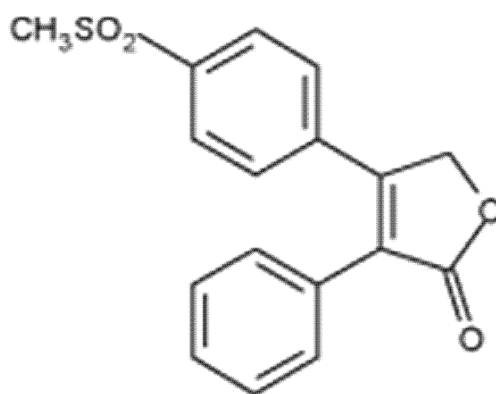




# Sample Final Examination Organic Chemistry I

**CHEM 2423**



**Rofecoxib (Vioxx)- is a nonsteroidal anti-inflammatory drug (NSAID) developed by Merck & Co.to treat osteoarthritis, acute pain conditions, and dysmenorrhoea**

**Practice Exam B**

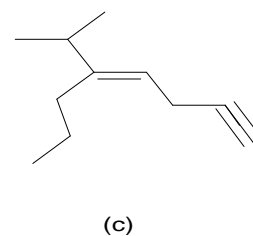
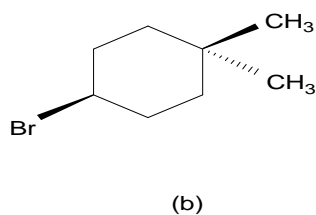
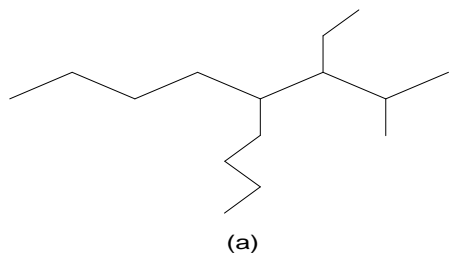
Name \_\_\_\_\_

CHEMISTRY 2423 Practice FINAL EXAM B

DIRECTIONS: A periodic table is attached at the end of this exam. Please answer all questions as completely and clearly as possible, showing all your work.

Part I. Nomenclature and Structures (2 points each)

1. Give the correct IUPAC name for the following structures (2 pts each):



(a) \_\_\_\_\_

(b) \_\_\_\_\_

(c) \_\_\_\_\_

2. Draw the structure that corresponds to the following name (2 pts each):

6-Ethyl-2,6,7-trimethyl-5-propylnonane

(Z)-3,4 – dimethyl- 3- heptene

6,6,6-trichloro-1-hexyne

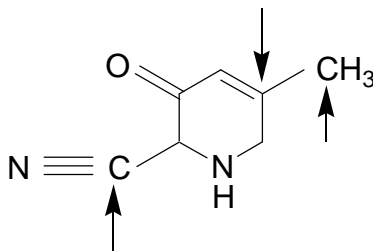
--	--	--

**Part II. Multiple choice. Circle the one best answer. (2 points each)**

\_\_\_\_\_ 3. Boron trifluoride ( $\text{BF}_3$ ) is a molecule in which the boron atom is \_\_\_\_\_ hybridized and the FBF bond angle is \_\_\_\_\_.

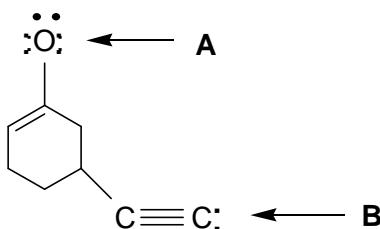
- A)  $\text{sp}^2$ ,  $180^\circ$       B)  $\text{sp}^2$ ,  $120^\circ$       C)  $\text{sp}^3$ ,  $109^\circ$       D)  $\text{sp}^3$ ,  $120^\circ$       E)  $\text{sp}$ ,  $180^\circ$

\_\_\_\_\_ 4. From left to right, what is the hybridization of the carbon atoms in the compound below?



