

grade key

Exam II Organic Chem II (CHEM 442) Spring 16 3/30W Dr. Hahn MWF 1pm Form A Exam# \_\_\_\_\_

Sign Name K. O'G Print Name \_\_\_\_\_  
(2 pts name above print & sign, 2 pt scantron name) (100 pts, 11 pages + periodic table + scantron sheet)

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper – If you want me to grade something not in the space for the answer, clearly specify in writing. Telling me during the exam where to find the answer does not qualify because I will just vaguely remember someone telling me something during the exam not which one of 200 students told me what to grade on what page.)

Circle answer on this form for backup to the scantron. There is no partial credit for showing work in the multiple choice.

In all questions on all parts of this exam, R is not equal to hydrogen but is an alkyl.

I. Multiple Choice (3 pts each, 27 pts) Choose the one best statement in each question.

1. Primary alcohol will go to aldehydes by reaction with the following reagent. Choose the best statement.

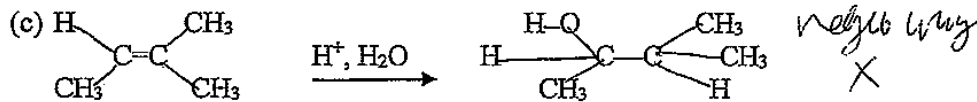
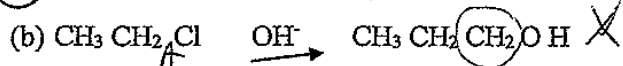
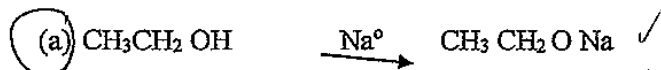
- (a) swern
- (b) PCC
- (c) Jones
- (d) All above reagents are correct.
- (e) (a) and (b) are correct.

key with points

2. To generate an alcohol from an alkene, one may use which of the following reagents over the arrow.

- (a) (1)  $\text{Hg}(\text{OAc})_2$ , THF/ $\text{H}_2\text{O}$  (2)  $\text{OH}^-$ ,  $\text{NaBH}_4$  to give Markovnikov product without the possibility of rearrangement.
- (b) Alkene reaction with MCPBA followed by reaction of a Grignard followed by workup. ✓
- (c)  $\text{H}^+/\text{H}_2\text{O}$  to give Markovnikov product. ✓
- (d) (1)  $\text{BH}_3:\text{THF}$  (2)  $\text{H}_2\text{O}_2$ ,  $\text{OH}^-$  to give anti-Markovnikov product ✓
- (e) All above statements are true.

3 Choose the best statement or correct reaction.



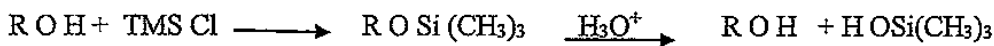
(e) all reactions shown are incorrect.

4. Choose the best statement below about alcohols.

(a) TsOH reaction is used to make a protected alcohol which does not react with almost anything. ✗



(b) TMS Cl is a way to make an especially good leaving group replacing the rather bad leaving group  $\text{OH}^-$  of an alcohol with the much better reacting TMS ether. ✗

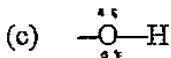
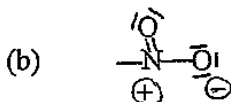


(c) Alcohols can be synthesized by  $\text{S}_{\text{N}}2$  or  $\text{S}_{\text{N}}1$  substitution reaction on some  $\text{RX}$  using reagents such as  $\text{NaOH}$  or  $\text{H}_2\text{O}$

(d) All statements above are true.

(e) (a) and (b) are true.

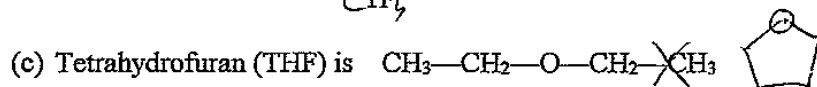
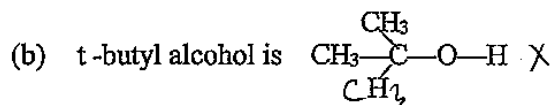
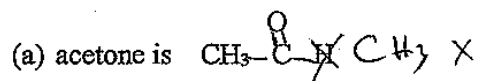
5 Which of the following is a o,p activator? I am showing the part that attaches to the benzene ring.



(d) (a) & (c) are o,p activators

(e) None shown are o,p activators.

6 Choose the best statement.



(d) All letters above are false

(e) All statements above are true [except for letter (d)]

7 Choose the one best statement.

(a) Alcohols have unusually <sup>high</sup> low BP/MP for comparable sized alkanes because of hydrogen bonding between molecules of alcohol.

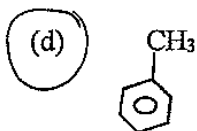
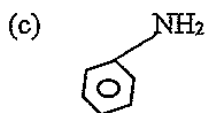
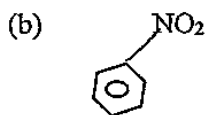
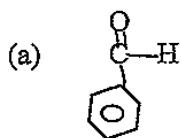
(b) Small alkyl chain alcohols are water soluble because of hydrogen bonding while long alkyl chain alcohol are not water soluble because the molecule is predominately an alkyl chain. ✓

(c) Ethers are good solvents because they are polar but don't have hydrogen bonding and are inert to a lot of reactions. ✓

(d) (a) and (c) are true.

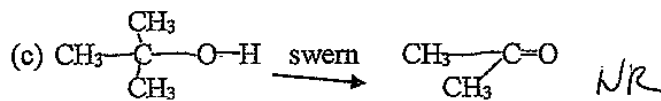
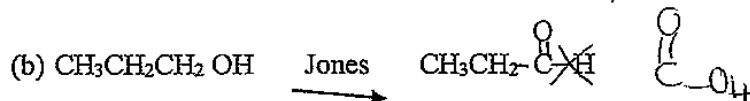
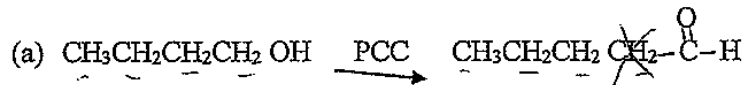
(e) (b) and (c) are true.

8. Which of following is the molecule toluene



(e) None of the above is toluene

9. Choose the best statement or correct reaction.



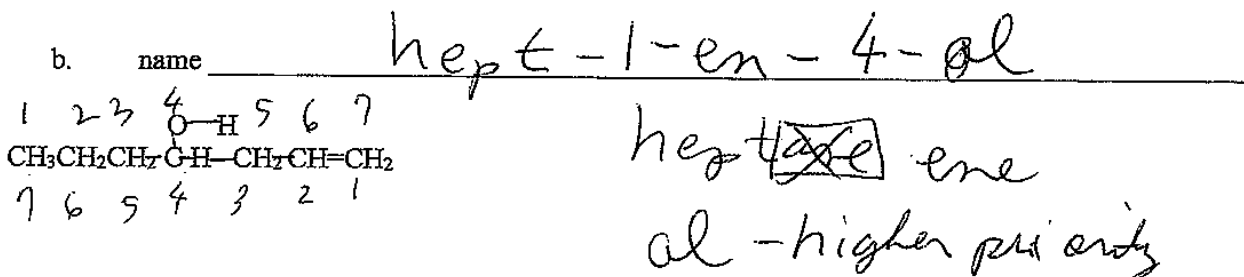
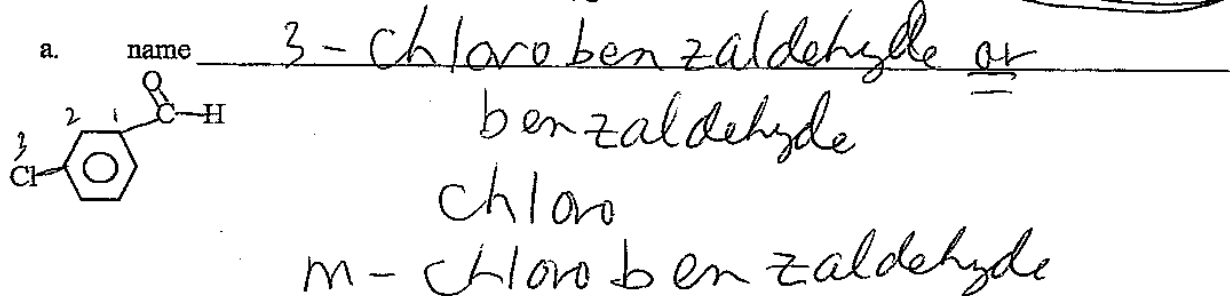
(d) All of the above reactions are wrong.

II. Short Answers (45 pts)

A. Nomenclature: (2 pts each, 8 pts)

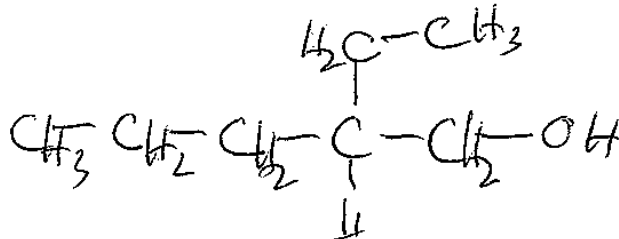
BA - 1 1/2  
2 pt each wrong

1. Given the structural formula shown below, give the IUPAC name of the molecule.



2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable - don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)

a. 2-ethyl-1-pentanol

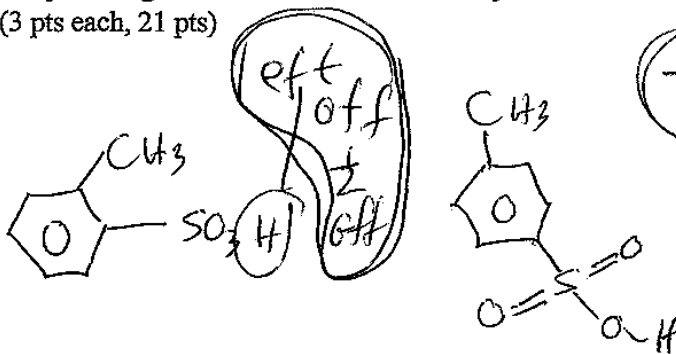
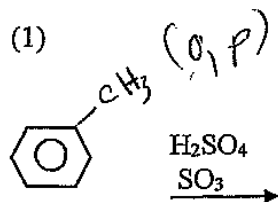


b. 2,3-epoxypentane



B. Reactions Part of Short Answers: (3 pts per reaction, 21 pts total)

Given the following, what is the the expected organic product? Choose to do 7 of the following reactions you want graded by circling the letter of the reaction. If you do not choose, I will just grade the first SEVEN (3 pts each, 21 pts)



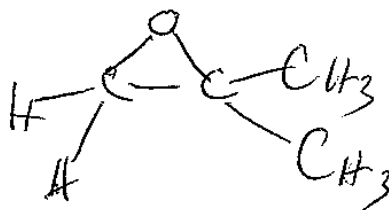
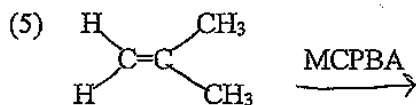
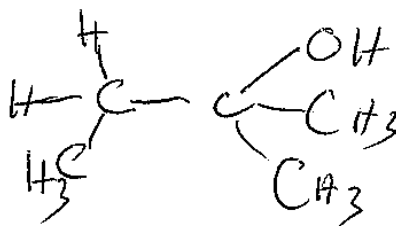
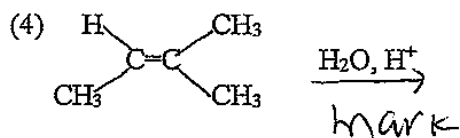
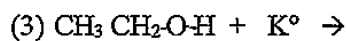
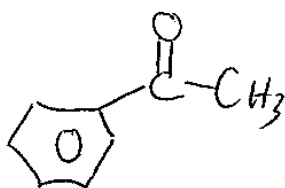
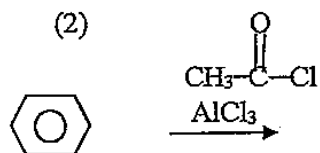
*-1/2 regio*

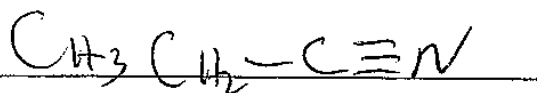
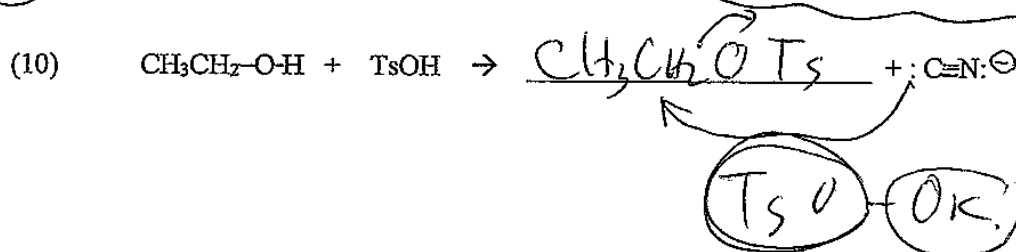
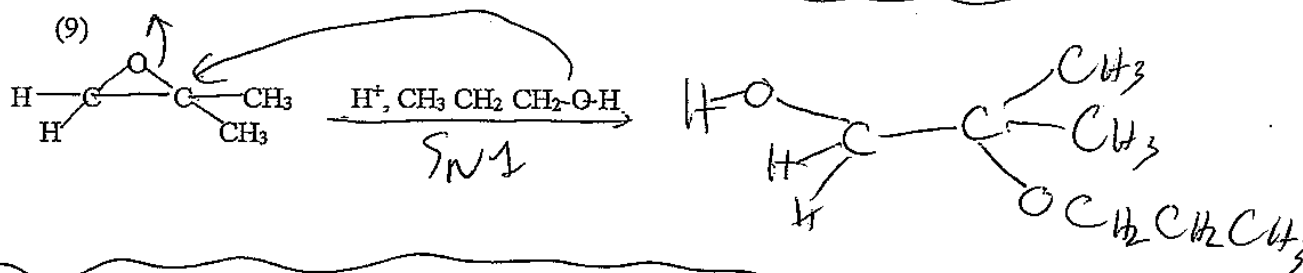
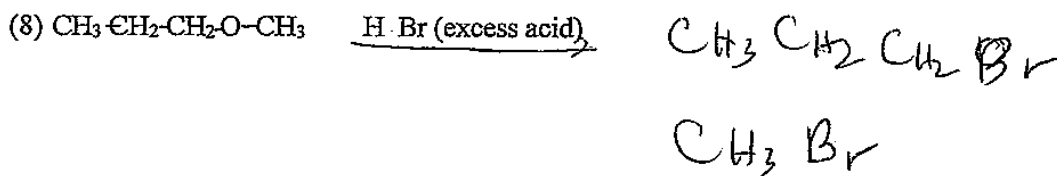
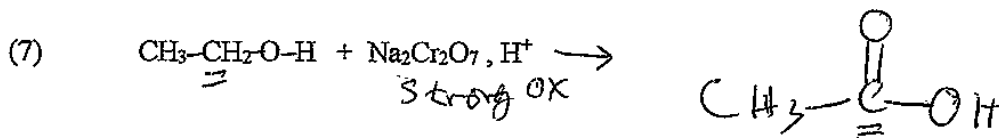
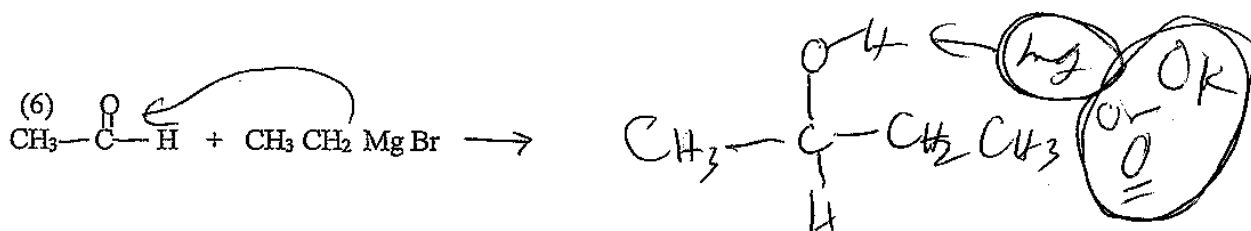
*NFE -1/2*

