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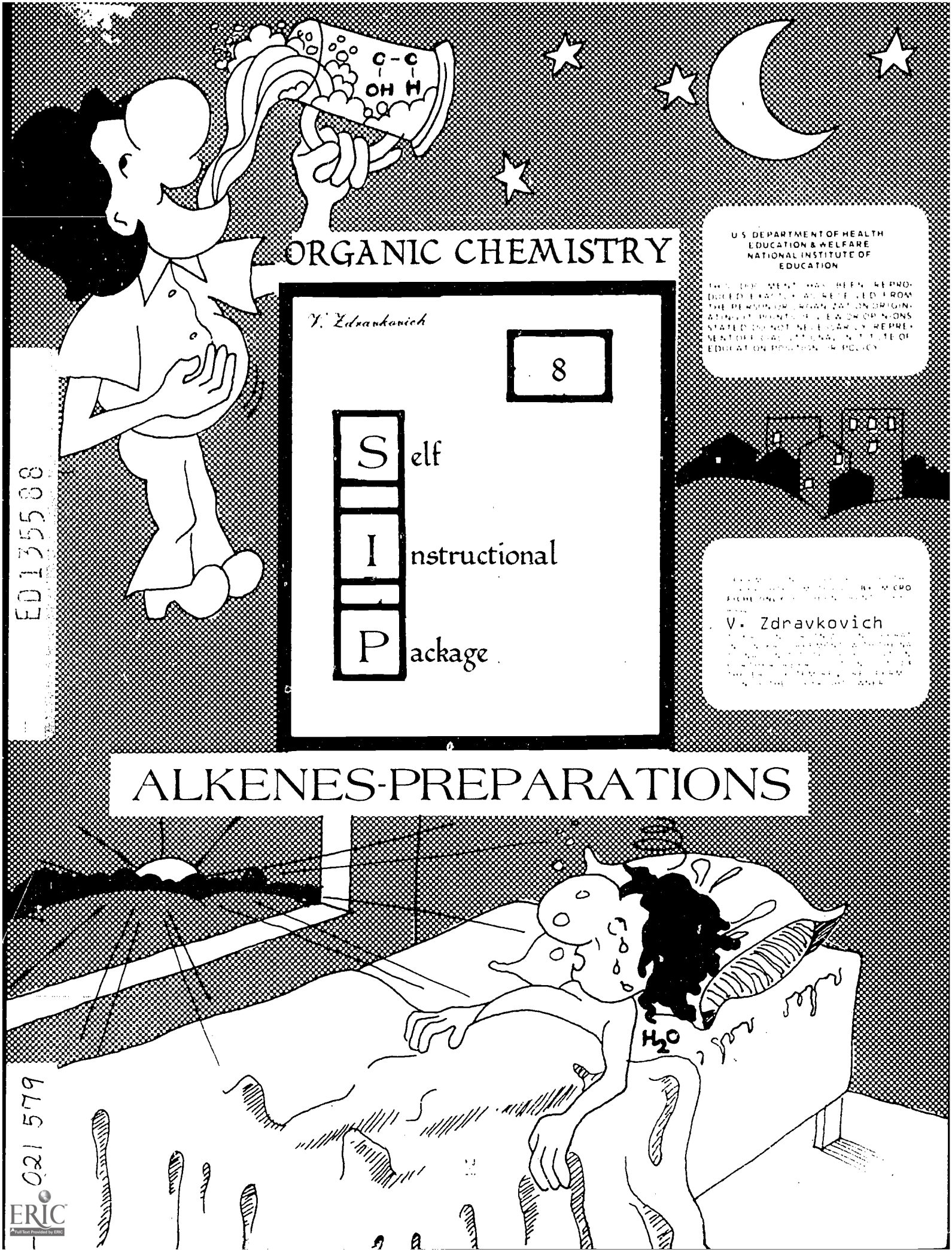
IDENTIFIERS	Alkenes; Prince Georges Community College

ABSTRACT

This booklet, one of a series of 17 developed at Prince George's Community College, Largo, Maryland, provides an individualized, self-paced undergraduate organic chemistry instruction module designed to augment any course in organic chemistry but particularly those taught using the text "Organic Chemistry" by Morrison and Boyd. The entire series of modules covers the first 13 chapters of the Morrison-Boyd text in great detail. Each module has been provided with from one to three audiotapes, available from Prince George's Community College, to provide students additional explanations of particular concepts. Each module includes a self-evaluation exercise, a reference guide, worksheets to be completed with the audiotapes, answer sheets for the worksheets, a progress evaluation, an answer sheet for the progress evaluation, an answer sheet for the self-evaluation exercise, an introduction to the topic covered by the module, and student performance objectives for the module. The topic of this module is alkenes-preparations. (SL)



Self Instructional Sequence in

ORGANIC CHEMISTRY

Self Instructional Package No. 8
Form A - List of Objectives

ALKENES - PREPARATIONS

Definitions -

The student will be able to define or explain and illustrate with appropriate examples where applicabl e the following terms: Elimination Reaction, Dehydrohalogenation, Dehydration, Carbonium Ion, Electrophile, Nucleophile, Sp^2 Hybridization, Hydride Shift, Methyl Shift.

Reaction Mechanisms

The student will be able to write the step by step mechanism for the dehydration and the dehydrohalogenation reaction.

The student will be able to draw the transition state in the dehydrohalogenation reaction.

The student will be able to predict the relative stabilities of different carbonium ions.

The student will be able to describe and explain the structure, shape and orbital picture of the carbonium ion.

The student will be able to explain the effect of the electron withdrawing and electron releasing groups on the stability of the carbonium ion.

The student will be able to predict the major product in the dehydration and dehydrohalogenation on the basis of the mechanism.

The student will be able to predict the relative reactivities of different alkylhalides and alcohols in the dehydration and the dehydrohalogenation reaction.

The student will be able to predict and explain the rearrangement in the dehydration reaction.

Preparations

The student will be able to write the reactions for the preparation of an alkene from an alkylhalide in alcohol and a vicinal alkyl dihalide.

Multi-Step Syntheti Schemes

The student will be able to devise a multi-step synthesis scheme for the synthesis of different alkenes from methane or any other small alkane.

The student will be able to identify the reagents in a given multi-step synthesis scheme.

The student will be able to identify i.e. draw the structures and name all the compounds in a given multi-step synthesis scheme.

Self Instructional Package No. 8
Form B - Self Evaluation Exercise

ALKENES - PREPARATIONS

Identify the statements below as true or false by placing a capital T or F on the line to the left.

1. _____ The first step in the dehydration mechanism is the heterolytic cleavage of the carbon-oxygen bond and the formation of the carbonium ion.

2. _____ The cleaving group in the dehydration mechanism is the hydroxide or OH group.

3. _____ Elimination reaction is a reaction in which an atom or a group of atoms is eliminated from the carbon atom.

4. _____ In the dehydrohalogenation reaction species removed from the alkyl halide are H positive ion and the halide anion.

5. _____ T-butyl carbonium ion is more stable than the isobutyl carbonium ion.

6. _____ 2-chloro butane undergoes dehydrohalogenation more readily than the 1-chloro butane.

7. _____ 2-butanol undergoes dehydration more readily than the 2-methyl-2-butanol.

8. _____ $CH_3-\overset{+}{C}H-CH_2Br$ is more stable than $CH_3-\overset{+}{C}H-CH_3$

9. _____ A presence of an atom or a group of atoms that exhibits electron withdrawing inductive effect stabilizes the carbonium ion.

10. _____ 1-chloro-2-butanol undergoes dehydration more readily than 2-butanol.

11. The following exothermic (energy releasing) changes take place in the dehydrohalogenation reaction:

    a) Solvation of the halide anion

    b) Cleavage of the carbon-halogen bond

    c) Formation of the bond between hydrogen and the base.

    d) π bond formation.

12. The energy required for the formation of the isopropyl carbonium ion is 277 kcal/mole as compared to 300 kcal/mole required for the formation of the ethyl carbonium ion. This in turn means that:

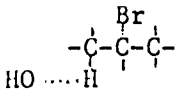
    a) isopropyl carbonium ion is more stable than the ethyl carbonium ion.

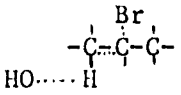
    b) isopropyl carbonium is less stable than the ethyl carbonium ion.

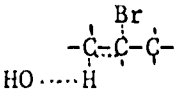
    c) they have the same stability.

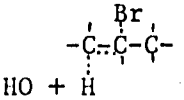
    d) not applicable.

13. The correct transition state for the dehydrohalogenation of 2-bromo propane in presence of KOH is:

    a) 

    b) 

    c) 

    d) 

14. The following statements about the carbonium ion are correct:

    a) A carbonium ion is flat.

    b) The hydridization on the carbon in the carbonium ion is Sp^3.

    c) The presence of an electron releasing group stabilizes the carbonium ion.

    d) The bond angles in the carbonium ion are 120°.

15. An alcohol I undergoes dehydration in presence of 80% sulfuric acid as compared to another alcohol II that undergoes dehydration in presence of 60% sulfuric acid. This means that:

    a) Alcohol I is more reactive toward dehydration than alcohol II.

    b) Alcohol I is less reactive toward dehydration than alcohol II.

    c) Alcohol I and II undergo dehydration at the same rate.

    d) Not applicable.

