

THE COLLEGE OF THE BAHAMAS

EXAMINATION

SEMESTER 01-2005

FACULTY OF PURE AND APPLIED SCIENCES

SCHOOL OF SCIENCES AND TECHNOLOGY

X NASSAU
FREEPORT
EXUMA
ELEUTHERA

DATE AND TIME OF EXAMINATION: Tuesday, April 26, 2005 at 7 pm
DURATION: 3 HOURS

COURSE NUMBER: CHEM 230

COURSE TITLE: ORGANIC CHEMISTRY

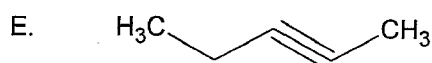
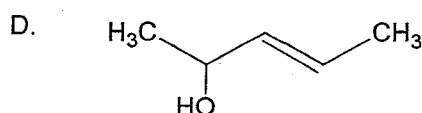
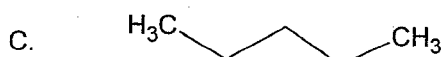
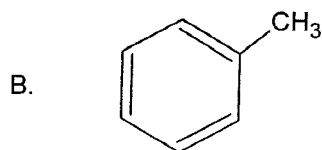
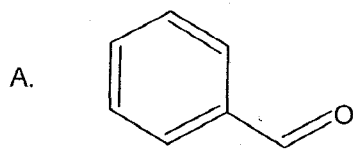
STUDENT NAME:

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LECTURER'S NAME:

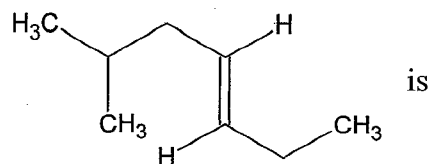
INSTRUCTIONS TO CANDIDATES: This paper has 9 pages and 33 questions. Please follow instructions given.

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Time allowed: 3 hours**Section A: Multiple Choice.**Answer **all** questions. For each question, select the best answer from the choices A to E, then shade the letter corresponding to this answer on the answer sheet provided. [25 marks]Questions **1 and 2** concern the following molecules:

- Which molecule has **all** of its carbon atoms sp^2 hybridized?
- Which molecule contains at least one sp hybridized carbon atom?

3. The correct IUPAC name for the compound



- is
- (*E*)-2-methyl-4-hexene
 - (*Z*)-2-methyl-4-hexene
 - (*E*)-6-methyl-3-heptene
 - (*Z*)-6-methyl-3-heptene
 - 3-octene

4. An alkene, X, produced ethanal as the only organic product of ozonolysis. Which is X?

- $CH_2=CH_2$
- $CH_3CH_2CH=CH_2$
- $CH_3CH=CHCH_3$
- $(CH_3)_2C=CH_2$
- $CH_3CH=CHCH_2CH_3$

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Questions 5-9 refer to the following types of reaction:

- A Electrophilic addition
- B Nucleophilic addition
- C Electrophilic substitution
- D Nucleophilic substitution
- E Free radical substitution

Select from A to E the type of reaction which takes place when

5. phenol is chlorinated to p-chlorophenol
6. toluene is chlorinated to benzyl chloride
7. propene is chlorinated to 1,2-dichloropropane
8. propane is chlorinated to 2-chloropropane
9. chloroethane reacts with sodium ethoxide to form ethoxyethane

Questions 10-15 refer to the following types of reaction:

- A Redox
- B Elimination
- C Hydration
- D Condensation
- E Decarboxylation

Select, from A to E, the best classification for the formation of

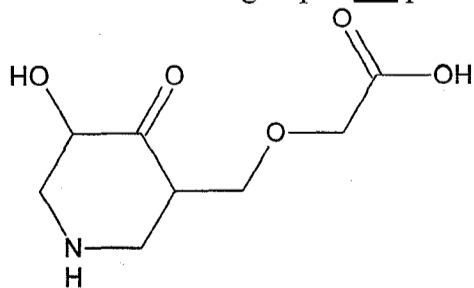
10. cyclohexene from cyclohexanol
11. cyclohexanol from cyclohexene
12. benzoic acid from toluene
13. ethyl propanoate from ethanol and propanoic acid
14. propane-1,2-diol from propene
15. propanone from 2-propanol

16. Which group, when attached to the benzene ring, deactivates the ring towards electrophiles and directs incoming electrophiles to the ortho- and para- positions?