*not far enough*

*IF too far*

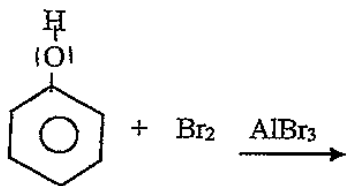
*half of half -0.8pt*



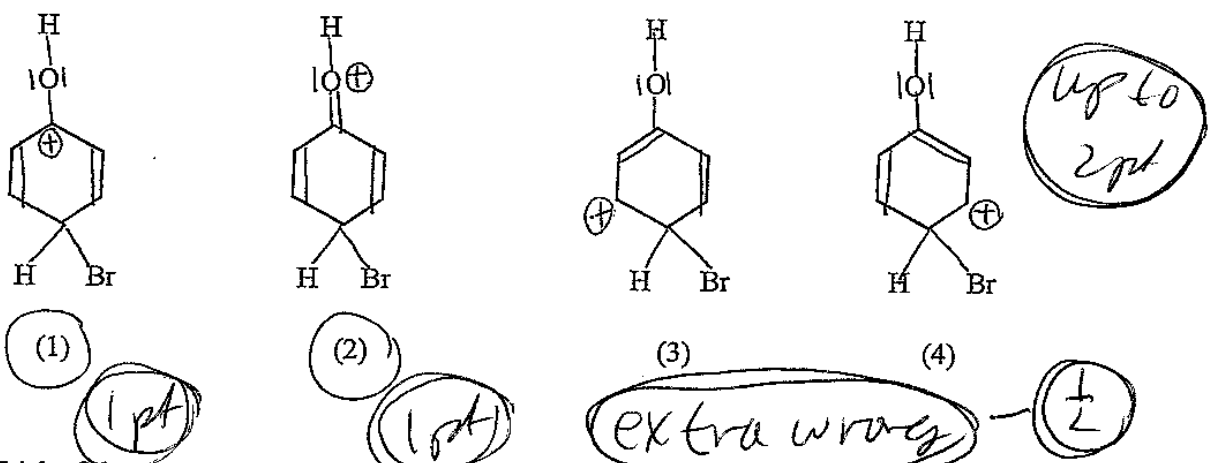


C. Short Answers part of Short Answers: (16 pts)

1. For a halogenation reaction the arenium resonance structure generated during the reaction mechanism are shown. (8 pts total)



- a. Given the following resonance structures, does the directing group shown act as a (o,p activator) or (m deactivator) (circle one entire parenthesis) (4 pts)



- b. Which of the resonance structures above determines the directing group effect which you chose above? Circle the resonance structure number and explain. You may circle more than one resonance structure and explain both resonance structures which you chose. (4 pts)

① 1 stabilizes + charge next to it explain

② extra resonance structure 2pt

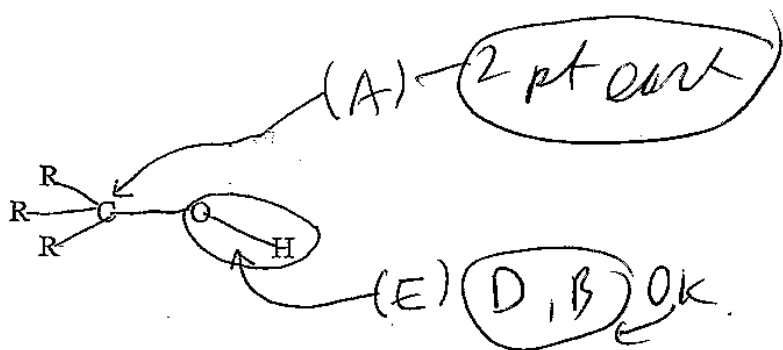
delocalizes + charge outside the ring attempt explain - 1 explain - 1

① + ② stabilizes p resulting in

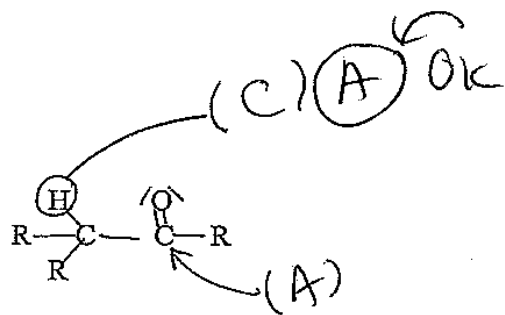
lower energy for p intermediate



2. Fill in the blank parenthesis with a letter. (A) reacts with nucleophile (B) reacts with acid (C) is an acidic proton (D) acts as nucleophile (E) leaving group ( $R \approx H$ ) (2 pts, 8 pts total)

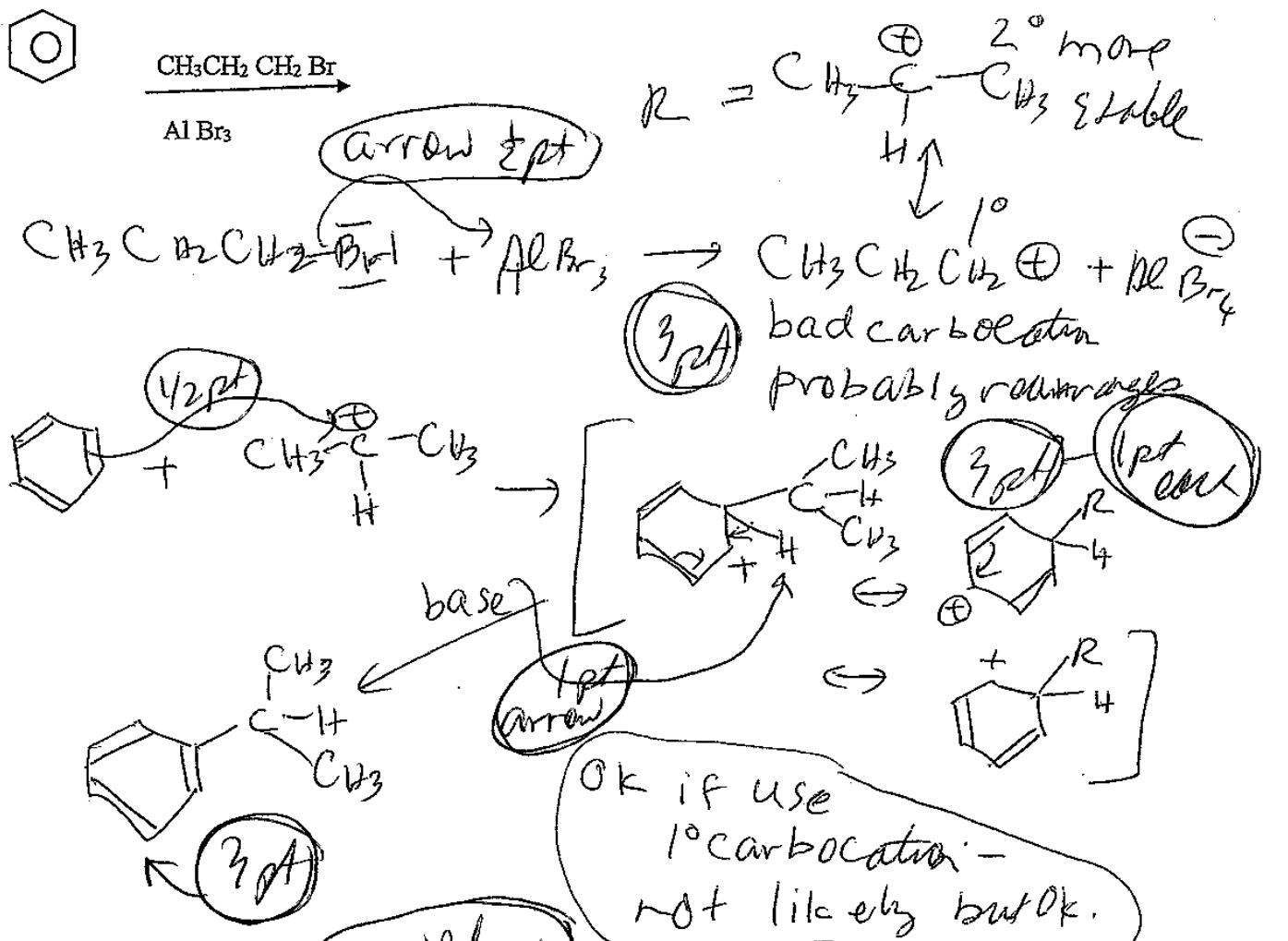


extra wrong -1



Part III. Long Answers (28 pts) Show work where applicable for full and partial credit.

1. a. Show the electrophilic substitution reaction mechanism for the following reaction. You must show the arenium resonance structures AND the generation of the electrophile. (11 pts)



- b. Explain something about the possibility of rearrangement and a possible alternate reaction to obtain the desired product of the above reaction. (5 pts)

Mechanism goes by carbocation - This is bad carbocation so will predominantly go by rearrangement. Use F.C. acylation which does not rearrange.





Grade Key

Exam II Organic Chem II (CHEM 442) Spring 16 3/30W Dr. Hahn MWF 1pm Form B Exam# \_\_\_\_\_

Sign Name Key Print Name \_\_\_\_\_

(2 pts name above print & sign, 2 pt scantron name) (100 pts, 11 pages + periodic table + scantron sheet)

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper - If you want me to grade something not in the space for the answer, clearly specify in writing. Telling me during the exam where to find the answer does not qualify because I will just vaguely remember someone telling me something during the exam not which one of 200 students told me what to grade on what page.)

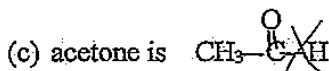
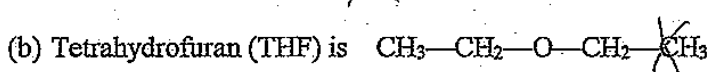
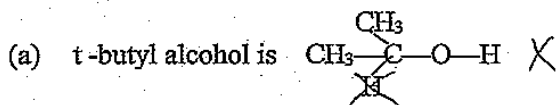
Circle answer on this form for backup to the scantron. There is no partial credit for showing work in the multiple choice.

color

In all questions on all parts of this exam, R is not equal to hydrogen but is an alkyl.

I. Multiple Choice (3 pts each, 27 pts) Choose the one best statement in each question.

1. Choose the best statement.

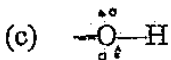


(d) All letters above are false

(e) All statements above are true [except for letter (d)]

key with points

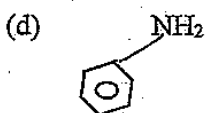
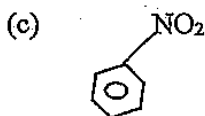
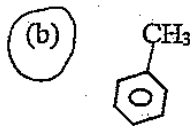
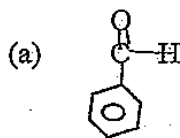
2. Which of the following is a o,p activator? I am showing the part that attaches to the benzene ring.



(d) (a) & (c) are o,p activators

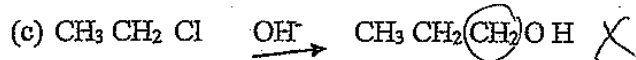
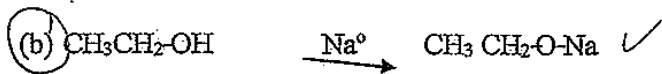
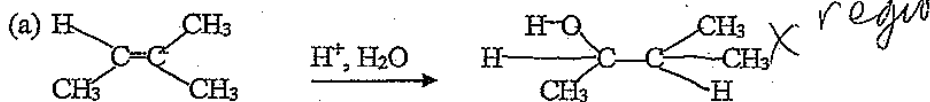
(e) None shown are o,p activators.

3. Which of following is the molecule toluene



(e) None of the above is toluene

4. Choose the best statement or correct reaction.

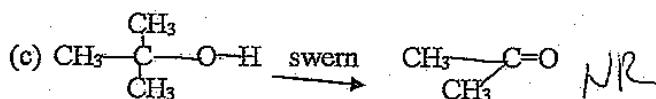
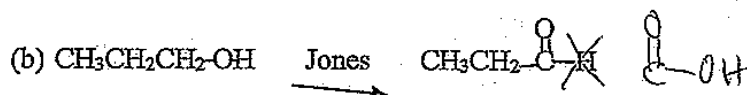
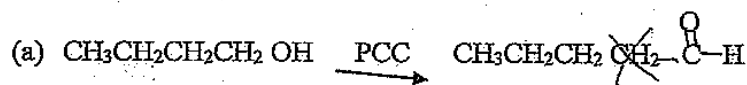


(e) all reactions shown are incorrect.

5 Choose the one best statement.

- (a) Alcohols have unusually <sup>high</sup> low BP/MP for comparable sized alkanes because of hydrogen bonding between molecules of alcohol.
- (b) Small alkyl chain alcohols are water soluble because of hydrogen bonding while long alkyl chain alcohol are not water soluble because the molecule is predominately an alkyl chain. ✓
- (c) Ethers are good solvents because they are polar but don't have hydrogen bonding and are inert to a lot of reactions. ✓
- (d) (a) and (c) are true.
- (e) (b) and (c) are true.

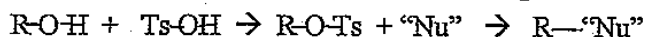
6 Choose the best statement or correct reaction.



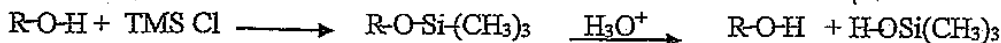
- (d) All of the above reactions are wrong.

7. Choose the best statement below about alcohols.

- (a) TsOH reaction is used to make a protected alcohol which does not react with almost anything. X



- (b) TMS Cl is a way to make an especially good leaving group replacing the rather bad leaving group OH of an alcohol with the much better reacting TMS ether. X



- (c) Alcohols can be synthesized by  $\text{S}_{\text{N}}2$  or  $\text{S}_{\text{N}}1$  substitution reaction on some R X using reagents such as Na OH or  $\text{H}_2\text{O}$ . ✓

- (d) All statements above are true.

- (e) (a) and (b) are true.

8. Primary alcohol will go to aldehydes by reaction with the following reagent. Choose the best statement.

- (a) swern
- (b) PCC
- (c) Jones
- (d) All above reagents are correct.
- (e) (a) and (b) are correct.

9. To generate an alcohol from an alkene, one may use which of the following reagents over the arrow.

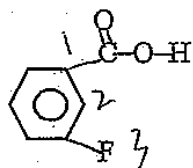
- (a)  $H^+/H_2O$  to give Markovnikov product. ✓
- (b) (1)  $BH_3:THF$  (2)  $H_2O_2, OH^-$  to give anti-Markovnikov product ✓
- (c) (1)  $Hg(OAc)_2, THF/H_2O$  (2)  $OH^-, NaBH_4$  to give Markovnikov product without the possibility of rearrangement. ✓
- (d) Alkene reaction with MCPBA followed by reaction of a Grignard followed by workup. ✓
- (e) All above statements are true.