16. The major product in the dehydration of 2,2-dimethyl-3-pentanol is:

    a) 2,2-dimethyl-2-pentene

    b) 4,4-dimethyl-2-pentene

    c) 2,3-dimethyl-2-pentene

    d) 3,4-dimethyl-2-pentene

17. The major product in the dehydrohalogenation of 3-bromo-2,2-dimethyl pentane is:

    a) 2,2-dimethyl-2-pentene

    b) 4,4-dimethyl-2-pentene

    c) 2,3-dimethyl-2-pentene

    d) 3,4-dimethyl-2-pentene

18. The major product in the dehydration of 3,4-dimethyl-2-pentanol is:

    a) 3,4-dimethyl-2-pentene

    b) 3,4-dimethyl-1-pentene

    c) 3,4-dimethyl-3-pentene

    d) 2,4-dimethyl-3-pentene

19. The major product in the dehydrohalogenation of 2-chloro-3,4-dimethyl pentane is:

    a) 3,4-dimethyl-2-pentene
    b) 3,4-dimethyl-1-pentene
    c) 3,4-dimethyl-3-pentene
    d) 2,4-dimethyl-3-pentene

20. The reagents required for the reaction below is/are:

2,3-dichloro butane $\longrightarrow$ 2-butane

a) acid

b) Zinc, acid

c) KOH, alcohol

d) $NaNH_2$

21. The reagents required for the formation of 3,4-dimethyl-3-hexene from butane are:

a) Br_2,hv; Na; Br_2, hv; KOH

b) Br_2,hv; Na; KOH

c) Br_2,hv; Li; CuBr; 2-bromo butane; Br_2,hv; KOH

d) Br_2,hv; Na; Br_2,hv; Acid

Self Instructional Package No. 8
Form C - Reference Guide

ALKENES - PREPARATIONS

The Reference Guide should be used in conjunction with Form B or the Self Evaluation Exercise. The references provide the correlation between the questions in Form B and the available material in the textbook and in the form of tapes.

Questions 1, 2	Chapter 5, Sections 20	Morrison & Boyd Organic Chemistry
Questions 3, 20	Chapter 5, Section 11	
Questions 4,11,13	Chapter 5, Sections 12,13	
Questions 5,8,9,10,12,14	Chapter 5, Sections 15,17,18	
Questions 6,17,19	Chapter 5, Section 14	
Questions 7,10,15	Chapter 5, Sections 19,23	
Question 14	Chapter 5, Sections 15,16	
Questions 16,18	Chapter 5, Sections 22,23	
Question 21	Chapter 3, Sections 17,19,20,21 Chapter 5, Sections 12,13,14	

For Questions 4,6,11,13,17,19,21, additional explanations and examples are provided in TAPE 1, titled DEHYDROHALOGENATION, with the accompanying worksheet and answer sheet.

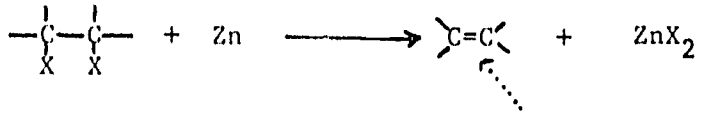
For Questions 1,2,5,7,8,9,10,12,14,15,16,18, additional explanations and examples are provided in TAPE 2, titled DEHYDRATION, with the accompanying worksheet and answer sheet.

If you would know what nobody knows, read what everybody reads, just one year afterwards. Emerson (1834)

ALKENES - PREPARATIONS

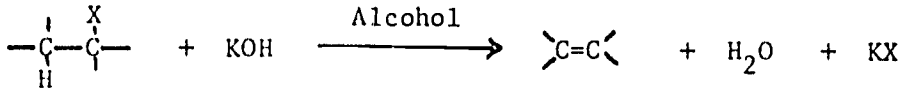
DEHYDROHALOGENATION REACTION

Example No. 1 - Dehalogenation (Elimination of Halogen)

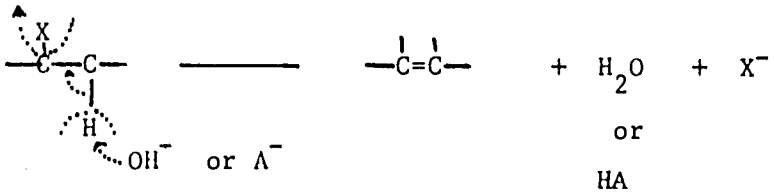


Vicinal Dihalide — Alkene

Example No. 2 - Dehydrohalogenation (Elimination of Hydrogen and Halogen)



Example No. 3 - Mechanism of the Dehydrohalogenation Reaction



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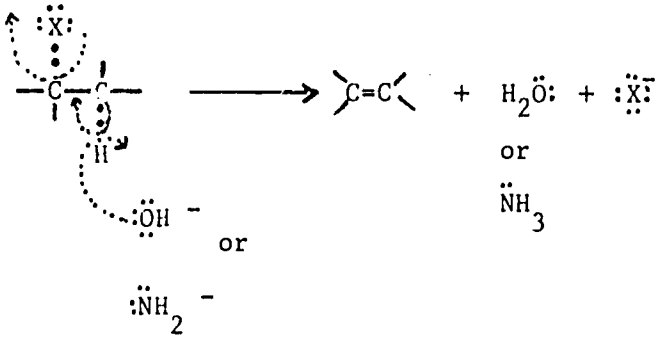


SIP No. 8
Tape I - Worksheet

Assignment No. 1.

Write mechanism for the Dehydrohalogenation of a) 2-Bromopropane and b) 2-Chlorobutane in the presence of: a) Potassium hydroxide and b) Sodamide $NaNH_2$ in alcoholic medium.

SIP No. 8
Tape I - Worksheet

Assignment No. 2.

Draw the transition state for the dehydrohalogenation mechanism of the a) Bromopropane and the 2-Chloro Butane with Potassium Hydroxide in alcoholic medium.

Example No. 4

	Reactant	⟶	Product	Relative Rates
(1°RX)	Ethyl Bromide	⟶	Ethylene	1.0
(1°RX)	Propyl Bromide	⟶	Propene	3.3
(2°RX)	2-Bromo Propane	⟶	Propene	9.4
(3°RX)	2-Bromo-2-Methyl Propane	⟶	2-Methyl Propene	120

a) Which of the given alkyl Halides reacts most readily? _____

b) Which of the given alkylhalides reacts most easily? _____

c) Compare the relative reactivities of: 3°RX, 2°RX, 1°RX

Assignment No. 3.

Arrange the following alkylhalides in order of their decreasing reactivity in the dehydrohalogenation reaction. Identify the one that exhibits maximum and the one which exhibits minimum reactivity.

a) 2-Bromo-3-Methyl Pentane

b) 3-Bromo-3-Methyl Pentane

c) 1-Bromo-3-Methyl Pentane

SIP No. 8
Tape I - Worksheet

Assignment No. 4.

Write the structures and name ALL the products which results from the dehydrohalogenation of the following alkyl halides -

a) 2-Bromo Butane

b) 2-Bromo-3-Methyl Pentane

c) 2-Bromo-2-Methyl Butane

Example No. 5.

2-Bromo Butane $\xrightarrow{\text{KOH (Alc)}}$ 2-Butene (81%) + 1-Butene (19%)

2-Bromo Pentane $\xrightarrow{\text{KOH (Alc)}}$ 2-Pentene (71%) + 1-Pentene (29%)

2-Bromo-2-Methyl Butane $\xrightarrow{\text{KOH (Alc)}}$ 2-Methyl-2-Butene (71%) + 2-Methyl-1-Butene (29%)

1. Which alkene will be the major product: the more branched or the less branched alkene? _____

   1) Which hydrogen is more easily abstracted: 1° or 2°? _____

      2° or 3°? _____ 1° or 3°? _____

   2) Which alkene will be the major product: the more branched or the less branched alkene? _____

SIP No. 8
Tape I - Worksheet

Example No. 6.

Relative ease of formation of alkenes

$R_2C = CR_2 > R_2C = CHR > RHC=CHR$ or $R_2C = CH_2 > RCH = CH_2$

Relative stability of alkenes

$R_2C = CR_2 > R_2C = CHR > RHC = CHR$ or $R_2C = CH_2 > RCH = CH_2$

Assignment No. 5.

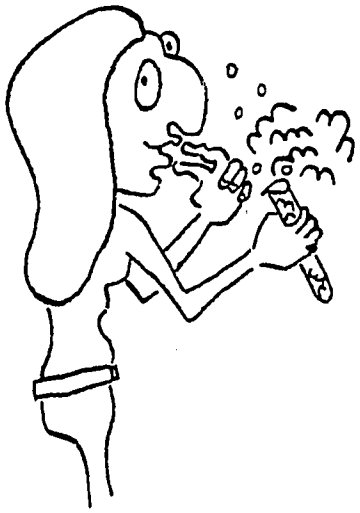
Draw the structures and name all the products expected from the dehydrohalogenation of the alkylhalides used below. In those cases where more than one product can be formed, predict the major product.

a) 2,3-Dimethyl-3-Bromo Pentane

b) 3-Methyl-3-Bromo Pentane

c) 3-Bromo-2,2-Dimethyl Pentane

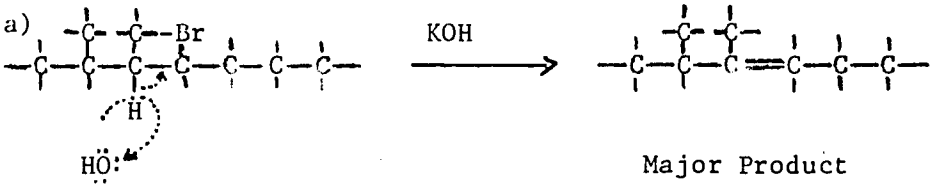
d) 3-Bromo-2-Methyl Pentane



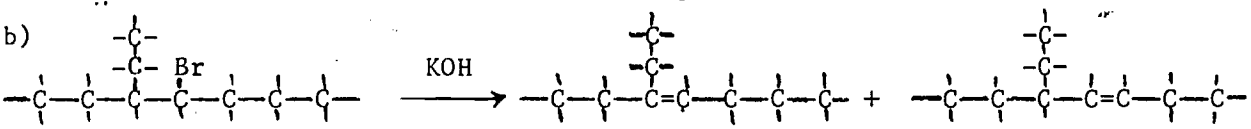
Assignment No. 6.

