



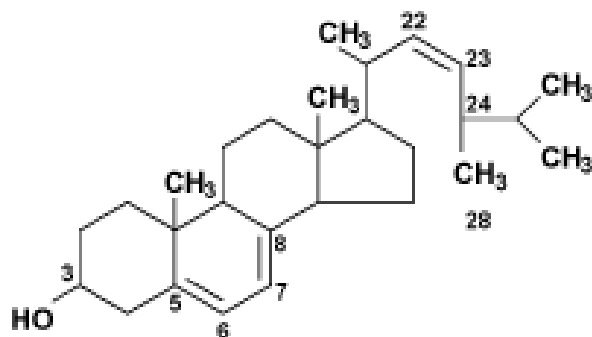
Houston Community College

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SAMPLE EXAM # 1A

Organic Chemistry I

2425



Egosterol

Egosterol — Ergosterol is a component of fungal cell membranes, serving the same function that cholesterol serves in animal cells. The presence of ergosterol in fungal cell membranes coupled with its absence in animal cell membranes makes it a useful target for antifungal drugs. Ergosterol is also present in the cell membranes of some protists, such as trypanosomes.^[2] This is the basis for the use of some antifungals against West African sleeping sickness.



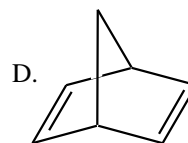
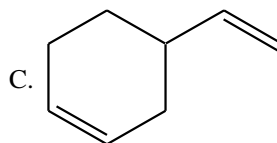
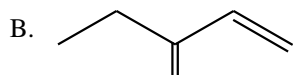
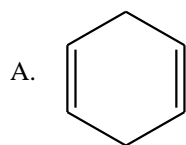
DIRECTIONS- Please answers all questions in the space provided as completely and clearly as possible. Show all your work for the writing portions of the exam.

PART I – Multiple choice : (3 points each)

_____ 1. How many sets of equivalent protons are there for $\text{CH}_2\text{Cl}-\text{CH}_2-\text{CH}_2\text{Cl}$

- A. 1 B. 2 C. 4 D. 6

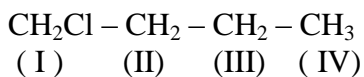
_____ 2. Which of the following is an example of a conjugated dienes?



_____ 3. Which of the following is the most likely fragment ion formed at 57?

- A. CH_3CH_2^+ B. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2^+$ C. $\text{CH}_3\text{CH}_2\text{CH}_2^+$ D. $\text{CH}=\text{CH}_2^+$

_____ 4. In the proton NMR spectrum for 1-chlorobutane, which of the proton has the lowest field resonance (lowest chemical shift)?



- A. I B. II C. III D. IV

_____ 5. What is the structure for a compound, $\text{C}_4\text{H}_8\text{Br}_2$, which has the following proton NMR spectrum?

Doublet δ 1.7 (6 H) and Quartet δ 4.4 (2 H)

- A. 1,1-dibromobutane B. 1,2-dibromobutane
C. 1,3-dibromobutane D. 2,3-dibromobutane

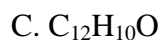
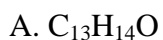
_____ 6. What kind of compound has a sharp IR absorption band in the region of 1710 cm^{-1} and a broad band at 3300 cm^{-1} ?

- A. Ethanol B. Acetic Acid C. Acetone D. Diethyl ether

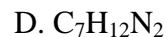
_____ 7. Examining the Proton NMR spectrum of a compound allows us to:

- A. Determine the types of functional groups present in the compound.
B. Determine the C-H framework of the compound.
C. Determine the molecular weight of the compound.
D. Determine the nature of the conjugated pi electrons system in the compound.

___ 8. Given $M^+ \cdot = 156$, the possible formula of compound which include only one oxygen is;



___ 9. An organic compound is composed of C, H, and N. It shows a molecular ion at $m/z = 112$ amu in the mass spectrum. What is the plausible molecular formula for this compound ?



___ 10. Which of the following statements is true about the molecular ion?

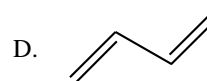
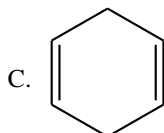
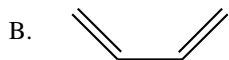
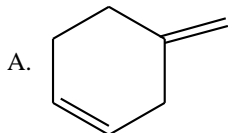
A. a compound that lost a pair of electrons

B. a compound that gained one electron

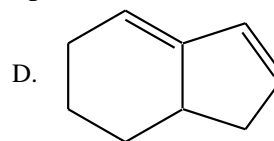
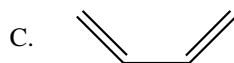
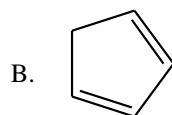
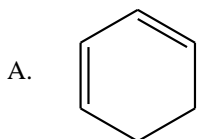
C. a compound that lost one electron

D. a compound that carries a free radical and a negative charge

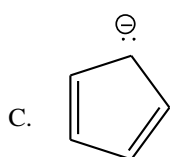
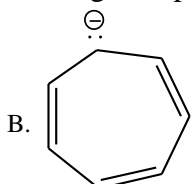
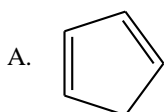
___ 11. Which of the following dienes is most stable?



___ 12. Which of the following dienes cannot be used as the diene component in Diels Alder Reaction?



___ 13. Which of the following is expected to be aromatic?



___ 14. Which of the following is a correct description of benzene?

A. The molecule is planar.

B. The molecule is aromatic.

C. The CCC bond angles are all 120° and each carbon is sp^2 hybridized.

D. All of the above

___ 15. Which is not a required for aromaticity?

A. The structure must be bicyclic.

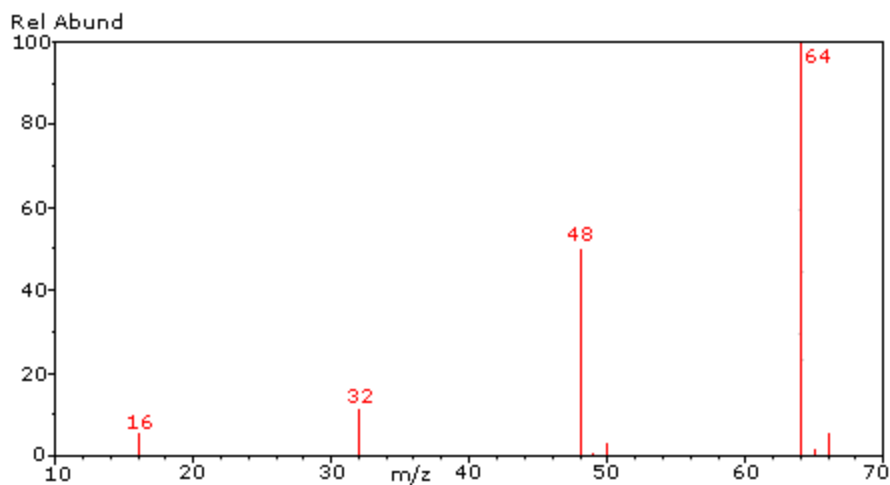
B. Each atom in the ring must have an unhybridized p orbital.

