic reactions are reversible. We studied the following functional groups in CHM 12B: arenes, alcohols, ethers, aldehydes, ketones, acids, acid derivatives, enols and enolates including α, β-unsaturated carbonyls and β-keto esters, amines, and phenols.
a. Construct a reaction map that shows how one functional group can be converted to another. Include the functional groups listed above. Include reaction conditions for each reaction. If the reaction is reversible, show the reaction conditions for each direction. Show reactions that we covered in this course. Your reaction map should fit on one 8.5" x 11" page.
b. Which functional group is involved in the most functional group conversions? Give the number of conversions based on your reaction map.
c. Which functional group is the least reactive? How can this group be made more reactive?
d. If you have a compound with two or more functional groups and want to convert one functional group to another without the other group reacting, what do you do?

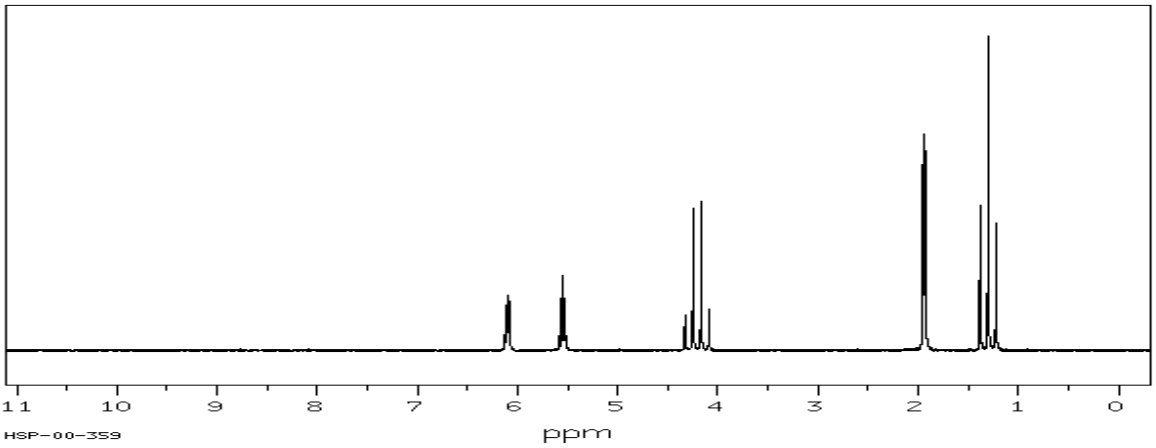
2. (3 units) a. Based on the reactions we covered in CHM 12B this semester, identify the reaction(s) that make a C-C bond. Give one example of each reaction.
b. Based on the reactions we covered in CHM 12B this semester, identify the reaction(s) that break a C-C bond. Give one example of each reaction.
c. Diacids, such as those related to malonic acid, and β–keto acids undergo decarboxylation. Give one reason why you would do a decarboxylation reaction rather than a reaction in Question 2b.

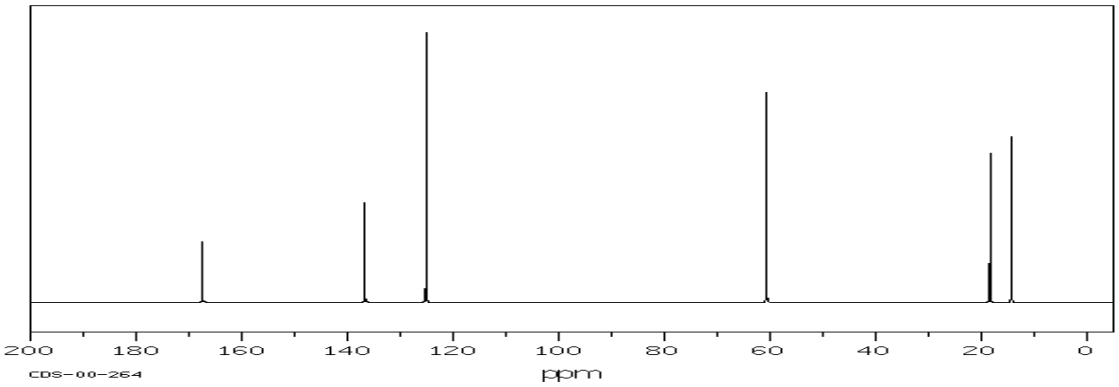
3. (3 units) You showed the synthesis of capsaicin from 6-methyl-4-heptenol (Carey, "Organic Chemistry", 8th ed., p. 921, Problem 20.63) in lecture.
Starting from benzene and using any necessary reagents, design a synthesis of 2-methoxy-4-methylaminophenol. (If your organic reagent contains more than two carbons, show a synthesis of this reagent starting from ethylene. If your organic reagent contains the benzene ring, show a synthesis of this reagent starting from benzene. See Chapters 21 or 22 for aryl amines or phenols.)