Forgetful Frieda was asked to draw the structures and name all the products expected from the dehydrohalogenation of 4-Bromo-2,3-Dimethyl Heptane and 4-Bromo-3-Ethyl Heptane. In addition, she was asked to identify the major product and to draw the transition state for both reactions indicating the formation of the major product. She completed the assignment, but failed to do it completely.

Complete her answer which is presented below.

a) 

Major Product

b) 

SIP No. 8
Tape I - Worksheet

Assignment No. 7.

Outline all steps in the laboratory synthesis of:

a) Propene from Propane

b) 2-Methyl-2-Butene from 2-Methyl Butane

Assignment No. 8.

Outline all steps and identify all reagents required for the laboratory synthesis of: a) 2,3-Dimethyl-2-Butene and b) 2-Methyl-2-Pentene from Propane.

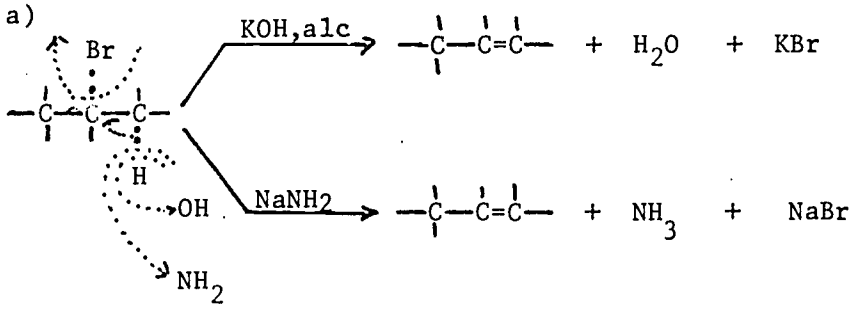
Self Instructional Package No. 8
Tape I - Answer Sheet

ALKENES - PREPARATIONS

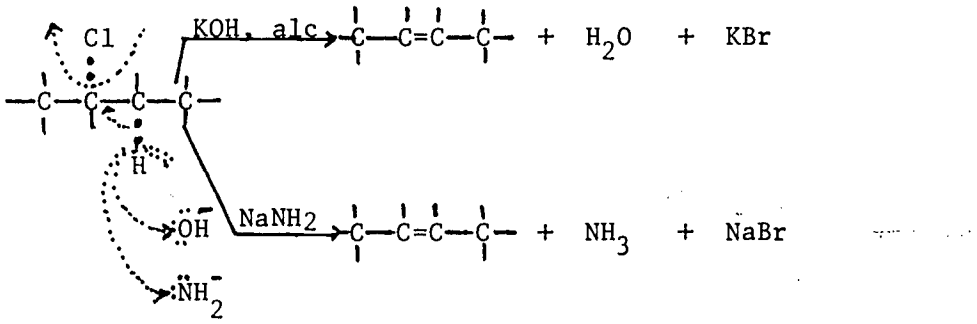
DEHYDROHALOGENATION REACTION

Assignment No. 1

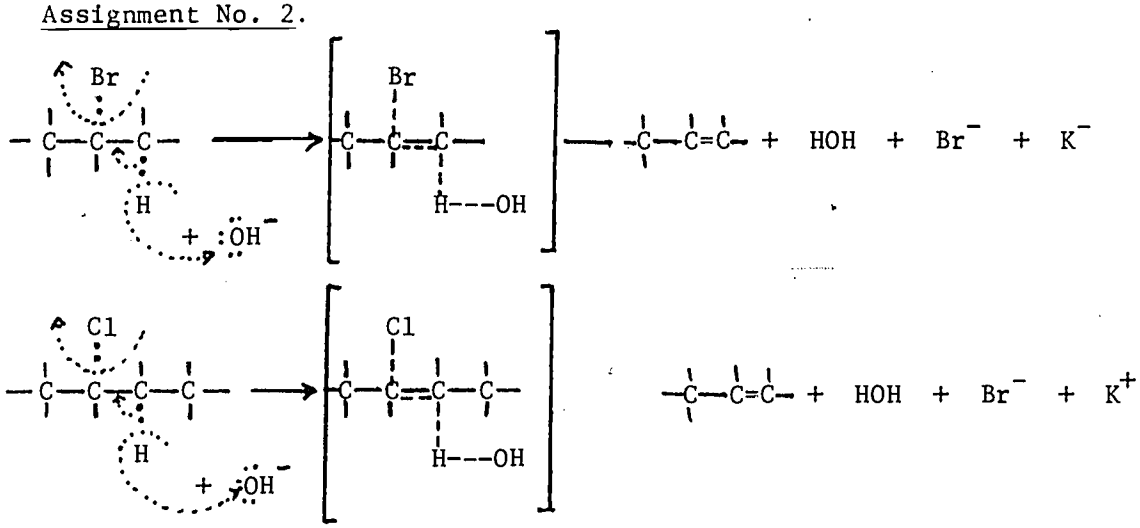
a)



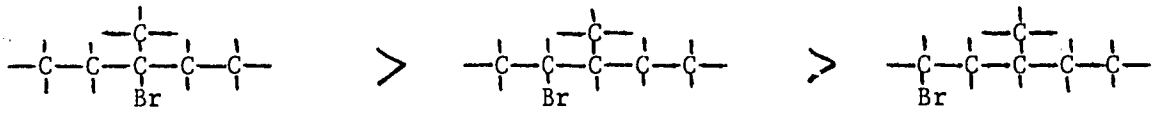
b)



Assignment No. 2.



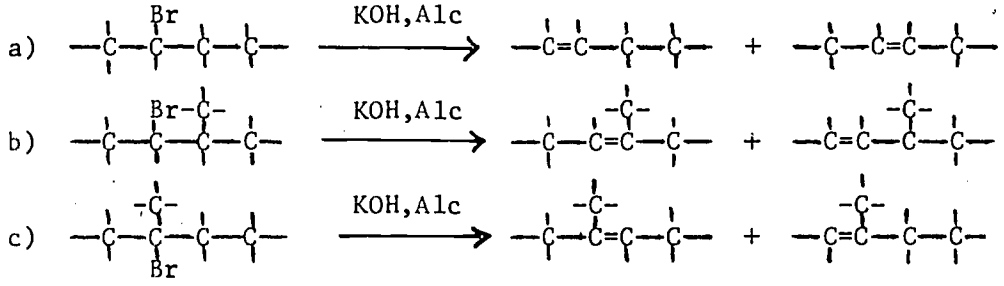
Assignment No. 3.



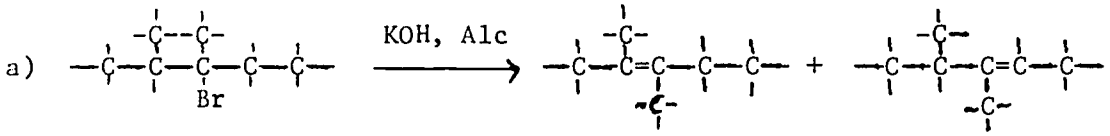
3-Methyl-3-Bromo Pentane 2-Bromo-3-Methyl Pentane 1-Bromo-3-Methyl Pentane

Max. Reactivity Min. Reactivity

Assignment No. 4.

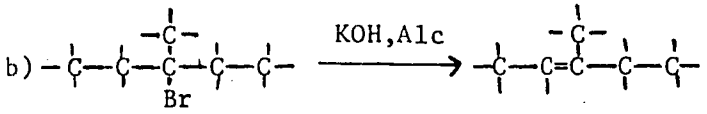


Assignment No. 5.

