Chapter 10 Review Problems

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10.1)

i) ***Alcohols*** contain one or more ______________ functional groups attached to a hydrocarbon (alkyl group) part.

a) carboxyl
b) amino
c) carbonyl
d) hydroxyl

ii) Alcohols are classified as primary (1°), secondary (2°), or tertiary (3°) based on the number of _____________ attached to the carbon that is carrying (bonded to) the hydroxyl group.

a) R groups
b) OH groups
c) methyl groups
d) lone pairs

iii) Molecules with more than one hydroxyl group are called ____________________ ***alcohols*** .

a) strong
b) polyhydroxy
c) adult beverage
d) fermentation

Go back

Click here for a **hint**

Click here to **check your answer**

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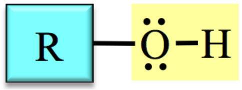
10.1)

i) ***Alcohols*** contain one or more _______________ functional groups attached to a hydrocarbon (alkyl group) part.

HINT:
a) carboxyl
~~b) amino~~
~~c) carbonyl~~
d) hydroxyl

The general form of an alcohol is: 

ii) Alcohols are classified as primary (1°), secondary (2°), or tertiary (3°) based on the number of ______________ attached to the carbon that is carrying (bonded to) the hydroxyl group.

HINT:
a) R groups
~~b) OH groups~~
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iii) Molecules with more than one hydroxyl group are called ______________________ ***alcohols*** .

HINT:
~~a) strong~~
b) polyhydroxy
~~c) adult beverage~~
d) fermentation

For more help: See chapter 10 part 1 video or chapter 10 section 2 in the textbook.

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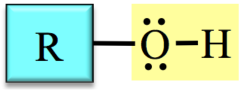
The general form of an alcohol is: 

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iii) Molecules with more than one hydroxyl group are called _____________________ ***alcohols*** .

a) strong
b) polyhydroxy
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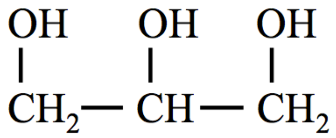
An example of a polyhydroxy alcohol is ***glycerol*** (also known as glycerin). Glycerol is an important biomolecule because it is one of the precursors to triglycerides (fats and vegetable oils) and some of the compounds found in cell membranes.

- The condensed structure a of glycerol is shown on the right.



glycerol (a polyhydroxy alcohol)

For more details: See chapter 10 part 1 video or chapter 10 section 2 in the textbook.

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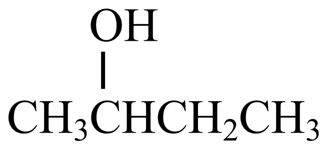
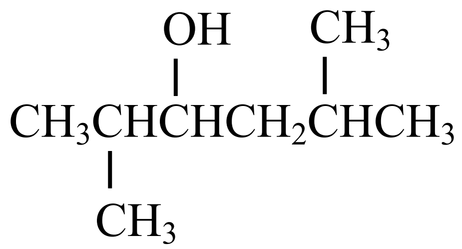
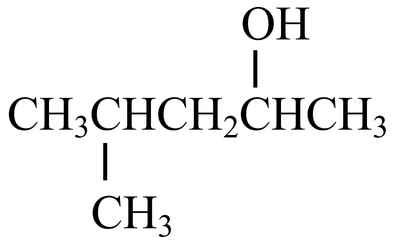
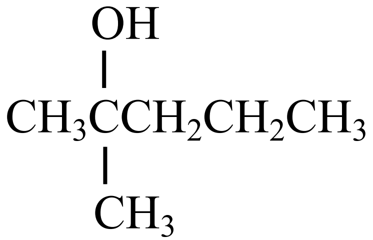
10.2) Identify each of the alcohols shown below as either primary (1°), secondary (2°), or tertiary (3°).

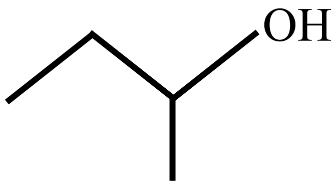
a) 

b) $CH_3CH_2CH_2OH$

c) 

d) 

e) 

f) 

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Click here for a **hint**

Click here to **check your answer**

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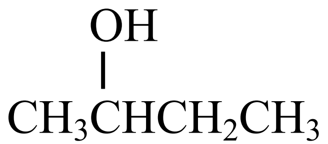
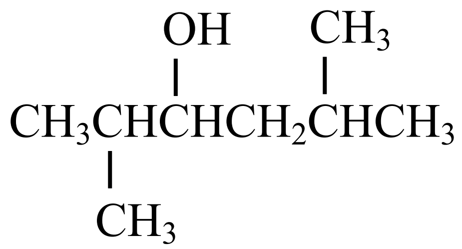
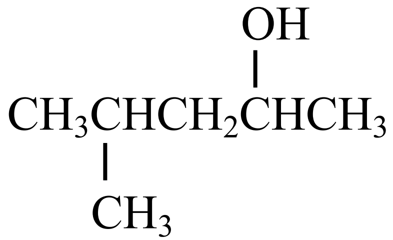
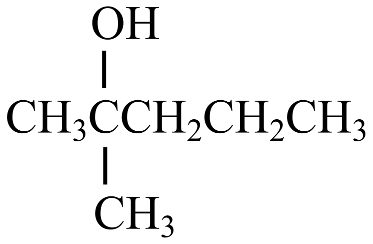
10.2) Identify each of the alcohols shown below as either primary (1°), secondary (2°), or tertiary (3°).

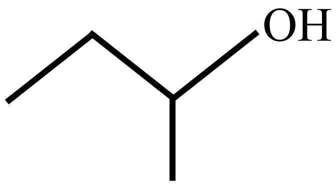
a) 

b) $CH_3CH_2CH_2OH$

c) 

d) 

e) 

f) 

HINT:

In **primary (1°) alcohols**, *the carbon that is "carrying" the hydroxyl group* is bonded to ***one*** **R** group.

In **secondary (2°) alcohols**, *the carbon "carrying" the hydroxyl group* is bonded to ***two*** **R** groups.

In **tertiary (3°) alcohols**, *the carbon "carrying" the hydroxyl group* is bonded to ***three*** **R** groups.

For more help: See chapter 10 part 1 video or chapter 10 section 2 in the textbook.

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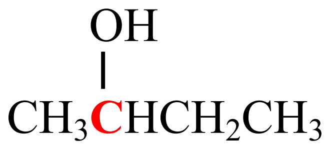
10.2) Identify each of the alcohols shown below as either primary (1°), secondary (2°), or tertiary (3°).

a)



secondary (2°) alcohol

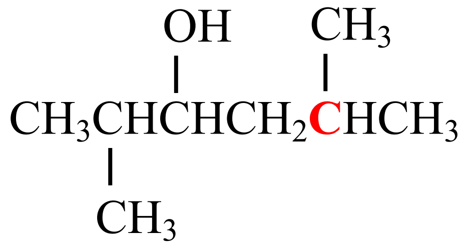
The carbon "carrying" the hydroxyl group is bonded to ***two*** **R** groups.

b) $CH_3CH_2CH_2OH$

primary (1°) alcohol

The carbon "carrying" the hydroxyl group is bonded to ***one*** **R** group.

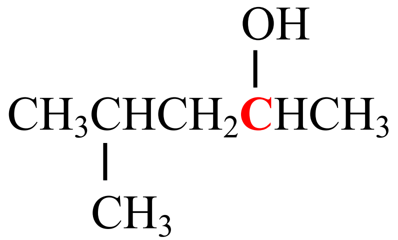
c)



secondary (2°) alcohol

The carbon "carrying" the hydroxyl group is bonded to ***two*** **R** groups.