II. Short Answers (45 pts)

A. Nomenclature: (2 pts each, 8 pts)

1. Given the structural formula shown below, give the IUPAC name of the molecule.

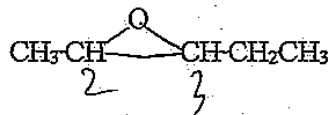
a. name 3-fluorobenzoic acid



benzoic acid

m-fluorobenzoic acid

b. name 2,3-epoxypentane



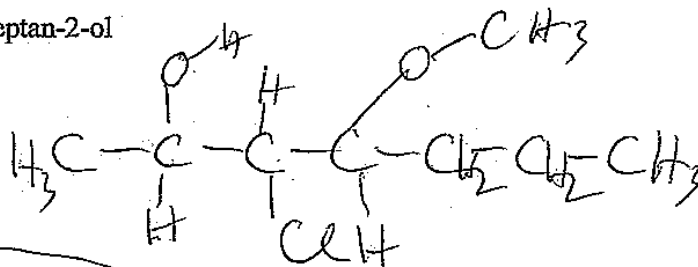
pentane

BA - 1/2

- 1/2 pt each wrong

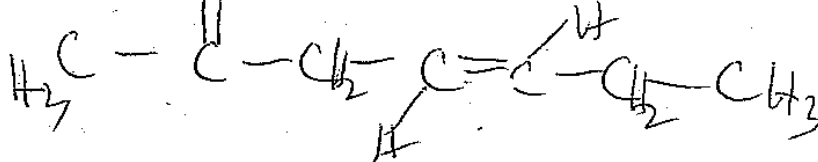
2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable - don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)

a. 3-chloro-4-methoxyheptan-2-ol



b. Hept-4-yne-2-one

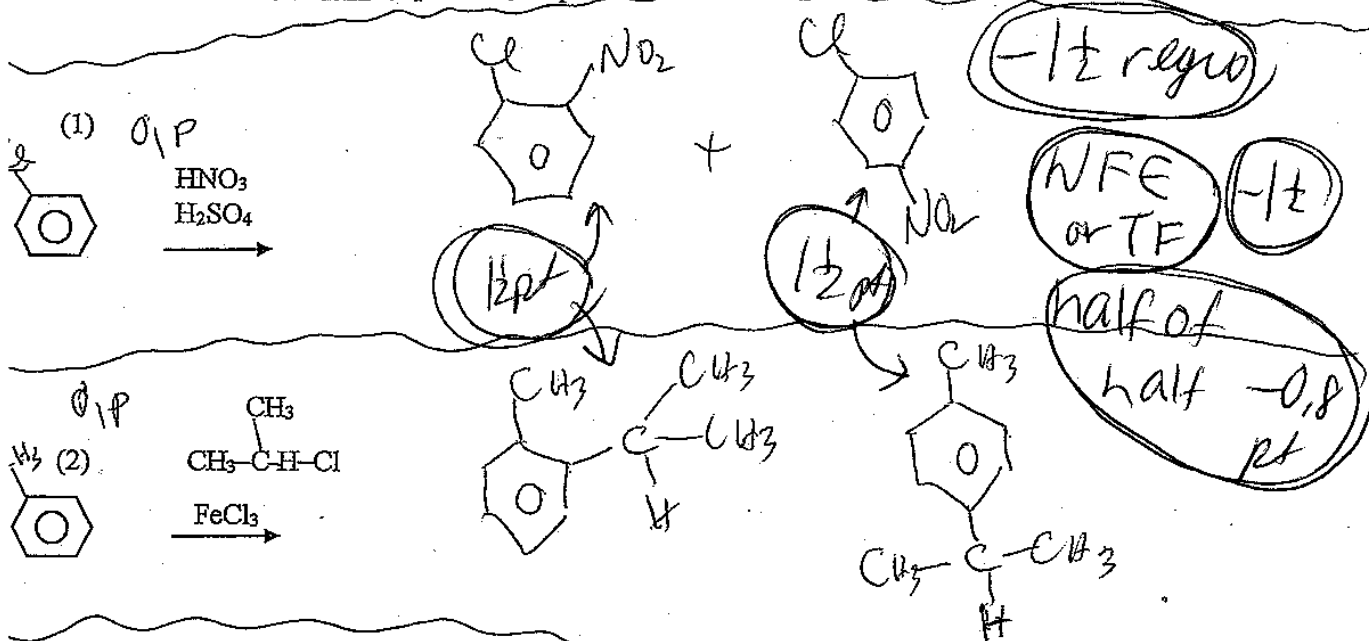
~~hept-4-yne-2-one~~ E-hept-4-en-2-one



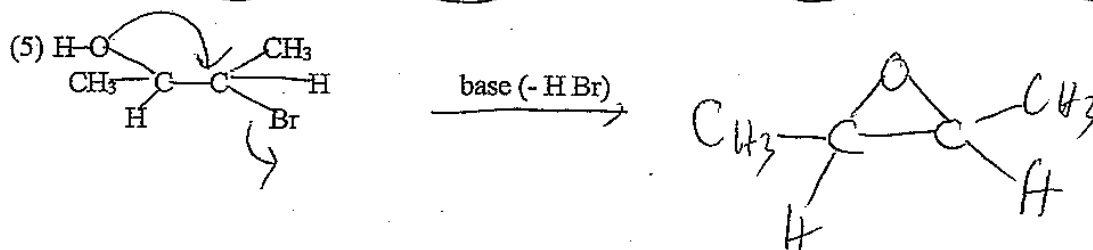
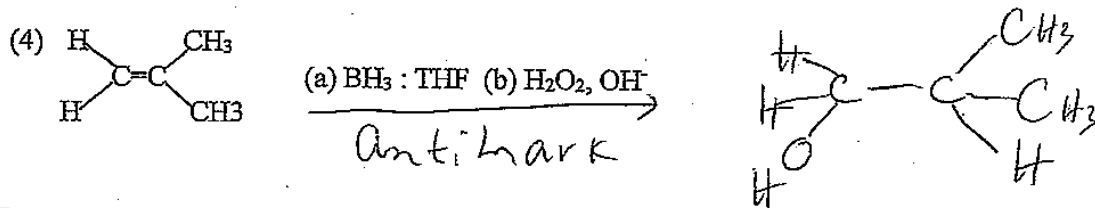
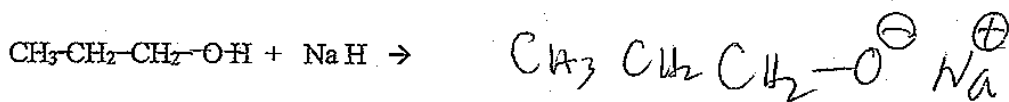


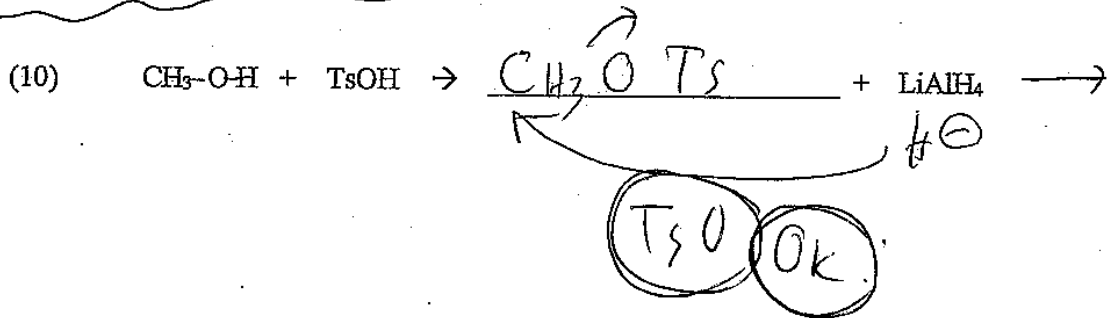
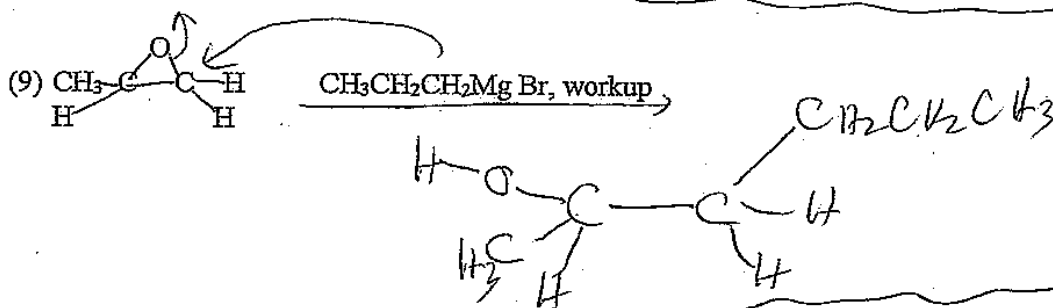
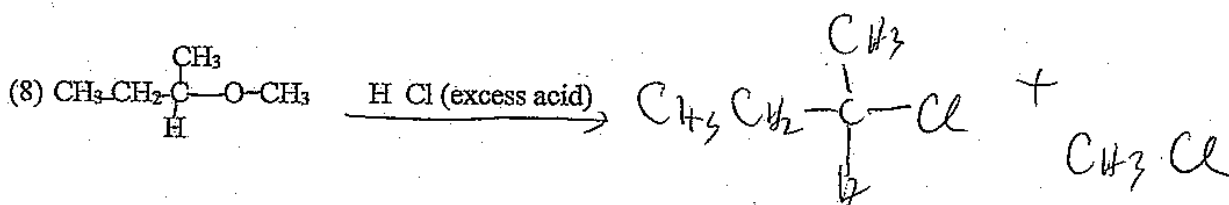
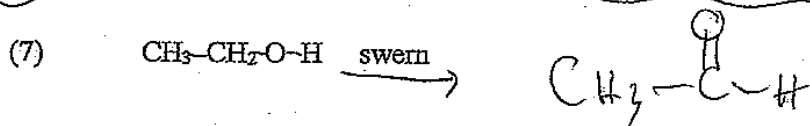
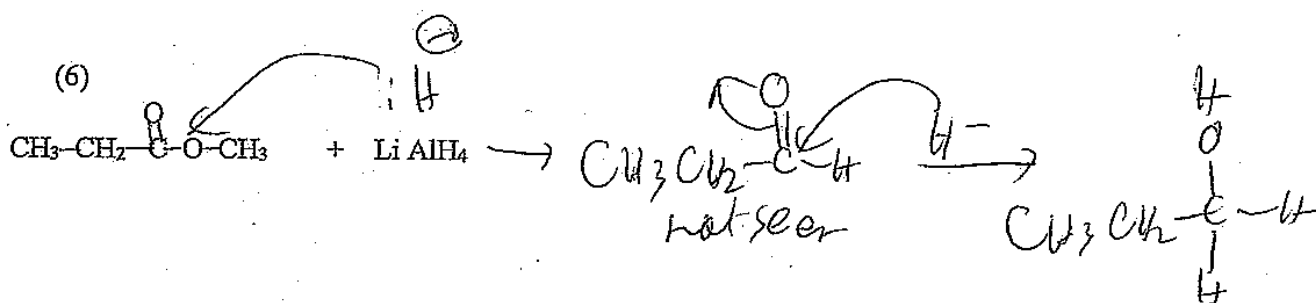
B. Reactions Part of Short Answers: (3 pts per reaction, 21 pts total)

Given the following, what is the the expected organic product? **Choose to do 7** of the following reactions you want graded by circling the letter of the reaction. If you do not choose, I will just grade the first **SEVEN** (3 pts each, 21 pts)



(3)

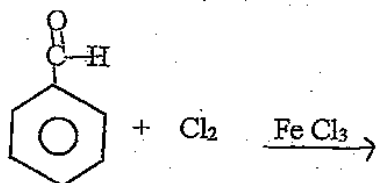




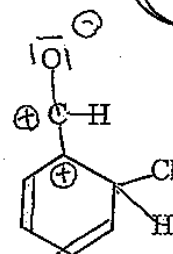
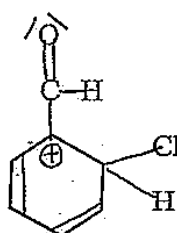
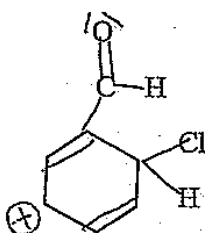
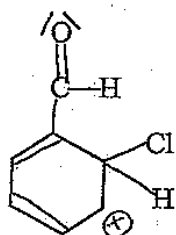
$\text{CH}_4$

C. Short Answers part of Short Answers: (16 pts)

1. For a halogenation reaction the arenium resonance structure generated during the reaction mechanism are shown. (8 pts total)



- a. Given the following resonance structures, does the directing group shown act as a [(o,p activator) or (m deactivator)] (circle one entire parenthesis). (4 pts)



extra  
wrong - 1/2

1 pt

1 pt

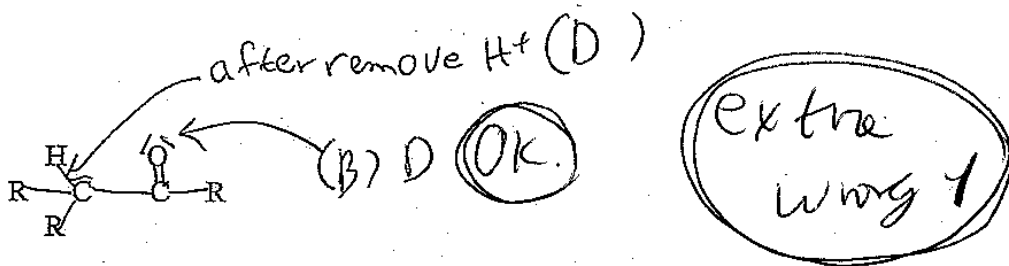
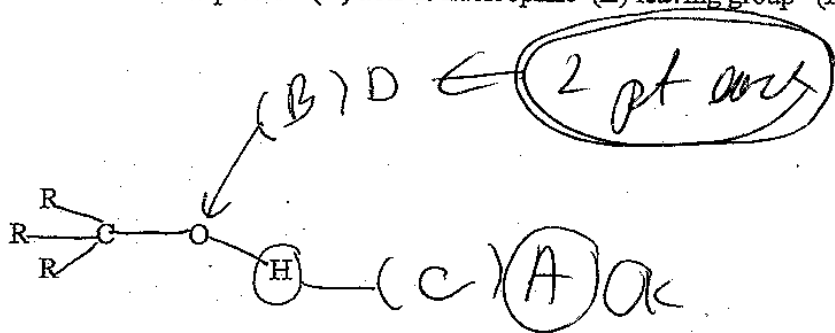
- b. Which of the resonance structures above determines the directing group effect which you chose above? Circle the resonance structure number and explain. You may circle more than one resonance structure and explain both resonance structures which you chose. (4 pts)

