Houston Community College

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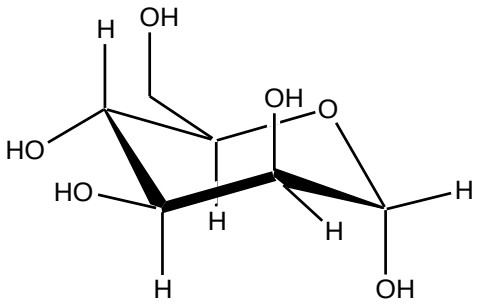
Final Examination

Organic Chemistry I

CHEM 2423



Practice Exam A

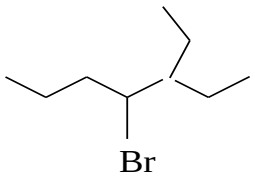
Name _____

CHEMISTRY 2423 Practice FINAL EXAM A

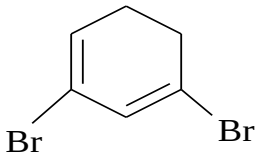
DIRECTIONS: A periodic table is attached at the end of this exam. Please answer all questions as completely and clearly as possible, showing all your work.

Part I. Nomenclature and Structures (2 pts each)

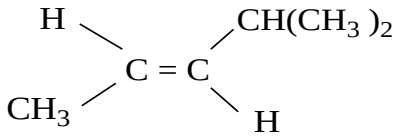
1. Give the correct IUPAC name for the following structures (2 pts each):



(a)



(b)



(c)

(a) _____

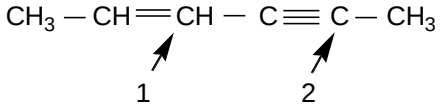
(b) _____

(c) _____

2. Draw the structure that corresponds to the following name (2 pts each):
(a) (S)-2-bromobutane (b) (E)-3-iodo-2-pentene (c) 2,2-dimethyl-3-hexyne

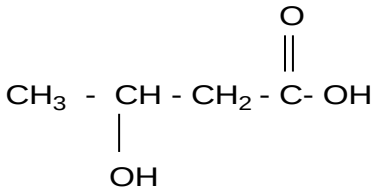
Part II. Multiple choice. Circle the one best answer. (2 pts each)

3. What is the correct hybridization for the indicated carbon atoms.



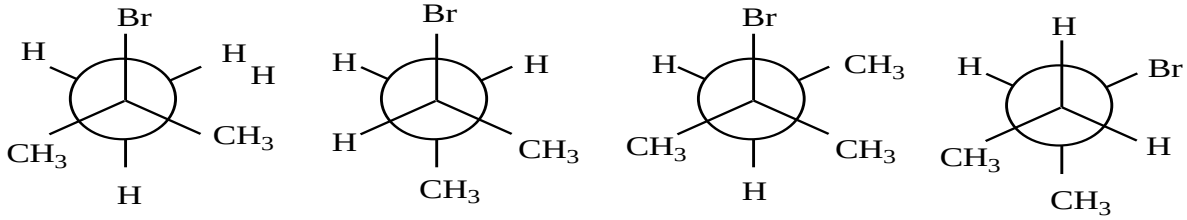
(A) sp^2, sp (B) sp^3, sp (C) sp^3, sp^2 (D) sp, sp^2

4. What functional groups are present in the following molecule?



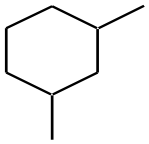
(A) alcohol and carboxylic acid (B) ketone and ether
(C) alcohol and ester (D) ketone and aldehyde

5. Which one of the following structures is the most stable conformation for 2-bromo butane (viewing down the C_2-C_3 bond axis)



(A) (B) (C) (D)

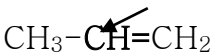
6. Identify the number of primary, secondary, and tertiary carbons, respectively, in the following molecule:



(A) 1, 3, 1 (B) 4, 1, 1 (C) 2, 4, 2 (D) 2, 2, 4

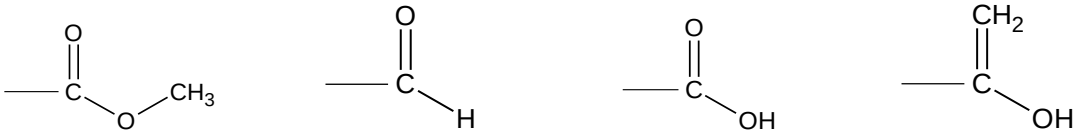
7. What is the conjugate Acid for CH_3OH?
(A) CH_3O^- (B) CH_2OH^- (C) CH_3^- (D) $CH_3OH_2^+$

8. Describe the indicated C-H bond indicated below in terms of orbital overlap:



(A) sp^3-sp^3 (B) sp^3-sp^2 (C) sp^2-1s (D) sp-1s

9. Which one of the following groups has the highest priority?

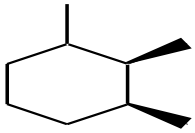
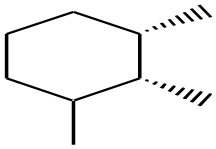


(A) (B) (C) (D)

10. Rank the following according to the most acidic to least acidic.
I) H-COOH II) CH_3-COOH III) CH_3CH_2COOH

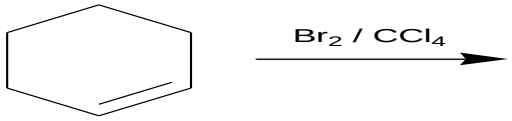
(A) I>II>III (B) II>I>III (C) III>II>I (D) II>III>I

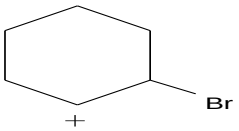
11. What is the relationship between the two compounds:

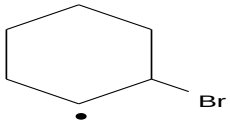

and


(A) enantiomers (B) diastereomers (C) same molecule (D) none of these

12. Which reaction intermediate is formed by the following reaction?





(A)


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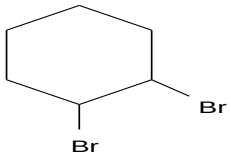
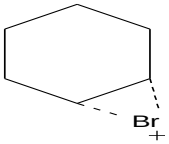
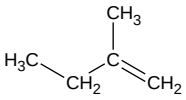


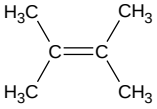
(C)


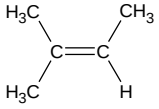
(D)

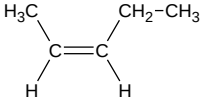
13. Which one of the following alkenes is the **least** stable?