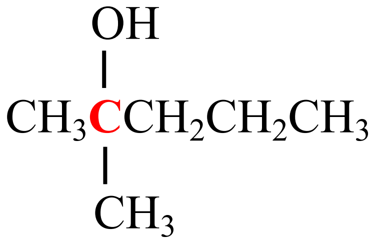
d)



secondary (2°) alcohol

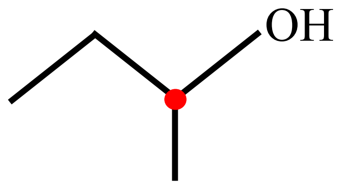
The carbon "carrying" the hydroxyl group is bonded to ***two*** **R** groups.

e)



tertiary (3°) alcohol *The carbon "carrying" the hydroxyl group* is bonded to ***three*** **R** groups.

f)



secondary (2°) alcohol

The carbon "carrying" the hydroxyl group is bonded to ***two*** **R** groups.

EXPLANATION:

In **primary (1°) alcohols**, *the carbon that is "carrying" the hydroxyl group* is bonded to ***one*** **R** group.

In **secondary (2°) alcohols**, *the carbon "carrying" the hydroxyl group* is bonded to ***two*** **R** groups.

In **tertiary (3°) alcohols**, *the carbon "carrying" the hydroxyl group* is bonded to ***three*** **R** groups.

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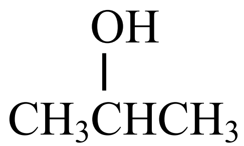
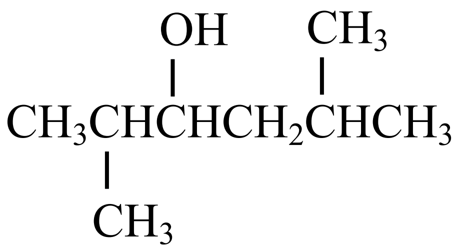
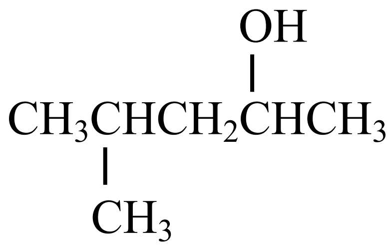
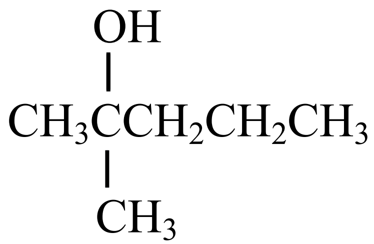
10.3) Write the *systematic name* for each of alcohol molecules below.

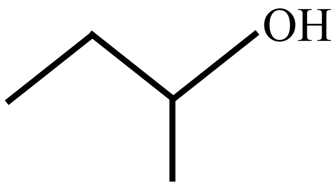
a) 

b) 

c) 

d) $CH_3CH_2CH_2OH$

e) 

f) 

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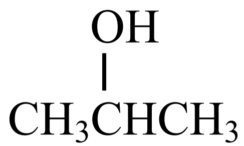
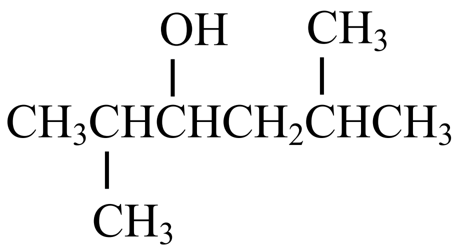
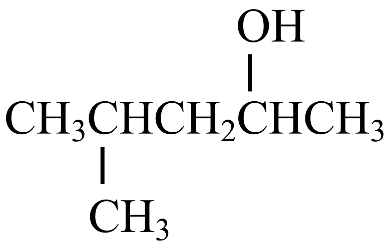
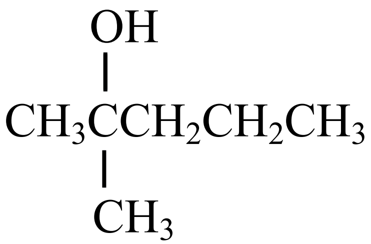
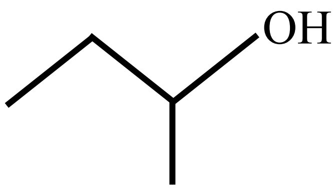
a) 

b) 

c) 

d) $CH_3CH_2CH_2OH$

e) 

f) 

HINT: Naming Alcohols

Step 1: Find and name the parent chain.

- The *parent chain is the longest, continuous chain of carbon atoms that contains the point of attachment to the hydroxyl group* (OH).

Starting with the alkane name that corresponds to the number of carbon atoms in the parent chain, replace the "**e**" at the end of the alkane name with "**ol**."

Assign *position numbers* to the carbons in the parent chain. Position number **1** is assigned to the carbon at the ***end*** *of the parent chain* that is nearest **to the *hydroxyl group*.**

- For alcohols with ***more than two carbons***, the position of *the point of attachment to the* ***hydroxyl group*** must be indicated by adding a number before the parent chain.

Steps 2, **3**, and **4** are done the **same way** as you did when naming other organic molecules.

Step 2: Name any alkyl group substituents.

Step 3: Determine the *point of attachments* of alkyl groups to the parent chain.

Step 4: Construct the name of the alcohol by placing the alkyl groups in alphabetical order and specifying their position number, followed by the name of the parent chain.

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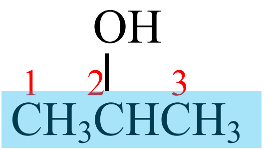
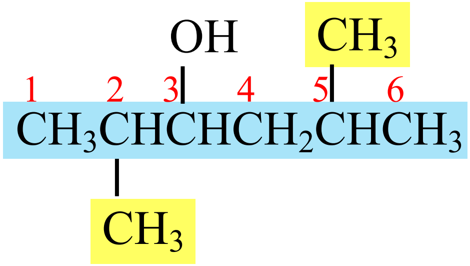


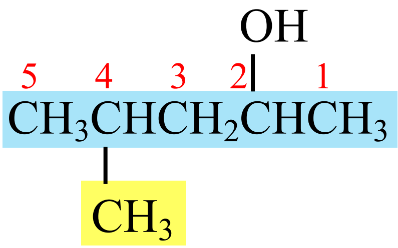
2-propanol

b)



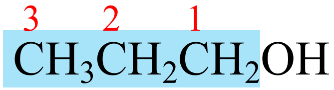
2,5-dimethyl-3-hexanol

c)



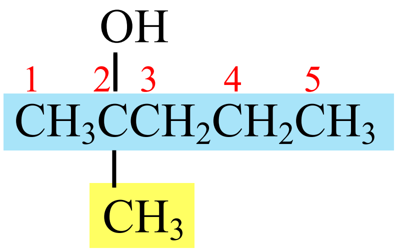
4-methyl-2-pentanol

d)



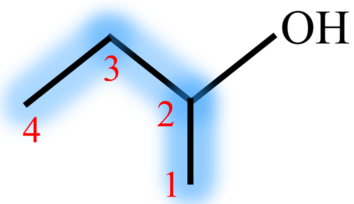
1-propanol

e)



2-methyl-2-pentanol

f)



2-butanol

EXPLANATION: Naming Alcohols

Step 1: Find and name the parent chain.

- The *parent chain is the longest, continuous chain of carbon atoms that contains the point of attachment to the hydroxyl group* (OH).

Starting with the alkane name that corresponds to the number of carbon atoms in the parent chain, replace the "**e**" at the end of the alkane name with "**ol**."

Assign *position numbers* to the carbons in the parent chain. Position number **1** is assigned to the carbon at the ***end*** *of the parent chain* that is nearest **to the *hydroxyl group*.**

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Step 4: Construct the name of the alcohol by placing the alkyl groups in alphabetical order and specifying their position number, followed by the name of the parent chain.