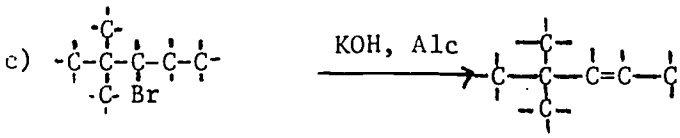


Major Product

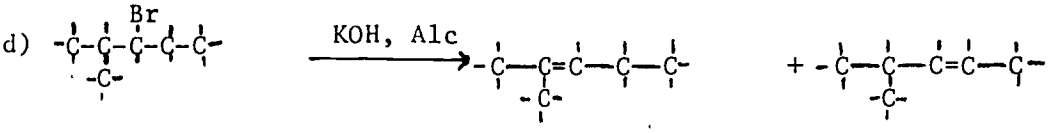
2,3-Dimethyl 2-Pentene 3,4-Dimethyl-2-Pentene



3-Methyl-2-Pentene

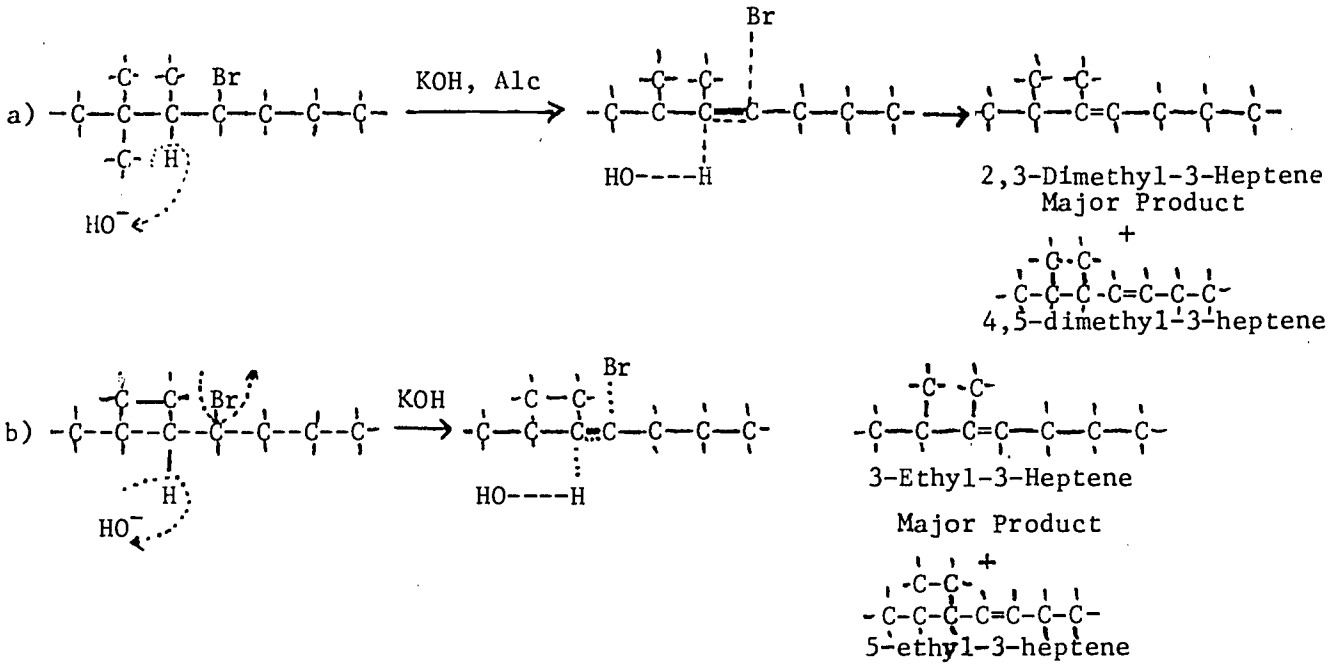


4,4-Dimethyl-2-Pentene

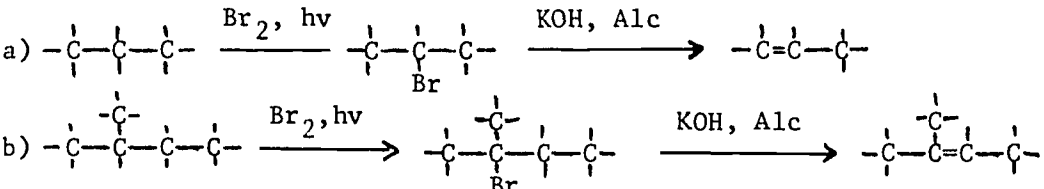


2-Methyl-2-Pentene 4-Methyl-2-Pentene

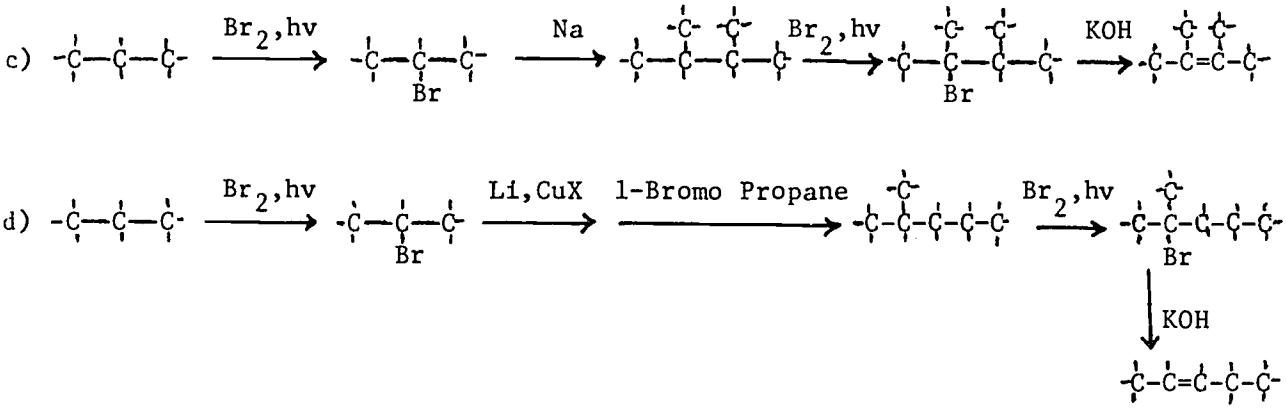
Assignment No. 6.



Assignment No. 7.



Assignment Nc. 8



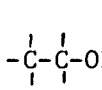
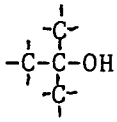
A theorist without practice is a tree without fruit; and a devotee without learning is a house without an entrance. Gulistan (1258)

Self Instructional Package No. 8
Tape II - Worksheet

ALKENES - PREPARATION

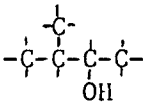
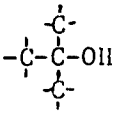
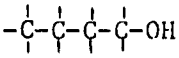
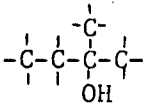
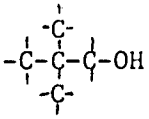
DEHYDRATION REACTION

ROH - General formula for an alcohol

 1° alcohol  2° alcohol  3° alcohol

Assignment No. 1

Identify each alcohol listed below as primary 1°, secondary 2° or tertiary 3°. Also assign the correct IUPAC names to each alcohol and the common names where applicable.

	1°	2°	3°	Name
				
				
				
				
				

SIP No. 8
Tape II - Worksheet

Assignment No. 2

Draw the structures of the alcohols that correspond to the IUPAC names below.

1-Propanol

2-Methyl-1-Propanol

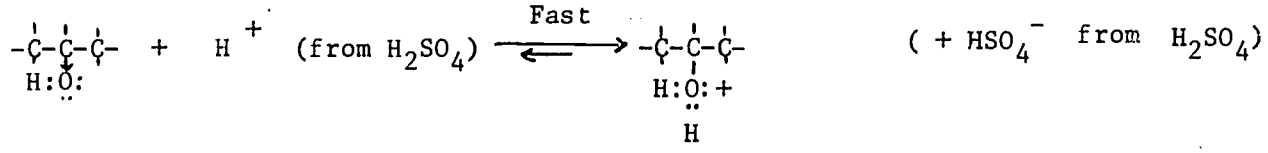
3,3-Dimethyl-2-Butanol

2,3-Dimethyl-2-Butanol

3-Methyl-3-Pentanol

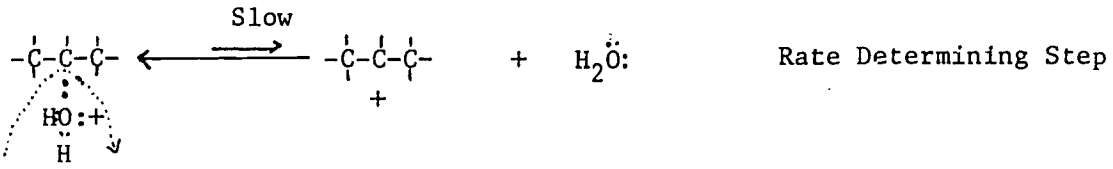
Example No. 1 - Dehydration Reaction Mechanism

Step 1 - Formation of the Oxonium Ion or Protonated Alcohol



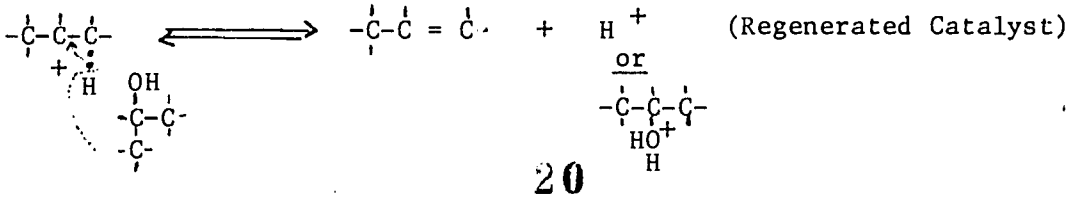
(stronger base) Oxonium Ion or Protonated Alcohol (weaker base)

Step 2 - Heterolytic Cleavage of the Carbon-Oxygen Bond in the Oxonium Ion and the Formation of the Carbonium Ion.