(A) (B) (C) (D)

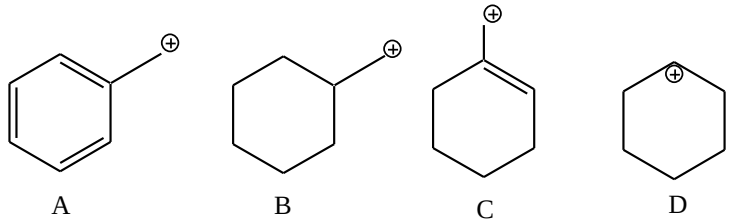








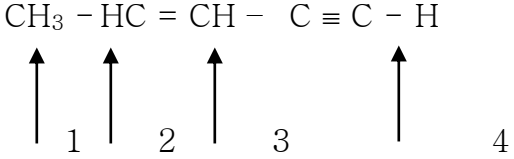
14. Which one of the following carbocation intermediates is the least stable?



15. Which one of the following substances is referred to as a Gilman reagent?

(A) CH_3I (B) $(CH_3)_2CuLi$ (C) CH_3MgBr (D) CH_3Li

16. An <u>allylic</u> hydrogen is indicated at which position in the structure below?



(A) 1
(B) 2
(C) 3
(D) 4

17. Which one of the following diagrams correctly illustrates the displacement of bromine by hydroxide via SN_2 reaction?

(A) (B) (C) (D)

18. Inversion of configuration results from which one of the following mechanisms?
(A) E1 (B) E2 (C) S_N1 (D) S_N2

19. Which one of the following molecules has the highest boiling point?

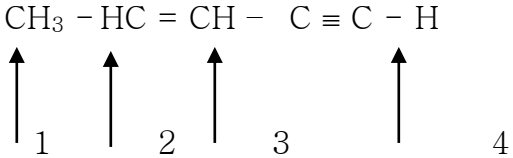
(A) $CH_3CH_2CH_3$ (B) $CH_3CH_2COCH_3$
(C) $CH_3CH_2CH_2OCH_3$ (D) $CH_3CH_2CH_2OH$

20. What sequence correctly describes the steps involved in a radical chain reaction?
I) initiation II) temination III) propagation

(A) I, III, II (B) I,II,III (C) III, I, II (D) none of these

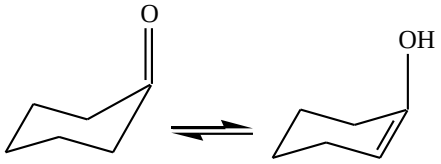
21. Which of the following are examples of *syn* addition to an alkene?
(A) hydrogenation and hydration (B) hydrobromination and hydroboration
(C) hydration and hydrobromination (D) All of theses

22. Which one of the following hydrogens is the most <u>acidic</u>?



(A) 1
(B) 2
(C) 3
(D) 4

23. The following process demonstrates:



(A) resonance (B) conjugation (C) racemization (D) tautomerism

24. What reagent is needed to convert 1-hexyne to 2-hexanone?
(A) O_3 /Zn/ $H3O^+$ (B) PCC (pyridinium chlorochromate)
(C) BH_3 /H_2O_2 /OH^- (D) $HgSO_4$ /H_2SO_4 / H_2O

25. In mass spectroscopy,
(A) the sample is irradiated with infrared radiation
(B) the heat of combustion of the sample is measured
(C) the sample is bombarded with a stream of high energy electrons
(D) the sample is irradiated with ultraviolet radiation

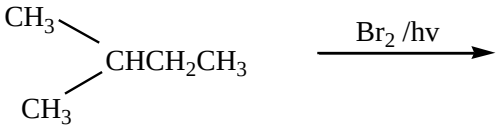
26. Select the structure of a compound with the molecular formula C_6H_{14} which has a base peak at m/e = 57 in the mass spectrum.

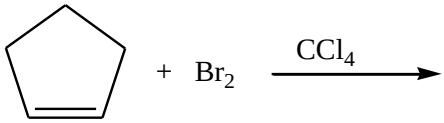
(A) $CH_3CH_2CH_2CH_2CH_2CH_3$ (B) $(CH_3)_2CHCH_2CH_2CH_3$

(C) $(CH_3)_3CCH_2CH_3$ (D) $(CH_3)_2CHCH(CH_3)_2$

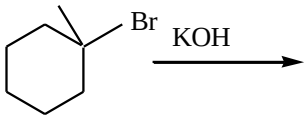
Part III. Reactions

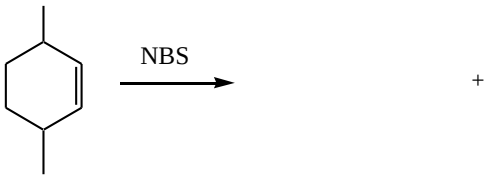
Give the major product(s) of each of the following reactions. Show all relevant stereochemistry. (2 pts each)

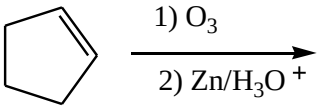
27. 

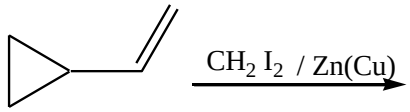
28. 

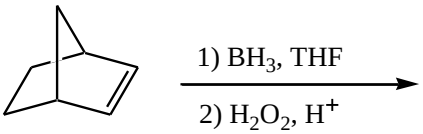
29. $CH_3C\equiv CH + HCl\,(1\text{ eq}) \xrightarrow{\text{ether}}$

30. 

31. 

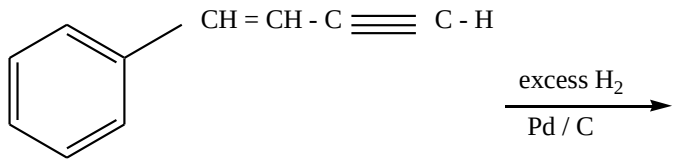
32. 

33. 

34. 