C. The π network must contain $4n+2$ pi electrons, where n is a whole number.

D. The structure must be planar.

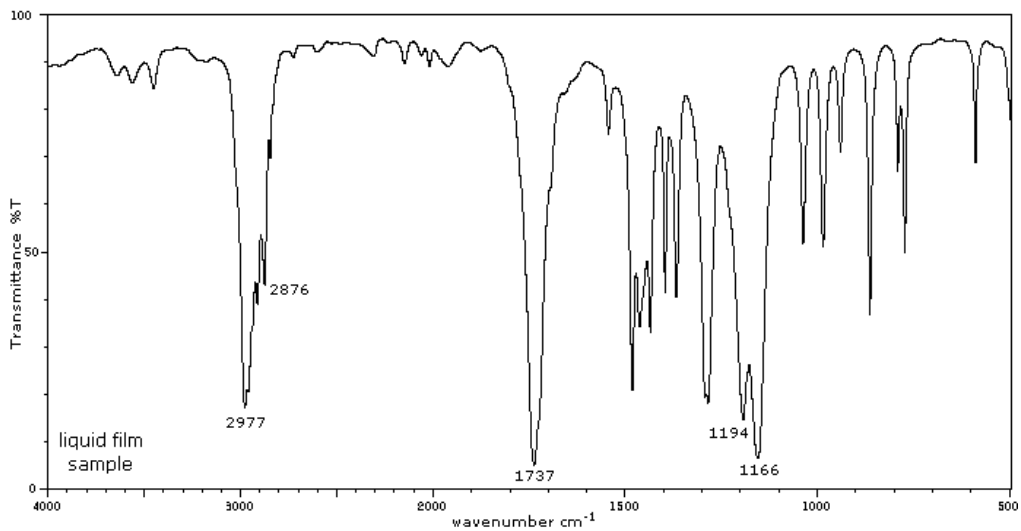
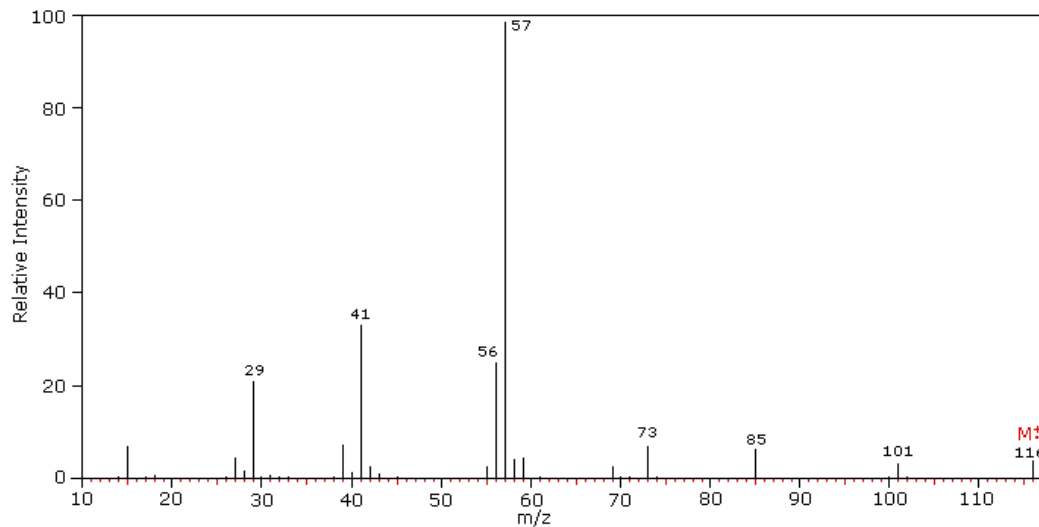
PART II. Show all your work for complete credit.

16. Refer to the mass spectrum of C_xH_y shown below to answer the following questions.
(4 points)

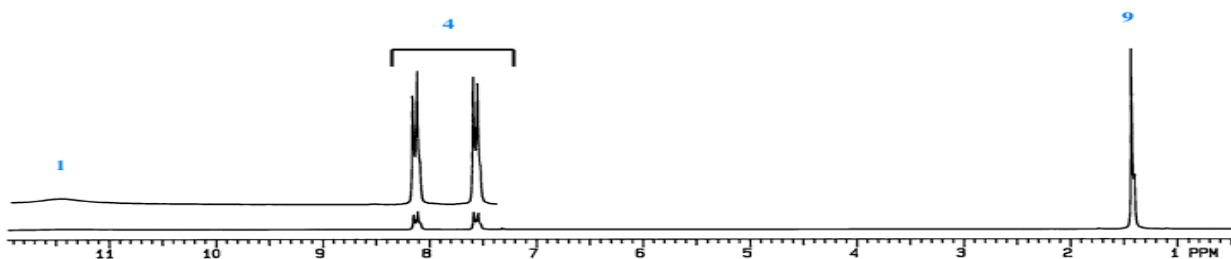
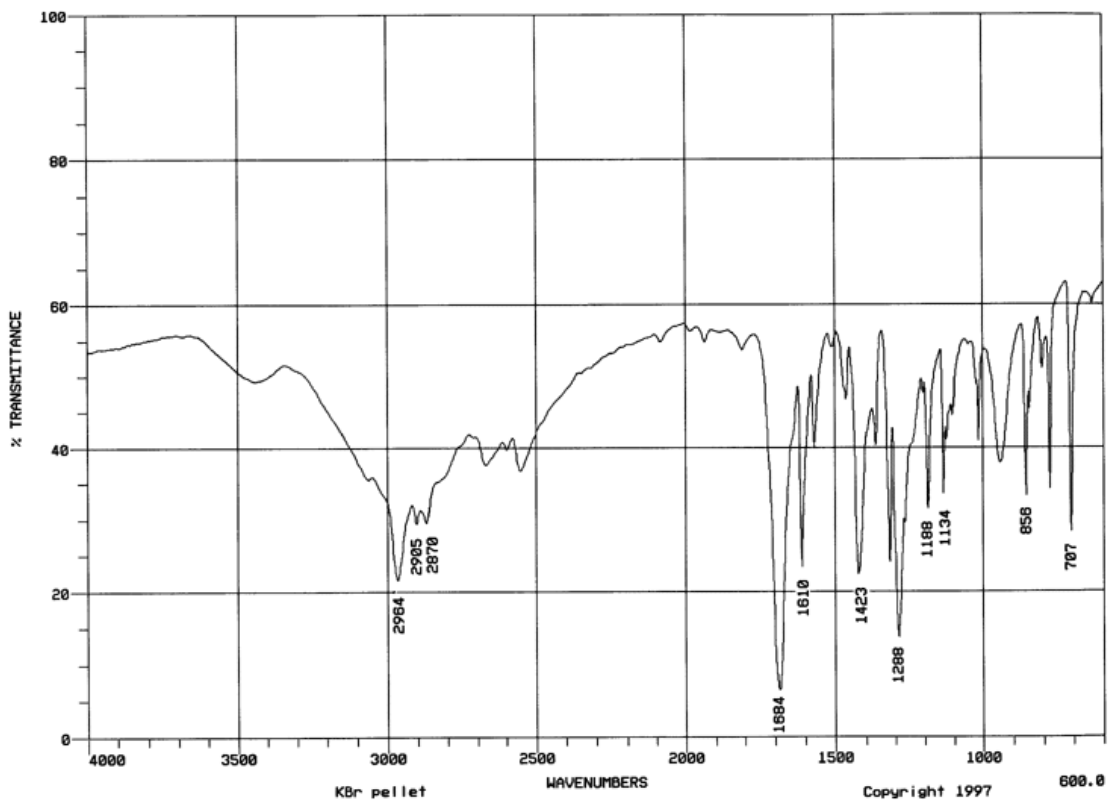


- What peak represents M^{+0} ?
- What peak represents the base peak?
- What peak represents the parent peak?