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10.4) Draw the condensed ***and*** skeletal structure for each of the molecules listed below.

a) 1-pentanol

b) 3-pentanol

c) 4-methyl-2-hexanol

d) 2,2-dimethyl-1-heptanol

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Click here for a **hint**

Click here to **check your answer**

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10.4) Draw the condensed ***and*** skeletal structure for each of the molecules listed below.

a) 1-pentanol **HINT:** $CH_3CH_2CH_2CH_2CH_2{-}OH$ ***or*** $CH_3CH_2CH_2CH_2CH_2OH$

b) 3-pentanol

For more help: See chapter 10 part 1 video or chapter 10 section 2 in the textbook.

c) 4-methyl-2-hexanol

d) 2,2-dimethyl-1-heptanol

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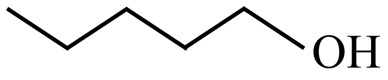
10.4) Draw the condensed ***and*** skeletal structure for each of the molecules listed below.

a) 1-pentanol

$CH_3CH_2CH_2CH_2CH_2—OH$

or

$CH_3CH_2CH_2CH_2CH_2OH$

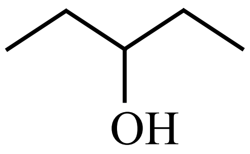


b) 3-pentanol

OH

|

$CH_3CH_2CHCH_2CH_3$

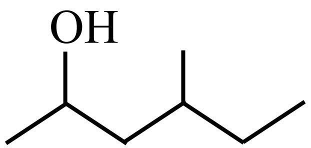


c) 4-methyl-2-hexanol

OH $\quad$ CH_3

| $\quad$ |

$CH_3CHCH_2CHCH_2CH_3$



d) 2,2-dimethyl-1-heptanol

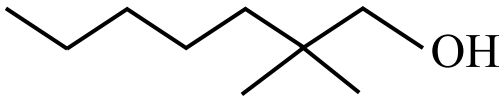
CH_3

|

$CH_3CH_2CH_2CH_2CH_2CCH_2—OH$

|

CH_3



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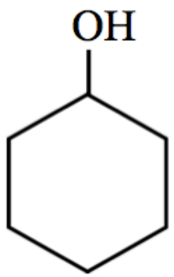
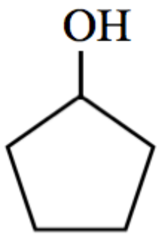
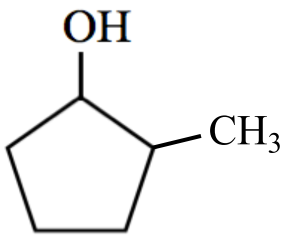
10.5) Write the name of each compound shown below.

a) 

b) 

c) 

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Click here for a **hint**

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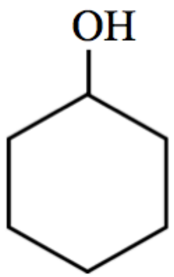
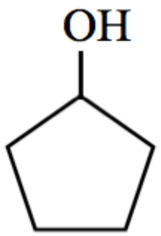
10.5) Write the names of the compounds shown below.

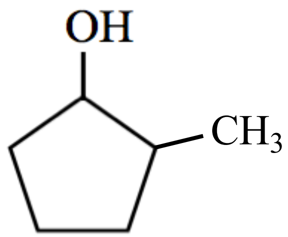
a)



b)



c)



HINT:

When the *hydroxyl group* of an alcohol is bound to a ***ring structure*** it is called a **cyclic alcohol**.

Cyclic alcohols are named in a manner similar to that for ***cycloalkanes***.

- Starting with the ***cyclo****alkane* name that corresponds to the number of carbon atoms in the *ring structure*, cyclic alcohols are named by replacing the "**e**" at the end of the ***cyclo***alkane name with "**ol**."
- The ring-carbon that is carrying the **OH** is always designated as position number **1**.

For more help: See chapter 10 part 1 video or chapter 10 section 2 in the textbook.

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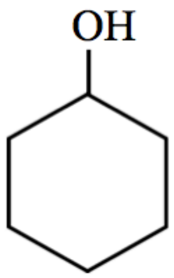
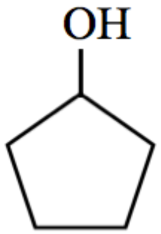
10.5) Write the names of the compounds shown below.

a)



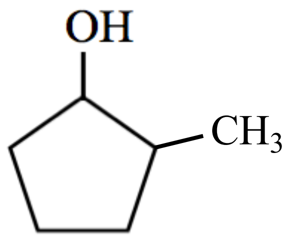
cyclohexanol

b)



cyclopentanol

c)



2-methylcyclopentanol

EXPLANATION:

When the *hydroxyl group* of an alcohol is bound to a ***ring structure*** it is called a **cyclic alcohol**.

Cyclic alcohols are named in a manner similar to that for ***cycloalkanes***.

- Starting with the ***cyclo****alkane* name that corresponds to the number of carbon atoms in the *ring structure*, cyclic alcohols are named by replacing the "**e**" at the end of the ***cyclo***alkane name with "**ol**."
- The ring-carbon that is carrying the **OH** is always designated as position number **1**.

For more details: See chapter 10 part 1 video or chapter 10 section 2 in the textbook.

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10.6) List the following alcohols in order of increasing solubility in water (least soluble to most soluble).

$CH_3CH_2CH_2CH_2CH_2CH_2-OH$
hexanol

CH_3CH_2-OH
ethanol

$CH_3CH_2CH_2CH_2-OH$
butanol

least soluble

____

____

____

most soluble

Go back

Click here for a **hint**

Click here to **check your answer**

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10.6) List the following alcohols in order of increasing solubility in water (least soluble to most soluble).

$CH_3CH_2CH_2CH_2CH_2CH_2—OH$
hexanol

$CH_3CH_2—OH$
ethanol

$CH_3CH_2CH_2CH_2—OH$
butanol

least soluble

____

____

____

most soluble

HINT:

Water molecules are attracted to alcohols and many other families of organic molecules through hydrogen bonding and/or dipole-dipole interactions.

- As the hydrocarbon part of various alcohol molecules gets larger, the water solubility ***decreases***.
- As the hydrocarbon part of a molecule gets larger, London forces become more important (stronger), the molecule becomes ***less*** polar, and the organic molecules are more attracted to each other than they are to water molecules. When this occurs, it is lower in energy for the organic molecules to be surrounded by other organic molecules and therefore the water solubility drastically decreases.

For more help: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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10.6) List the following alcohols in order of increasing solubility in water (least soluble to most soluble).

$CH_3CH_2CH_2CH_2CH_2CH_2—OH$
hexanol

$CH_3CH_2—OH$
ethanol

$CH_3CH_2CH_2CH_2—OH$
butanol

least soluble

hexanol

butanol

ethanol

most soluble

EXPLANATION:

Water molecules are attracted to alcohols and many other families of organic molecules through hydrogen bonding and/or dipole-dipole interactions.

- As the hydrocarbon part of various alcohol molecules gets larger, the water solubility ***decreases***.
- As the hydrocarbon part of a molecule gets larger, London forces become more important (stronger), the molecule becomes ***less*** polar, and the organic molecules are more attracted to each other than they are to water molecules. When this occurs, it is lower in energy for the organic molecules to be surrounded by other organic molecules and therefore the water solubility drastically decreases.

For more details: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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10.7) Predict the order of increasing ***boiling points*** for the following compounds.

$CH_3CH_2CH_2CH_2CH_2CH_2—OH$	$CH_2CH_2CH_2CH_2CH_2CH_3CH_2—OH$	$CH_3CH_2CH_2CH_2—OH$
hexanol	**octanol**	**butanol**

lowest boiling point

____

____

____

highest boiling point

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10.7) Predict the order of increasing ***boiling points*** for the following compounds.