- A -OH
- B -COOH
- C -NO₂
- D -Cl
- E -CH₃

17. Which reagent will **not** convert ethanol to chloroethane?

- A PCl₅
- B PCl₃
- C SOCl₂
- D HCl
- E Cl₂

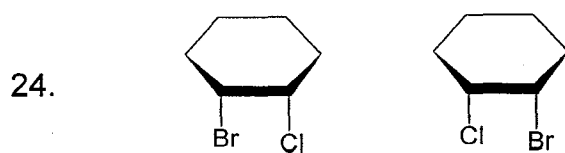
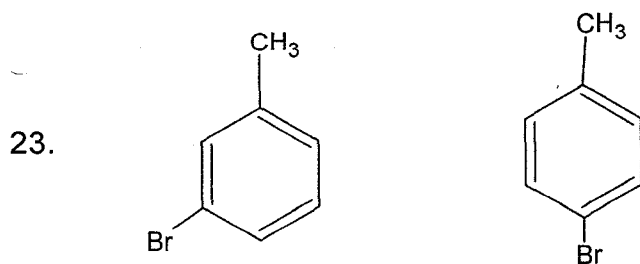
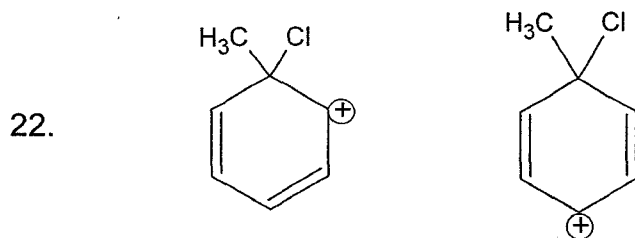
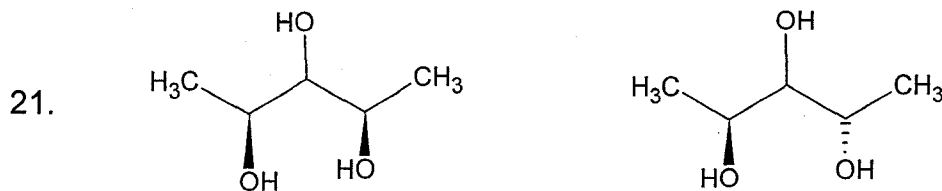
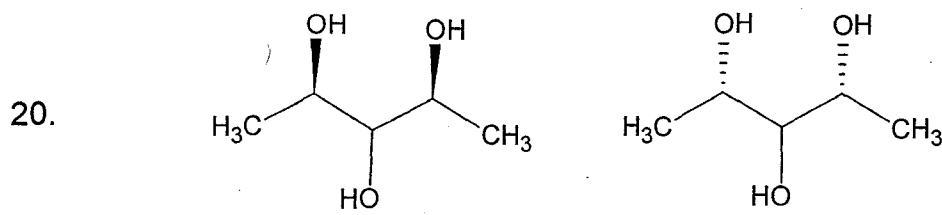
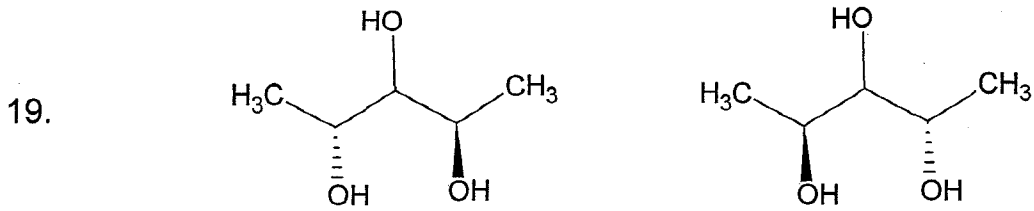
18. Which functional group is **not** present in the compound shown below?

- A Ether
- B Ketone
- C Alcohol
- D Amide
- E Carboxylic acid

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Questions 19-24. For each pair of structures given, decide whether the pair represents

- A Constitutional isomers
 B Enantiomers
 C Diastereomers
 D Identical molecules
 E Resonance structures.