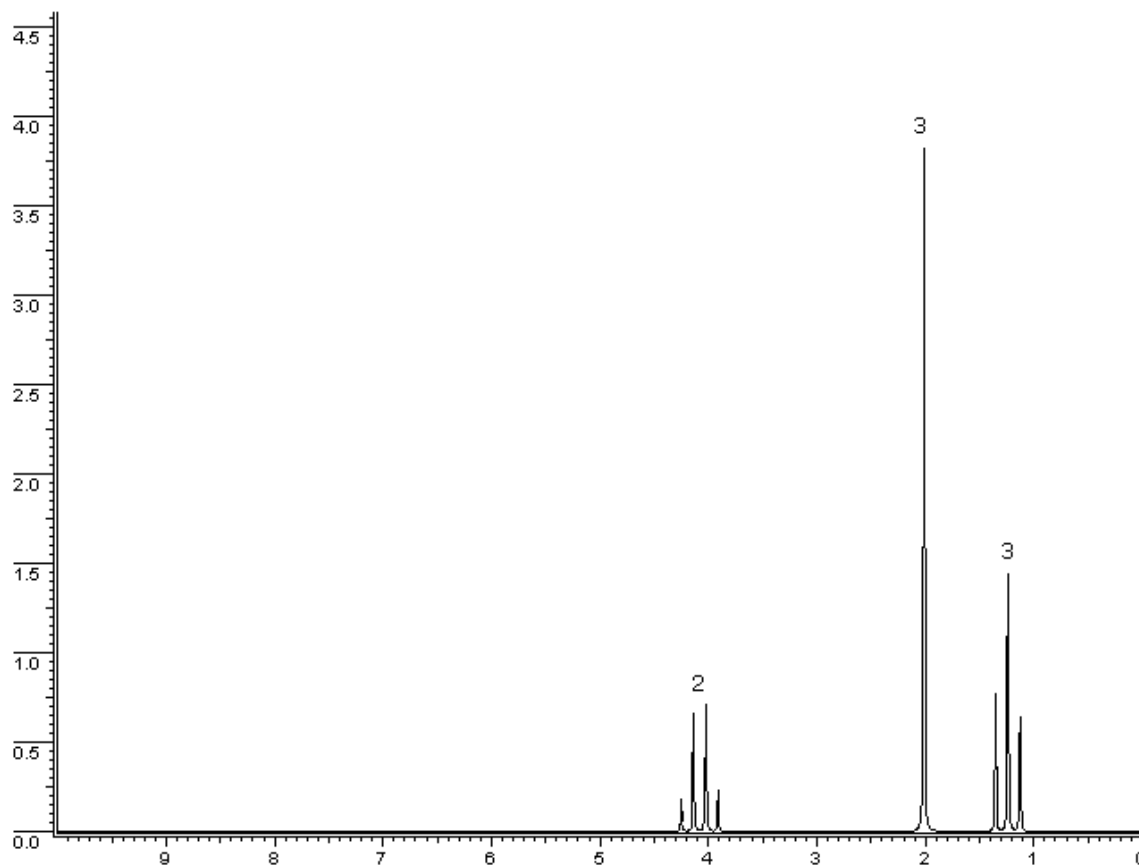
17. Suggest a structure which is consistent with all the spectral data given below for $C_xH_yO_2$. (4 points)



18. Suggest a structure, which is consistent with the IR and ^1H NMR spectra shown below. ($\text{C}_{11}\text{H}_{14}\text{O}_2$) (4 points)



19. Suggest a structure, which is consistent with the ^1H NMR spectra shown below. (4 points)



20. How many different type of hydrogens (in different environments) are there in the following compounds? (4 points)

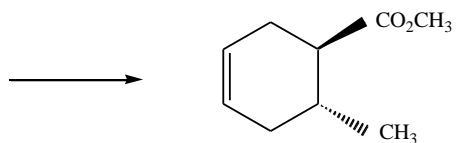
a) cis-1,3-dibromopropene

b) 2-chloropropane

21. Propose structure that fit the following ^1H NMR data: (4 points)

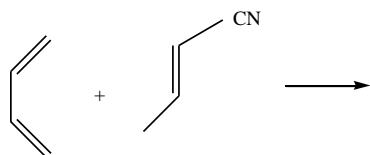
$\text{C}_8\text{H}_9\text{Br}$ 3 H doublet at δ 2.0 , 1 H quartet at δ 5.0 , 5 H singlet at δ 7.3

22. What diene and dienophile would you react to give the product below? (4 points)

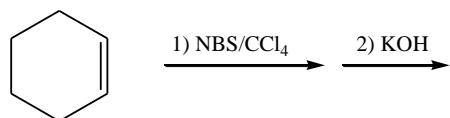


23. Provide the structures of the major product(s) in the following reactions. (15 points)

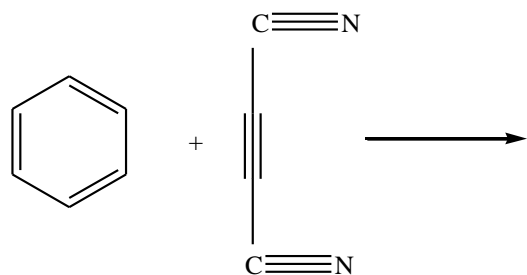
a)



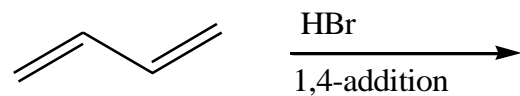
b)



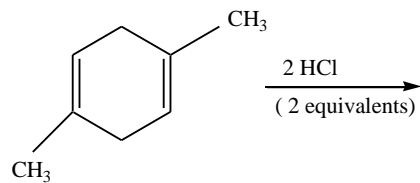
c)



d)

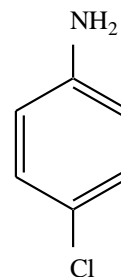
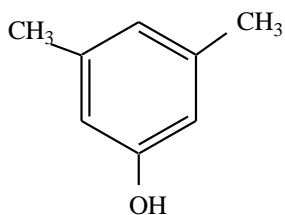
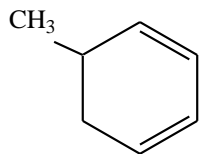


e)



24. Nomenclatures: (12 points)

I) Give the correct names (IUPAC)



II) Give the correct structures

a) m-nitroaniline



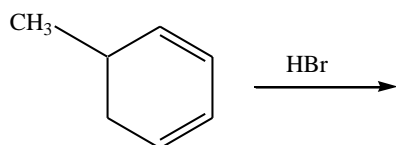
b) 2,4,6-trinitrophenol



c) 3-bromo-(3Z,5E) -octadiene



Bonus question(10 points)- Provide a detailed stepwise mechanism for the reaction shown below. Please show all your work including electron flow.