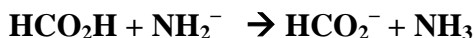
- A)  $\text{sp}^3$ ,  $\text{sp}$ ,  $\text{sp}^2$       B)  $\text{sp}^3$ ,  $\text{sp}^2$ ,  $\text{sp}^2$       C)  $\text{sp}^3$ ,  $\text{sp}$ ,  $\text{sp}$       D)  $\text{sp}$ ,  $\text{sp}^2$ ,  $\text{sp}^3$       E)  $\text{sp}^3$ ,  $\text{sp}^2$ ,  $\text{sp}$

\_\_\_\_\_ 5. Assign any formal charges to the oxygen atom (A) and carbon atom (B) in the following structure respectively.



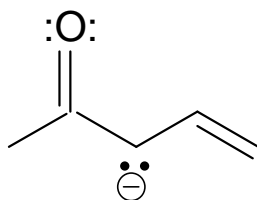
- A) -1 and +1      B) -1 and -1      C) 0 and -1      D) -1 and 0      E) +1 and +1

\_\_\_\_\_ 6. Given a completed equation for the acid-base pair shown below. Which of the following represents acid/conjugate base pair in the reaction?



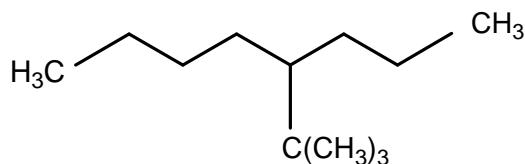
- A)  $\text{NH}_2^- / \text{NH}_3$       B)  $\text{HCO}_2\text{H} / \text{HCO}_2^-$       C)  $\text{HCO}_2^- / \text{HCO}_2\text{H}$   
D)  $\text{NH}_3 / \text{NH}_2^-$       E) none of these

\_\_\_\_\_ 7. How many other resonance structures are possible for the substance below?



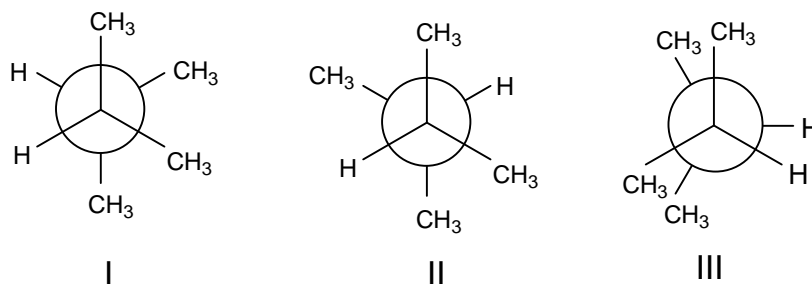
- A) two      B) three      C) four      D) five      E) none

\_\_\_\_\_ 8. What is the correct IUPAC name for the compound pictured below?



- A) 4- isopropyloctane                      B) 4- t-butyloctane                      C) 4-sec-butyloctane  
D) 4-(2,2-dimethylethyl)heptane      E) 5-t-butyloctane

\_\_\_\_\_ 9. From the perspective of viewing down the C2- C3 bond, what is the Newman projection of the most stable conformation of 2,3-dimethylbutane?

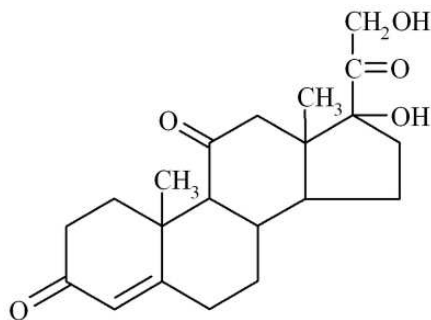


- A) I only                      B) II only                      C) I and III                      D) I and II                      E) III only

\_\_\_\_\_ 10. Consider the structure of trans-1,4-dimethylcyclohexane. Which statement is fully correct?