(3) has  $\bar{e}$  withdrawing group next to  $\oplus$  charge - unstable  
 (4) has  $\oplus$  charge next to  $\oplus$  charge unstable - m deactivator  
 are unstable for o,p so go by meta regiochemistry - (3) + (4) destabilize  
 $\underline{\underline{\text{O}}}$  arenium

explained one - 1/2

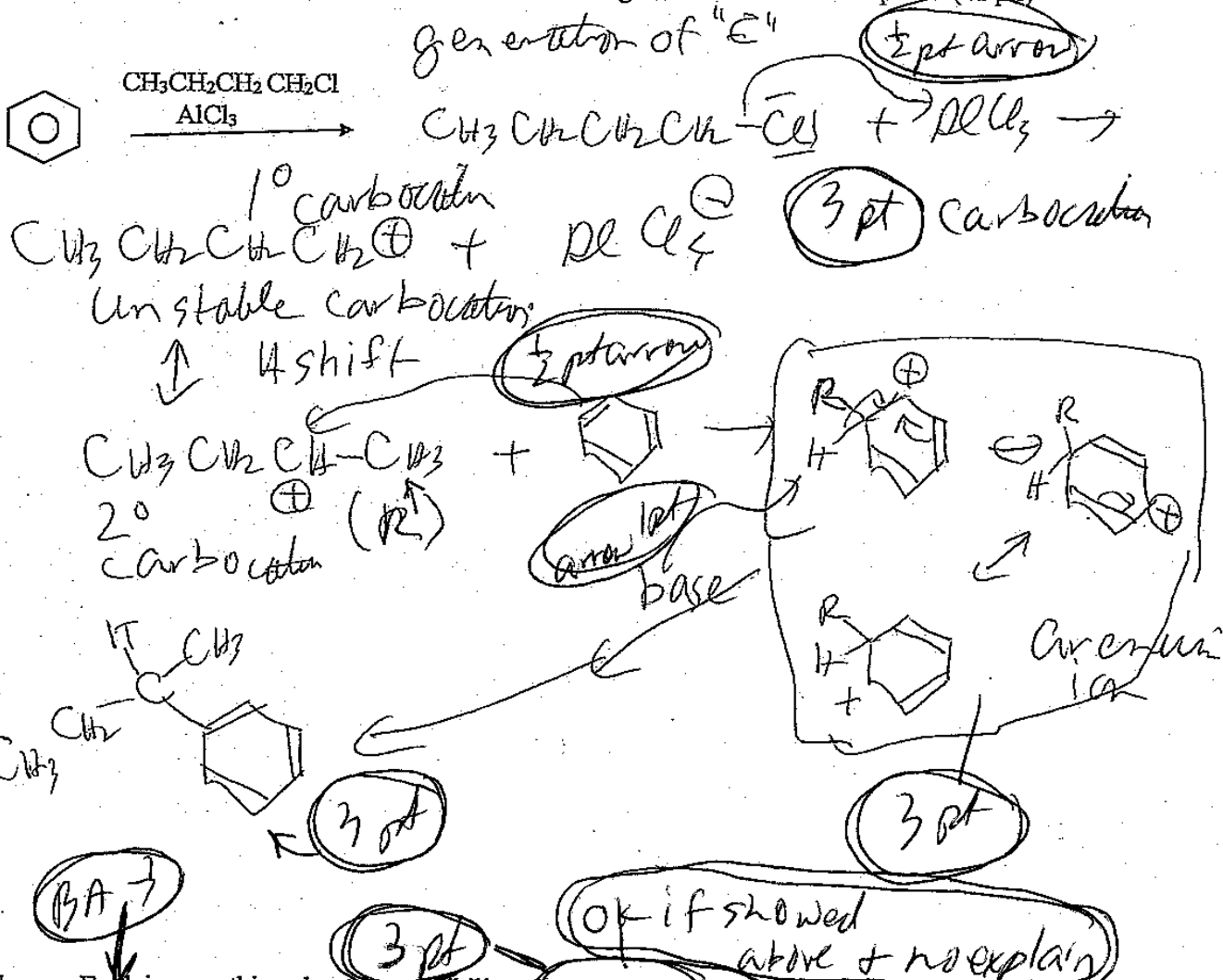
attempt explain 1

2. Fill in the blank parenthesis with a letter. (A) reacts with nucleophile (B) reacts with acid (C) is an acidic proton (D) acts as nucleophile (E) leaving group ( $R \neq H$ ) (2 pts, 8 pts total)



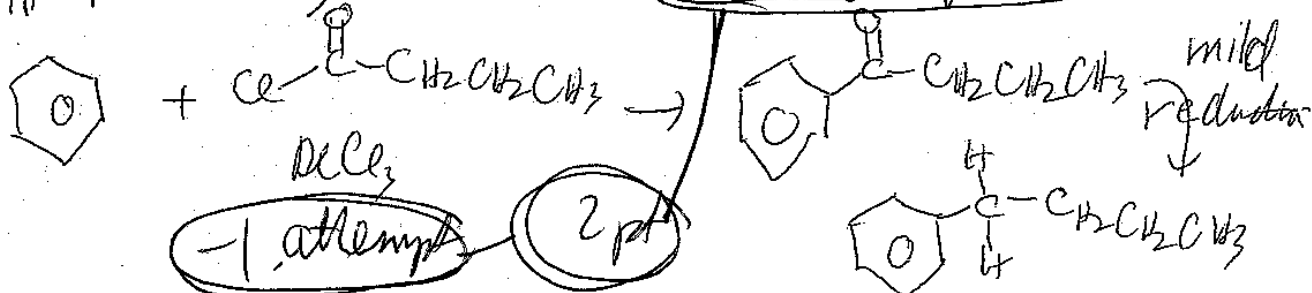
Part III. Long Answers (28 pts) Show work where applicable for full and partial credit.

1. a. Show the electrophilic substitution reaction mechanism for the following reaction. You must show the arenium resonance structures AND the generation of the electrophile. (11 pts)

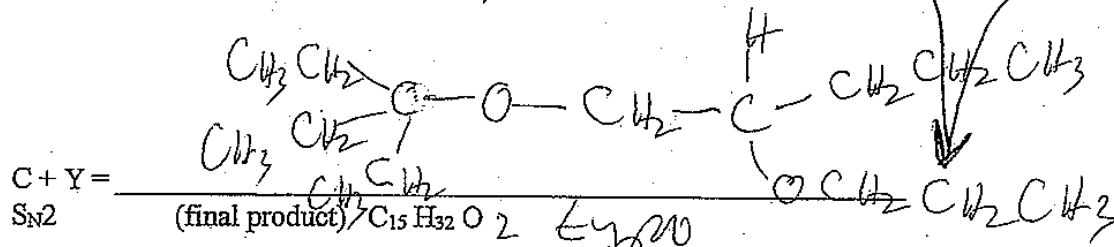
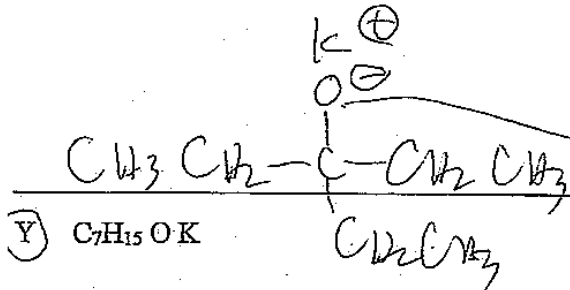
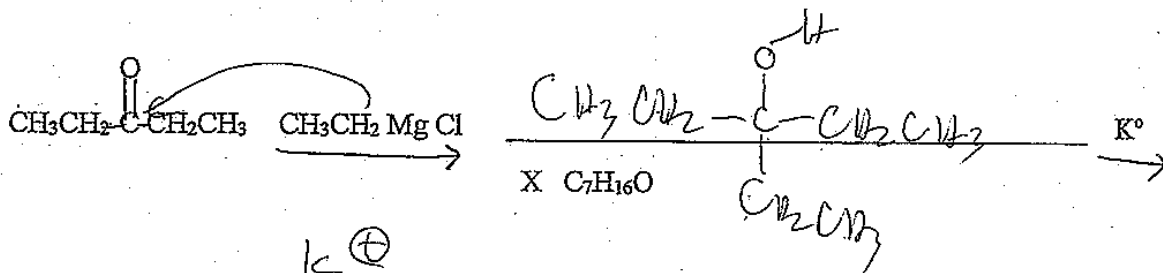
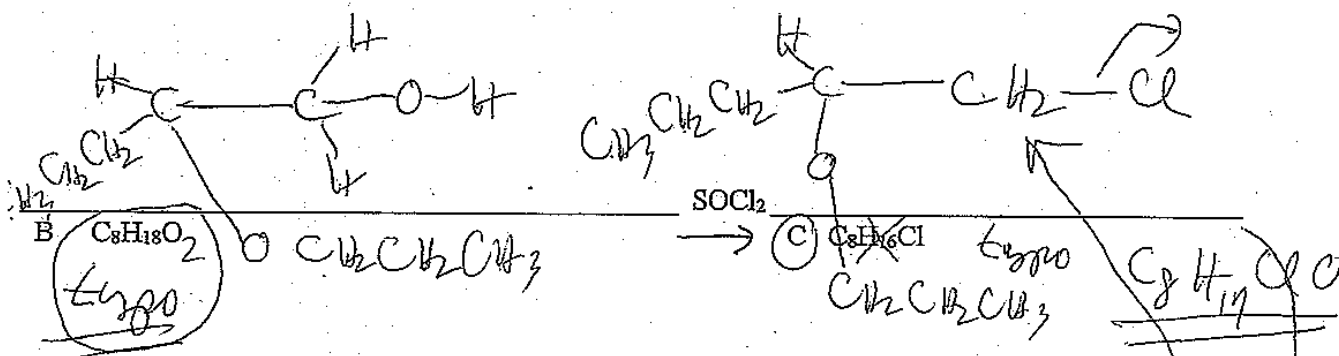
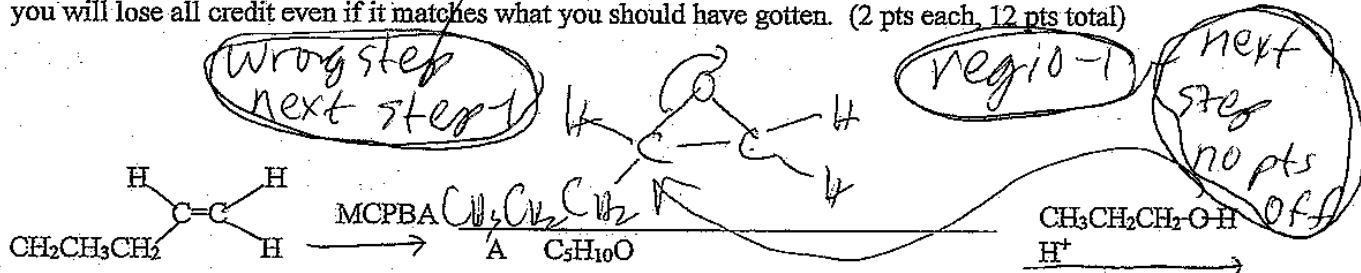


- b. Explain something about the possibility of rearrangement and a possible alternate reaction to obtain the desired product of the above reaction. (5 pts)

2° carbocation more stable than 1° carbocation  
 Will rearrange to 2° - alternate path



2 Complete the following synthesis by filling in the blank. I have provided some hints to help you come up with the answers. NOTE: The way I grade this is for you to fill in reasonable molecules based on the immediate prior molecule. i.e. If you fill in part A with the wrong molecule and then do the next reaction to molecule B correctly you will get half credit for answering B correctly. If you fill in B with what you would have gotten if you got A correctly but which cannot possibly be generated from your wrong A, you will lose all credit even if it matches what you should have gotten. (2 pts each, 12 pts total)



II. Short Answers (45 pts)

A. Nomenclature: (2 pts each, 8 pts)

key so can read answer

1. Given the structural formula shown below, give the IUPAC name of the molecule.

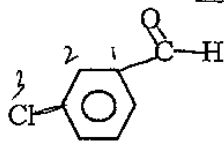
a. name

3-chlorobenzaldehyde or

benzaldehyde

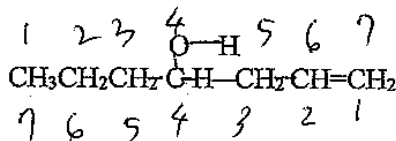
chloro

m-chlorobenzaldehyde



b. name

hept-1-en-4-ol

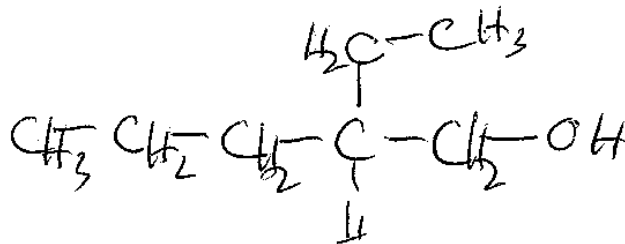


hept-1-en-4-ol

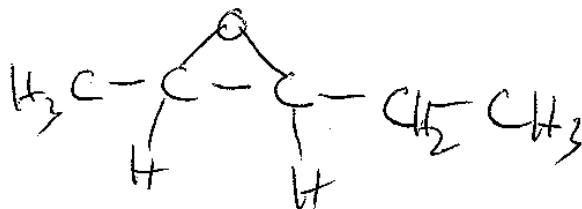
al - higher priority

2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable - don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)

a. 2-ethyl-1-pentanol

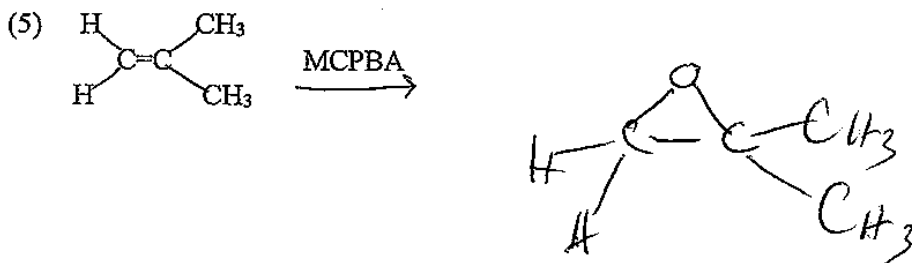
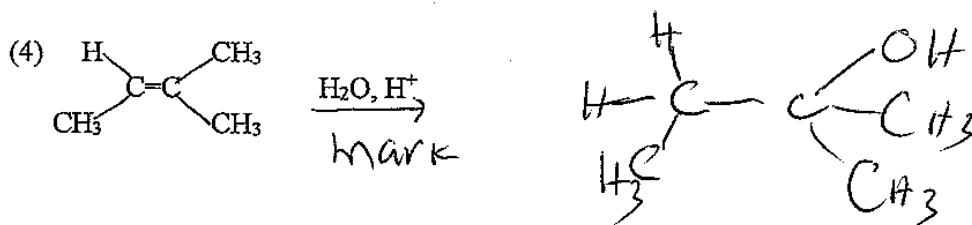
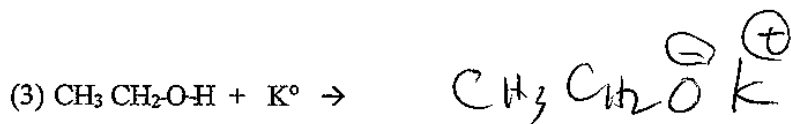
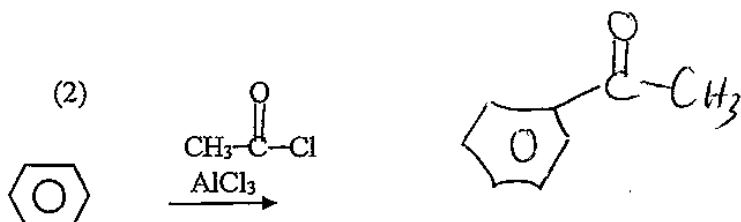
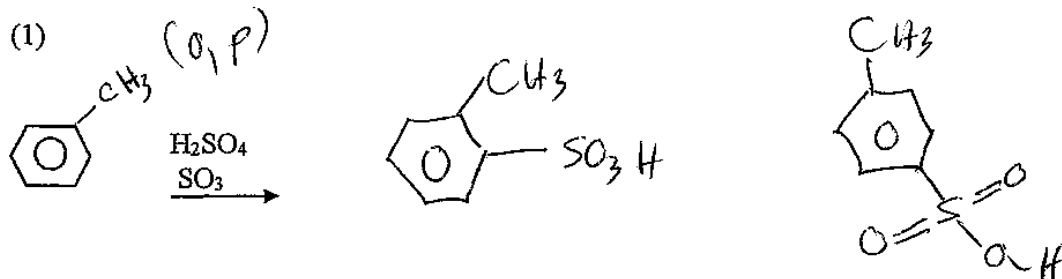