35. $CH_3 - CH_2 - C\equiv C^{\ominus}Na^{\oplus} \xrightarrow[2)\ H_2 / \text{Lindlar catalyst}]{1)\ CH_3Br}$

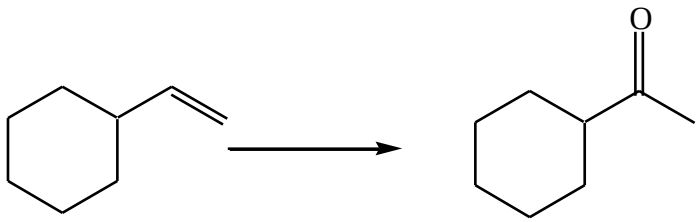
36.



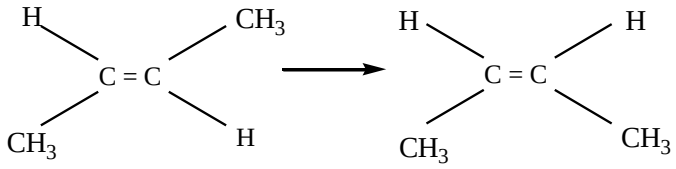
Part IV. Synthesis (3 points each)

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

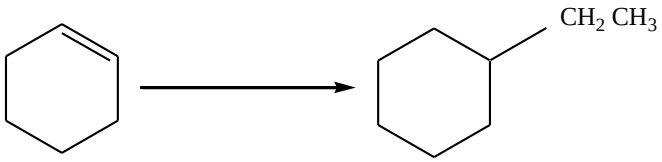
37.



38.



39.

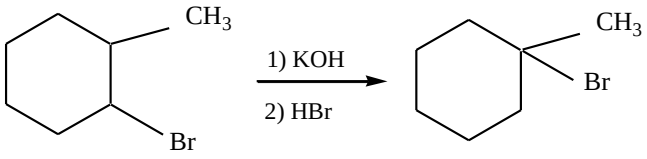


Part V. Mechanisms

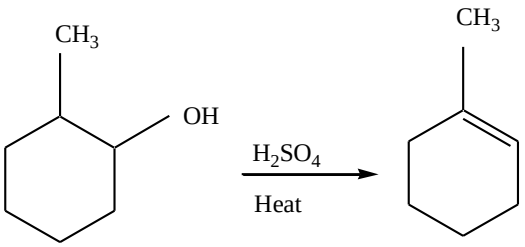
Write a complete mechanism for the following reactions. Show all intermediate structures, formal charges, and electron flow using the curved arrow convention.

(3 pts each)

40.



41.



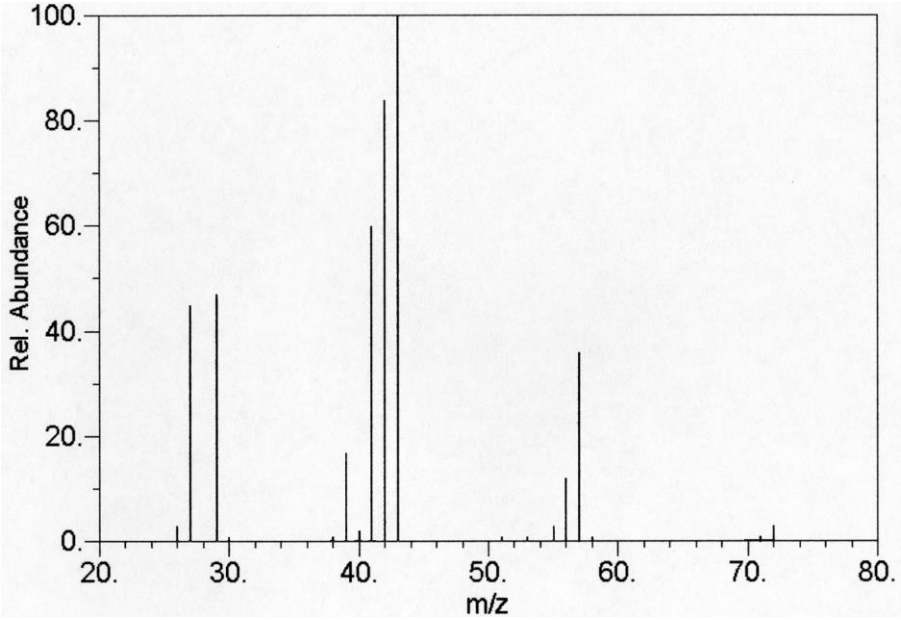
Part VI. Spectra (5 points)

Use the mass spectrum for a hydrocarbon shown below to answer questions 42 - 44.

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

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

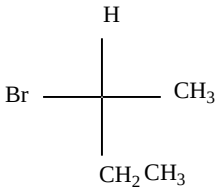
44. What is the structure of the compound (3 pts)?



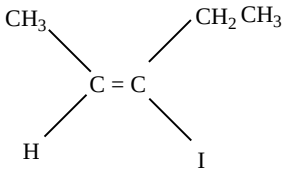
CHEMISTRY 2423 Practice FINAL EXAM A (Answers)

PART I. (2 points each)

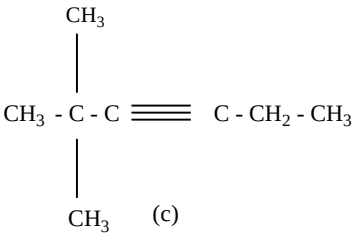
1. (a) 4-bromo-3-ethylheptane
   (b) 1,3-dibromo-1,3-cyclohexadiene
   (c) trans-4-methyl-2-pentene
2.



(a)



(b)



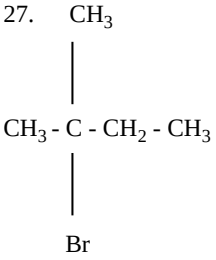
(c)

PART II. (2 points each)

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

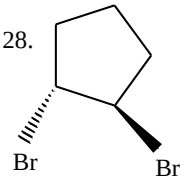
PART III. (2 points each)

27.



or others (R &S)

28.