$CH_3CH_2CH_2CH_2CH_2CH_2—OH$
hexanol

$CH_2CH_2CH_2CH_2CH_2CH_3CH_2—OH$
octanol

$CH_3CH_2CH_2CH_2—OH$
butanol

lowest boiling point

____

____

____

highest boiling point

HINT:

Stronger/more noncovalent interactions = higher boiling and melting points

For more help: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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10.7) Predict the order of increasing ***boiling points*** for the following compounds.

$CH_3CH_2CH_2CH_2CH_2CH_2—OH$
hexanol

$CH_2CH_2CH_2CH_2CH_2CH_3CH_2—OH$
octanol

$CH_3CH_2CH_2CH_2—OH$
butanol

lowest boiling point

butanol

hexanol

octanol

highest boiling point

EXPLANATION:

Stronger/more noncovalent interactions = higher boiling and melting points

- As the hydrocarbon part of a molecule gets larger, London forces become stronger, so the molecules are more strongly attracted to each other.

For more details: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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10.8) Ethanol is produced in nature in a process called alcohol ________________.

a) fermentation
b) hydroxylation
c) India pale ale
d) distillation

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10.8) Ethanol is produced in nature in a process called alcohol ________________.

HINT:
a) fermentation
b) ~~hydroxylation~~
c) ~~India pale ale~~
d) distillation

For more help: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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10.8) Ethanol is produced in nature in a process called alcohol ________________.

a) fermentation
b) hydroxylation
c) India pale ale
d) distillation

EXPLANATION:

In the 1850s and 1860s, Louis Pasteur discovered that fermentation involved living organisms. It was not until 1897 that Eduard Buchner found that ground fragments of dead yeast could produce ethanol and CO_2. As a result of Buchner's work, the term "enzyme" was applied to materials that enabled fermentation, and the understanding that fermentation was a result of enzymatic processes gained acceptance. Buchner's results are often regarded as the birth of biochemistry, and he was awarded the Nobel Prize in chemistry for this work in 1907.

Alcohol fermentation is a series of chemical reactions that convert sugar molecules, such as glucose, into ethanol and CO_2. The final step in this reaction series involves an enzyme which is only present in yeast and some bacteria. The overall reaction of ethanol formation from a sugar molecule (glucose) is shown below:

$$\underset{\text{glucose}}{C_6H_{12}O_6} \longrightarrow \underset{\text{ethanol}}{\mathbf{2}\ CH_3CH_2OH} + \underset{\text{carbon dioxide}}{\mathbf{2}\ CO_2}$$

For more details: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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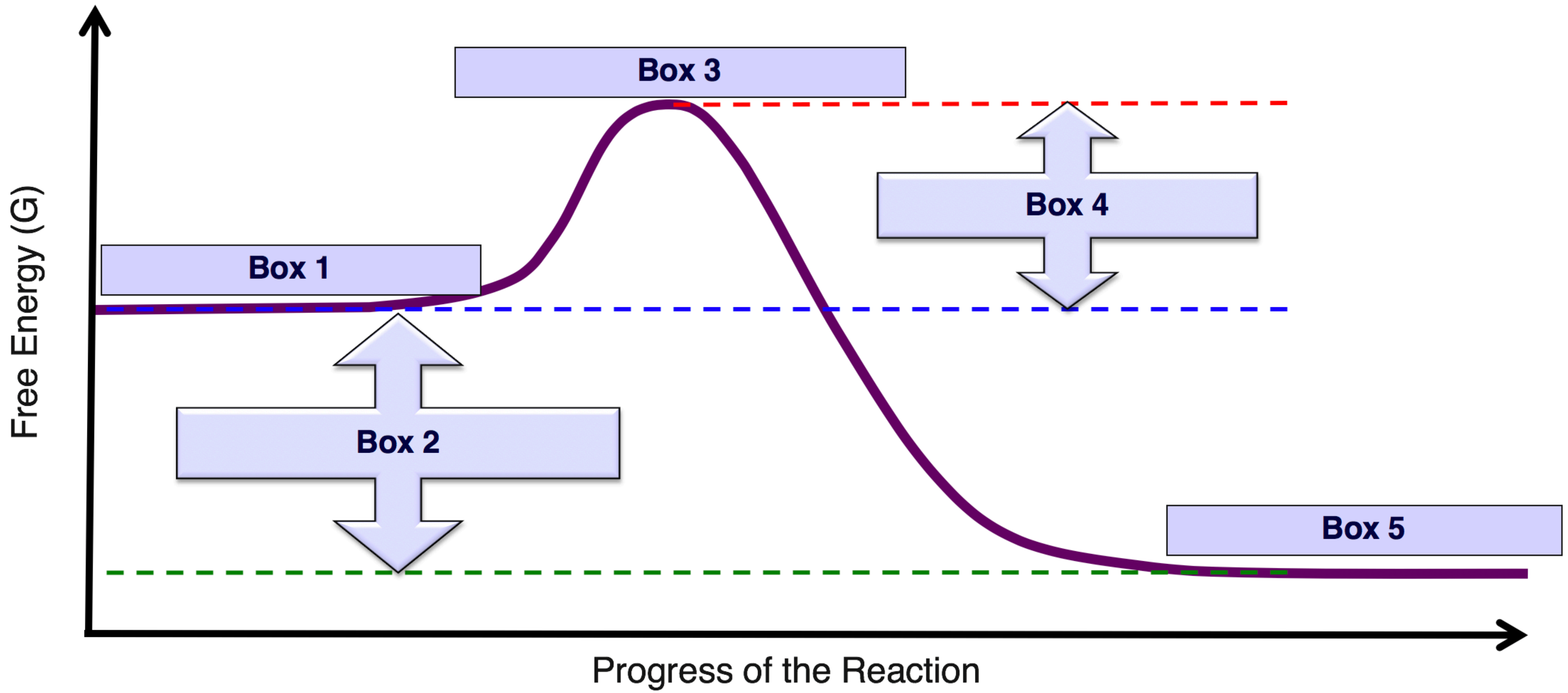
10.9) Match each of the following terms with the appropriate numbered box in the energy level diagram.

a) energy of transition state
b) energy of products
c) energy of reactants
d) activation energy (E_a)
e) $\Delta G = G_{products} - G_{reactants}$



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10.9) Match each of the following terms with the appropriate numbered box in the energy level diagram.