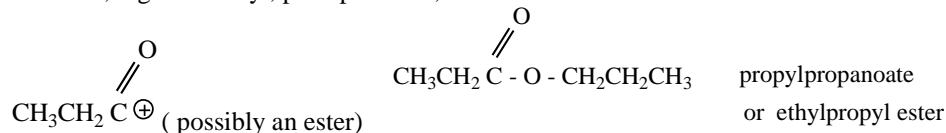
PART I.

1. B 2. B 3. B 4. E 5. D 6. B 7. B 8. B 9. B 10. C 11. D 12. D 13. C 14.E 15. A

PART II.

16. a) $m/z = 66$ b) $m/z = 64$ c) $m/z = 66$

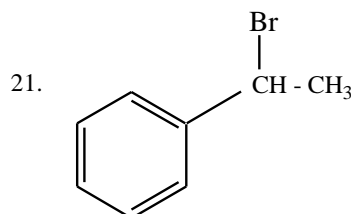
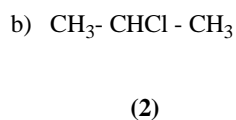
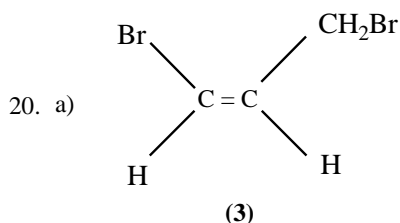
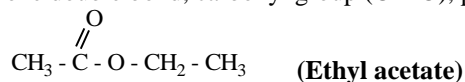
17. MW = 116, The band at 1737 cm^{-1} indicates a carbonyl.
At $m/z = 57$, high intensity, peak presents ;



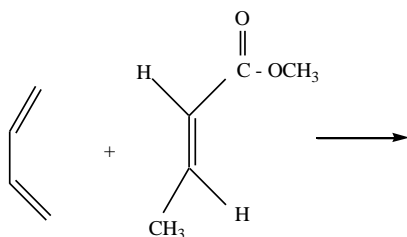
18. The band at 1684 cm^{-1} indicates a carbonyl. The wide band from $3300\text{-}2500\text{ cm}^{-1}$ is characteristic of the O-H stretch of carboxylic acids. The bands at $3000\text{-}2850\text{ cm}^{-1}$ indicate C-H alkane stretches. The bands in the region $1320\text{-}1000\text{ cm}^{-1}$ indicate the C-O stretch of carboxylic acids. The band (unmarked on the graph below) just to the left of 3000 cm^{-1} indicates aromatic C-H stretch. Aromatics also show bands in the regions $1600\text{-}1585\text{ cm}^{-1}$ and $1500\text{-}1400\text{ cm}^{-1}$ (C-C in-ring stretch), and $900\text{-}675\text{ cm}^{-1}$ (C-H out-of- plane).

para-t-butylbenzoic acid or *para-(1,1-dimethylethyl)benzoic acid*

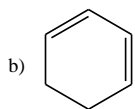
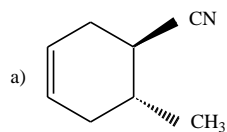
19. $\text{C}_4\text{H}_8\text{O}_2$ Degree of unsaturation = $4 - (8/2) + 1 = 1$, one double bond, carbonyl group (C = O), possibly ester.



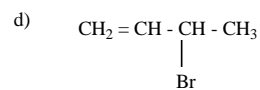
22.



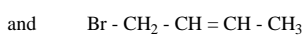
23.



c) No reaction (benzene too stable to undergo Diel's Alder reaction)

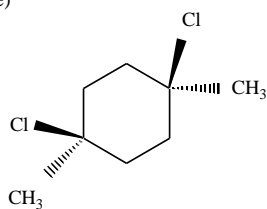


(1,2-addition)

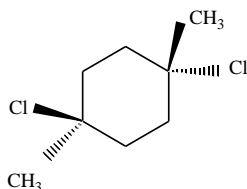


1,4-addition)

e)



and



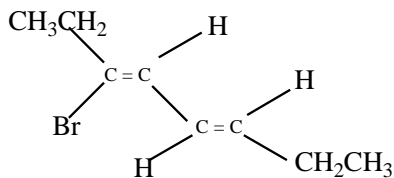
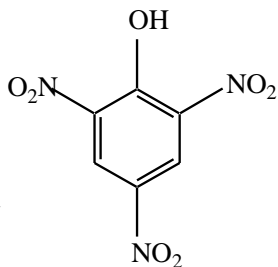
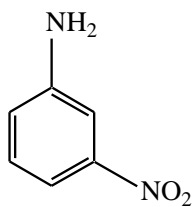
24.

I) 5-methyl-1,3-cyclohexadiene

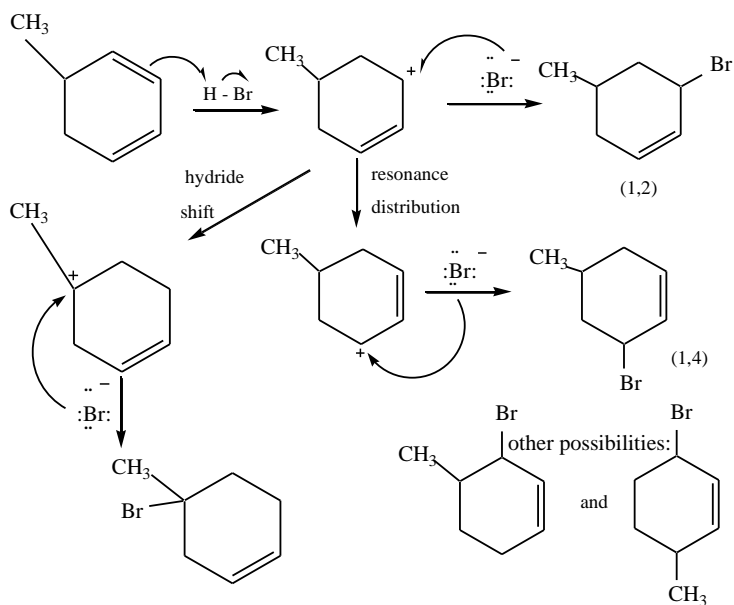
3,5-dimethylphenol

4-chloroaniline
Or (p-chloroaniline)

II)



25. Bonus question

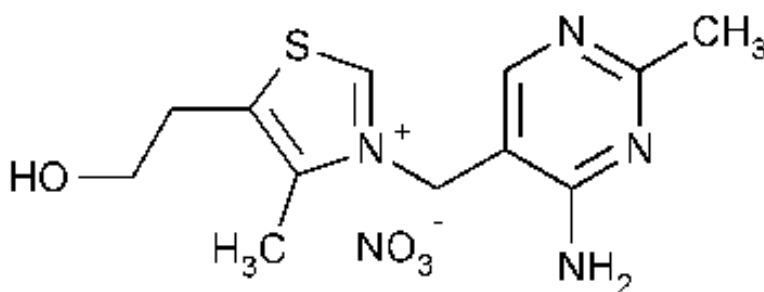




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SAMPLE EXAM # 1B
Organic Chemistry I
2425



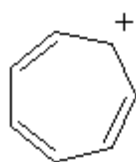
Thiamin

Thiamin— Thiamine Mononitrate: Nitrate salt form of thiamine for the preparation of various multivitamins. Thiamine Pyrophosphate: The coenzyme in a variety of reactions or prosthetic component of carboxylase.