b. 2,3-epoxypentane

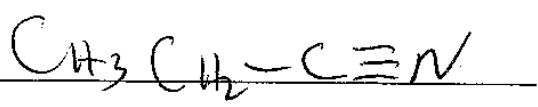
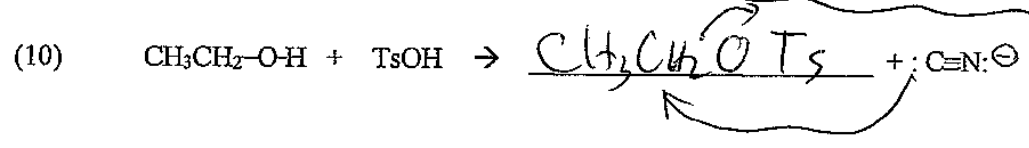
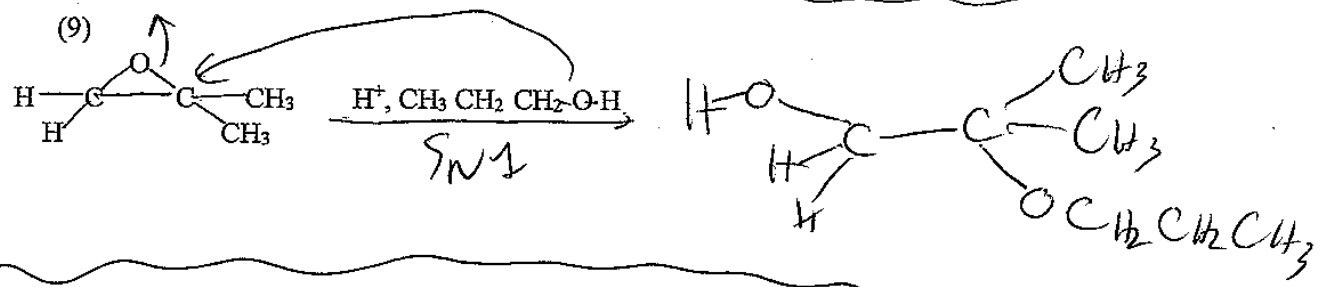
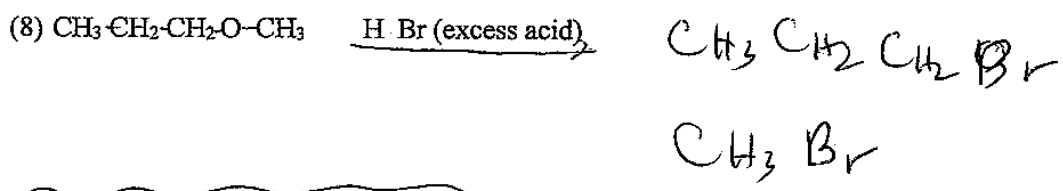
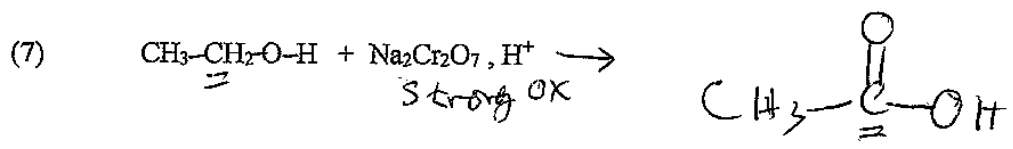
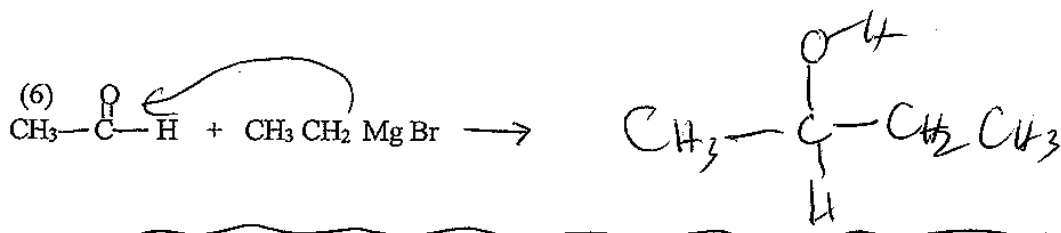


B. Reactions Part of Short Answers: (3 pts per reaction, 21 pts total)

Given the following, what is the the expected organic product? **Choose to do 7** of the following reactions you want graded by circling the letter of the reaction. If you do not choose, I will just grade the first **SEVEN** (3 pts each, 21 pts)

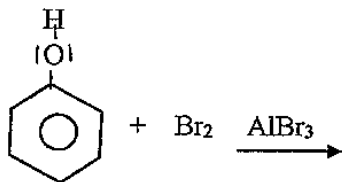




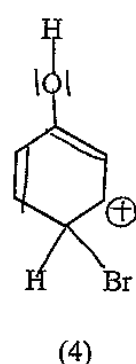
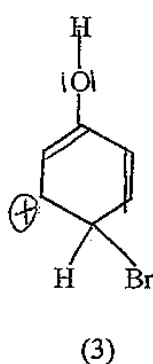
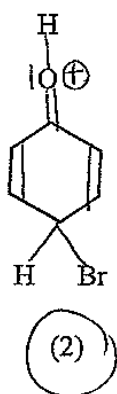
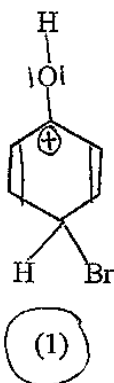


C. Short Answers part of Short Answers: (16 pts)

1. For a halogenation reaction the arenium resonance structure generated during the reaction mechanism are shown. (8 pts total)



- a. Given the following resonance structures, does the directing group shown act as a [(o,p activator) or (m deactivator)] (circle one entire parenthesis). (4 pts)



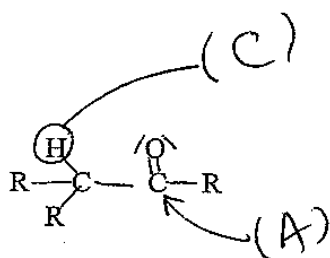
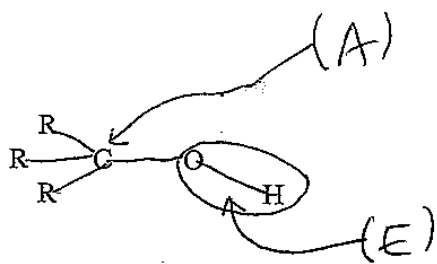
- b. Which of the resonance structures above determines the directing group effect which you chose above? Circle the resonance structure number and explain. You may circle more than one resonance structure and explain both resonance structures which you chose. (4 pts)

① 1 stabilizes + charge next to it

② extra resonance structure delocalizes + charge outside the ring

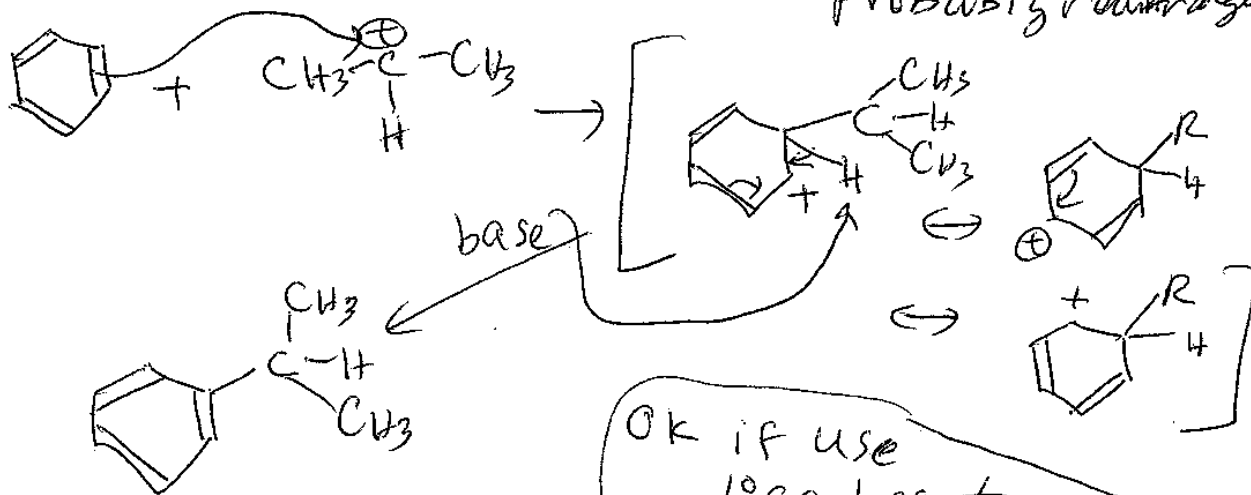
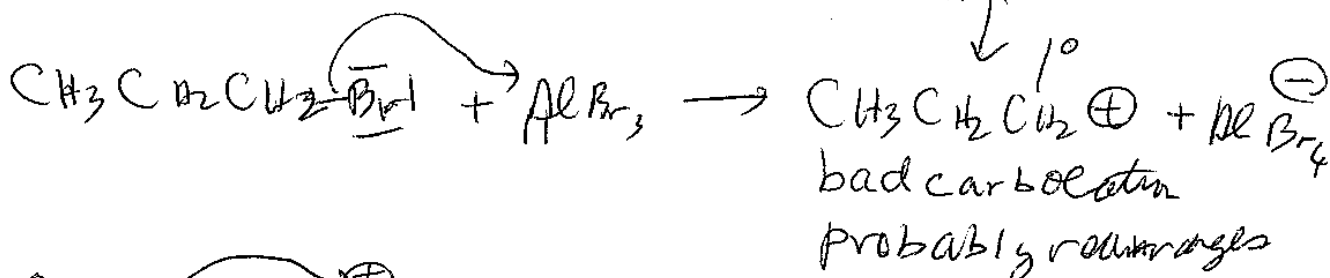
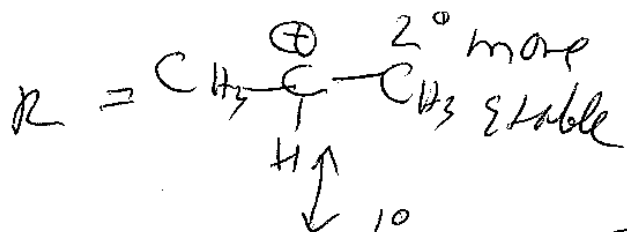
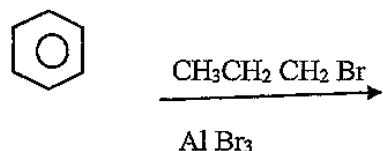
① + ② stabilizes p resulting in lower energy for p intermediate

2. Fill in the blank parenthesis with a letter. (A) reacts with nucleophile (B) reacts with acid (C) is an acidic proton (D) acts as nucleophile (E) leaving group ( $R \neq H$ ) (2 pts, 8 pts total)



Part III. Long Answers (28 pts) Show work where applicable for full and partial credit.

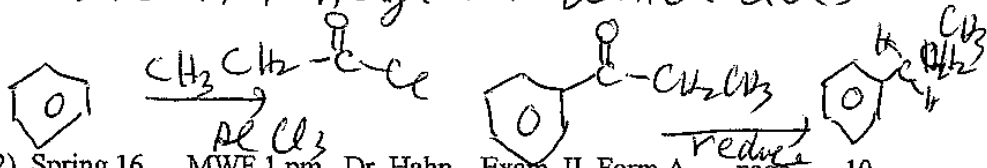
1. a. Show the electrophilic substitution reaction mechanism for the following reaction. You must show the arenium resonance structures AND the generation of the electrophile. (11 pts)



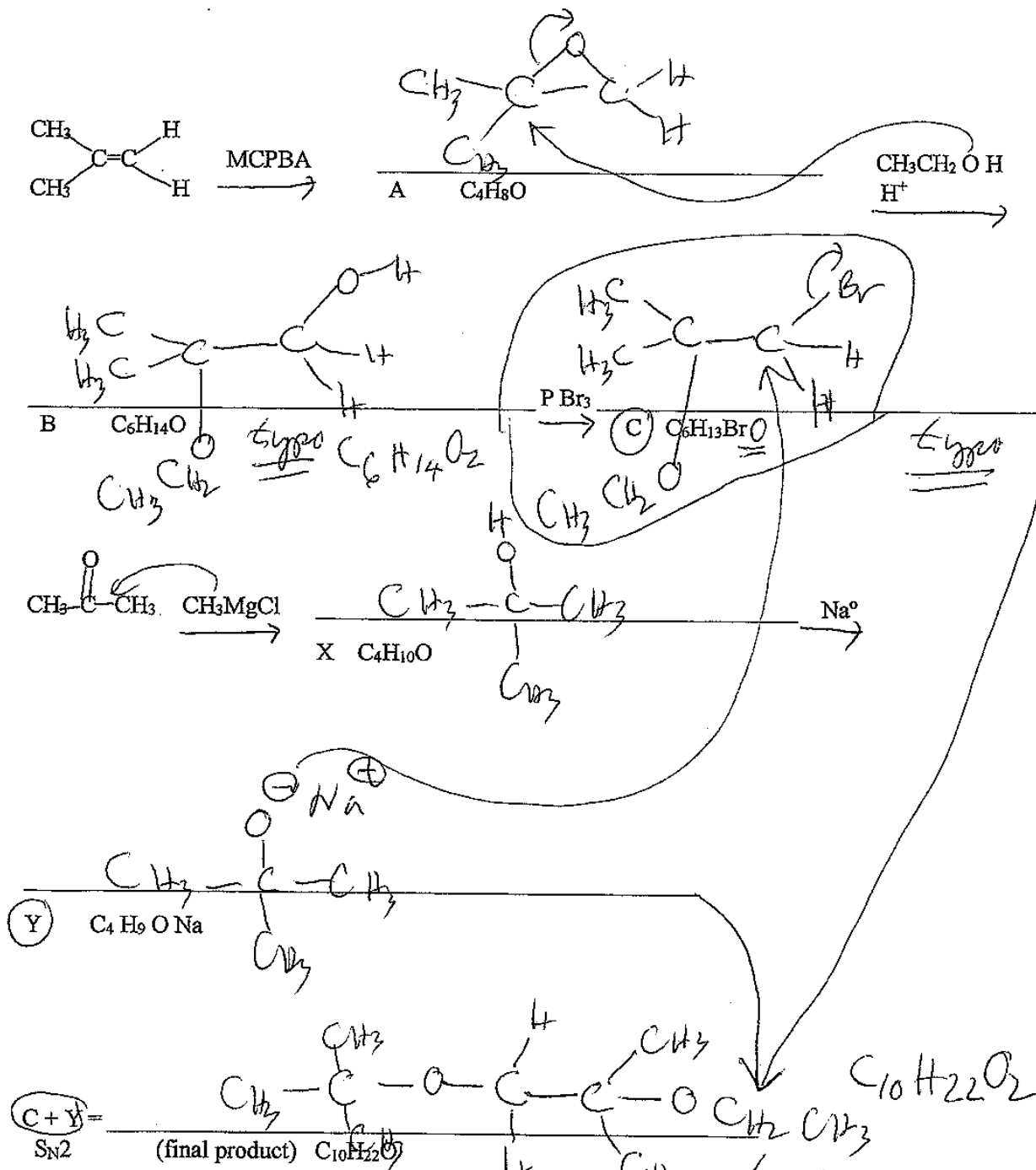
OK if use 1° carbocation - not likely but ok.