4. (3 units) Ethyl propanoate is treated with LDA to make Compound A. Compound A is treated with formaldehye and heat to make Compound B. IR, NMR, and MS spectra for Compound B are shown below. Draw the structures of Compounds A and B. Describe your analysis of each spectrum for full credit.









5. (3 units) According to the Chem 12B Course Information Handout, your "grade will be based on your performance and mastery of the last Course Objective." Each course objective is shown below.

a. For each objective, give yourself a grade (A – F) that reflects your understanding of that objective. Be honest and be fair to yourself. Don't be too easy but don't be too harsh either

b. Give yourself an overall course grade based on your understanding of the course objectives. Objectives 6, 7, and 10 are the most important objectives. (The grade you give yourself may not be your official course grade. Your instructor will determine your overall course grade.)

Objective	Description	Grade
1	relate the name of organic compounds to structure and vice versa	
2	relate the structure, bonding, and geometry of a compound to its reactivity	
3	identify common nucleophiles and electrophiles	
4	identify common organic mechanistic processes in a reaction mechanism and the use of curved arrows	
5	understand reactivity principles and trends (see handout)	
6	apply and relate (3), (4), and (5) to predict conditions and products of organic reactions, e.g., the conversion of one functional group to another	
7	design syntheses of organic compounds	
8	identify and distinguish between different characterization methods for organic compounds	
9	interpret IR spectra, NMR spectra, and MS to determine the structure of an organic compound	
10	perform organic laboratory techniques	
	Overall Chem 12B Grade	

Name: _____

Chem 12B
May 30, 2012

Final Exam
show all work!!

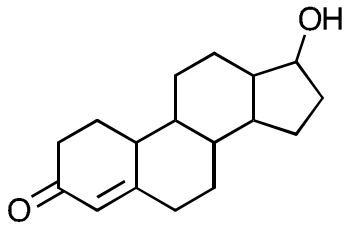
The In-Class part of the Final Exam is worth 10% of your grade. You are allowed to use one 3"x5" note card. Show all work for full credit. Write your answers legibly. You may ask me for a hint; however, each hint will cost you 1 point.

1. (2 units) Organic synthesis involves making big molecules (target compound) from small molecules (starting materials) and involves the conversion of one functional group into another.

a. Name one reason for treating ethanol with an acid, such as H_2SO_4. Draw the structure of the product. What reaction type of the four listed above can this product undergo?

b. Nucleophilic addition reactions and nucleophilic acyl substitution reactions involve a _____ intermediate. Explain the structural feature that determines whether a nucleophilic addition reaction or nucleophilic acyl substitution reaction occurs.

2. (4 units) Nandrolone is a synthetic anabolic steroid.