- A) The two chair conformations are equal in energy.  
B) The higher energy chair conformation contains one axial methyl group and one equatorial methyl group.  
C) The lower energy chair conformation contains one axial methyl group and one equatorial methyl group.  
D) The higher energy chair conformation contains two axial methyl groups.  
E) The lower energy chair conformation contains one axial methyl group.

\_\_\_\_\_ 11. Cortisone (steroid) reduces swelling and decreases the body's immune response. How many different functional groups are in the following structure of cortisone?



- A) one                      B) two                      C) three                      D) four                      E) five

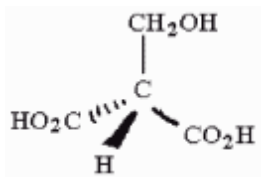
\_\_\_\_\_ 12. Which reagent gives a non-stereospecific reaction with alkenes?

- A)  $\text{Cl}_2$                       B)  $\text{Br}_2 / \text{H}_2\text{O}$                       C)  $\text{HBr}$                       D)  $\text{OsO}_4$                       E) none

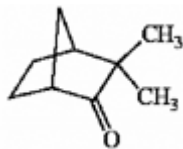
\_\_\_\_\_ 13. Which of the following carbocations does not rearrange?

- A)  $\text{CH}_3\text{CH}_2^+$                       B)  $\text{CH}_3\text{CH}^+\text{CH}_3$                       C)  $(\text{CH}_3)_3\text{C}^+$   
D)  $\text{CH}_3\text{CH}_2\text{CH}^+\text{CH}_3$                       E) All the above

\_\_\_\_\_ 14. Identify the molecules shown below chiral or achiral?



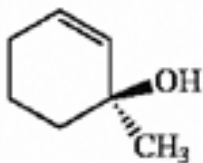
I.



II.

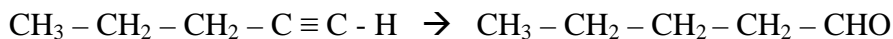
- A) only I is chiral                      B) Only II is chiral                      C) Both chiral  
D) Both achiral                      E) can not be determine

\_\_\_\_\_ 15. What is the correct absolute configuration for the following compound?



- A) R                      B) S                      C) achiral                      D) two of these                      E) cannot be determined

\_\_\_\_\_ 16. Which of the following reagents would be used to complete the following reaction?

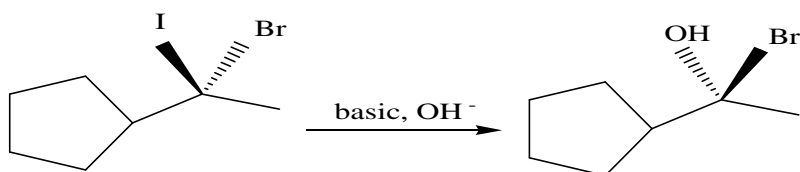


- A) 1.  $\text{BH}_3$ , THF    2.  $\text{H}_2\text{O}_2$ ,  $\text{NaOH}$ ,  $\text{H}_2\text{O}$                       B)  $\text{HgSO}_4$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$                       C)  $\text{KMnO}_4$   
D)  $\text{O}_3 / \text{H}_3\text{O}^+$                       E) none of these

\_\_\_\_\_ 17. If (*S*)-glyceraldehyde has a specific rotation of  $-8.7^\circ$ , what is the specific rotation of (*R*)-glyceraldehyde?

- A)  $0.0^\circ$                       B)  $-8.7^\circ$                       C)  $+8.7^\circ$   
D)  $100^\circ$                       E) cannot be determined from the information given

\_\_\_ 18. Consider the following reaction mechanism. What statement is true about this reaction?