Oxonium Ion Carbonium Ion

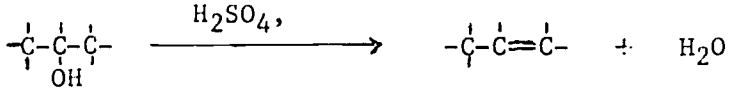
Step 3 - Removal of H^+ and Formation of the Double Bond



SIP No. 8
Tape II - Work Sheet

Assignment No. 2 (continued)

Example No. 2
Overall Reaction:



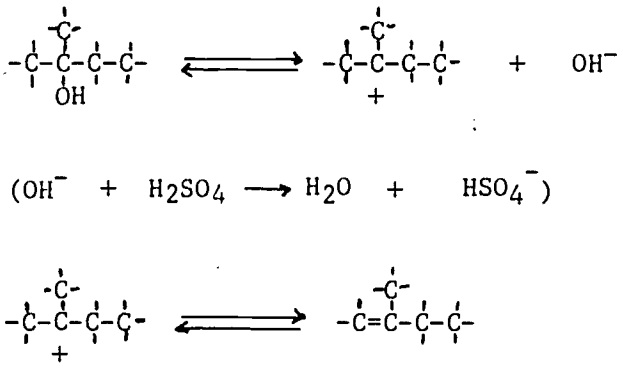
Assignment No. 3

Write the step by step mechanism for the dehydration of a) 2-Propanol and b) 2-Methyl-2-Butanol.

SIP No. 8
Tape II - Work Sheet

Assignment No. 4

Confused Clyde was asked to write the step by step mechanism for the dehydration reaction of: 2-Methyl-2-Butanol and to indicate the rate determining step. Find the mistakes Clyde has made and rectify his state of confusion.



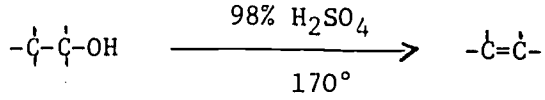
$(OH^- + H_2SO_4 \longrightarrow H_2O + HSO_4^-)$

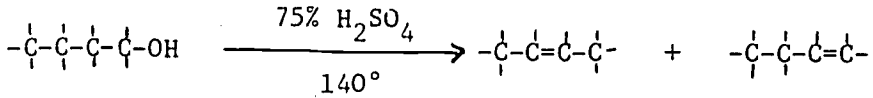
Assignment No. 5

Write the step by step mechanism for the HYDRATION reaction of: a) Propene and b) 2-Methyl-2-Butene in acidic medium. (Dehydration is eleimination of water from an alcohol; hydration is addition of water to alkene to yield an alcohol. Remember, each step of the dehydration mechanism is reversible)

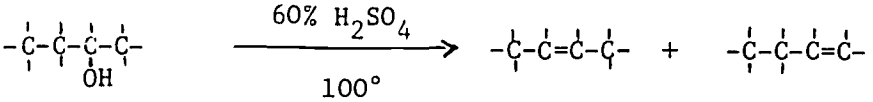
SIP No. 8
Tape II - Work Sheet

Example No. 2

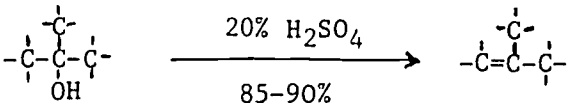
(1°) 

(1°) 

Major Product

(2°) 

Major Product

(3°) 

a) Which of the given alcohols undergoes dehydration most easily?_____

b) Which of the given alcohols is most reactive? _____

c) Relative reactivities of different alcohols (1°, 2°, 3°) are:

Assignment No. 6

Draw the structures and name all the possible alkenes which can be obtained from alcohols listed below. Which alcohol of each pair will be more easily dehydrated?

a) 2-Butanol

2-Methyl-2-Butanol

Assignment No. 6 (continued)

b) 1-Pentanol

2-Pentanol

c) 1-Pentanol

2-Methyl-2-Pentanol

Assignment No. 7

Saturated Sam was given four different alcohols and asked to predict the dehydration products. He has done this correctly but failed to indicate the alcohols from which the products were obtained. Identify the original alcohols.

a) 4,4-Dimethyl-2-Pentene

b) 4,4-Dimethyl-2-Pentene + 4,4-Dimethyl-1-Pentene

c) 2,3-Dimethyl-2-Pentene + 3,4-Dimethyl-2-Pentene

d) 2-Methyl-1-Butene + 2-Methyl-2-Butene

Example No. 3

$$CH_4 + 332 \frac{kcal}{mole} \longrightarrow CH_3^+$$

$$C_2H_6 + 299 \frac{kcal}{mole} \longrightarrow C_2H_5^+$$

$$CH_3CH_2CH_3 + 276 \frac{kcal}{mole} \longrightarrow CH_3\overset{+}{C}HCH_3$$

$$CH_3-\overset{CH_3}{\underset{H}{C}}-CH_3 + 262 \frac{kcal}{mole} \longrightarrow CH_3-\overset{CH_3}{\underset{+}{C}}-CH_3$$

Example No. 3 (continued)

Which carbonium ion requires the most energy to be formed?	1°	2°	3°
Which carbonium ion contains the most energy?	1°	2°	3°
Which carbonium ion is the most stable?	1°	2°	3°

Assignment No. 8

Identify the more stable carbonium ion in each set below.

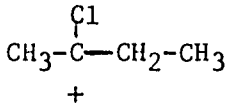
a) $CH_3\ CH\ CH_2\ CH_3^+$ $CH_3\ CH_2\ CH_2\ CH_2^+$

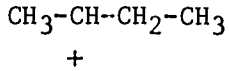
b) $CH_3\ C\ (CH_3)\ CH_2\ CH_3^+$ $CH_3\ CH\ CH_2\ CH_3^+$

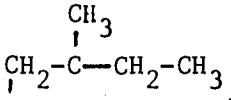
c) $CH_3\ C\ (CH_3)\ CH_2\ CH_3^+$ $CH_3\ CH(CH_3)\ CHCH_3^+$

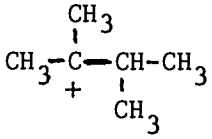
Assignment No. 9

Identify the more stable carbonium ion in the sets below.

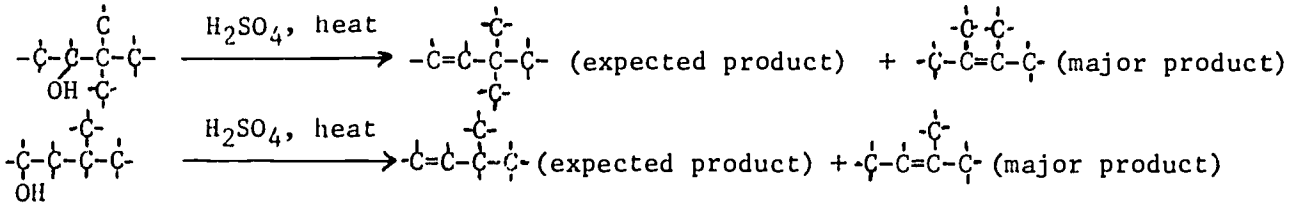








Example No. 4



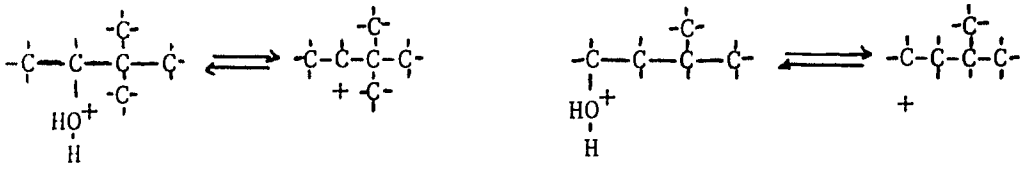
SIP No. 8
Tape II - Work Sheet

Example No. 5 - Hydration Reaction Mechanism

Dehydration of 3,3-Dimethyl-2-Butanol

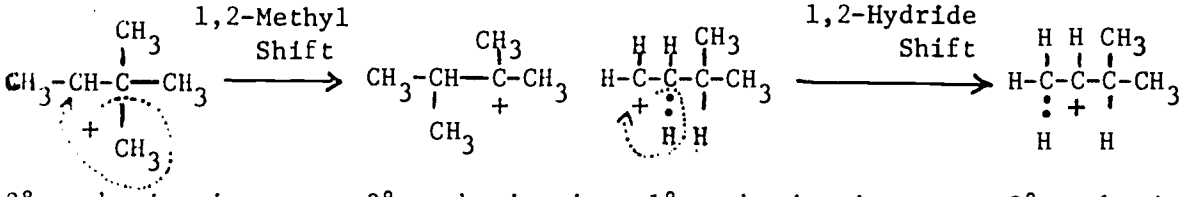
Step 1 - Formation of the oxonium ion

Step 2 - Formation of the carbonium ion



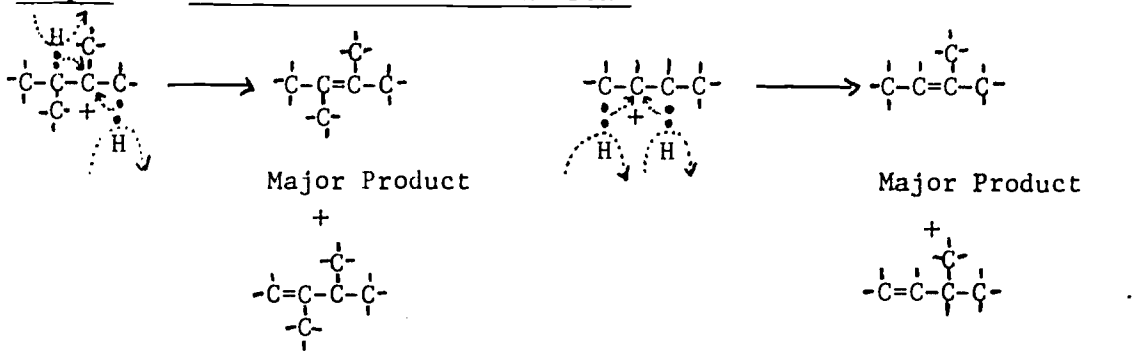
2° carbonium ion 1° carbonium ion

Step 2a - Rearrangement of the carbonium ion to yield a more stable carbonium ion