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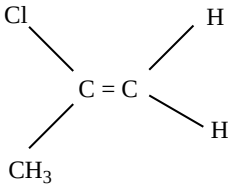

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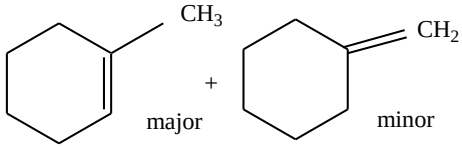

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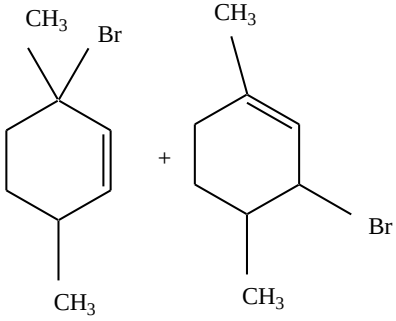

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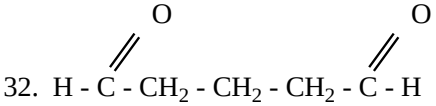
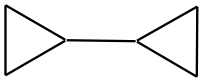


33.



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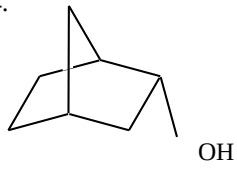

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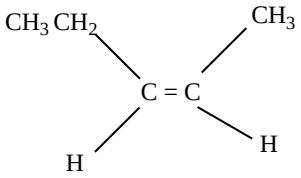

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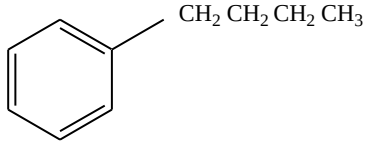
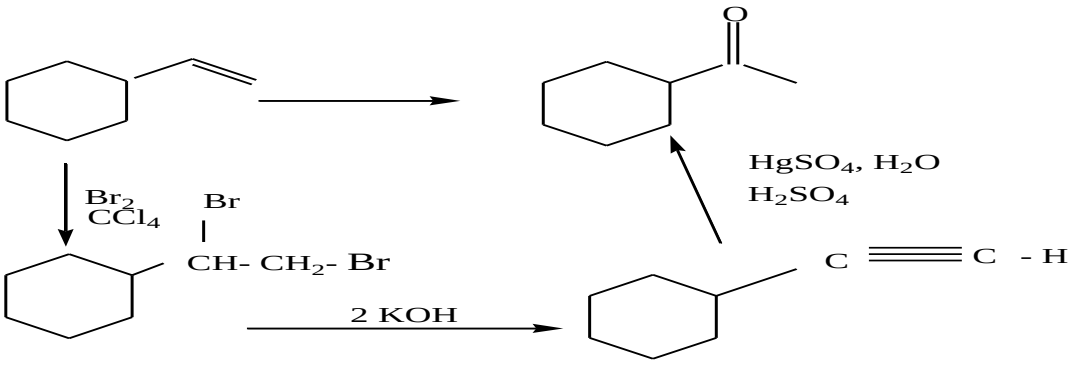


PART IV. (3 points each)

37.



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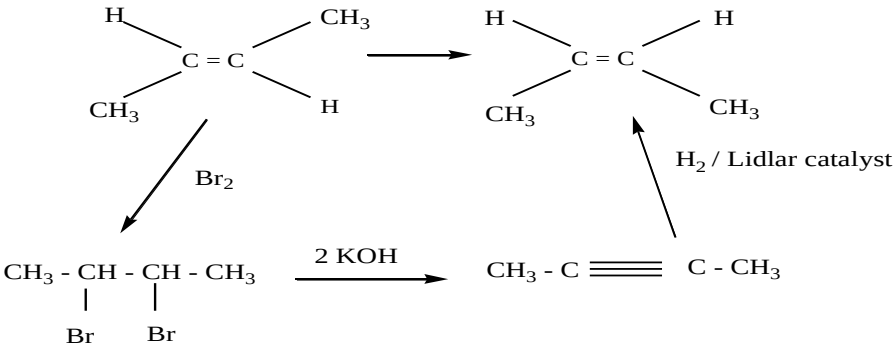

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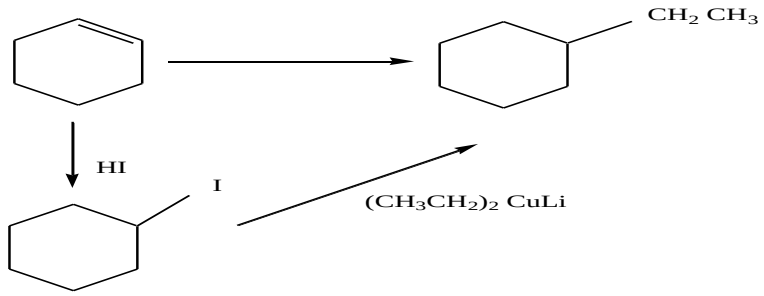

PART V. (3 points each)

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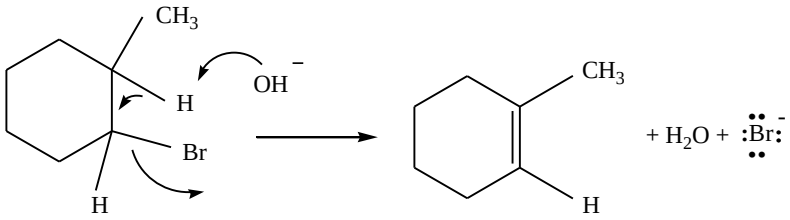

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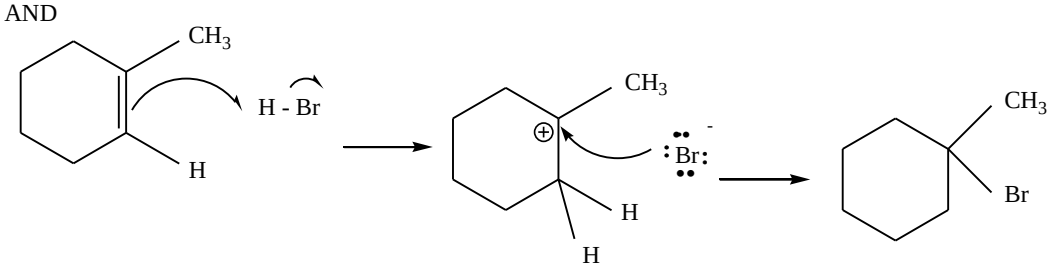