HINT: a) energy of transition state **box 3**

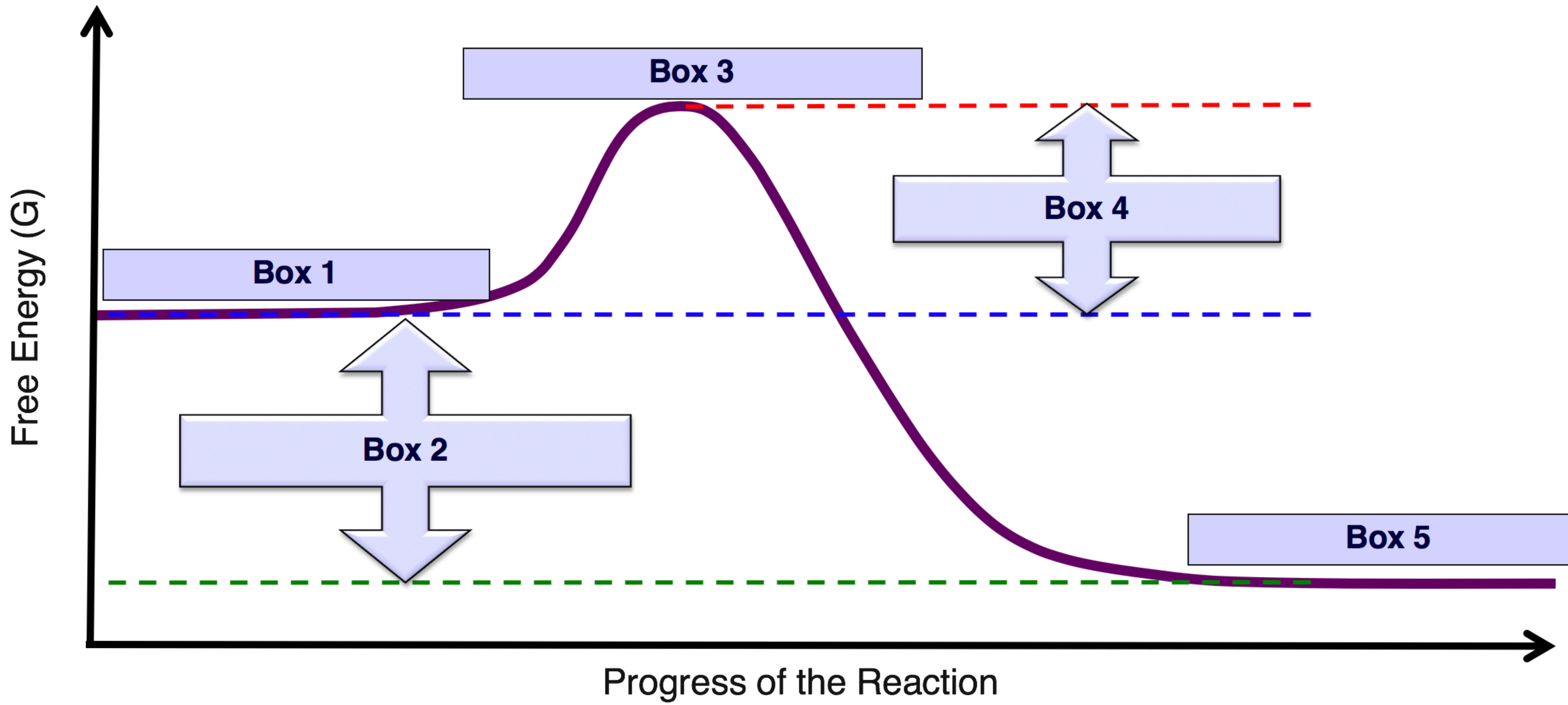
b) energy of products

c) energy of reactants

d) activation energy (E_a)

e) $\Delta G = G_{products} - G_{reactants}$

For more help: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.



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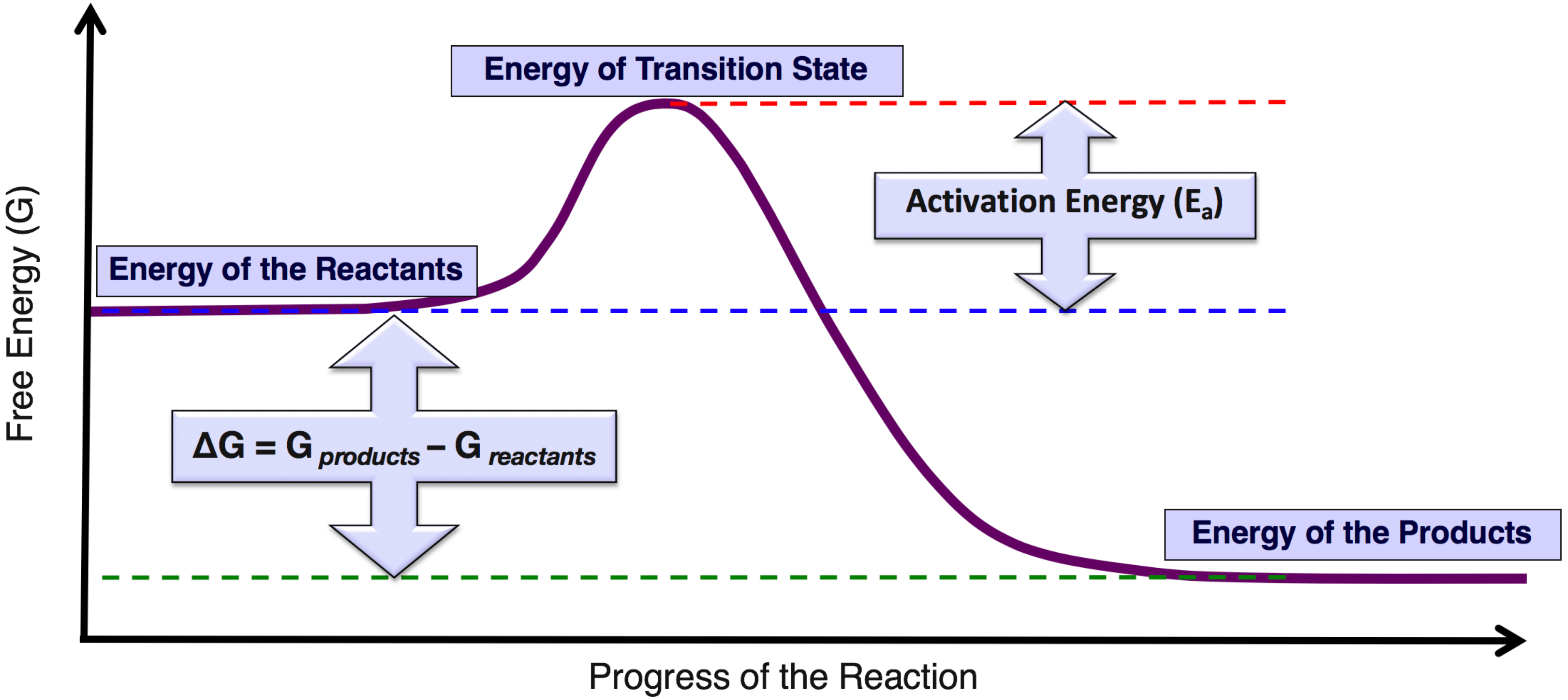
10.9) Match each of the following terms with the appropriate numbered box in the energy level diagram.

a) energy of transition state **box 3**
b) energy of products **box 5**
c) energy of reactants **box 1**
d) activation energy (E_a) **box 4**
e) $\Delta G = G_{products} - G_{reactants}$ **box 2**



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For more details: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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10.10) In the nucleophilic substitution (S_N2) reaction for the formation of an alcohol, a hydroxide ion reacts with an **alkyl halide** molecule.

- An **alkyl halide** is a hydrocarbon that had one of its hydrogens replaced with a halogen (F, Cl, Br, or I).

The general form for the (S_N2) reaction for the formation of an alcohol is shown below.

$$R{-}X \quad + \quad OH^- \quad \rightleftarrows \quad R{-}OH \quad + \quad X^-$$

alkyl halide	hydroxide ion	alcohol	halogen ion

X represents
F, Cl, Br, or I

Predict the products of the following nucleophilic substitutions reaction.

$$CH_3{-}F \quad + \quad OH^- \quad \rightleftarrows$$

$$CH_3CH_2CH_2CH_2{-}Br \quad + \quad OH^- \quad \rightleftarrows$$

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.10) In the nucleophilic substitution (S_N2) reaction for the formation of an alcohol, a hydroxide ion reacts with an **alkyl halide** molecule.

- An **alkyl halide** is a hydrocarbon that had one of its hydrogens replaced with a halogen (F, Cl, Br, or I).