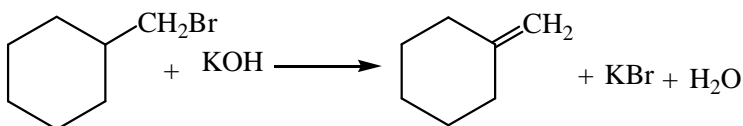
- A) It is an example of inversion  
 B) It is an example of  $S_N1$  mechanism  
 C) It is an example of  $S_N2$  mechanism  
 D) Two of these  
 E) None of these

\_\_\_ 19. Which of the following is a primary alkyl halide?

- A) methyl bromide  
 B) isopropyl bromide  
 C) *t*-butyl iodide  
 D) cyclohexyl bromide  
 E) isobutyl chloride

\_\_\_ 20. Identify the correct order of the following reaction mechanisms as  $S_N1$ ,  $S_N2$ , E1, or E2

- I.  $\text{CH}_3\text{CH}_2\text{Br} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{OH} + \text{HBr}$   
 II.  $\text{Rate} = k[\text{RX}]$  for this elimination reaction  
 III. Using  $\text{Nu}^- = \text{Cl}^-$  or  $\text{I}^-$  does not affect the rate of this substitution reaction  
 IV.



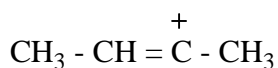
V. Results in inversion of configuration

- A)  $S_N2$ , E2,  $S_N2$ , E1,  $S_N1$   
 B)  $S_N2$ , E1,  $S_N1$ , E2,  $S_N2$   
 C.  $S_N1$ , E2,  $S_N1$ , E1,  $S_N2$   
 D)  $S_N1$ , E1,  $S_N2$ , E2,  $S_N1$   
 E) none of these

\_\_\_ 21. Which of the following represents allylic carbocation?



I



II



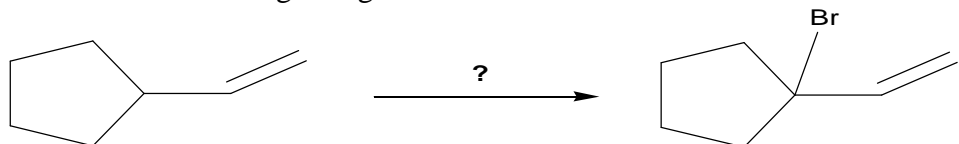
III

- A) I only  
 B) I and II  
 C) I and III  
 D) II only  
 E) III only

\_\_\_ 22. How many distinct alkynes exist with a molecular formula of  $\text{C}_4\text{H}_8$ ?

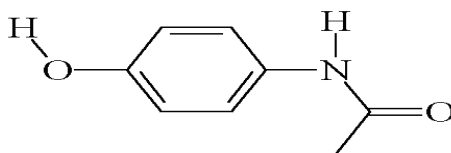
- A) 0  
 B) 1  
 C) 2  
 D) 3  
 E) 4

\_\_\_\_\_ 23. Which of the following will give the transformation shown?



- A. HBr /ether                      B. Br<sub>2</sub> /light                      C. NBS/ CCl<sub>4</sub>, heat  
D. NBS/ H<sub>2</sub>O , DMSO           E. two of these

\_\_\_\_\_ 24. Acetaminophen is used to relieve mild to moderate pain from headaches, muscle aches, menstrual periods, colds and sore throats, toothaches, backaches, and reactions to vaccinations (shots), and to reduce fever. How many degree of unsaturation acetaminophen has?

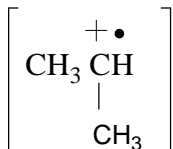


- A) 3                      B) 4                      C) 5                      D) 6                      E. none of these

\_\_\_\_\_ 25. Which of the following molecular changes is necessary for mass spectrometry to occur?

- A) Excitation of an electron from the ground state to higher energy state  
B) Change of alignment of a proton in a magnetic field  
C) Change of alignment of an electron in a magnetic field  
D) Loss of an electron  
E) Molecular vibration

\_\_\_\_\_ 26. Which of the following statements best describes the meaning of the following species?