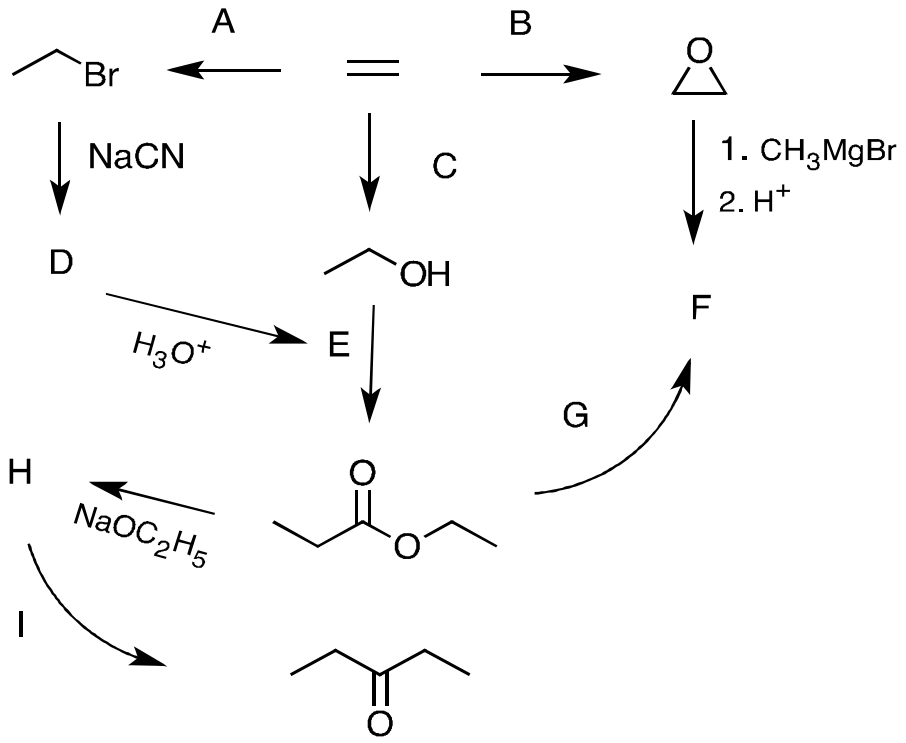


Nandrolone

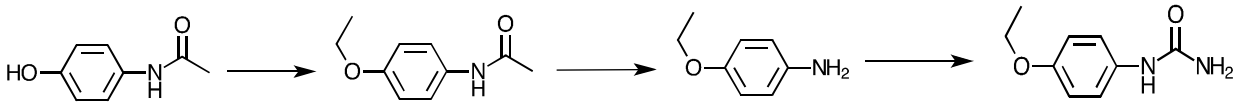
a. We looked at four reaction types in Chem 12B: acid-base, addition, elimination, and substitution.
(i) Draw a circle around <u>one</u> reactive site (an atom or bond) in nandrolone that undergoes an acid-base reaction.
(ii) Draw a box around <u>one</u> reactive site (an atom or bond) in nandrolone that undergoes an addition reaction.
(iii) Draw a triangle around <u>one</u> reactive site (an atom or bond) in nandrolone that undergoes an elimination reaction.
(iv) Draw a pentagon around <u>one</u> reactive site (an atom or bond) in nandrolone that undergoes a substitution reaction.

b. How would you synthesize the α, β-unsaturated ketone in Nandrolone? Draw the structure of the reactant(s) to make this α, β-unsaturated ketone in Nandrolone.

3. (6 units) a. Draw the structure or identify the reaction conditions/synthesis steps for the letters A through I.

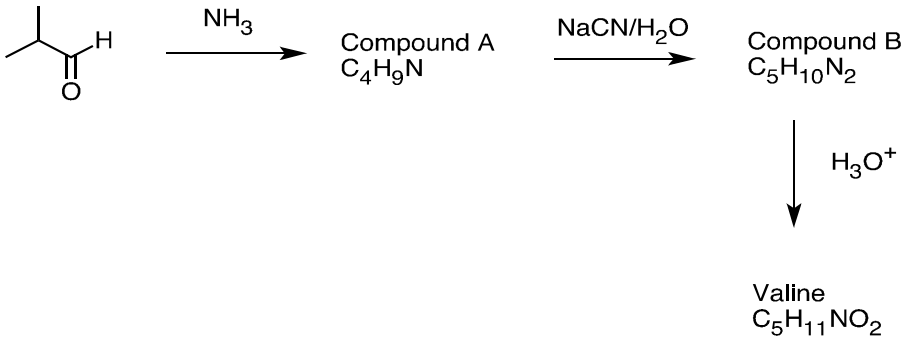


4. (2 units) You made Dulcin from Acetaminophen in lab.



Explain why this synthesis method is better than using the method: Acetaminophen → Compound III → Compound II → Dulcin.

5. (3 units) Valine is an amino acid. Draw the structures of Compounds A and B and valine.



6. (3 units) In glycolysis, glucose is converted to pyruvate in a 10 step reaction sequence. The 2nd step is shown below. Suggest a reasonable mechanism for this reaction. For each step, identify the nucleophile and electrophile and use curved arrows to show bonds breaking and forming. Use any necessary organic or inorganic reagents.