2° carbonium ion 3° carbonium ion 1° carbonium ion 2° carbonium ion

Step 3 - Formation of the double bond



Major Product + Major Product +

SIP No. 8
Tape II - Work Sheet

Assignment No. 10

Write the step by step mechanism which will account for the formation of the products in each set:

a) 2,2-Dimethyl-1-Propanol $\xrightarrow{H^+}$ 2-Methyl-2-Butene

b) 3,4-Dimethyl-1-Pentanol $\xrightarrow{H^+}$ 3,4-Dimethyl-2-Pentene

Assignment No. 11

Complete the reactions below. Draw the structures and name all the products. Identify the major product in each reaction.

a) 3,3-Dimethyl-1-Butanol $\xrightarrow{H^+}$

b) 3-Methyl-2-Butanol $\xrightarrow{H^+}$

c) 3,4-Dimethyl-2-Pentanol $\xrightarrow{H^+}$

SIP No. 8
Tape II - Work Sheet

Assignment No. 12

Complete the reactions below. Draw the structures and name the products. (You may want to refer back to the Assignment No. 5)

a) 2-Methyl-1-Butene $\xrightarrow{H_2O,\ H^+}$

b) 3-Methyl-1-Butene $\xrightarrow{H_2O,\ H^+}$

c) 3,3-Dimethyl-1-Butene $\xrightarrow{H_2O,\ H^+}$

Assignment No. 13

Outline all steps and identify all the reagents in the possible laboratory synthesis of the compounds below from the given reactants.

a) 2-Propanol from Propane

b) 2-Methyl-2-Butanol from Propane

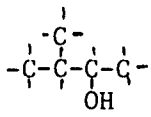
c) 2,2,3-Trimethyl-3-Pentanol from 2-Methyl Propane

Self Instructional Package No. 8
Tape 2 - Answer Sheet

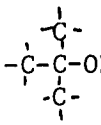
ALKENES - PREPARATION

DEHYDRATION REACTION

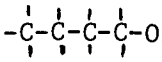
Assignment No. 1



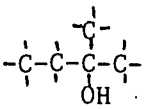
2° ROH; 3-methyl-2-butanol



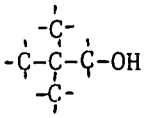
3° ROH; 2-methyl-2-propanol (t-butyl alcohol)



1° ROH; 1-butanol (n-butyl alcohol)

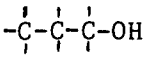


3° ROH; 2-methyl-2-butanol

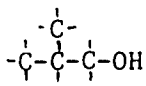


1° ROH; 2, 2-dimethyl-1-propanol

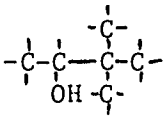
Assignment No. 2



n-propanol



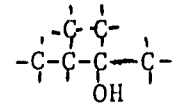
2-methyl-1-propanol



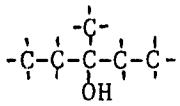
3,3-dimethyl-2-butanol

SIP No. 8
Tape 2 - Answer Sheet

Assignment No. 2 (continued)



2,3-dimethyl-2-butanol



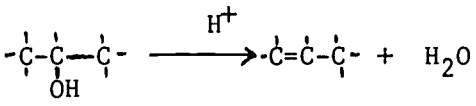
3-methyl-3-pentanol

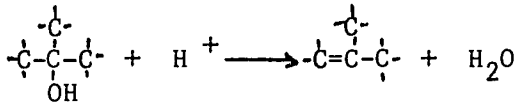
Assignment No. 3

Dehydration of 2-propanol

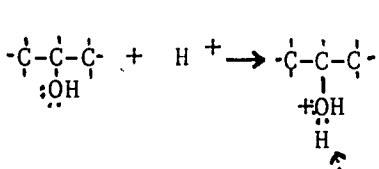
Dehydration of 2-methyl-2-butanol

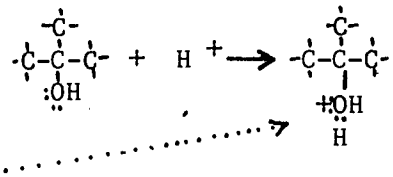
Overall Reaction





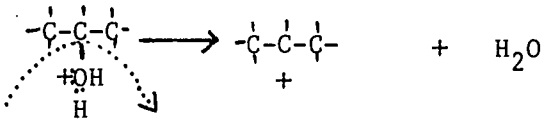
Step 1 - Formation of the oxonium ion



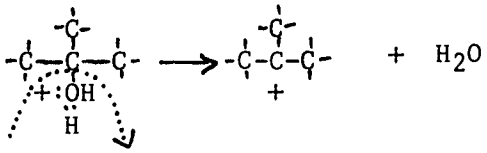


Oxonium ion

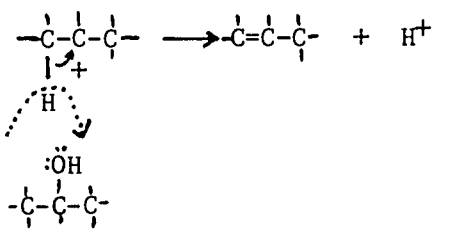
Step 2 - Formation of the carbonium ion

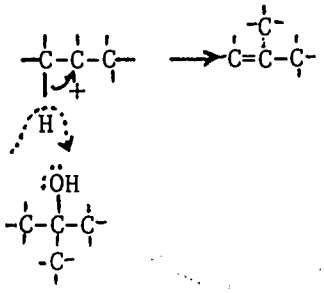


carbonium ion



Step 3 - Formation of the Alkene and
Regeneration of the catalyst

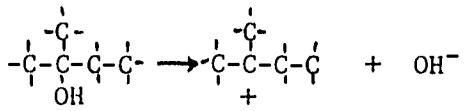




SIP No. 8
Tape 2 - Answer Sheet

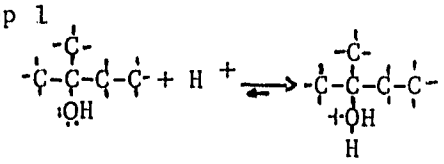
Assignment No. 4

Incorrect:



Correct:

Step 1

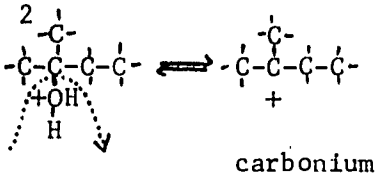


oxonium ion

Incorrect:

$$OH^- + H_2SO_4 \longrightarrow H_2O + HSO_4^-$$

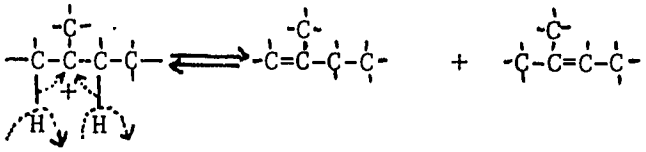
Step 2



carbonium ion

Step 3

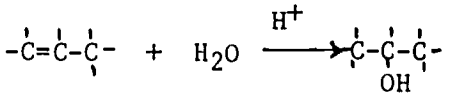
Correct:



Assignment No. 5 - Hydration Reaction

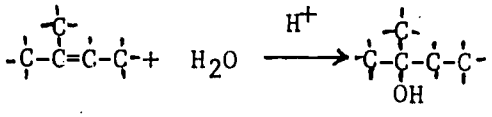
Hydration of propene

Overall Reaction



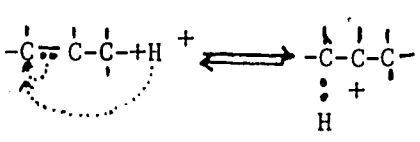
Hydration of 2-methyl-2-butene

Overall Reaction

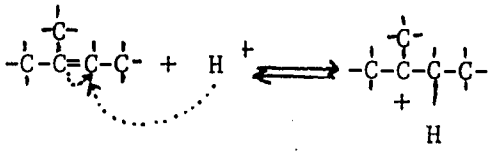


Mechanism

Step 1 - Formation of the carbonium ion (via addition of H^+ to the double bond)



carbonium ion

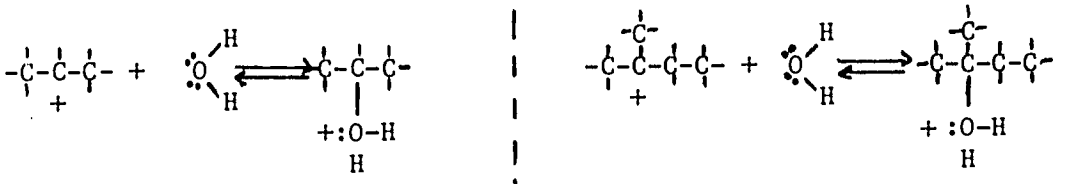


carbonium ion

Assignment No. 5 (continued)