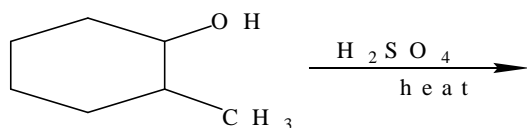


- A) It is the molecular ion of propane                      B) It is the parent ion of propane  
C) It is the radical cation of propane                      D) The m/z value is 43  
E) All of the above

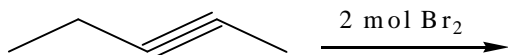
### Part III. Reactions (2 points each)

Give the major product(s) of each of the following reactions. Show all relevant stereochemistry.

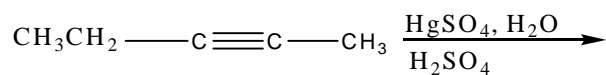
27.



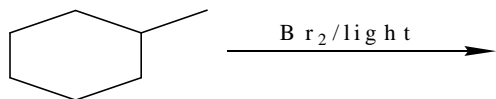
28.



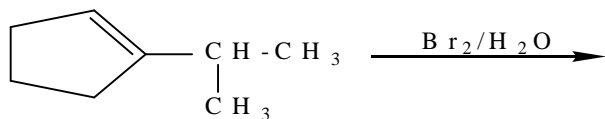
29.



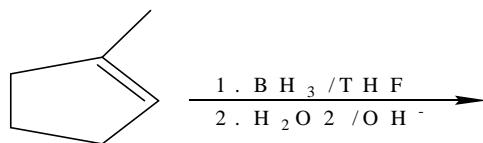
30.



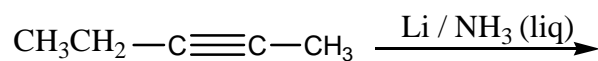
31.



32.



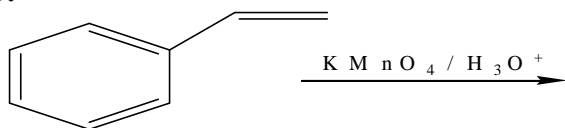
33.



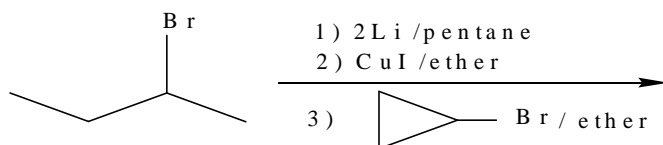
34.



35.



36.





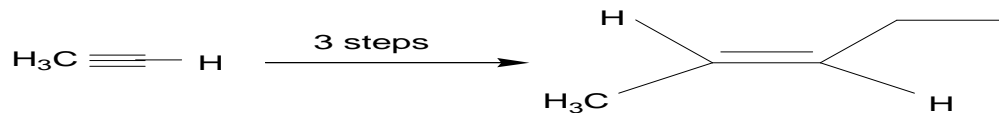
**Part IV. Synthesis (3 points each)**

Show by a series of reactions how you could prepare the following compounds (major) from the indicated starting compound. Be sure to clearly indicate the reagent used in each step.

37.



38.

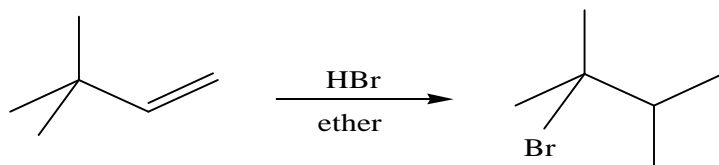


39. Compound **A** ( $\text{C}_5\text{H}_8$ ) absorbed 2 equivalents of  $\text{H}_2$  on catalytic reduction over a Pt catalyst to give compound **B** ( $\text{C}_5\text{H}_{12}$ ). On ozonolysis, compound A gave acetic acid and compound C. What are the structures for **A**, **B**, and **C**?