The general form for the (S_N2) reaction for the formation of an alcohol is shown below.

$$R{-}X \quad + \quad OH^- \quad \rightleftharpoons \quad R{-}OH \quad + \quad X^-$$

alkyl halide — hydroxide ion — alcohol — halogen ion

X represents F, Cl, Br, or I

Predict the products of the following nucleophilic substitutions reaction.

$$CH_3{-}F \quad + \quad OH^- \quad \rightleftharpoons$$

HINT:
$CH_3{-}OH \quad + \quad$ **?**

$$CH_3CH_2CH_2CH_2{-}Br \quad + \quad OH^- \quad \rightleftharpoons$$

For more help: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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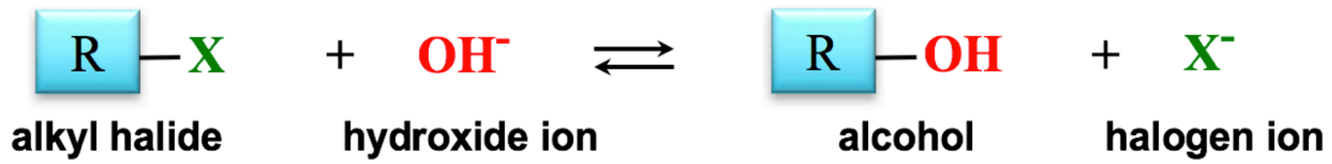
Click here to check your answer

Go to next question

10.10) In the nucleophilic substitution (S_N2) reaction for the formation of an alcohol, a hydroxide ion reacts with an **alkyl halide** molecule.

- An **alkyl halide** is a hydrocarbon that had one of its hydrogens replaced with a halogen (F, Cl, Br, or I).

The general form for the (S_N2) reaction for the formation of an alcohol is shown below.



X represents
F, Cl, Br, or I

Predict the products of the following nucleophilic substitutions reaction.

$$CH_3—F \quad + \quad OH^- \quad \rightleftharpoons \quad CH_3—OH \quad + \quad F^-$$

$$CH_3CH_2CH_2CH_2—Br \quad + \quad OH^- \quad \rightleftharpoons \quad CH_3CH_2CH_2CH_2—OH \quad + \quad Br^-$$

For more details: See chapter 10 part 2 video or chapter 10 section 2 in the textbook.

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10.11) In chapter 6, you learned that an ***alkene*** can react with ***water*** to produce an ***alcohol***. In this reaction, a hydrogen from $\mathbf{H_2O}$ is added to one of the double-bonded carbon atoms and **OH** from the $\mathbf{H_2O}$ is added to the ***other*** double-bonded carbon atom in the ***alkene,*** to produce the corresponding ***alcohol.*** In chapter 6, we always began with ***symmetric*** alkenes when doing hydration reactions. In ***symmetric*** alkenes, a **line** drawn perpendicular to, and through, the middle of the double bond of its structural formula results in ________________ parts on each side of the line.

a) hydroxyl
b) different
c) identical
d) carbonyl

When a ***symmetric alkene*** undergoes a hydration reaction, there is only **<u>one</u>** possible product. When an ***asymmetric alkene*** undergoes a hydration reaction, there are ________ different alcohol molecules produced.

a) two
b) three
c) four

The hydration of an asymmetric alkene produces an __________ amount of each alcohol product.

a) equal
b) unequal
c) large
d) small

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Click here for a **hint**

Click here to **check your answer**

Go to next question

10.11) In chapter 6, you learned that an ***alkene*** can react with ***water*** to produce an ***alcohol***. In this reaction, a hydrogen from **H_2O** is added to one of the double-bonded carbon atoms and **OH** from the **H_2O** is added to the ***other*** double-bonded carbon atom in the ***alkene***, to produce the corresponding ***alcohol.*** In chapter 6, we always began with ***symmetric*** alkenes when doing hydration reactions. In ***symmetric*** alkenes, a **line** drawn perpendicular to, and through, the middle of the double bond of its structural formula results in _________________ parts on each side of the line.

HINT:
- ~~a) hydroxyl~~
- b) different
- c) identical
- ~~d) carbonyl~~

When a ***symmetric alkene*** undergoes a hydration reaction, there is only **one** possible product. When an ***asymmetric alkene*** undergoes a hydration reaction, there are _________ different alcohol molecules produced.

HINT:
- a) two
- ~~b) three~~
- c) four

The hydration of an asymmetric alkene produces an ___________ amount of each alcohol product.

HINT:
- a) equal
- b) unequal
- ~~c) large~~
- ~~d) small~~

For more help: See chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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Click here to **check your answer**

Go to next question

10.11) In chapter 6, you learned that an ***alkene*** can react with ***water*** to produce an ***alcohol***. In this reaction, a hydrogen from **H_2O** is added to one of the double-bonded carbon atoms and **OH** from the **H_2O** is added to the ***other*** double-bonded carbon atom in the ***alkene***, to produce the corresponding ***alcohol.*** In chapter 6, we always began with ***symmetric*** alkenes when doing hydration reactions. In ***symmetric*** alkenes, a **line** drawn perpendicular to, and through, the middle of the double bond of its structural formula results in ________________ parts on each side of the line.

a) hydroxyl
b) different
c) identical
d) carbonyl

When a ***symmetric alkene*** undergoes a hydration reaction, there is only **<u>one</u>** possible product. When an ***asymmetric alkene*** undergoes a hydration reaction, there are ________ different alcohol molecules produced.

a) two
b) three
c) four

The hydration of an asymmetric alkene produces an __________ amount of each alcohol product.

a) equal
b) unequal
c) large
d) small

The hydration of an ***asymmetric alkene*** does not produce an equal amount of each alcohol product. The product made in ***greater quantity*** is called the "**major product**," and the product made in ***lesser quantity*** is called the "**minor product**."

For more details: See chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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10.12) The hydration of an ***asymmetric alkene*** does not produce an equal amount of each alcohol product. The product made in ***greater quantity*** is called the "**major product**," and the product made in ***lesser quantity*** is called the "**minor product**."

Using compete sentence(s), explain how **Markovinkov's Rule** is used to predict the ***major*** and ***minor products*** for the hydration of an *asymmetric alkene.*

Click here for a **hint**

Click here to **check your answer**

10.12) The hydration of an ***asymmetric alkene*** does not produce an equal amount of each alcohol product. The product made in ***greater quantity*** is called the "**major product**," and the product made in ***lesser quantity*** is called the "**minor product**."

Using compete sentence(s), explain how **Markovinkov's Rule** is used to predict the ***major*** and ***minor products*** for the hydration of an *asymmetric alkene.*

HINT: Fill in the blanks to get the answer

This rule says that, the ***major product*** is formed by adding the __________ - from water - to the alkene's double-bonded carbon that ***originally carried the most*** _____________, and adding the __________ - from water - to the ***other*** double-bonded carbon.

For more help: See your **lecture notes** or see chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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Click here to **check your answer**

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10.12) The hydration of an ***asymmetric alkene*** does not produce an equal amount of each alcohol product. The product made in ***greater quantity*** is called the "**major product**," and the product made in ***lesser quantity*** is called the "**minor product**."