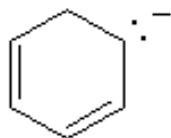
DIRECTIONS- Please answers all questions in the space provided as completely and clearly as possible. Show all your work for the writing portions of the exam.

PART I – Multiple choice : (3 points each)

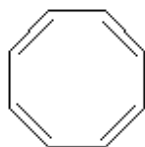
_____ 1. Which of the following is aromatic?



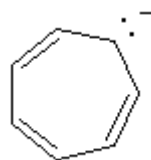
A.



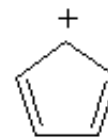
B.



C.



D.



E.

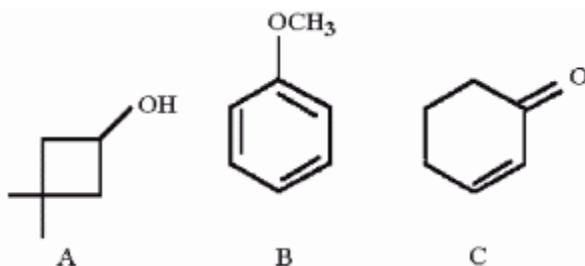
_____ 2. What is the major difference between an antiaromatic and aromatic compound?

- A) The structure must be cyclic for aromatic but not antiaromatic compounds?
- B) Antiaromatic compounds have at least one sp^3 hybridized atom in the ring.
- C) Antiaromatic compounds can assume a chair-like structure while aromatic compounds are nearly flat.
- D) Aromatic compounds cannot have a charged atom in the structure.
- E) Only aromatic compounds follow Huckle's rule.

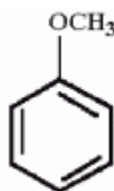
_____ 3. 2-Methylhexane shows an intense peak in the mass spectrum at $m/z = 43$. Propose a likely structure for this fragment.

- A. CH_3CH_2^+
- B. $(\text{CH}_3)_2\text{CH}^+$
- C. $\text{CH}_3\text{CH}_2\text{CH}_2^+$
- D. CH_3C^+
- E. none of these

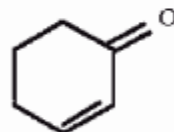
_____ 4. Which compound would be expected to show intense IR absorption at 1680 cm^{-1} ?



A



B



C

- A. A only
- B. B only
- C. C only
- D. A and C
- E. all of these

_____ 5. What is the major organic product which results when cycloheptene is irradiated in the presence of *N*- bromosuccinimide?

- A. 1-bromocycloheptene
- B. 2-bromocycloheptene
- C. 1,2-dibromocycloheptane
- D. 3-bromocycloheptene
- E. 4-bromocycloheptene

_____6. When a high energy electron impacts molecule M in the ionization chamber, what type of species is initially produced?

- A. Cation B. anion C. radical D. radical cation E. radical anion

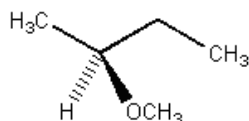
_____7. Which of the following most closely matches the $C\equiv C$ stretching frequency?

- A. 3300 B. 3000 C. 2200 D. 1700 E. 1200

_____8. Which of the following does not have a broad absorption with one or more spikes that is centered about 3300 cm^{-1} in the IR?

- A. $(\text{CH}_3\text{CH}_2\text{CH}_2)_3\text{N}$ B. $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{NH}$ C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
D. $(\text{CH}_3)_3\text{CNH}_2$ E. $(\text{CH}_2=\text{CHCH}_2)_2\text{NH}$

_____9. Predict the number of signals expected (disregarding splitting) in the ^1H NMR spectrum of the compound shown below.



- A. 6 B. 5 C. 4 D. 3 E. 2

_____10. What is the hybridization of the central carbon of allene (1,2-propadiene)?

- A. sp B. sp^2 C. sp^3 D. p E. none of the above

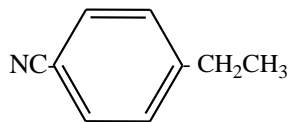
_____11. What descriptive term is applied to the type of diene represented by 2,4-hexadiene?

- A. conjugated diene B. cumulated diene C. isolated diene
D. alkynyl diene E. none of the above

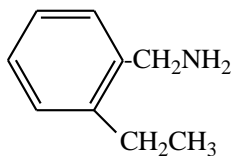
_____12. Provide a structure that is consistent with the data below. **$\text{C}_9\text{H}_9\text{N}$**

IR (cm^{-1}): 3050, 2950, 2240, 1630

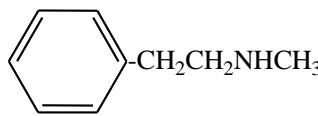
^1H NMR (d): 7.5 (2H, d), 7.1 (2H, d), 2.3 (2H, q), 0.9 (3H, t)



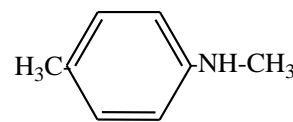
A.



B.

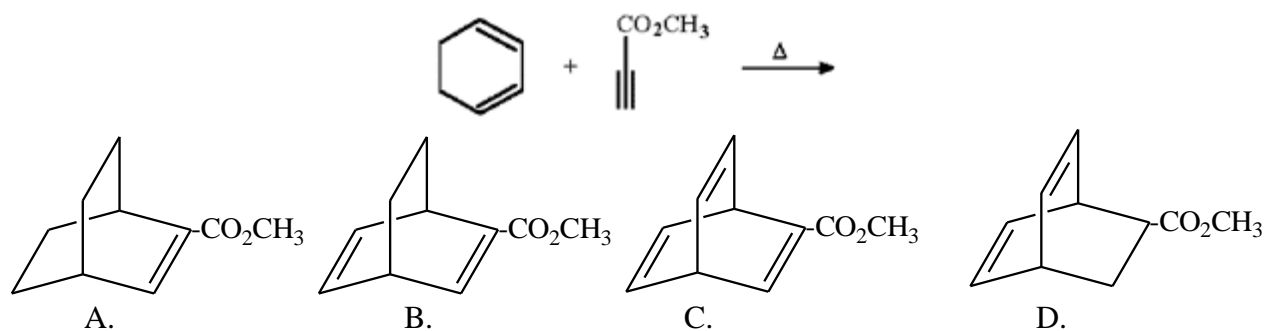


C.