- b. Explain something about the possibility of rearrangement and a possible alternate reaction to obtain the desired product of the above reaction. (5 pts)

Mechanism goes by carbocation - This is bad carbocation so will predominantly go by rearrangement. Use F.C. acylation which does not rearrange



2 Complete the following synthesis by filling in the blank. I have provided some hints to help you come up with the answers. NOTE: The way I grade this is for you to fill in reasonable molecules based on the immediate prior molecule. i.e. If you fill in part A with the wrong molecule and then do the next reaction to molecule B correctly you will get half credit for answering B correctly. If you fill in B with what you would have gotten if you got A correctly but which cannot possibly be generated from your wrong A, you will lose all credit even if it matches what you should have gotten. (2 pts each, 12 pts total)



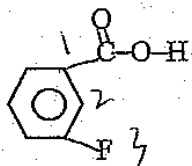
II. Short Answers (45 pts)

A. Nomenclature: (2 pts each, 8 pts)

key so can see

1. Given the structural formula shown below, give the IUPAC name of the molecule.

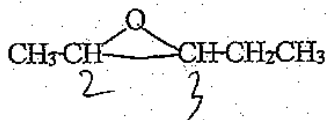
a. name 3-fluorobenzoic acid *answer*



benzoic acid

m-fluorobenzoic acid

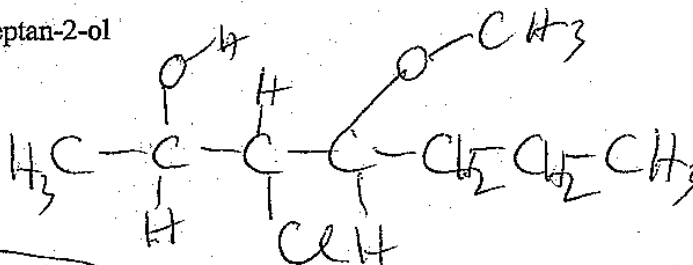
b. name 2,3-epoxypentane



pentane

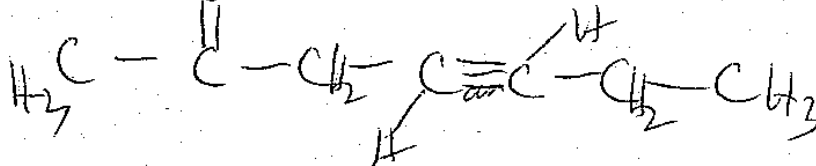
2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable - don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)

a. 3-chloro-4-methoxyheptan-2-ol



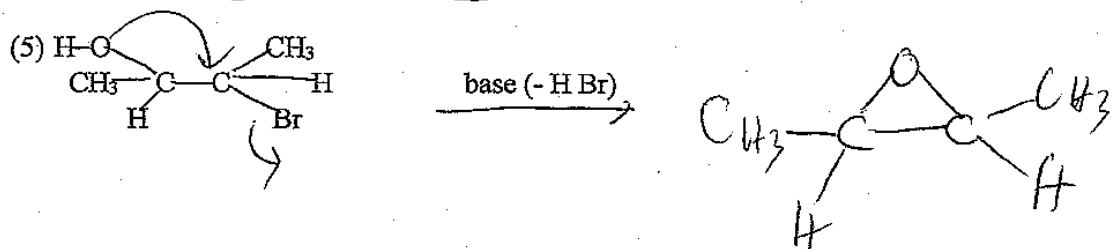
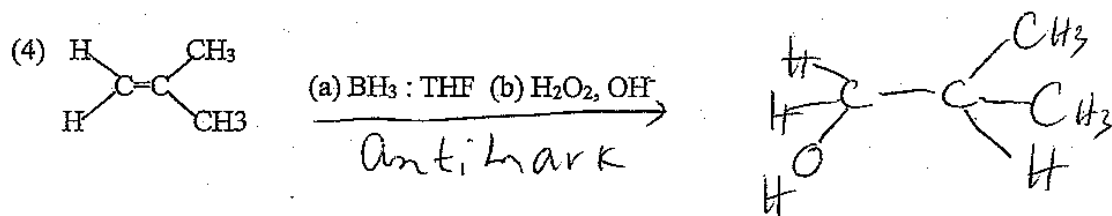
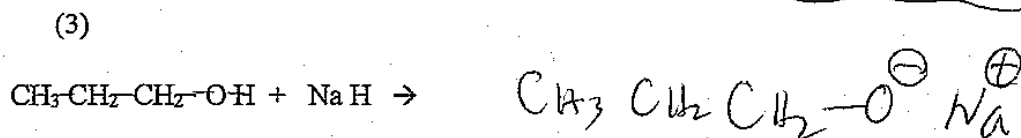
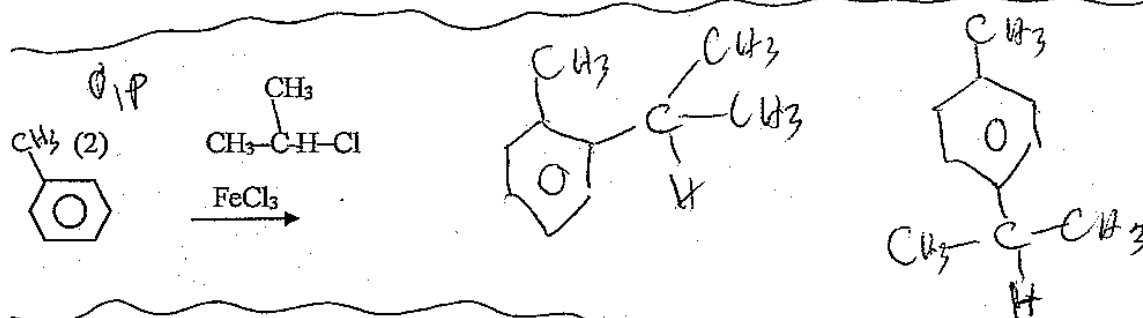
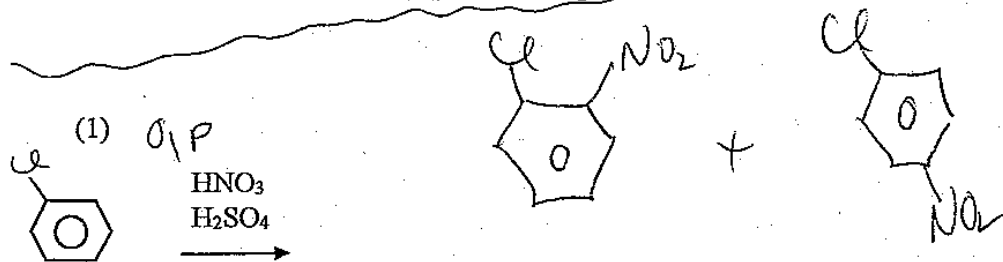
b. Hept-4-yne-2-one

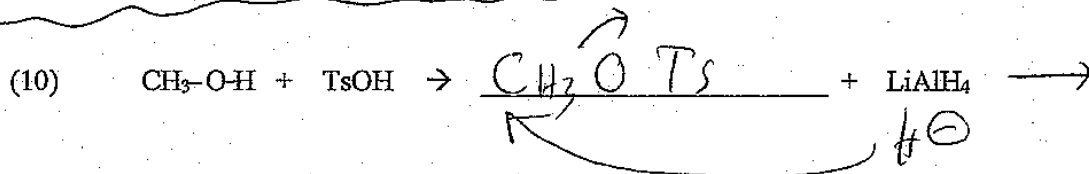
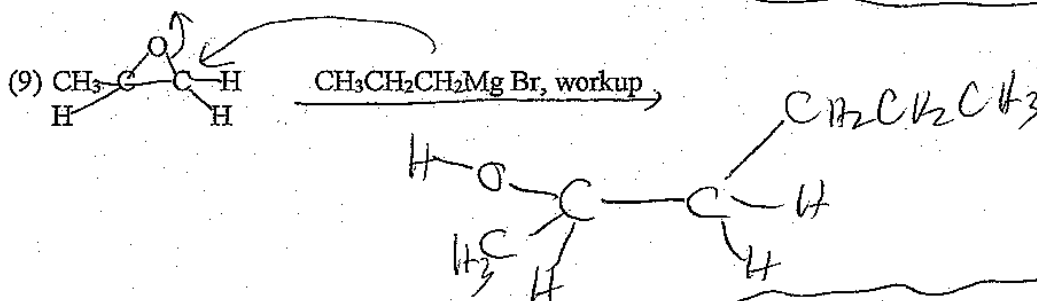
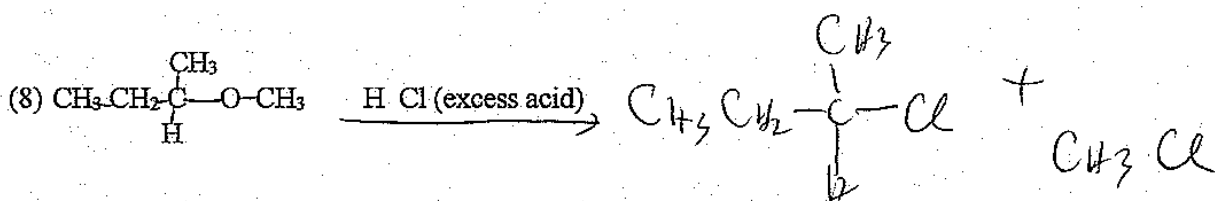
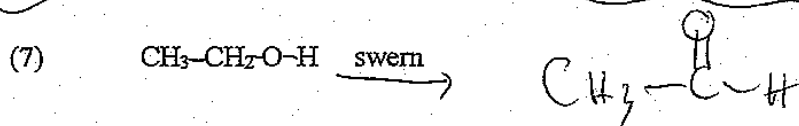
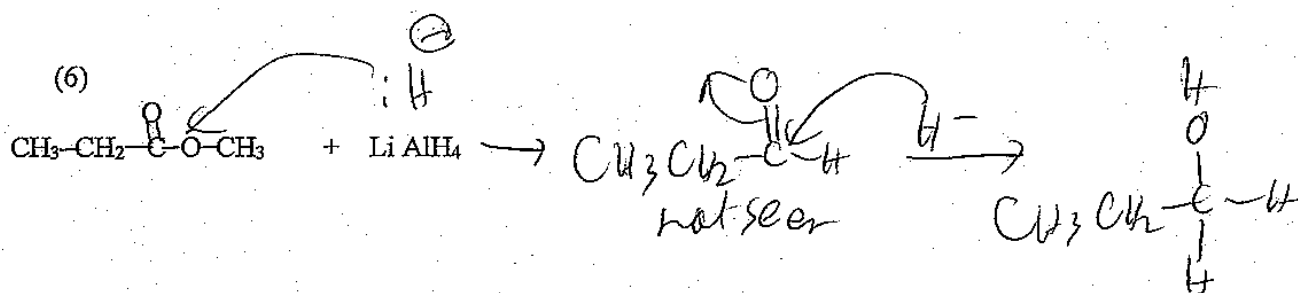
Eyne - yne - ene → E-hept-4-en-2-one



B. Reactions Part of Short Answers: (3 pts per reaction, 21 pts total)

Given the following, what is the the expected organic product? **Choose to do 7** of the following reactions you want graded by circling the letter of the reaction. If you do not choose, I will just grade the first **SEVEN** (3 pts each, 21 pts)



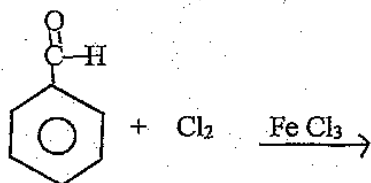


CH<sub>4</sub>

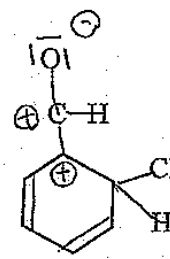
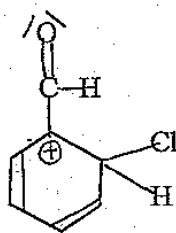
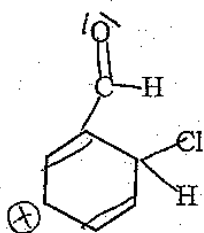
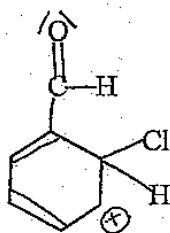


C. Short Answers part of Short Answers: (16 pts)

1. For a halogenation reaction the arenium resonance structure generated during the reaction mechanism are shown. (8 pts total)



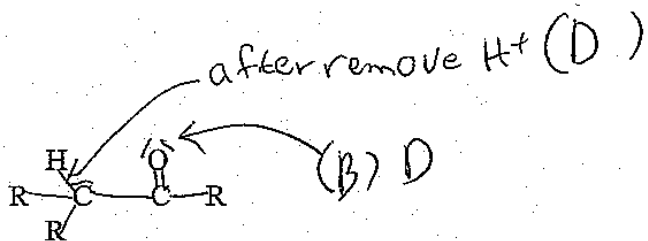
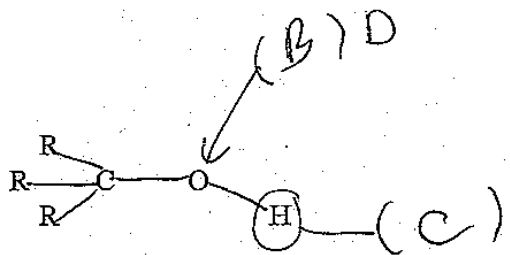
- a. Given the following resonance structures, does the directing group shown act as a [(o,p activator) or (m deactivator)] (circle one entire parenthesis). (4 pts)



- b. Which of the resonance structures above determines the directing group effect which you chose above? Circle the resonance structure number and explain. You may circle more than one resonance structure and explain both resonance structures which you chose. (4 pts)

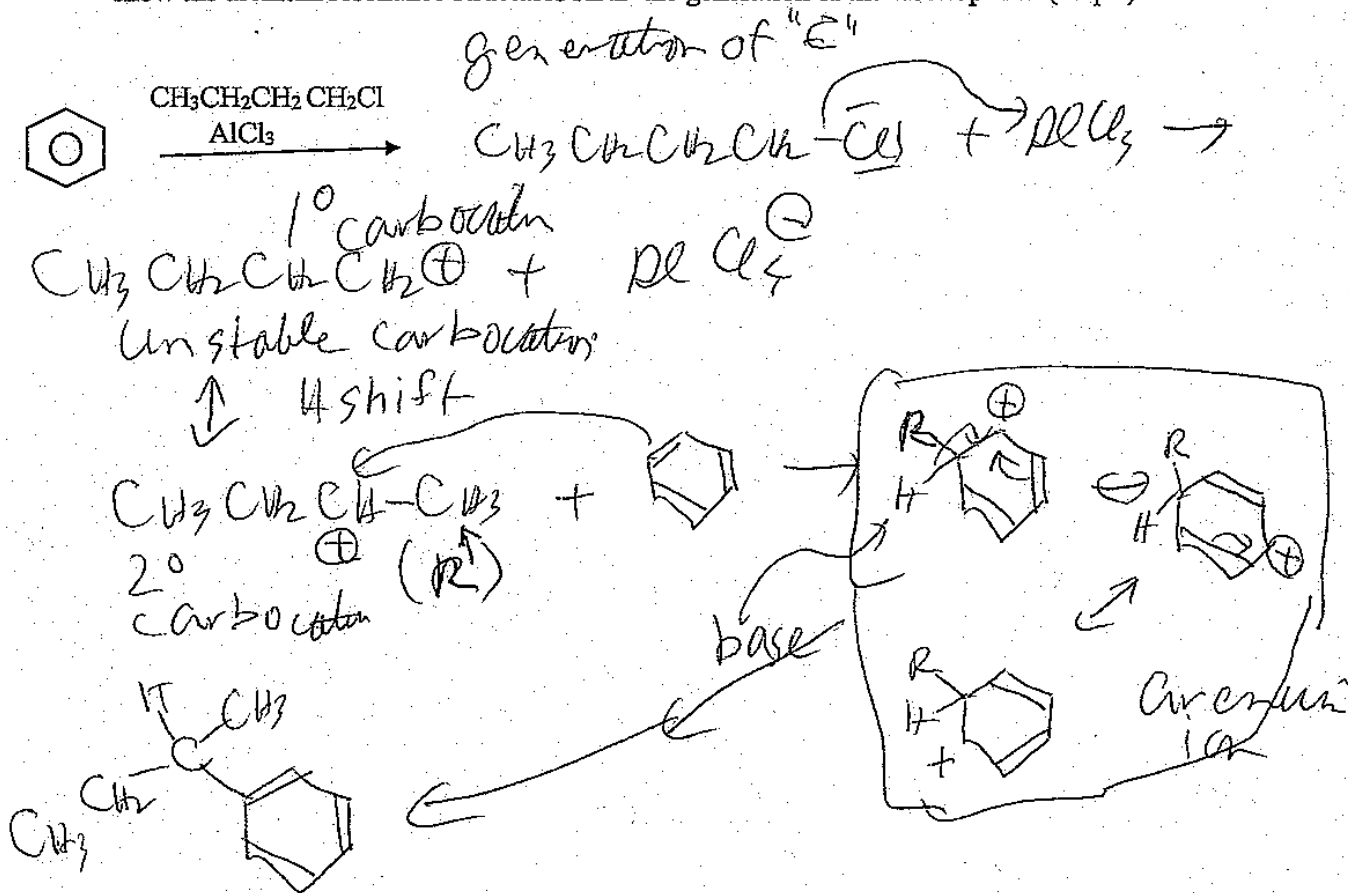
(3) has  $\bar{e}$  withdrawing group next to  $\oplus$  charge - unstable (4) has  $\oplus$  charge next to  $\oplus$  charge unstable - m deactivator are unstable for o,p so go by meta regiochemistry - (3) + (4) destabilize arenium

2. Fill in the blank parenthesis with a letter. (A) reacts with nucleophile (B) reacts with acid (C) is an acidic proton (D) acts as nucleophile (E) leaving group ( $R \neq H$ ) (2 pts, 8 pts total)



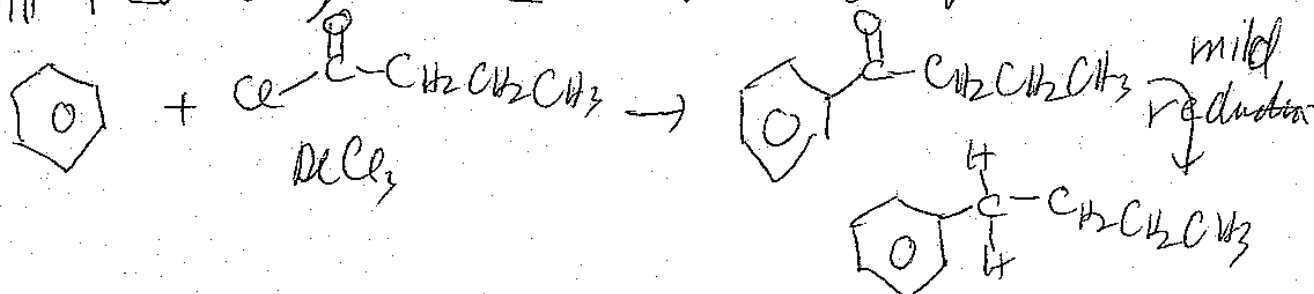
Part III. Long Answers (28 pts) Show work where applicable for full and partial credit.