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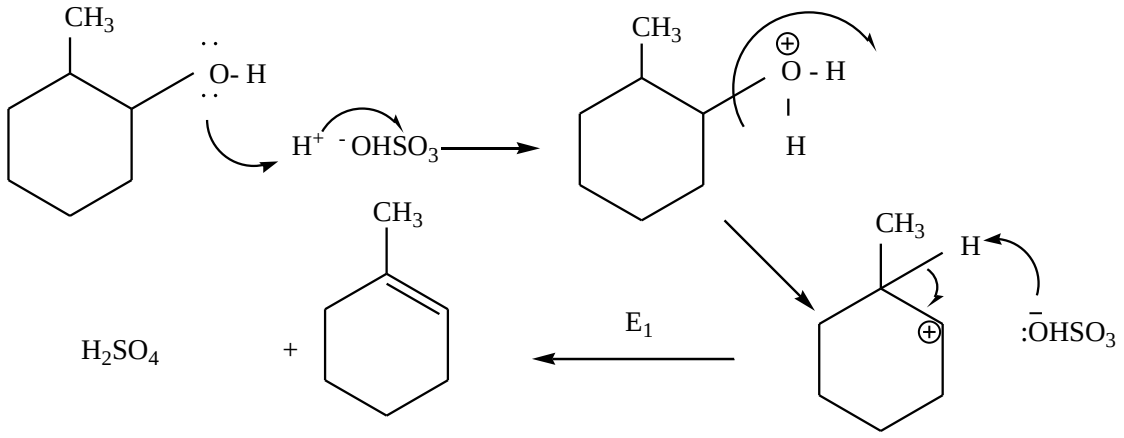


PART IV. (5 points) (1+ 1+ 3)

42. m/e^- = 43 43. m/e^- = 72

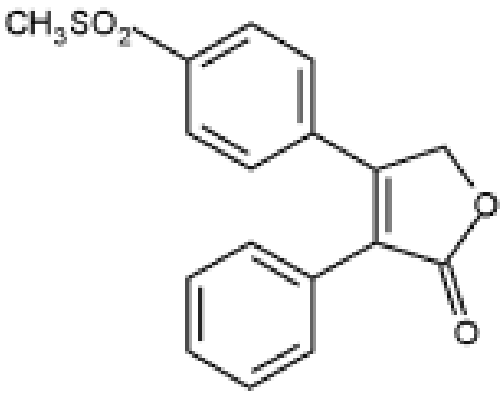
44.

$CH_3 - CH - CH_2 - CH_3$

CH_3

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

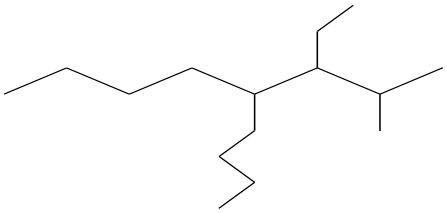
Name :_____

CHEMISTRY 2423 Practice FINAL EXAM B

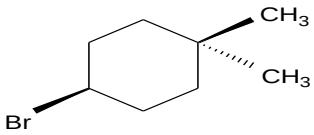
DIRECTIONS: A periodic table is attached at the end of this exam. Please answer all questions as completely and clearly as possible, showing all your work.

Part I. Nomenclature and Structures (2 pts each)

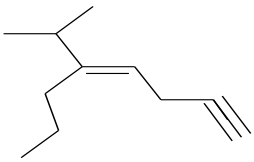
1. Give the correct IUPAC name for the following structures (2 pts each):



(a)



(b)



(c)

(a) _____

(b) _____

(c) _____

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

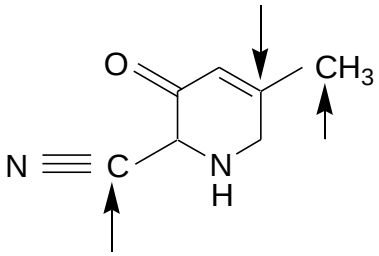
6-Ethyl-2,6,7-trimethyl-5-propylnonane (Z)-3,4 – dimethyl- 3- heptene 6,6,6-trichloro-1-hexyne

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

_____ 3. Boron trifluoride (BF_3) is a molecule in which the boron atom is _____ hybridized and the FBF bond angle is _____.

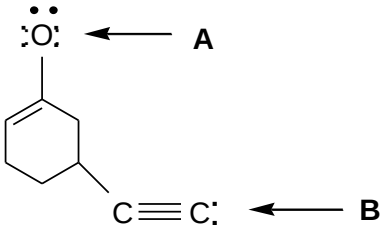
A) sp^2, 180° B) sp^2, 120° C) sp^3, 109° D) sp^3, 120° E) sp, 180°

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



A) sp^3 , sp, sp^2 B. sp^3 , sp^2, sp^2 C) sp^3 , sp, sp D) sp , sp^2, sp^3 E) sp^3 , sp^2, sp

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



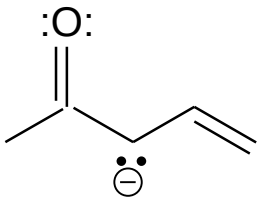
A) -1 and +1 B) –1 and –1 C) 0 and -1 D) -1 and 0 E) +1 and +1

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

$HCO_2H + NH_2^-$ → $HCO_2^- + NH_3$

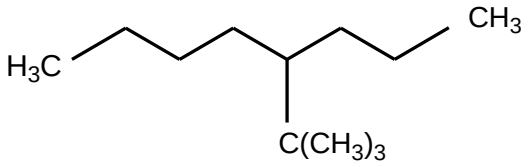
A) NH_2^- / NH_3 B) HCO_2H / HCO_2^- C) HCO_2^- / HCO_2H
D) NH_3 / NH_2^- E) none of these

_____7. How many other resonance structures are possible for the substance below?



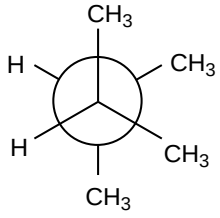
A) two B) three C) four D) five E) none

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

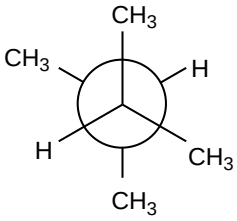


A) 4- isopropyloctane B) 4- t-butyloctane C) 4-sec-butyloctane
D) 4-(2,2-dimethylethyl)heptane E) 5-t-butyloctane

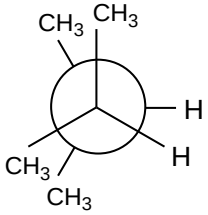
_____9. From the perspective of viewing down the C2- C3 bond, what is the Newman projection of the most stable conformation of 2,3-dimethylbutane?