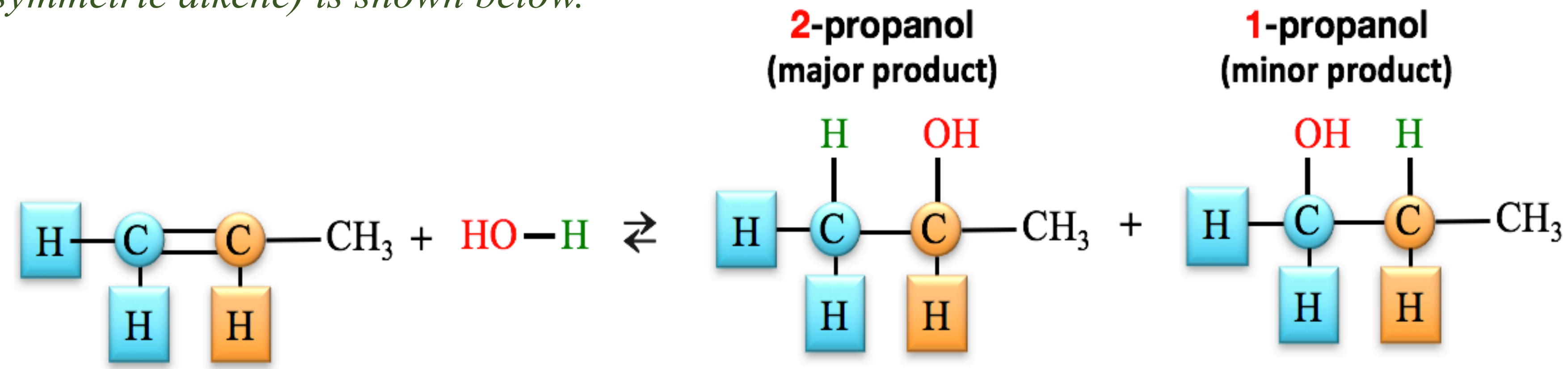
Using compete sentence(s), explain how **Markovinkov's Rule** is used to predict the ***major*** and ***minor products*** for the hydration of an *asymmetric alkene.*

This rule says that, the ***major product*** is formed by adding the **H** - from water - to the alkene's double-bonded carbon that ***originally carried the most hydrogens***, and adding the **OH** to the ***other*** double-bonded carbon.

- The ***minor product*** is formed by adding the **H** and **OH** in a manner **opposite** to that described for the *major product*.

An easy way to remember **Markovinkov's** Rule is by using the old saying, "***the rich get richer***," where the **H**'s represent money.

An example of the use of **Markovinkov's Rule** to predict the ***major*** and ***minor products*** for the hydration of propene (a *asymmetric alkene) is shown below.*



For more details: See chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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10.13) Draw (condensed structures) **and** name the ***major*** and ***minor*** products for the hydration of 1-pentene.

$CH_2{=}CHCH_2CH_2CH_3 + H_2O \rightleftarrows$

1-pentene

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Click here for a **hint**

Click here to **check your answer**

Go to next question

10.13) Draw (condensed structures) **and** name the ***major*** and ***minor*** products for the hydration of 1-pentene.

$CH_2 = CHCH_2CH_2CH_3 + H_2O \rightleftarrows$

1-pentene

HINT:

Markovinkov's Rule is used to predict the ***major*** and ***minor products*** for the hydration of an *asymmetric alkene.*

The ***major product*** is formed by adding the **H** - from water - to the alkene's double-bonded carbon that ***originally carried the most hydrogens***, and adding the **OH** to the ***other*** double-bonded carbon.

- The ***minor product*** is formed by adding the **H** and **OH** in a manner **opposite** to that described for the *major product.*

An easy way to remember **Markovinkov's** Rule is by using the old saying, "***the rich get richer***," where the **H**'s represent money.

For more help: See chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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Click here to **check your answer**

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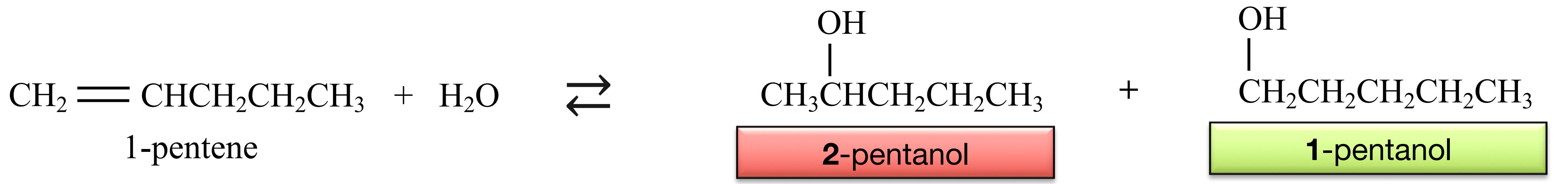
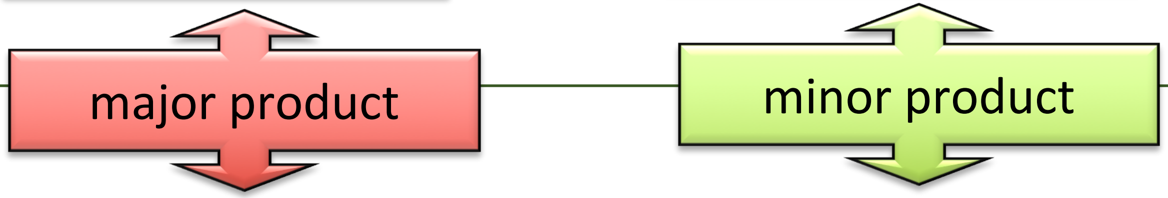
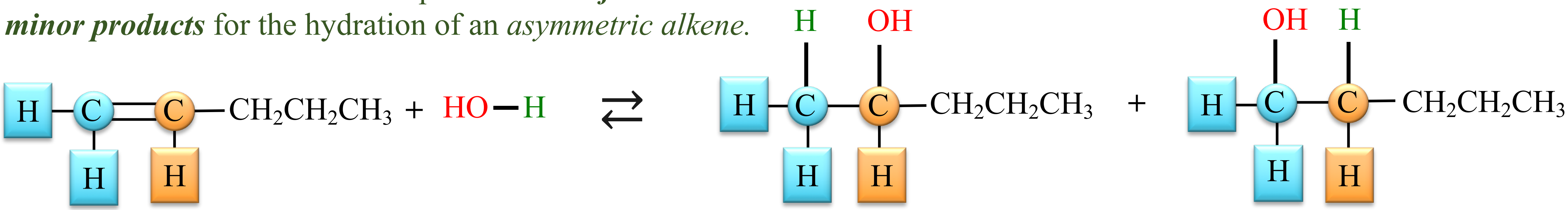
10.13) Draw (condensed structures) **and** name the ***major*** and ***minor*** products for the hydration of 1-pentene.





EXPLANATION:

Markovinkov's Rule is used to predict the ***major*** and ***minor products*** for the hydration of an *asymmetric alkene.*



The ***major product*** is formed by adding the **H** - from water - to the alkene's double-bonded carbon that ***originally carried the most hydrogens***, and adding the **OH** to the ***other*** double-bonded carbon.

- The ***minor product*** is formed by adding the **H** and **OH** in a manner **opposite** to that described for the *major product*.

An easy way to remember **Markovinkov's** Rule is by using the old saying, "***the rich get richer***," where the **H**'s represent money.

For more details: See chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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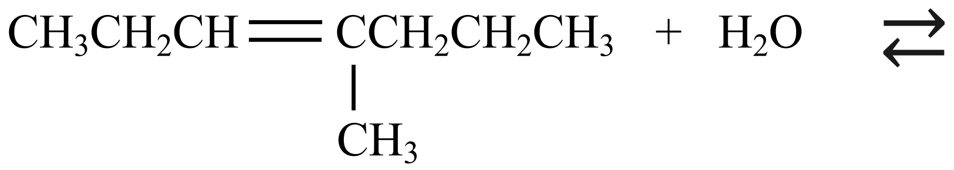
10.14) Draw (condensed structures) **and** name the ***major*** and ***minor*** products for the hydration of 4-methyl-3-heptene.



4-methyl-3-heptene

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Click here for a **hint**

Click here to **check your answer**

Go to next question

10.14) Draw (condensed structures) **and** name the ***major*** and ***minor*** products for the hydration of 4-methyl-3-heptene.

$$CH_3CH_2CH{=}\underset{\displaystyle CH_3}{\underset{|}{C}}CH_2CH_2CH_3 \ + \ H_2O \ \rightleftarrows$$

4-methyl-3-heptene

HINT:

Markovinkov's Rule is used to predict the ***major*** and ***minor products*** for the hydration of an *asymmetric alkene.*

The ***major product*** is formed by adding the **H** - from water - to the alkene's double-bonded carbon that ***originally carried the most hydrogens***, and adding the **OH** to the ***other*** double-bonded carbon.