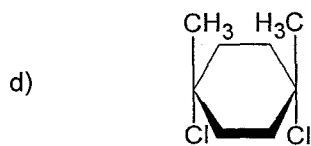
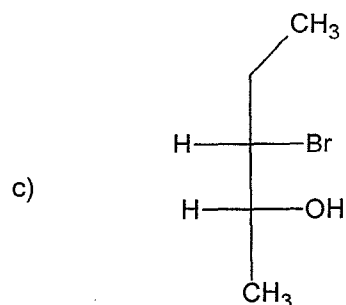
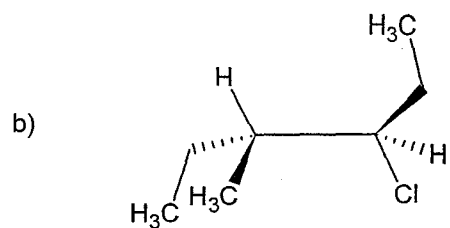
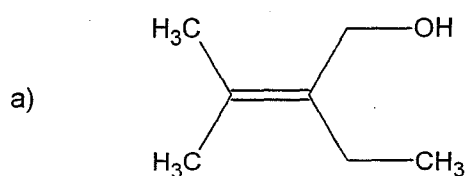


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25. Monosodium glutamate (MSG) is a flavor enhancer used in foods. (*S*)-MSG has a specific rotation of $+24^\circ$. Which mixture has a specific rotation of -12° ?
- A 50% (*S*)-MSG + 50% (*R*)-MSG
 B 75% (*S*)-MSG + 25% (*R*)-MSG
 C 25% (*S*)-MSG + 75% (*R*)-MSG
 D 80% (*S*)-MSG + 20% (*R*)-MSG
 E 20% (*S*)-MSG + 80% (*R*)-MSG

SECTION B: Answer **all** questions in the spaces provided in the question paper.

1. Name each compound, including stereochemical designations (*E*), (*Z*), *cis*, *trans*, (*R*), (*S*) where appropriate. [4]



2. Draw the structure for each compound, showing stereochemical designations where applicable. [3]

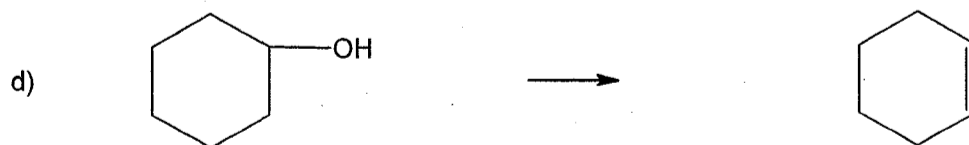
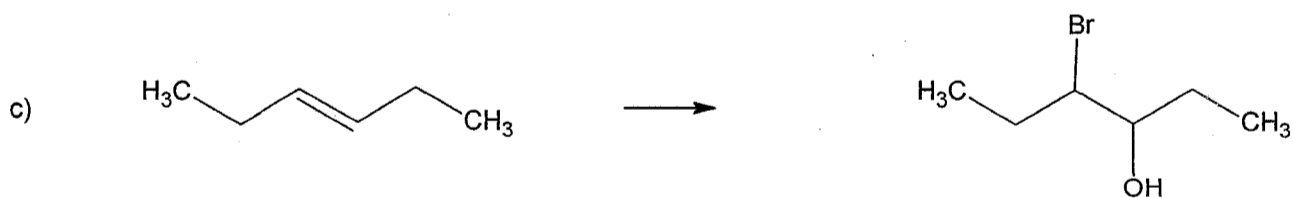
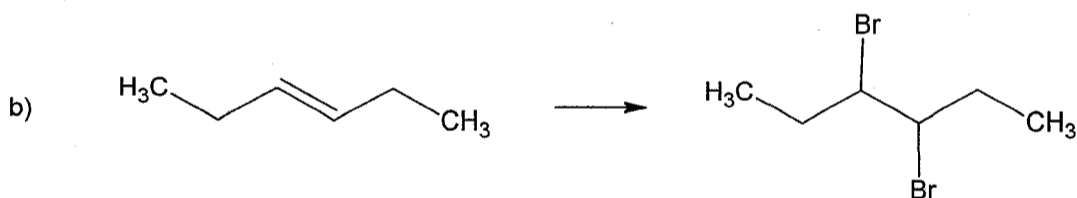
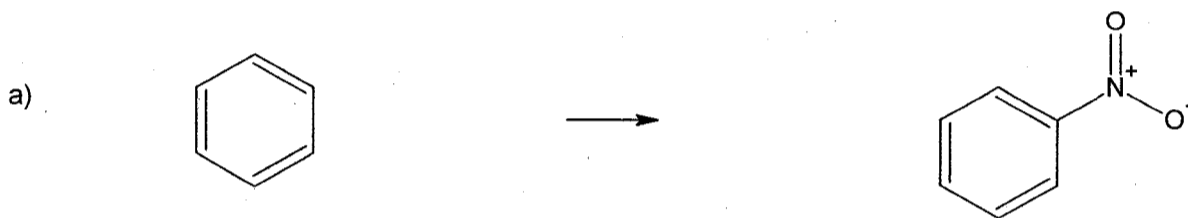
- a) (*2R,3S*)-2-hydroxy-3-chlorobutanoic acid.