I



II



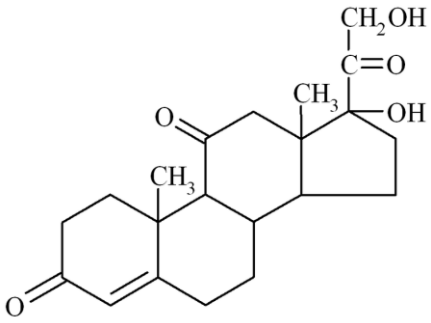
III

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 groups.

_____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

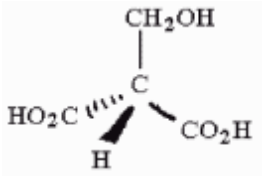
_____ 12. Which reagent gives a non-stereospecific reaction with alkenes?

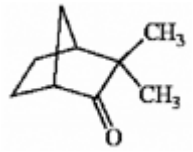
A) Cl_2 B) Br_2 /H_2O C) HBr D) OsO_4 E) none

_____ 13. Which of the following carbocations does not rearrange?

A) $CH_3CH_2^+$ B) $CH_3\ CH^+\ CH_3$ C) $(CH_3)_3C^+$
D) $CH_3CH_2CH^+\ CH_3$ E) All the above

_____14. Identify the molecules shown below chiral or achiral?

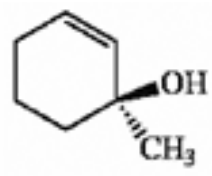




I. II.

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 compoud?



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?

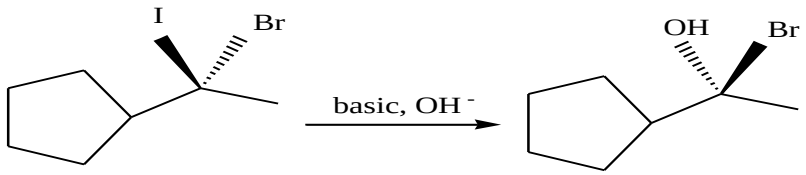
$CH_3 – CH_2 – CH_2 – C \equiv C - H \rightarrow CH_3 – CH_2 – CH_2 – CH_2 – CHO$

A) 1. BH_3,THF 2. H_2O_2, NaOH , H_2O B) $HgSO_4$, H_2SO_4, H_2O C) $KMnO_4$
D) O_3 / H_3O^+ E) none of these

_____17. If (*S*)-glyceraldehyde has a specific rotation of -8.7°, what is the specific rotation of (*R*)-glyceraldehyde?

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

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



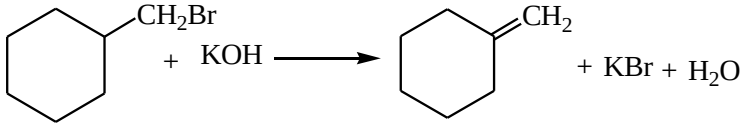
A) It is an example of inversion B) It is an example of S_{N1} mechanism
C) It is an example of S_{N2} mechanism D) Two of these
E) None of these

____ 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. $CH_3CH_2Br + H_2O \rightarrow CH_3CH_2OH + HBr$
II. Rate = k[RX] for this elimination reaction
III. Using $Nu^- = Cl^-$ or 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?

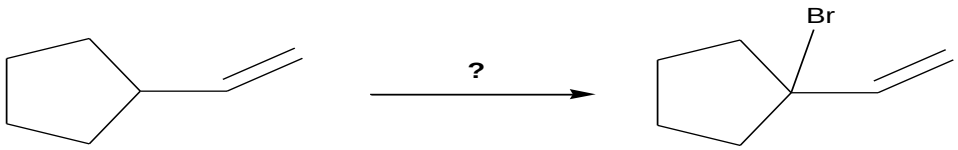
$CH_2^+ - CH = CH_2$ (I) $\quad CH_3 - CH = C^+ - CH_3$ (II) $\quad CH_3 - CH^+ - CH = CH_2$ (III)

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 C_4H_8?

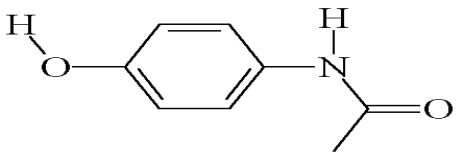
A) 0 B) 1 C) 2 D) 3 E) 4

_____ 23. Which of the following will give the transformation shown?



A. HBr /ether B. Br_2 /light C. NBS/ CCl_4, heat
D. NBS/ H_2O , 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?

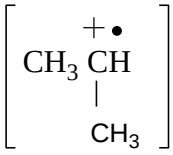


A) 3 B) 4 C) 5 D) 6 E. none of these

_____ 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?

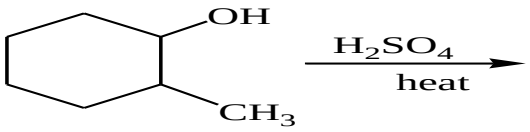


A) It is the molecular ion of propane B) It is the parent ion of propane
C) It is the radical cation of propane D) The m/z value is 43
E) All of the above

Part III. Reactions (2 points each)

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

27.



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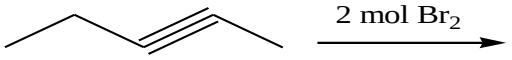

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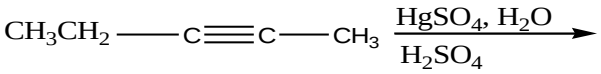

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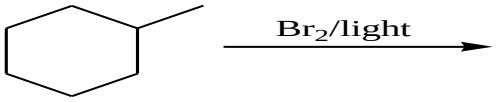

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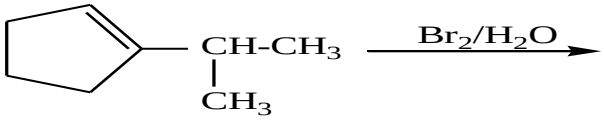

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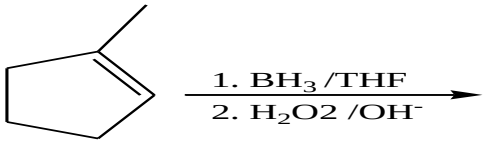