1. a. Show the electrophilic substitution reaction mechanism for the following reaction. You must show the arenium resonance structures AND the generation of the electrophile. (11 pts)

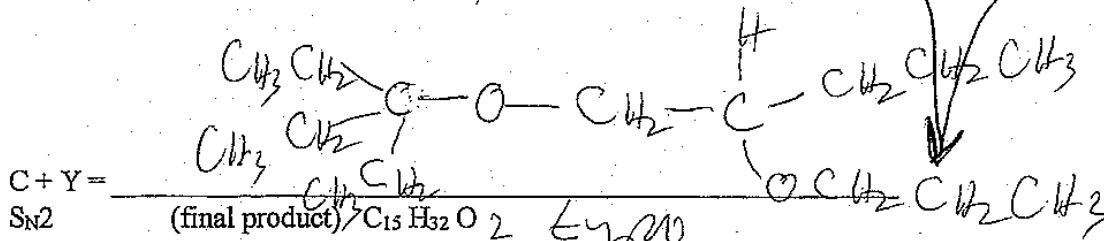
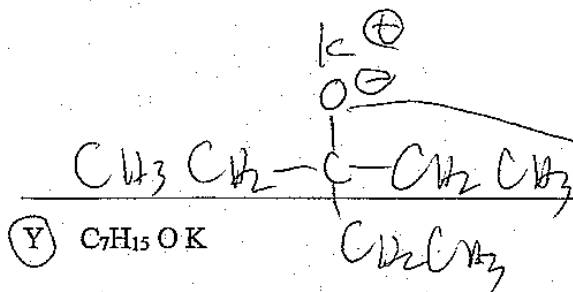
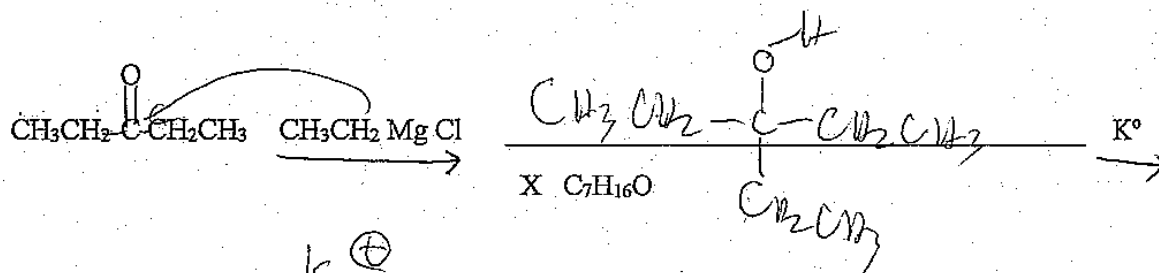
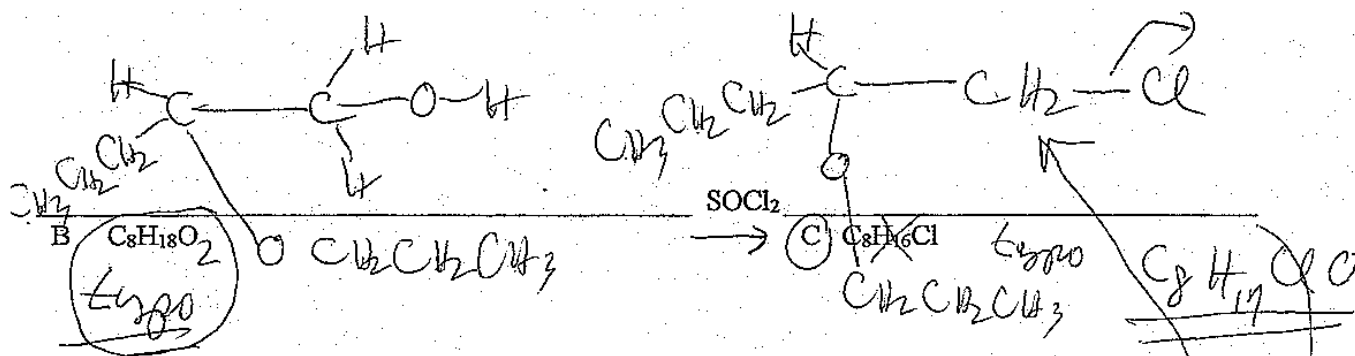
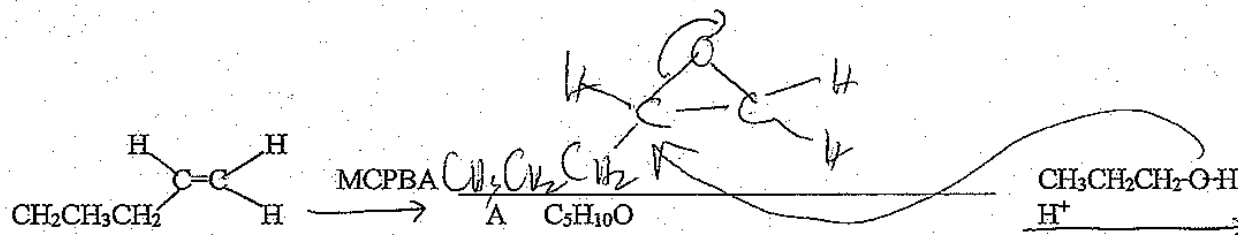


- b. Explain something about the possibility of rearrangement and a possible alternate reaction to obtain the desired product of the above reaction. (5 pts)

2° carbocation more stable than 1° carbocation  
 Will rearrange to 2° - alternate path



2 Complete the following synthesis by filling in the blank. I have provided some hints to help you come up with the answers. NOTE: The way I grade this is for you to fill in reasonable molecules based on the immediate prior molecule. i.e. If you fill in part A with the wrong molecule and then do the next reaction to molecule B correctly you will get half credit for answering B correctly. If you fill in B with what you would have gotten if you got A correctly but which cannot possibly be generated from your wrong A, you will lose all credit even if it matches what you should have gotten. (2 pts each, 12 pts total)



Sign Name \_\_\_\_\_ Print Name \_\_\_\_\_  
(2 pts name above print & sign, 2 pt scantron name) (100 pts, 11 pages + periodic table + scantron sheet)

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper – If you want me to grade something not in the space for the answer, clearly specify in writing. Telling me during the exam where to find the answer does not qualify because I will just vaguely remember someone telling me something during the exam not which one of 200 students told me what to grade on what page.)

Circle answer on this form for backup to the scantron. There is no partial credit for showing work in the multiple choice.

In all questions on all parts of this exam, R is not equal to hydrogen but is an alkyl.

I. Multiple Choice (3 pts each, 27 pts) Choose the **one** best statement in each question.

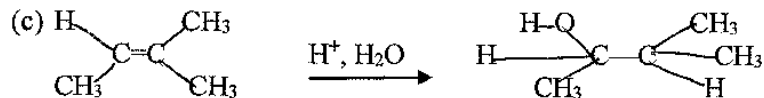
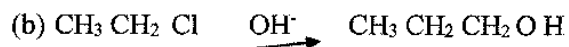
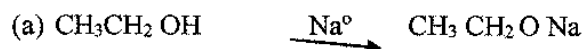
1. Primary alcohol will go to aldehydes by reaction with the following reagent. Choose the best statement.

- (a) swern
- (b) PCC
- (c) Jones
- (d) All above reagents are correct.
- (e) (a) and (b) are correct.

2. To generate an alcohol from an alkene, one may use which of the following reagents over the arrow.

- (a) (1)  $\text{Hg}(\text{OAc})_2$ , THF/ $\text{H}_2\text{O}$  (2)  $\text{OH}^-$ ,  $\text{NaBH}_4$  to give Markovnikov product without the possibility of rearrangement.
- (b) Alkene reaction with MCPBA followed by reaction of a Grignard followed by workup.
- (c)  $\text{H}^+/\text{H}_2\text{O}$  to give Markovnikov product.
- (d) (1)  $\text{BH}_3 \cdot \text{THF}$  (2)  $\text{H}_2\text{O}_2$ ,  $\text{OH}^-$  to give anti-Markovnikov product
- (e) All above statements are true.

3 Choose the best statement or correct reaction.



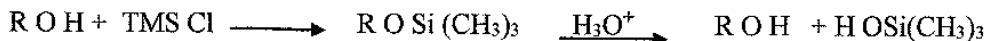
(e) all reactions shown are incorrect.

4. Choose the best statement below about alcohols.

(a) TsOH reaction is used to make a protected alcohol which does not react with almost anything.



(b) TMS Cl is a way to make an especially good leaving group replacing the rather bad leaving group O H of an alcohol with the much better reacting TMS ether.

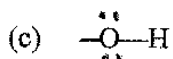
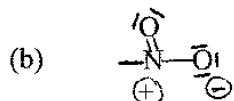


(c) Alcohols can be synthesized by S<sub>N</sub>2 or S<sub>N</sub>1 substitution reaction on some R X using reagents such as Na OH or H<sub>2</sub>O

(d) All statements above are true.

(e) (a) and (b) are true.

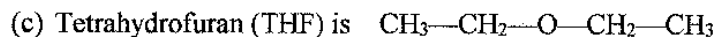
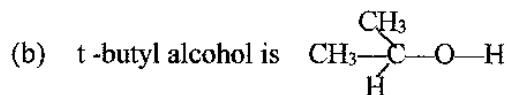
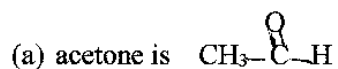
5 Which of the following is a o,p activator ? I am showing the part that attaches to the benzene ring.



(d) (a) & (c) are o,p activators

(e) None shown are o,p activators.

6 Choose the best statement.



(d) All letters above are false

(e) All statements above are true [except for letter (d)]

7 Choose the one best statement.

(a) Alcohols have unusually low BP/MP for comparable sized alkanes because of hydrogen bonding between molecules of alcohol.

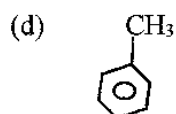
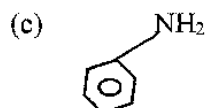
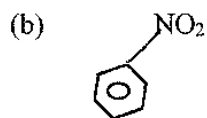
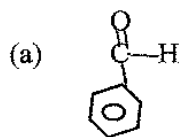
(b) Small alkyl chain alcohols are water soluble because of hydrogen bonding while long alkyl chain alcohol are not water soluble because the molecule is predominately an alkyl chain.

(c) Ethers are good solvents because they are polar but don't have hydrogen bonding and are inert to a lot of reactions.

(d) (a) and (c) are true.

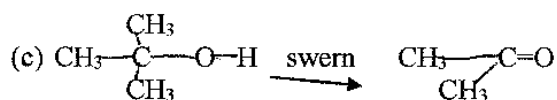
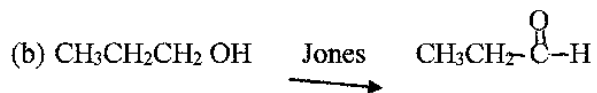
(e) (b) and (c) are true.

8. Which of following is the molecule toluene



(e) None of the above is toluene

9. Choose the best statement or correct reaction.



(d) All of the above reactions are wrong.

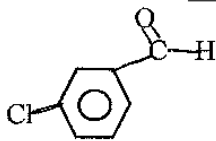


II. Short Answers ( 45 pts)

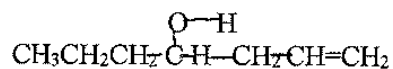
A. Nomenclature: (2 pts each, 8 pts)

1. Given the structural formula shown below, give the IUPAC name of the molecule.

a. name \_\_\_\_\_



b. name \_\_\_\_\_



2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable - don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)

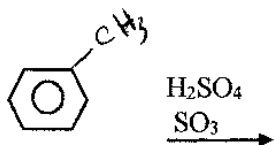
a. 2-ethyl-1-pentanol

b. 2,3-epoxypentane

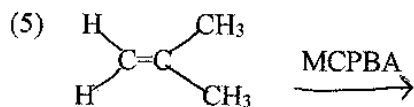
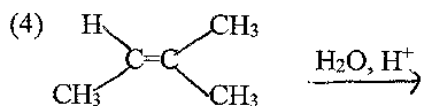
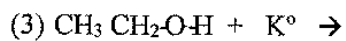
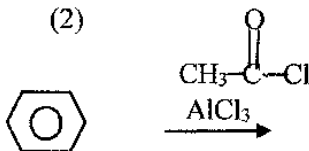
B. Reactions Part of Short Answers: (3 pts per reaction, 21 pts total)

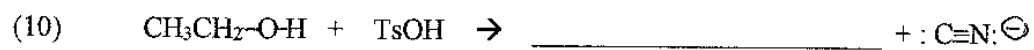
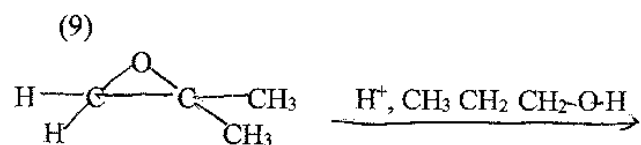
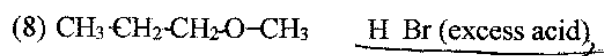
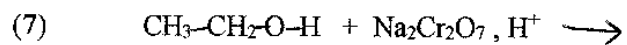
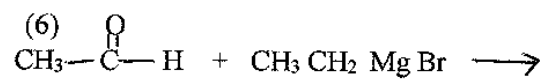
Given the following, what is the the expected organic product? **Choose to do 7** of the following reactions you want graded by circling the letter of the reaction. If you do not choose, I will just grade the first **SEVEN** (3 pts each, 21 pts)

(1)



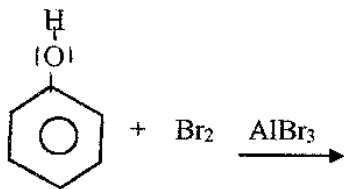
(2)



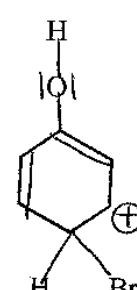
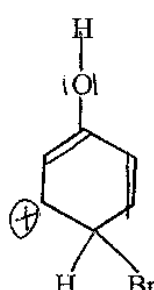
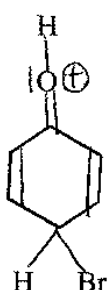
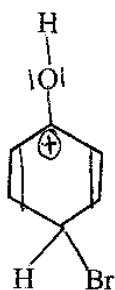


C. Short Answers part of Short Answers: (16 pts)

1. For a halogenation reaction the arenium resonance structure generated during the reaction mechanism are shown. (8 pts total)