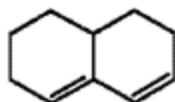


D.

____13. Provide the structure of the major organic product in the following reaction.



____14. Why does the diene shown below fail to undergo a Diels-Alder reaction with even the most reactive dienophiles?



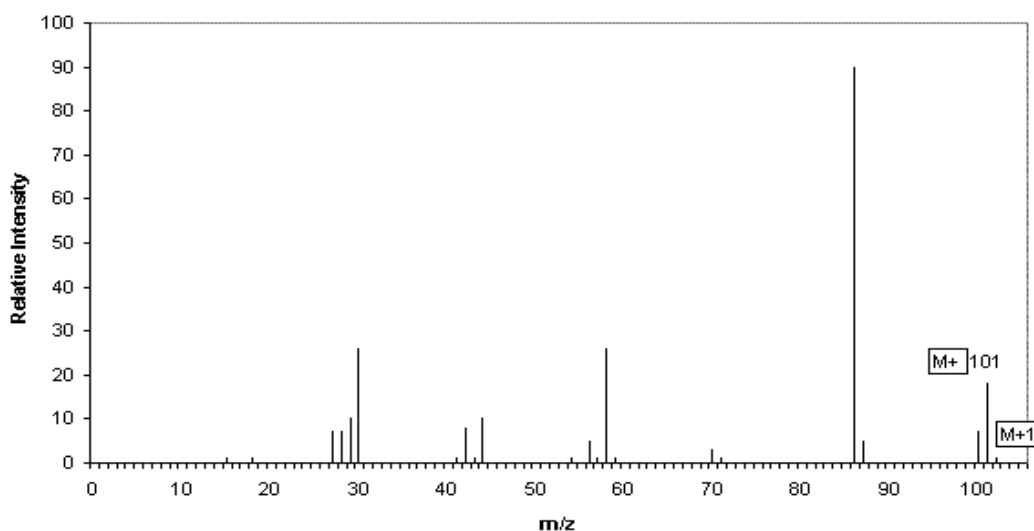
- A. The diene cannot achieve the necessary *s*-cis conformation. B. This is not dienene
C. It is not monocyclic D. It is a planar molecule E. Do not obey Hukel's rule

____15. Which of the following is **correct** description of benzene?

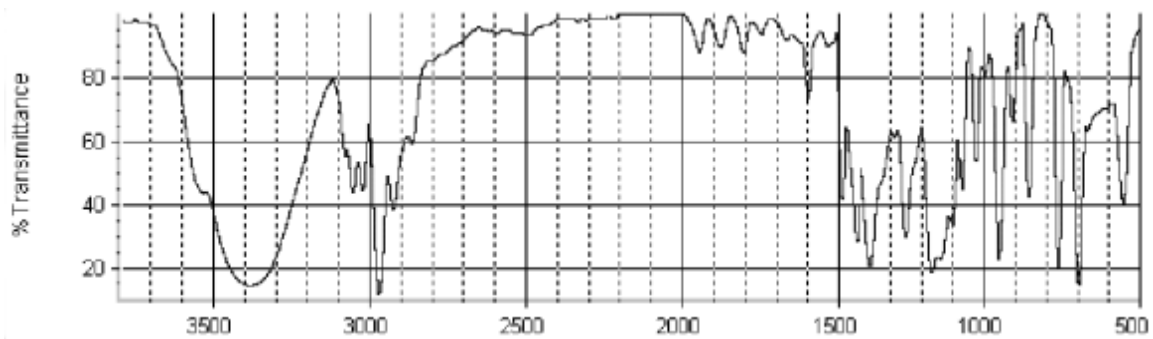
- A. The CCC bond angles are all equal to 120°.
B. Addition of Br₂ to benzene is highly unfavorable.
C. The molecule can be drawn as a resonance hybrid of two Kekule structures.
D. all carbons have are sp² hybridized.
E. All of these are correct.

PART II. Show all your work for complete credit.

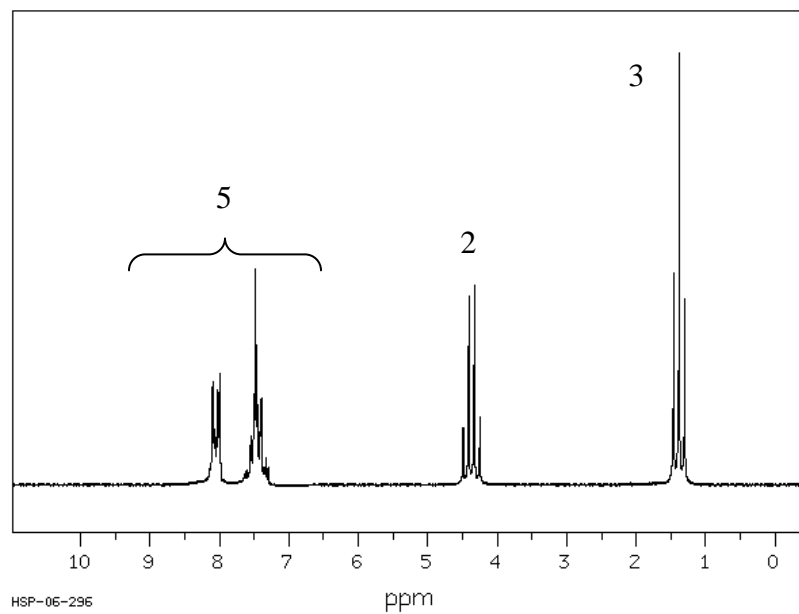
16. Suggest a structure, which is consistent with all the spectral data given below. (4 points)
(C₆H₁₅N)