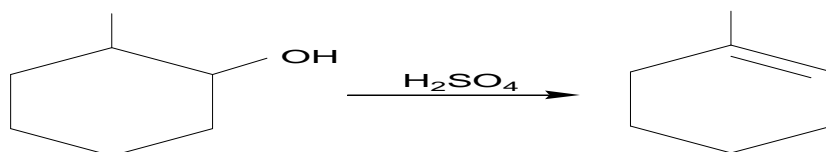
**Part V. Mechanisms (3 points each)**

Write a complete mechanism for the following reactions. Show all intermediate structures, formal charges, and electron flow using the curved arrow convention.

40.



41.



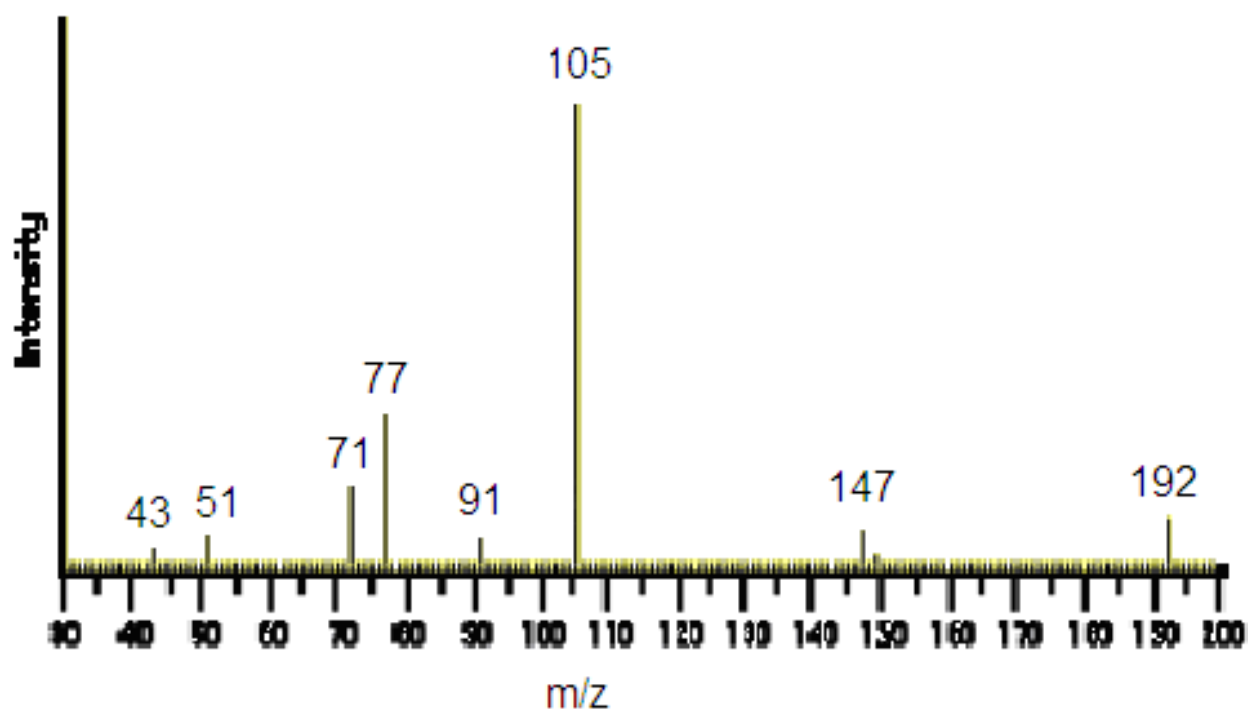
**Part VI. Spectra (5 points)**

Use the mass spectrum for a Hydrocarbon ,  $C_xH_yO_3$  , shown below to answer questions 42 - 44.