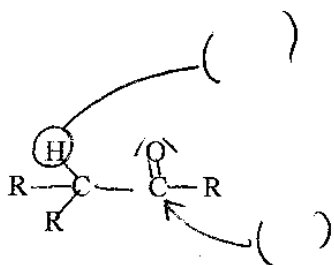
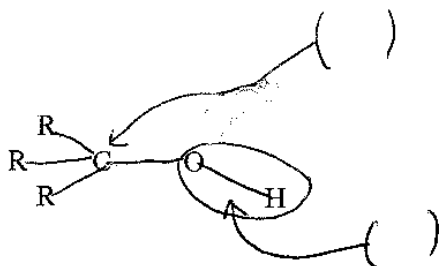


- a. Given the following resonance structures, does the directing group shown act as a [o,p activator) or (m deactivator)] (circle one entire parenthesis). (4 pts )



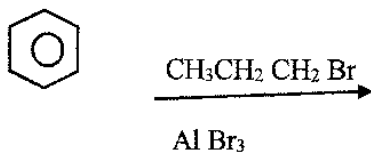
- b. Which of the resonance structures above determines the directing group effect which you chose above? **Circle the resonance structure number** and explain. You may circle more than one resonance structure and explain both resonance structures which you chose. (4 pts)

2. Fill in the blank parenthesis with a letter. (A) reacts with nucleophile (B) reacts with acid (C) is an acidic proton (D) acts as nucleophile (E) leaving group ( $R \approx H$ ) (2 pts, 8 pts total)



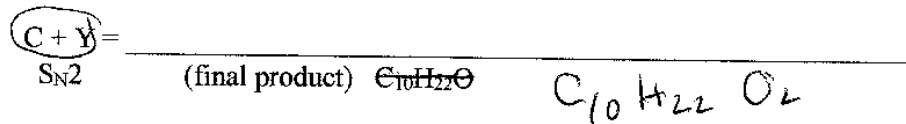
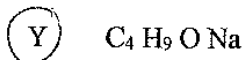
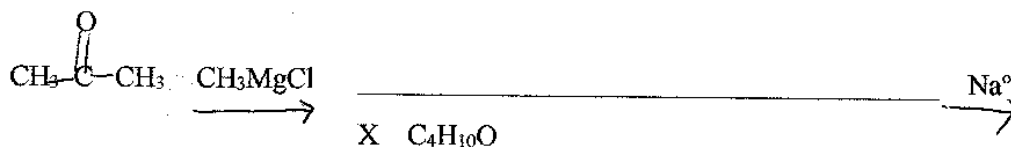
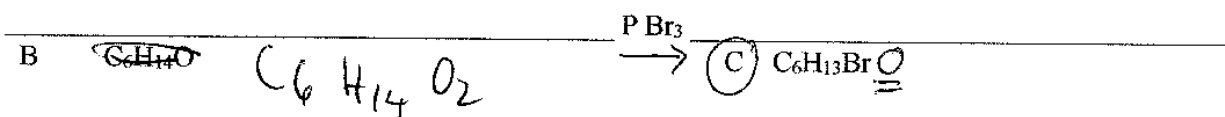
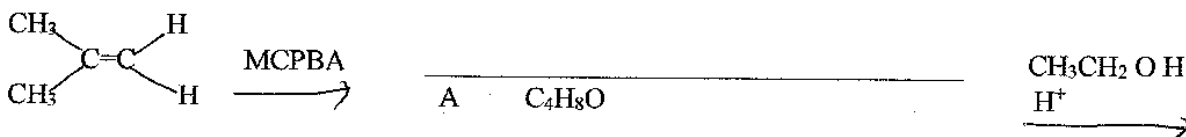
Part III. Long Answers (28 pts) Show work where applicable for full and partial credit.

1. a. Show the electrophilic substitution reaction mechanism for the following reaction. You must show the arenium resonance structures AND the generation of the electrophile. (11 pts)



- b. Explain something about the possibility of rearrangement and a possible alternate reaction to obtain the desired product of the above reaction. (5 pts)

2 Complete the following synthesis by filling in the blank. I have provided some hints to help you come up with the answers. NOTE: The way I grade this is for you to fill in reasonable molecules based on the immediate prior molecule. i.e. If you fill in part A with the wrong molecule and then do the next reaction to molecule B correctly you will get half credit for answering B correctly. If you fill in B with what you would have gotten if you got A correctly but which cannot possibly be generated from your wrong A, you will lose all credit even if it matches what you should have gotten. (2 pts each, 12 pts total)



Sign Name \_\_\_\_\_ Print Name \_\_\_\_\_

(2 pts name above print &amp; sign, 2 pt scantron name) (100 pts, 11 pages + periodic table + scantron sheet)

Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper – If you want me to grade something not in the space for the answer, clearly specify in writing. Telling me during the exam where to find the answer does not qualify because I will just vaguely remember someone telling me something during the exam not which one of 200 students told me what to grade on what page.)

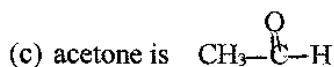
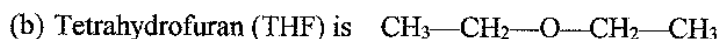
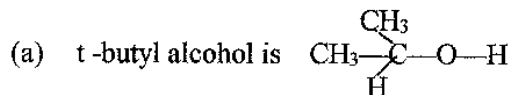
Circle answer on this form for backup to the scantron. There is no partial credit for showing work in the multiple choice.

color

In all questions on all parts of this exam, R is not equal to hydrogen but is an alkyl.

I. Multiple Choice (3 pts each, 27 pts) Choose the one best statement in each question.

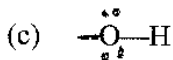
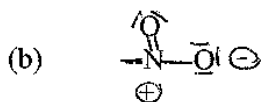
1. Choose the best statement.



(d) All letters above are false

(e) All statements above are true [except for letter (d)]

2. Which of the following is a o,p activator? I am showing the part that attaches to the benzene ring.

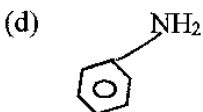
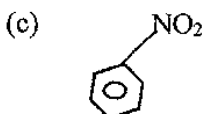
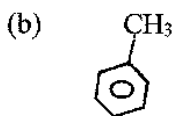
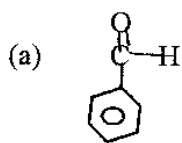


(d) (a) & (c) are o,p activators

(e) None shown are o,p activators.

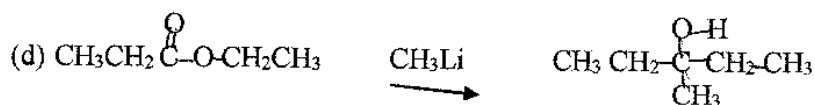
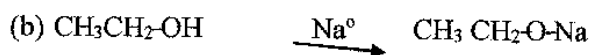
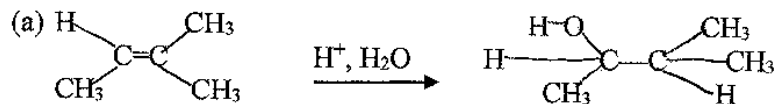


3. Which of following is the molecule toluene



(e) None of the above is toluene

4. Choose the best statement or correct reaction.

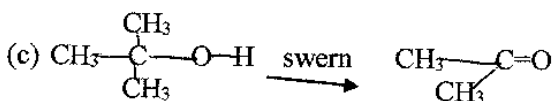
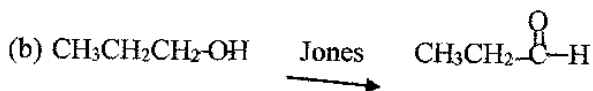


(e) all reactions shown are incorrect.

5 Choose the one best statement.

- (a) Alcohols have unusually low BP/MP for comparable sized alkanes because of hydrogen bonding between molecules of alcohol.
- (b) Small alkyl chain alcohols are water soluble because of hydrogen bonding while long alkyl chain alcohol are not water soluble because the molecule is predominately an alkyl chain.
- (c) Ethers are good solvents because they are polar but don't have hydrogen bonding and are inert to a lot of reactions.
- (d) (a) and (c) are true.
- (e) (b) and (c) are true.

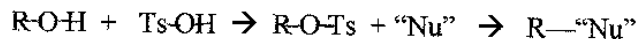
6 Choose the best statement or correct reaction.



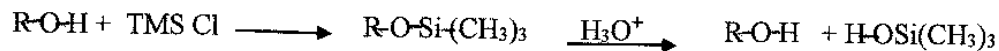
(d) All of the above reactions are wrong.

7. Choose the best statement below about alcohols.

(a) TsOH reaction is used to make a protected alcohol which does not react with almost anything.



(b) TMS Cl is a way to make an especially good leaving group replacing the rather bad leaving group O H of an alcohol with the much better reacting TMS ether.



(c) Alcohols can be synthesized by  $\text{S}_{\text{N}}2$  or  $\text{S}_{\text{N}}1$  substitution reaction on some R X using reagents such as Na OH or  $\text{H}_2\text{O}$

(d) All statements above are true.

(e) (a) and (b) are true.

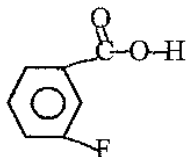
8. Primary alcohol will go to aldehydes by reaction with the following reagent. Choose the best statement.
- (a) swern
  - (b) PCC
  - (c) Jones
  - (d) All above reagents are correct.
  - (e) (a) and (b) are correct.
9. To generate an alcohol from an alkene, one may use which of the following reagents over the arrow.
- (a)  $\text{H}^+/\text{H}_2\text{O}$  to give Markovnikov product.
  - (b) (1)  $\text{BH}_3\cdot\text{THF}$  (2)  $\text{H}_2\text{O}_2, \text{OH}^-$  to give anti-Markovnikov product
  - (c) (1)  $\text{Hg}(\text{OAc})_2, \text{THF}/\text{H}_2\text{O}$  (2)  $\text{OH}^-, \text{NaBH}_4$  to give Markovnikov product without the possibility of rearrangement.
  - (d) Alkene reaction with MCPBA followed by reaction of a Grignard followed by workup.
  - (e) All above statements are true.

II. Short Answers ( 45 pts)

A. Nomenclature: (2 pts each, 8 pts)

1. Given the structural formula shown below, give the IUPAC name of the molecule.

a. name \_\_\_\_\_



b. name \_\_\_\_\_



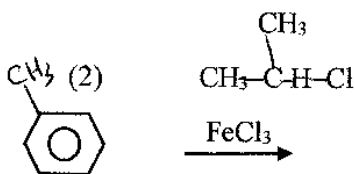
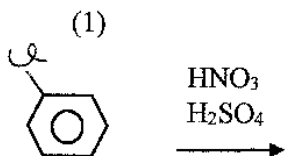
2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable - don't forget to show the hydrogens in your formula unless you are using the skeletal structure.)

a. 3-chloro-4-methoxyheptan-2-ol

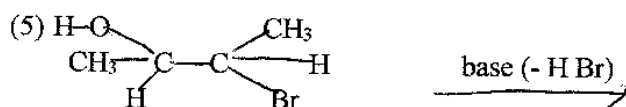
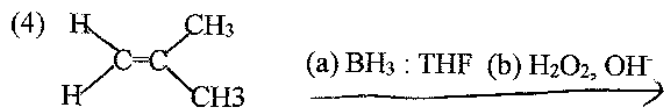
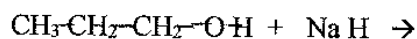
b. Hept-4-yne-2-one

B. Reactions Part of Short Answers: (3 pts per reaction, 21 pts total)

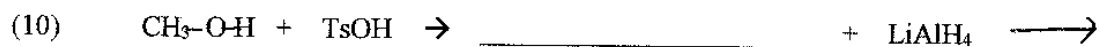
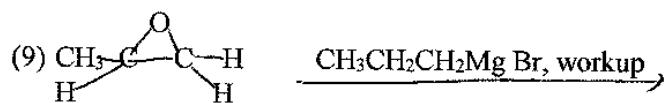
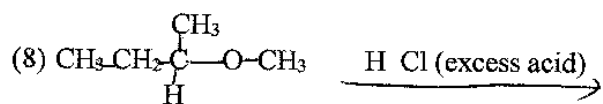
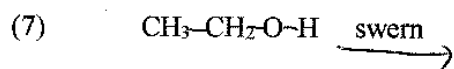
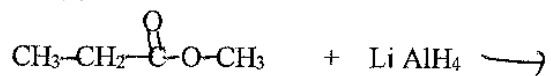
Given the following, what is the the expected organic product? **Choose to do 7** of the following reactions you want graded by circling the letter of the reaction. If you do not choose, I will just grade the first **SEVEN** (3 pts each, 21 pts)



(3)

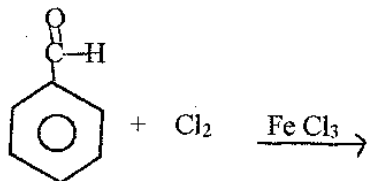


(6)

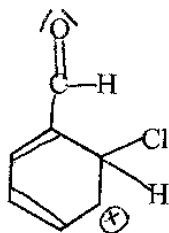


C. Short Answers part of Short Answers: (16 pts)

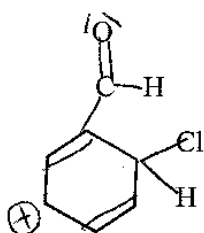
1. For a halogenation reaction the arenium resonance structure generated during the reaction mechanism are shown. (8 pts total)



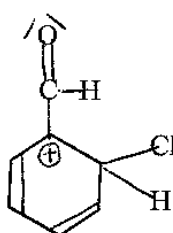
- a. Given the following resonance structures, does the directing group shown act as a [o,p activator) or (m deactivator) ] (circle one entire parenthesis). (4 pts )



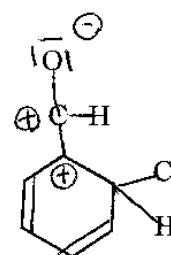
(1)



(2)



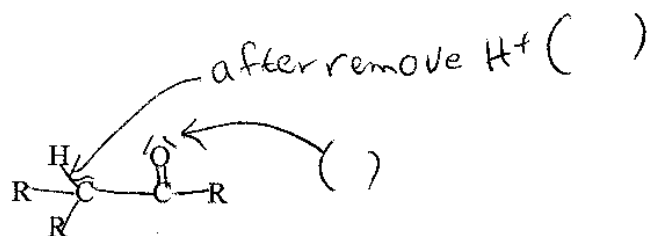
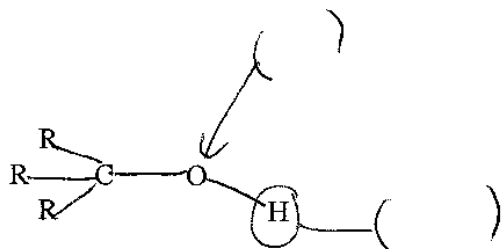
(3)



(4)

- b. Which of the resonance structures above determines the directing group effect which you chose above? Circle the resonance structure number and explain. You may circle more than one resonance structure and explain both resonance structures which you chose. (4 pts)

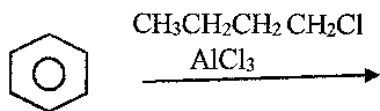
2. Fill in the blank parenthesis with a letter. (A) reacts with nucleophile (B) reacts with acid (C) is an acidic proton (D) acts as nucleophile (E) leaving group ( $R \neq H$ ) (2 pts, 8 pts total)





Part III. Long Answers (28 pts) Show work where applicable for full and partial credit.

1. a. Show the electrophilic substitution reaction mechanism for the following reaction. You must show the arenium resonance structures AND the generation of the electrophile. (11 pts)



- b. Explain something about the possibility of rearrangement and a possible alternate reaction to obtain the desired product of the above reaction. (5 pts)

2 Complete the following synthesis by filling in the blank. I have provided some hints to help you come up with the answers. NOTE: The way I grade this is for you to fill in reasonable molecules based on the immediate prior molecule. i.e. If you fill in part A with the wrong molecule and then do the next reaction to molecule B correctly you will get half credit for answering B correctly. If you fill in B with what you would have gotten if you got A correctly but which cannot possibly be generated from your wrong A, you will lose all credit even if it matches what you should have gotten. (2 pts each, 12 pts total)