Mechanism

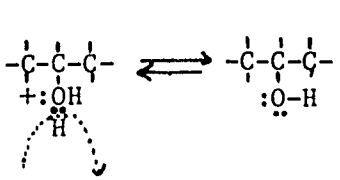
Step 2 - Formation of the oxonium ion (via addition of H_2O to the carbonium ion)

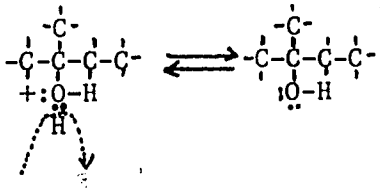


oxonium ion

oxonium ion

Step 3 - Repulsion of H^+ and formation of the alcohol





Example No. 2

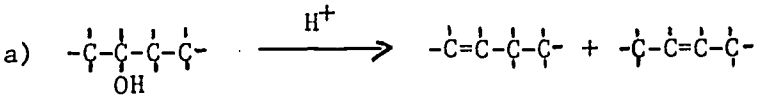
a) 3° ROH undergoes dehydration most easily.

b) 3° ROH is the most reactive.

c) relative reactivities of different alcohols:

$$3° > 2° > 1°$$

Assignment No. 6

a) 

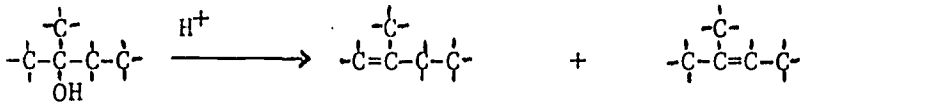
1-butene 2-butene

SIP No. 8
Tape 2 - Answer Sheet

Assignment No. 6 (continued)

a) (continued)

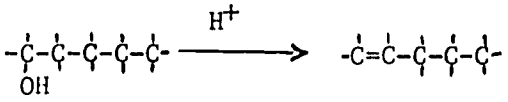
More Reactive:



2-methyl 1-butene

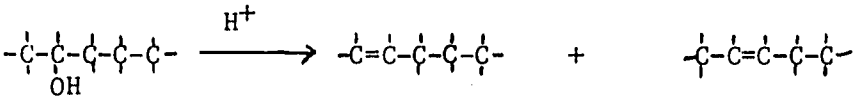
2-methyl-2-butene

b)



1-pentene

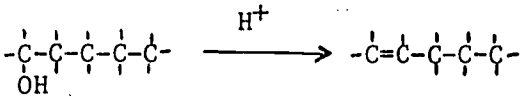
More Reactive:



1-pentene

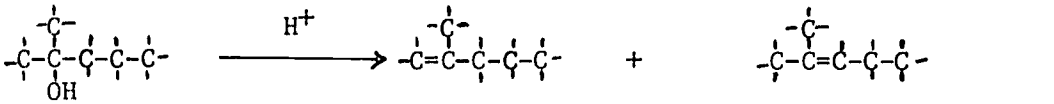
2-pentene

c)



1-pentene

More Reactive:

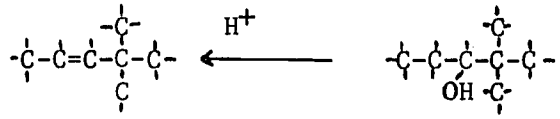


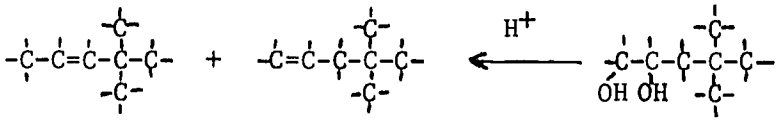
2-methyl 1-pentene

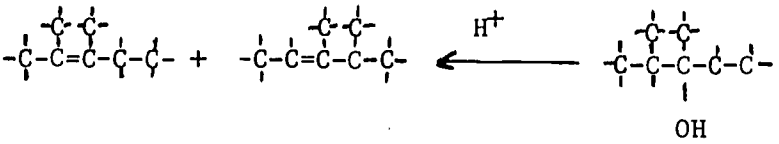
2-methyl-2-pentene

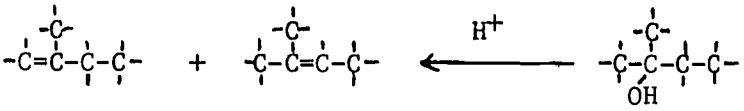
SIP No. 8
Tape 2 - Answer Sheet

Assignment No. 7

a) 

b) 

c) 

d) 

Assignment No. 8

a) $CH_3\,CH\,(+)\,CH_2\,CH_3$ is more stable than $CH_3\,CH_2\,CH_2\,CH_2^+$

b) $CH_3\,C(CH_3)CH_2\,CH_3^+$ is more stable than $CH_3\,CH\,CH_2\,CH_3^+$

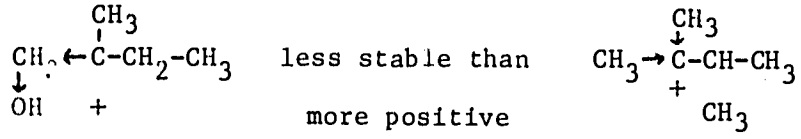
c) $CH_3\,C(CH_3)\,CH_2\,CH_3^+$ is more stable than $CH_3\,CH\,(CH_3)\,CH\,CH_3^+$

Assignment No. 9

a) $CH_3-\overset{Cl}{\overset{|}{\overset{+}{C}}}-CH_2-CH_3$ less stable than (MORE POSITIVE) $CH_3-\overset{+}{C}H-CH_2\,CH_3$

Chlorine is very electronegative, exhibits electron withdrawing inductive effect, increases the positive charge on the carbonium ion and destabilizes it.

Assignment No. 9 (continued)

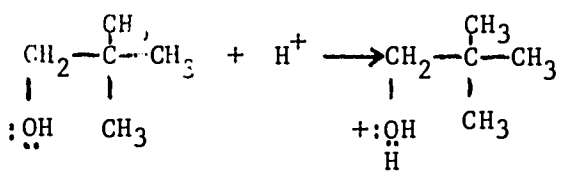
b) 

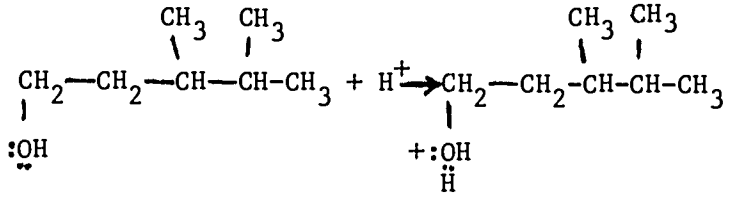
Oxygen is highly electronegative, exhibits electron withdrawing inductive effect, increases the positive charge on the carbonium ion and destabilizes it.

Assignment No. 10

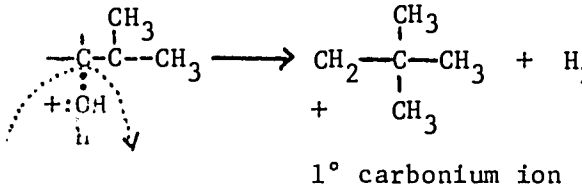
Mechanism

Step 1

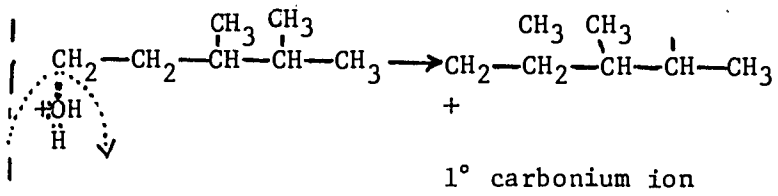




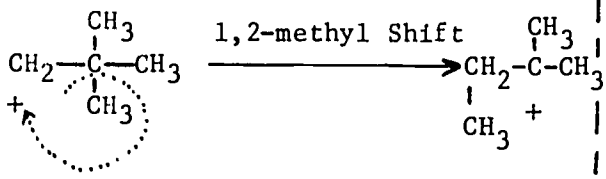
Step 2



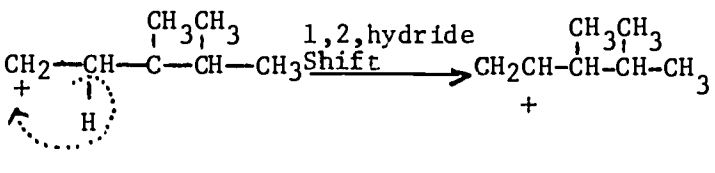
Step 2



Step 2a - Rearrangement



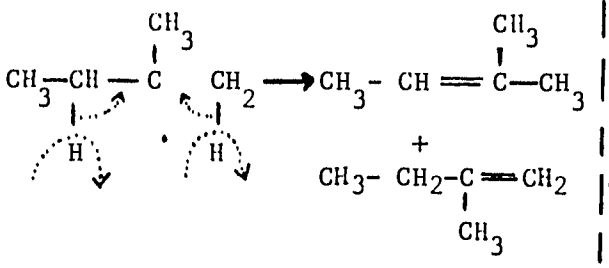
Step 2a - Rearrangement



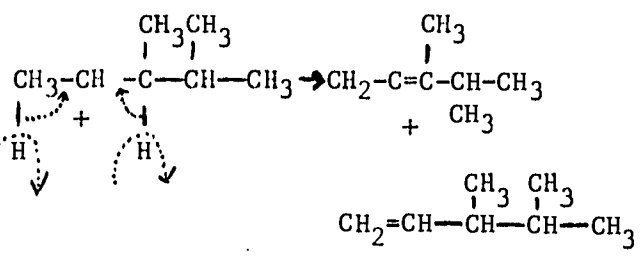
Assignment No. 10 (continued)