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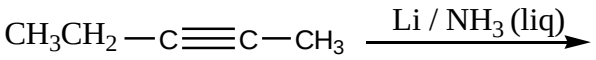

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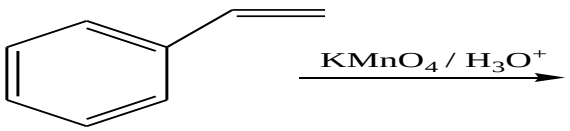

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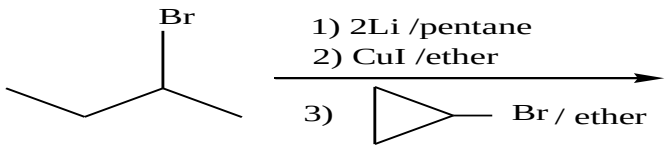
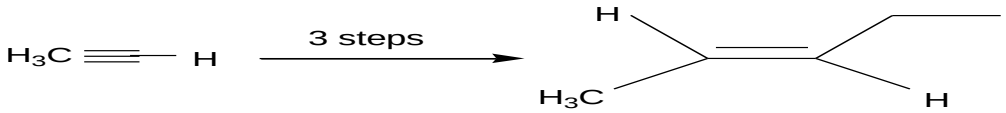


Part IV. Synthesis (3 points each)

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.

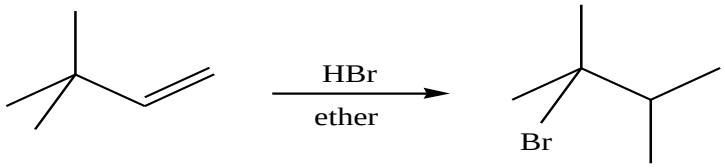


39. Compound **A (C_5H_8)** aborbed 2 equivalents of H_2 on catalytic reduction over a Pt catalyst to give compound **B (C_5H_{12})**. On ozonolysis, compound A gave acetic acid and compound C. What are the structures for **A, B, and C**?

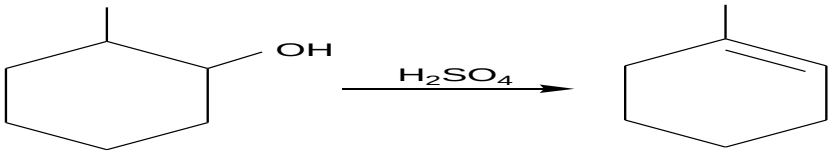
Part V. Mechanisms (3 points each)

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

40.



41.



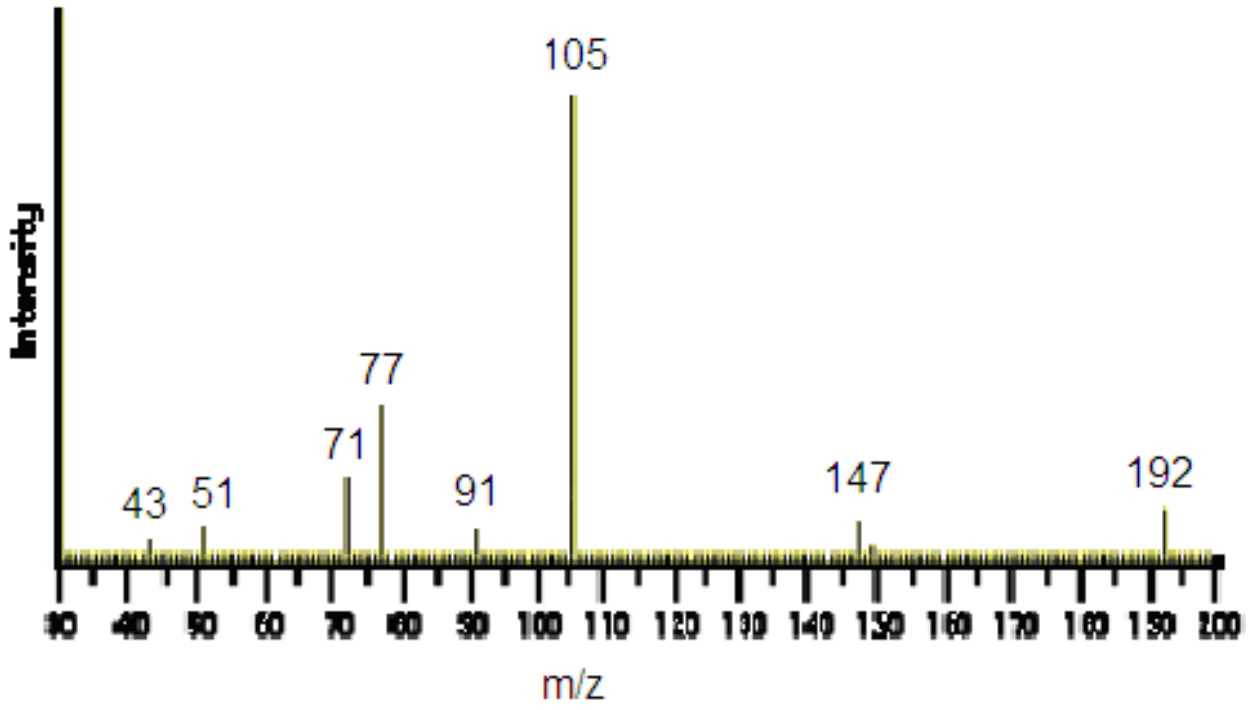
Part VI. Spectra (5 points)

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)?



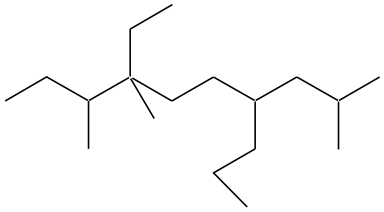
CHEMISTRY 2423 Practice FINAL EXAM B (Answers)

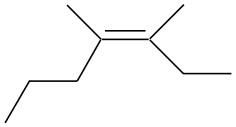
PART I – Nomenclature and structures (2 points each)

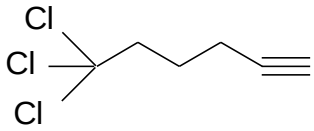
1.