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b) 2-chloro-3-nitrophenol

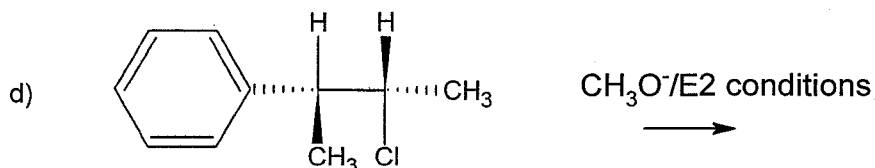
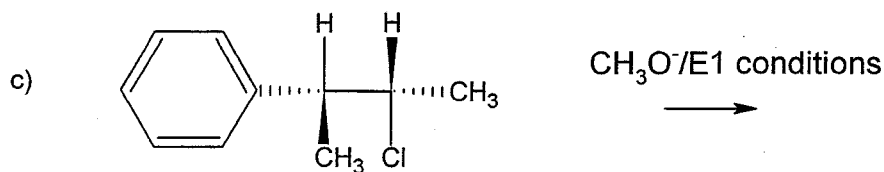
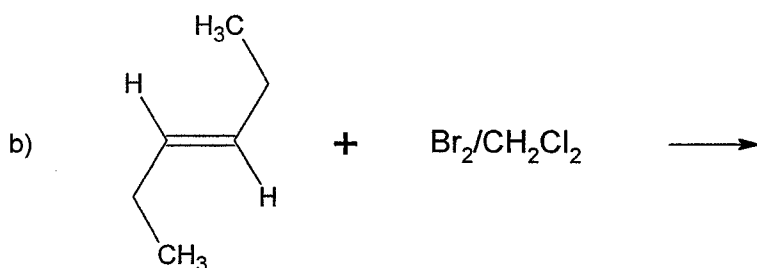
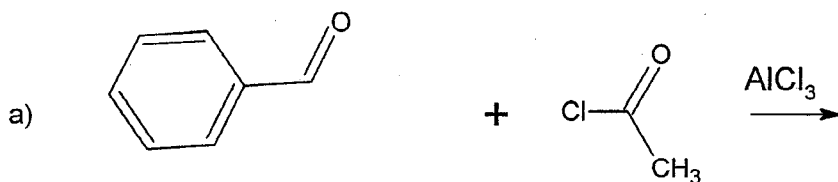
c) (*E*)-1,2-dibromo-3-methylhex-2-ene

3. In each case, state the reagent(s) and conditions required to bring about the **one step** conversion. [4]



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4. Give the structure of the **major** product formed in each case. Show stereochemical designation where appropriate. [4]



5. When toluene ($C_6H_5CH_3$) reacts with chlorine in the presence of ultra-violet light, it does so in a similar fashion to methane, under the same conditions, to produce benzyl chloride ($C_6H_5CH_2Cl$). Propose a mechanism for the reaction. [4]

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6. a) When toluene ($C_6H_5CH_3$) reacts with chlorine in the presence $FeCl_3$, the major product is 2-chlorotoluene. Propose a mechanism for the reaction. [4]
- b) Explain why 2-chlorotoluene is produced in greater abundance than 4-chlorotoluene even though the $-CH_3$ group is *ortho-para* directing. [1]
- c) Explain why 2-chlorotoluene is produced in **much greater** abundance than 3-chlorotoluene. [3]

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7. Give an explanation for each of the following observations. You need to propose mechanisms for reactions and refer to the proposed mechanisms in your explanations.

- a) When $(\text{CH}_3)_3\text{C}-\text{CH}(\text{Cl})-\text{CH}_3$ undergoes an E1 reaction with CH_3OH , the main product of the reaction is 2,3-dimethylbut-2-ene, rather than 3,3-dimethylbut-1-ene. [5]

- c) The reaction of (2*R*)-2-bromobutane with sodium methoxide produces only (2*S*)-2-methoxybutane, whereas the reaction with methanol produces a racemic mixture of 2-methoxybutane. [7]

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8. Give a reaction scheme, including reagents, for the following conversions. Each scheme must involve more than one step. [6]