42. What is the base peak (1 pt)?

43. What is the parent ion peak (1 pt)?

44. What is the structure of the compound (3 pts)?



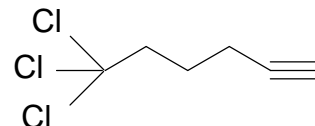
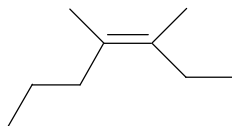
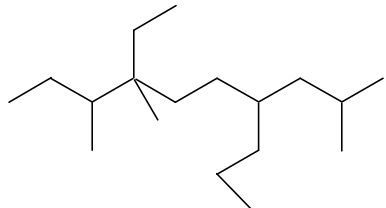
## CHEMISTRY 2423 Practice FINAL EXAM B (Answers)

### PART I. Nomenclature and Structures (2 points each)

1.

- (a) 5-(1-Ethyl-2-methylpropyl)nonane      (b) 4-Bromo-1,1-dimethylcyclohexane      (c) 5-isopropyl-4-nonene-1-yne  
5-isopropyl-4-nonene-1-yne

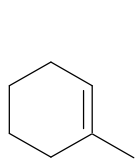
2.



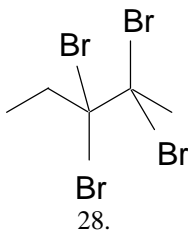
### PART II. Multiple Choice (2 points each)

- |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|
| 3. B  | 4. D  | 5. B  | 6. B  | 7. A  | 8. B  | 9. B  |
| 10. D | 11. C | 12. C | 13. E | 14. B | 15. B | 16. A |
| 17. C | 18. D | 19. A | 20. B | 21. C | 22. A | 23. C |
| 24. C | 25. D | 26. E |       |       |       |       |

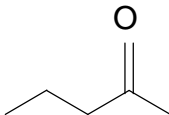
### PART III. Reactions (2 points each)



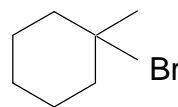
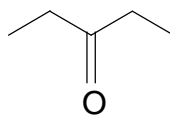
27.



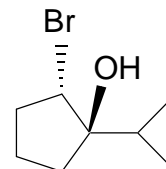
28.



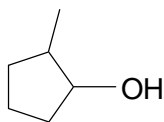
29.



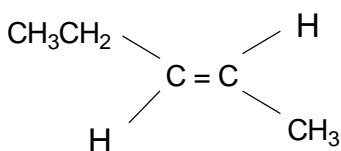
30.



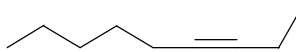
31.



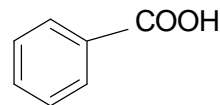
32.



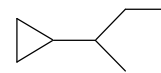
33.



34.



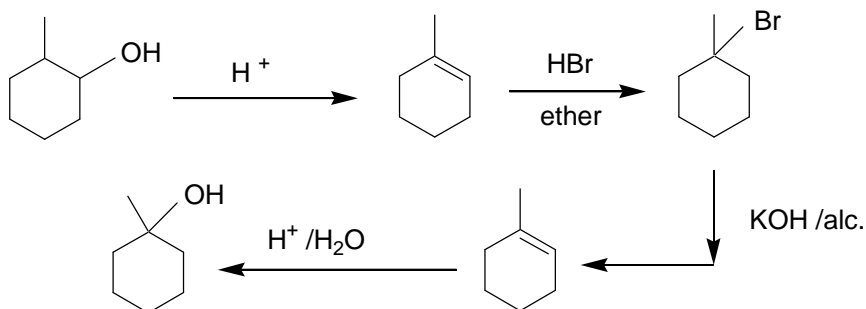
35.



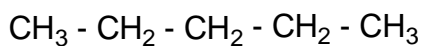
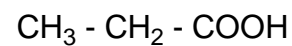
36.