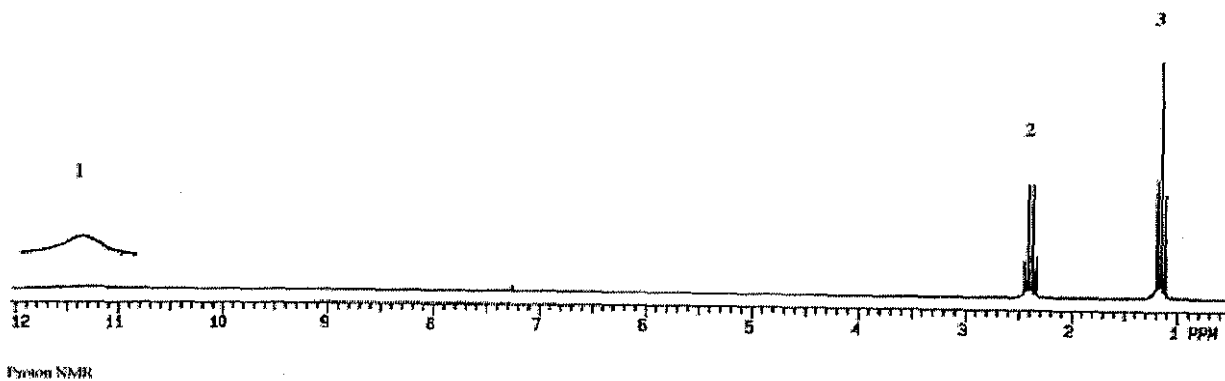
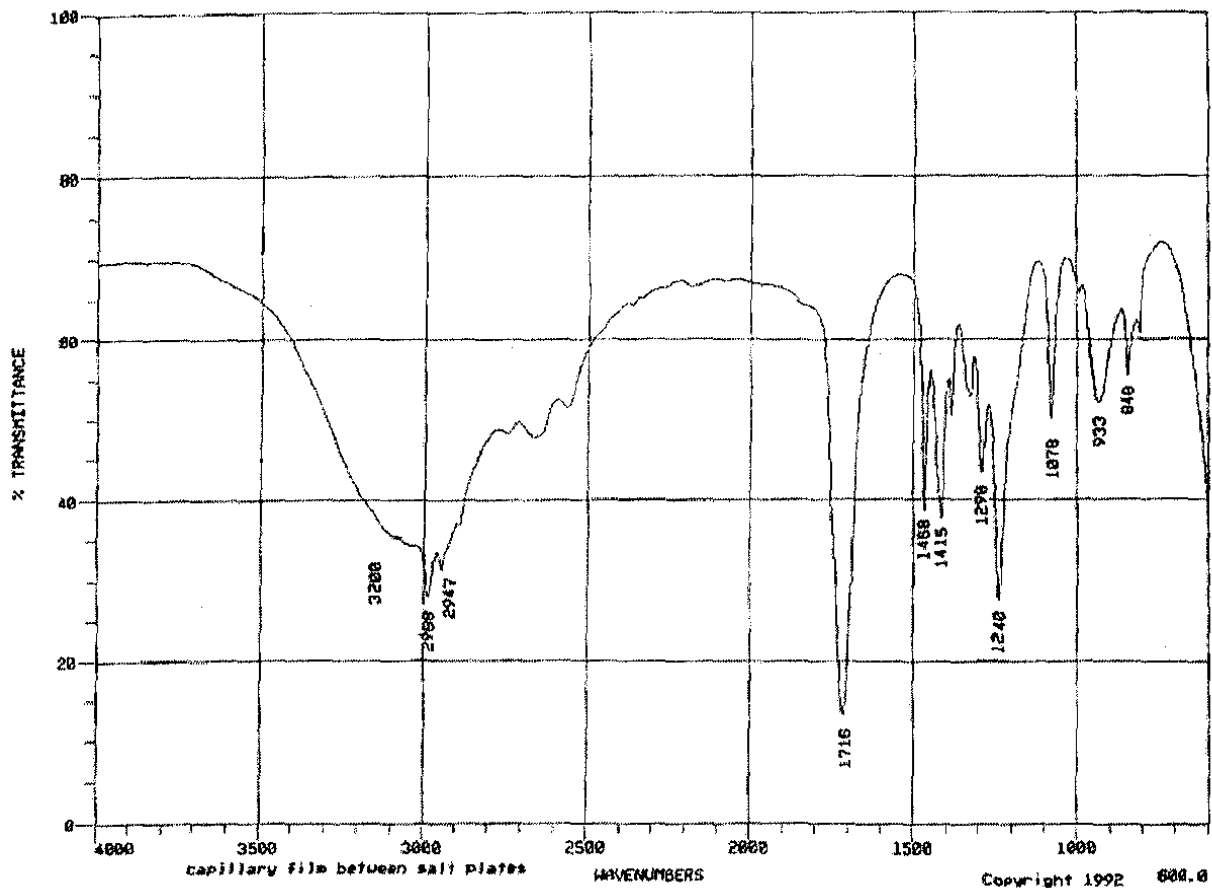
17. Suggest a structure, which is consistent with all the spectral data given below. (4 points)
($C_9H_{12}O$)



18. Suggest a structure, which is consistent with the NMR spectra shown below. (4 points)($C_9H_{10}O_2$)



19. Suggest a structure, which is consistent with the IR and ^1H NMR spectras shown below. ($\text{C}_3\text{H}_6\text{O}_2$) (4 points)



20. How many different type of hydrogens are there in the following compounds? (4 points)

a) m - Chlorotoluene

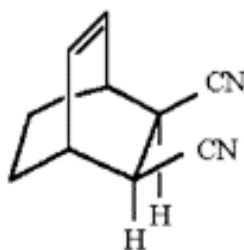
b) 1-Methyl-1,3- cyclohexadiene

21. Propose structure that fits the following ^1H NMR data: (4 points)

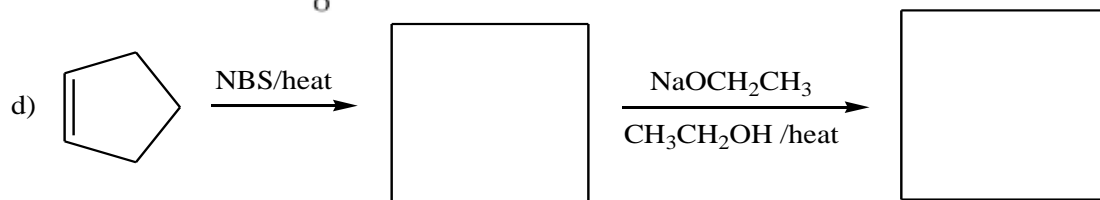
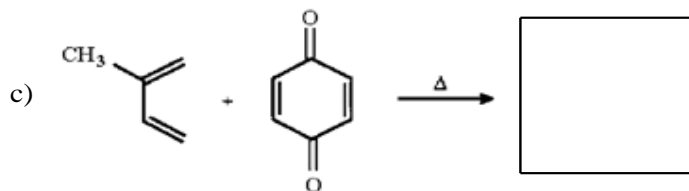
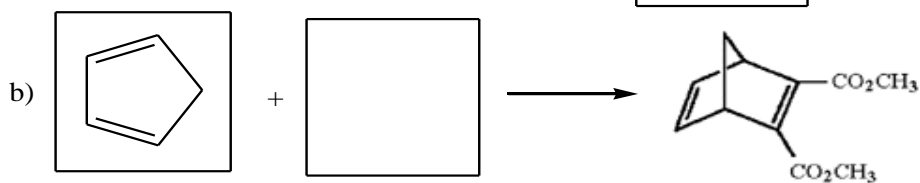
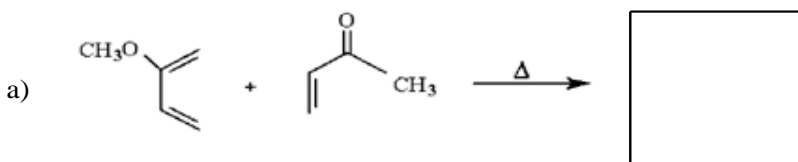
a) $\text{C}_3\text{H}_6\text{O}_2$ 3 signals: (3H, triplet); (2H, quartet); (1H, singlet)

b) $\text{C}_3\text{H}_8\text{O}$ 3 signals: (3H, triplet); (2H, quartet); (3H, singlet)