Mechanism

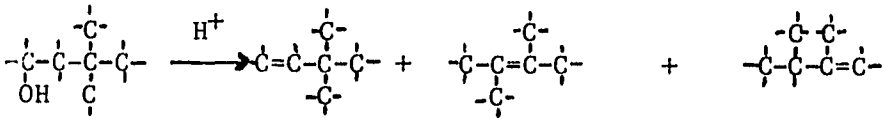
Step 3



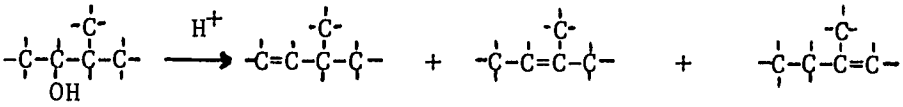
Step 3



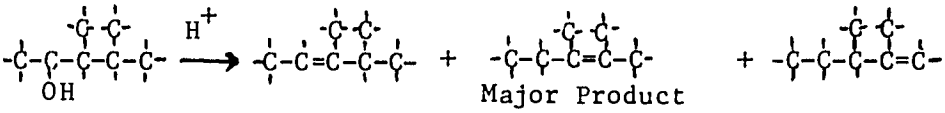
Assignment No. 11

a) 

3,3-dimethyl 1-butene — Major Product 2,3-dimethyl-2-butene — 2,3-dimethyl-1-butene

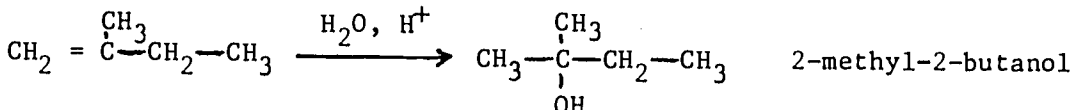
b) 

3-methyl-1-butene — Major Product 2-Methyl-2-butene — 2-methyl-1-butene

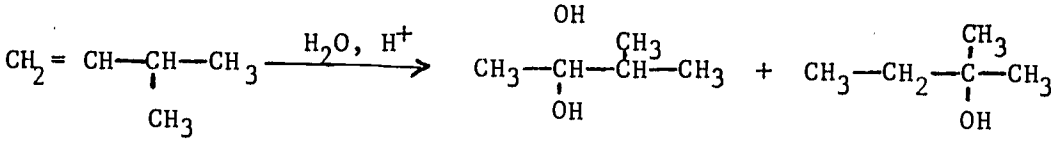
c) 

3,4-dimethyl 2-pentene — Major Product 2,3-dimethyl 2-pentene — 2,3-dimethyl 1-pentene

Assignment No. 12

a) 

2-methyl-2-butanol

b) 

3-methyl-2-butanol — Major Product

Assignment No. 12 (continued)

c) $CH_2=CH-C(CH_3)(CH_3)-CH_3 \xrightarrow{H_2O,\ H^+} CH_3-CH(OH)-C(CH_3)(CH_3)-CH_3$ + $CH_3-CH(CH_3)-C(CH_3)(OH)-CH_3$

3,3-dimethyl 2-butanol

2,3-dimethyl-2-butanol Major Product

Assignment No. 13

a) $CH_3-CH_2-CH_3 \xrightarrow{Br_2,hv} CH_3-CH(Br)-CH_3 \xrightarrow{KOH,\ alc.} CH_2=CH-CH_2 \xrightarrow{H_2O,\ H^+} CH_3-CH(OH)-CH_3$

b) $CH_3-CH_2-CH_3 \xrightarrow{Br_2,hv} CH_3-CH(Br)-CH_3 \xrightarrow{Li} \xrightarrow{CuX} \xrightarrow{CH_3-CH_2-Br} CH_3-CH(CH_3)-CH_2-CH_3 \xrightarrow{Br_2,hv} CH_3-C(CH_3)(Br)-CH_2-CH_3$

$CH_3-C(CH_3)(Br)-CH_2-CH_3 \xrightarrow{KOH} CH_3-C(CH_3)=CH-CH_3 \xrightarrow{H_2O,\ H^+} CH_3-C(CH_3)(OH)-CH_2-CH_3$

c) $CH_3-CH(CH_3)-CH_3 \xrightarrow{Br_2,hv} CH_3-C(CH_3)(Br)-CH_3 \xrightarrow{Li} \xrightarrow{Cu\ X} \xrightarrow{2\text{-Bromobutane}} CH_3-C(CH_3)(CH_3)-CH(CH_3)-CH_2-CH_3 \xrightarrow{Br_2,hv}$

$CH_3-C(CH_3)(CH_3)-C(CH_3)(Br)-CH_2-CH_3 \xrightarrow{KOH} CH_3-C(CH_3)=C(CH_3)-CH_3 \xrightarrow{H_2O,\ H^+} CH_3-C(CH_3)(CH_3)-C(CH_3)(OH)-CH_2-CH_3$

Self Instructional Package No. 8
Form D - Progress Check Evaluation

ALKENES - PREPARATIONS

Identify statements below as true or false by placing a capital T or F on the line to the left.

1. _____ The carbon in a carbonium ion has Sp^2 hybrid orbitals.

2. _____ The carbon in a carbonium ion has an empty p orbital perpendicular to the plane of the σ bonds.

3. _____ The angles in the carbonium ion are 90°.

4. _____ The first step in the dehydration reaction mechanism is the formation of the oxonium ion.

5. _____ Oxonium ion undergoes a heterolytic cleavage to yield carbonium ion and hydroxide anion.

6. _____ Branching increases the stability of a carbonium ion.

7. _____ Isobutyl carbonium ion is more stable than a tertiary butyl carbonium ion.

8. _____ $CH_3-\overset{+}{C}(CH_3)CH_3$ is more stable than $CH_3\overset{+}{C}(CH_3)CH_2Br$.

9. _____ An electron releasing group bonded to the positive carbon stabilizes the carbonium ion.

10. _____ 2-bromo-2-methyl propane is more easily dehydrohalogenated than 2-bromo hexane.

11. _____ 2-butanol is more easily dehydrated than 2-methyl-2-propanol.

12. The energy required for the formation of tertiary butyl radical as compared to that required for the formation of the isobutyl free radical will be:

    a) higher
    b) the same
    c) lower
    d) not applicable.

13. The correct reactivity sequence of the three alkylhalides below in the dehydrohalogenation reaction is

2-bromo propane	2-bromo-2-methyl butane	1-bromo butane
I	II	III

13. (continued)

a) I > II > III

b) III > II > I

c) II > I > III

d) III > I > II

14. The major product in the dehydration of the 2,4,5-trimethyl-2-hexanol is:

a) 2,4,5-trimethyl-2-hexene

b) 2,4,5-trimethyl-3-hexene

c) 2,3,5-trimethyl-2-hexene

d) 2,3,5-trimethyl-3-hexene

15. The major product in the dehydrohalogenation of the 3-bromo-2,4,5-trimethyl hexane is:

a) 2,4,5-trimethyl-2-hexene

b) 2,4,5-trimethyl-3-hexene

c) 2,3,5-trimethyl-2-hexene

d) 2,3,5-trimethyl-3-hexene

16. The major product in the dehydration of the 4,5-dimethyl-3-hexanol is:

a) 4,5-dimethyl-3-hexene

b) 4,5-dimethyl-2-hexene

c) 2,4-dimethyl-2-hexene

d) 2,3-dimethyl-2-hexene

17. The major product in the dehydrohalogenation of the 3-bromo-4,5-dimethyl hexane is:

a) 4,5-dimethyl-3-hexene

b) 4,5-dimethyl-2-hexene

c) 2,4-dimethyl-2-hexene

d) 2,3-dimethyl-2-hexene

18. A reactant that will produce an alkene when treated with zinc and acid is:

    a) an alkylhalide

    b) an alcohol

    c) a dihalide

    d) a vicinal dihalide.

19. The reagents necessary to produce 2,4-dimethyl-2-pentene from propane are:

    a) Br_2, hv ; Na ; Br_2,hv ; KOH

    b) Br_2,hv , Na , Br_2,hv , Acid

    c) Br ,hv , Li , CuBr , Isobutyl bromide , Br_2,hv , KOH

    d) Br_2,hv , Li , CuBr , Isopropyl bromide , Br_2,hv , KOH

Self Instructional Package No. 8
Form B^1 - Answer Sheet

ALKANES - PREPARATIONS

1. F
2. F
3. F
4. T
5. T
6. T
7. F
8. F
9. T
10. F
11. a, c, d
12. a
13. c
14. a, c, d
15. b
16. c
17. b
18. c
19. a
20. b
21. a, c

Self Instructional Package No. 8
Form D^1 - Answer Sheet

ALKENES - PREPARATIONS

1.	T	12.	c
2.	T	13.	c
3.	F	14.	c
4.	T	15.	a, d
5.	F	16.	d
6.	T	17.	a
7.	F	18.	d
8.	T	19.	c
9.	T		
10.	T		
11.	F		