### PART IV. Synthesis (3 points each)

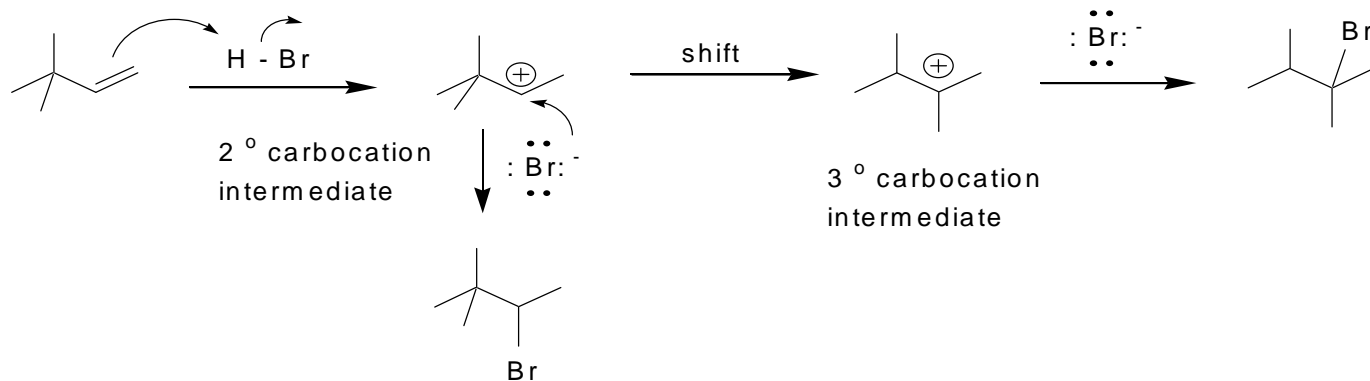
37.



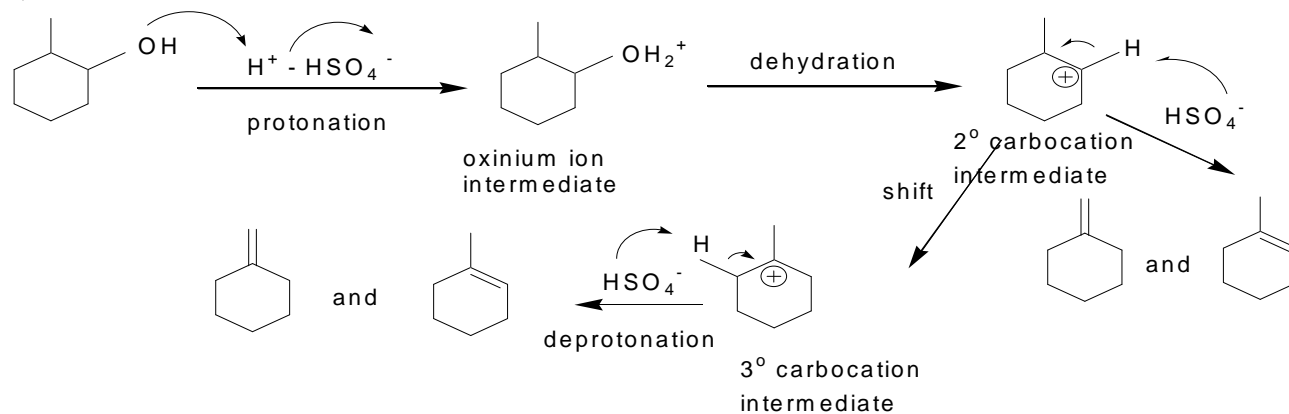
39.

**Compound (A)****compound (B)****compound (C)****Part V. Mechanisms (3 pts each)**

40.



41.

**Part VI. Spectra (5 points)**42. base peak  $\rightarrow m/z = 105$ 43. parent peak  $\rightarrow m/z = 192$ 

44.  $192 - 3 \times 16 \text{ oxygens} = 144 \rightarrow 144 / 12 = \text{C}_{11}\text{H}_{12}\text{O}_3$   
 Degree of Unsaturation =  $(11) - (12/2) + 1 = 6$  (benzene ring + 2 db)