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

2.



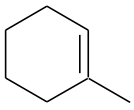




PART II – Multiple Choice (2 points each)

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)



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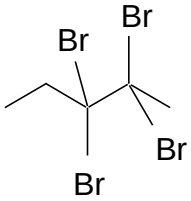
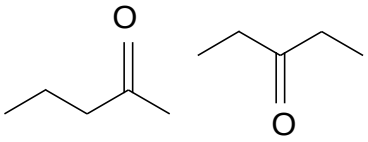


28.



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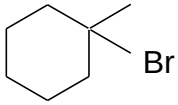

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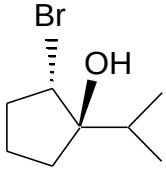

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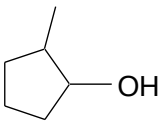

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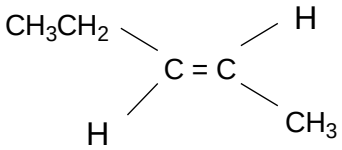

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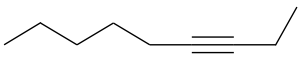

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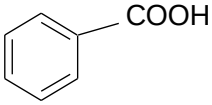

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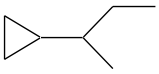
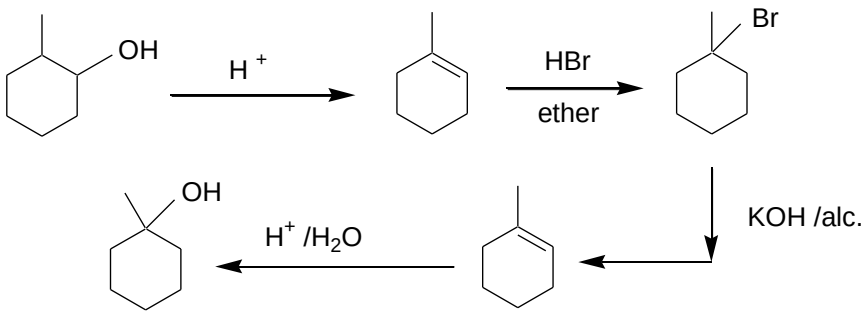


36.

PART IV. Synthesis (3 points each)

37.



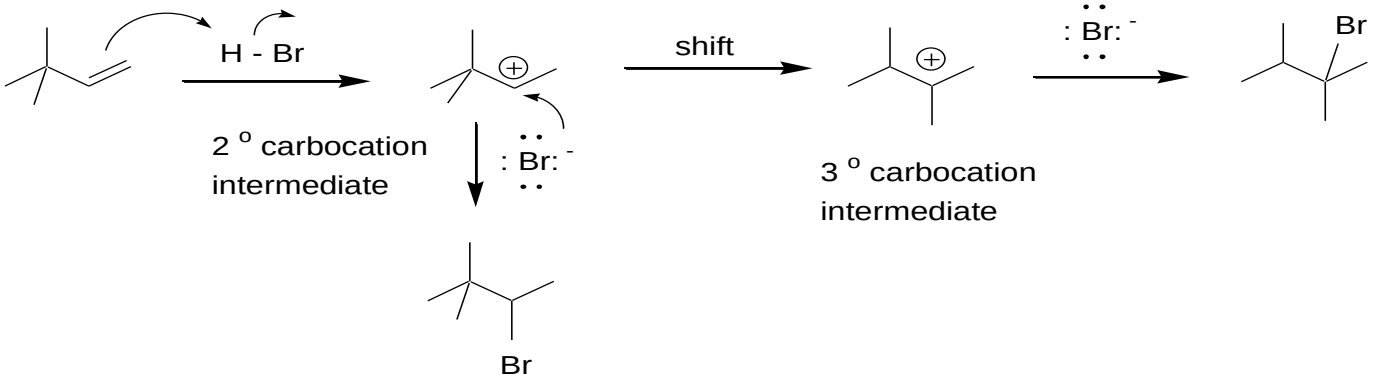
39.

$CH_3 - CH_2 - C \equiv C - CH_3$ $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$ $CH_3 - CH_2 - COOH$

Compound (A) **compound (B)** **compound (C)**

Part V. Mechanisms (3 pts each)

40.



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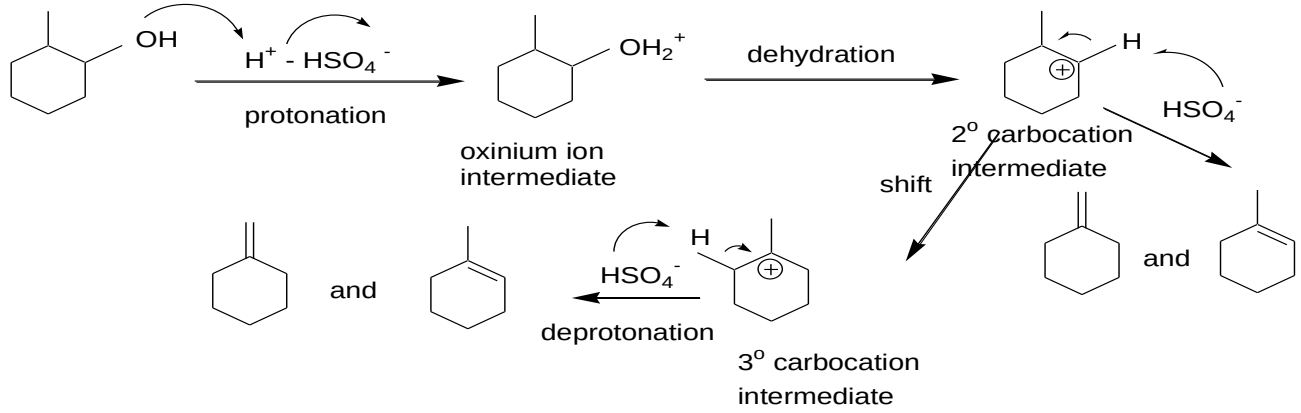

Part VI. Spectra (5 points)

42. base peak ➔ m/z = 105 43. parent peak ➔ m/z = 192

44. 192 – 3x16 oxygens = 144 ➔ 144 /12 = $C_{11}H_{12}O_3$
Degree of Unsaturation = (11) – (12/2) +1 = 6 (bezene ring + 2 db)