22. What diene and dienophile would you react to give the product below? (4 points)

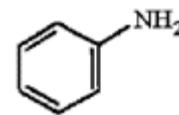
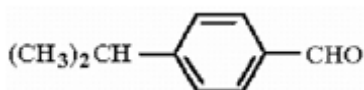
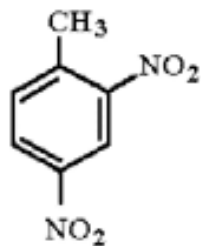


23. Provide the structures of missing compounds in the following reactions. (15 points)



24. Nomenclatures: (12 points)

I) Give the correct names (IUPAC)



II) Give the correct structures

a) Acetophenone



b) 2-Bromo-4-chlorobenzoic acid

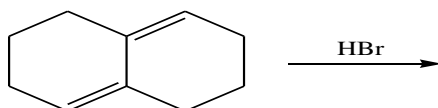


c) cis 1,3-pentadiene

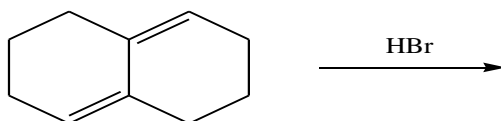


Bonus question (5 points each)

a) Provide a detailed stepwise mechanism for the reaction of 1,4 - addition of HBr to the diene shown below. Identify the major product and show all your work including electron flow.



b) Provide a detailed stepwise mechanism for the reaction of 1,2 - addition of Br₂ to the diene shown below. Identify the major product and show all your work including electron flow.



ORGANIC CHEM 2425 EXAM #1B(Chapters 12-15) (Answers)

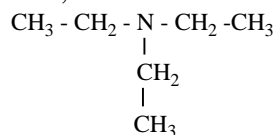
Part I. - Multiple choice questions (3 points each)

1. A 2. E 3. B 4. C 5. D 6. D 7. C 8. A 9. B 10. A 11. A 12. A 13. B 14. A 15. E

PART II. Show all your work for complete credit.

16. D.U. = (# C) - (# H/2) + (# N/2) - (#X /2) + 1 = (6) - (15/2) + 1 = 0,

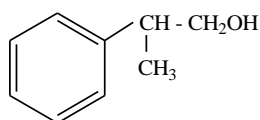
$M^{+0} = 101$, Peak at $m/z = 29$ represents (CH_3CH_2^+)



17. D.U. = (# C) - (# H/2) + (# N/2) - (#X /2) + 1 = (9) - (12/2) + 1 = 4 (benzene ring)

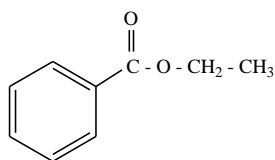
IR : peak at 3400 cm^{-1} represents (-OH)

Structure :



18. D.U. = (# C) - (# H/2) + (# N/2) - (#X /2) + 1 = (9) - (10/2) + 1 = 5 (benzene ring + 1 db)

$^1\text{H NMR}$: at $\delta 1.4$ (- CH_3), at $\delta 4.5$ (- CH_2), at $\delta 7-8$ (5 Ar-H)

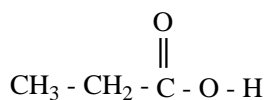


19. D.U. = (# C) - (# H/2) + (# N/2) - (#X /2) + 1 = (3) - (6/2) + 1 = 1 (1 db)

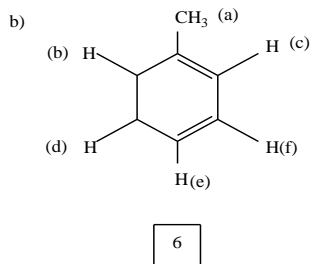
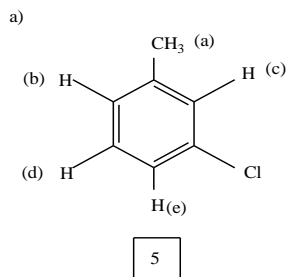
IR: peak at 1716 cm^{-1} represents carbonyl group, (-CO-)

$^1\text{H NMR}$: at $\delta 1.2$ ppm (- CH_3), at $\delta 2.4$ ppm (- CH_2) at $\delta 11-12$ (-OH)

Structure :



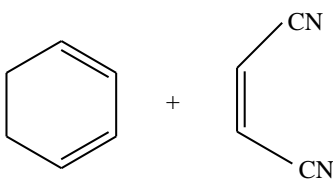
20.



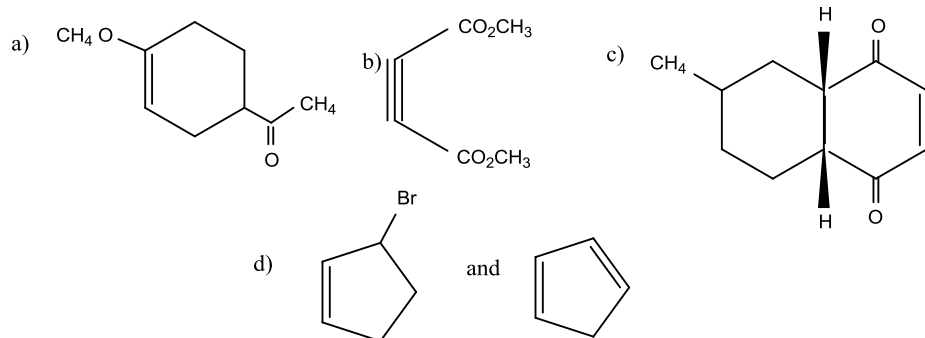
21. a) $C_3H_6O_2$ 3 signals: (3H, triplet); (2H, quartet); (1H, singlet), CH_3CH_2COOH

b) C_3H_8O 3 signals: (3H, triplet); (2H, quartet); (3H, singlet), $CH_3 - CH_2 - O - CH_3$

22.



23.



24.

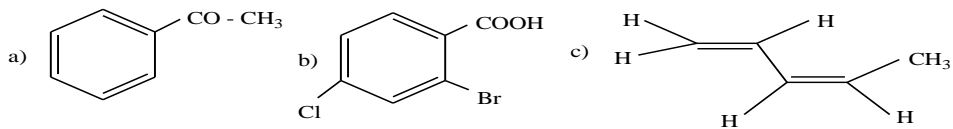
I.

a) 2-,4-Dinitro toluene

b) p- isopropylbenzaldehyde

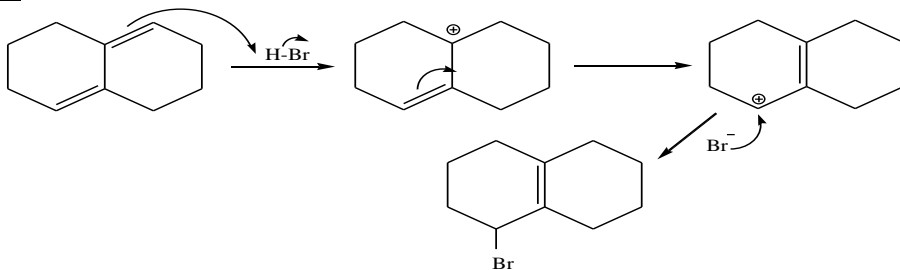
c) Aniline (aminobenzene)

II.



Bonus Question

a)



b)