- The ***minor product*** is formed by adding the **H** and **OH** in a manner **opposite** to that described for the *major product*.

An easy way to remember **Markovinkov's** Rule is by using the old saying, "***the rich get richer***," where the **H**'s represent money.

For more help: See chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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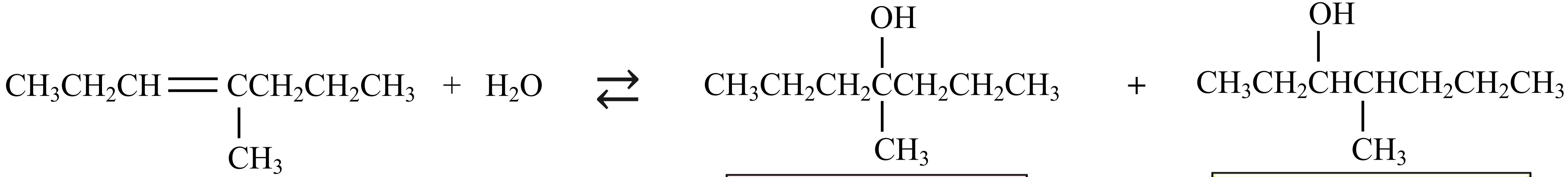
Click here to **check your answer**

Go to next question

10.14) Draw (condensed structures) **and** name the ***major*** and ***minor*** products for the hydration of 4-methyl-3-heptene.



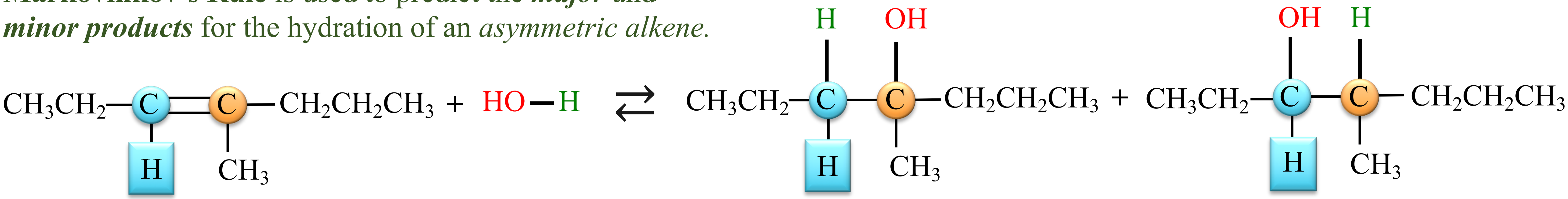
4-methyl-3-heptene

4-methyl-**4**-heptanol — major product

4-methyl-**3**-heptanol — minor product

EXPLANATION:

Markovinkov's Rule is used to predict the ***major*** and ***minor products*** for the hydration of an *asymmetric alkene.*



The ***major product*** is formed by adding the **H** - from water - to the alkene's double-bonded carbon that ***originally carried the most hydrogens***, and adding the **OH** to the ***other*** double-bonded carbon.

- The ***minor product*** is formed by adding the **H** and **OH** in a manner **opposite** to that described for the *major product*.

An easy way to remember **Markovinkov's** Rule is by using the old saying, "***the rich get richer***," where the **H**'s represent money.

For more details: See chapter 10 part 3 video or chapter 10 section 2 in the textbook.

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10.15)

i) If one of the hydrogens from water is replaced by an alkyl group (**R**), then a(n) ________________is obtained.

a) ester
b) ether
c) peroxide
d) alcohol

ii) If the hydrogen from an alcohol is replaced by an alkyl group (**R'**), then a(n) __________ is obtained.

a) ester
b) ether
c) peroxide
d) disulfide

iii) ________________ contain two oxygen atoms that are single-bonded to each other and situated between hydrogens, alkyl groups, or any other organic groups.

a) esters
b) carboxylic acids
c) peroxides
d) disulfides

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.15)

i) If one of the hydrogens from water is replaced by an alkyl group (**R**), then a(n) ________________is obtained.

HINT:
a) ester
b) ~~ether~~
c) ~~peroxide~~
d) alcohol

ii) If the hydrogen from an alcohol is replaced by an alkyl group (**R'**), then a(n) __________ is obtained.

HINT:
a) ester
b) ether
c) peroxide
d) ~~disulfide~~

iii) ________________ contain two oxygen atoms that are single-bonded to each other and situated between hydrogens, alkyl groups, or any other organic groups.

HINT:
a) ~~esters~~
b) carboxylic acids
c) peroxides
d) ~~disulfides~~

For more help: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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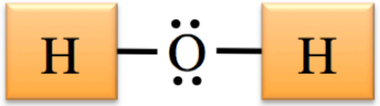
Go to next question

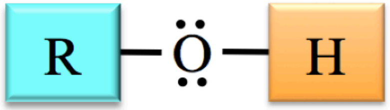
10.15)

i) If one of the hydrogens from water is replaced by an alkyl group (**R**), then a(n) ________________ is obtained.

a) ester
b) ether
c) peroxide
d) alcohol



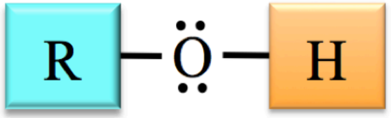
water



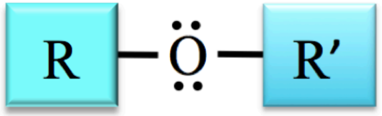
alcohol

ii) If the hydrogen from an alcohol is replaced by an alkyl group (**R'**), then a(n) __________ is obtained.

a) ester
b) ether
c) peroxide
d) disulfide



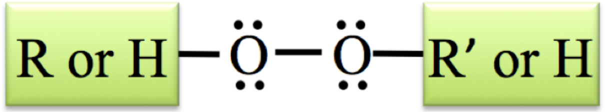
alcohol



ether

iii) ________________ contain two oxygen atoms that are single-bonded to each other and situated between hydrogens, alkyl groups, or any other organic groups.

a) esters
b) carboxylic acids
c) peroxides
d) disulfides



general form of a peroxide

Peroxides are quite reactive because of the two oxygen atoms that are single-bonded to each other. When the oxygen-oxygen single bond breaks, the oxygen atoms acquire more electrons by oxidizing another molecule. It is for this reason that peroxides are very effective oxidizing agents, and are frequently used as disinfectants and bleaching agents.

For more details: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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10.16) Predict the order of increasing ***boiling points*** for the following compounds.

$CH_3CH_2CH_2CH_2CH_2CH_3$
hexane

$CH_3CH_2CH_2CH_2CH_2CH_2—OH$
1-hexanol

$CH_3CH_2CH_2—O—CH_2CH_2CH_3$
dipropyl ether

lowest boiling point

____

____

____

highest boiling point

10.16) Predict the order of increasing ***boiling points*** for the following compounds.

$CH_3CH_2CH_2CH_2CH_2CH_3$	$CH_3CH_2CH_2CH_2CH_2CH_2-OH$	$CH_3CH_2CH_2-O-CH_2CH_2CH_3$
hexane	**1-hexanol**	**dipropyl ether**

lowest boiling point

____

____

____

highest boiling point

HINT:

Stronger/more noncovalent interactions = higher boiling and melting points

Because all of these molecules are about the same size, the strength of their London forces would be about equal.

For more help: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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Click here to **check your answer**

Go to next question

10.16) Predict the order of increasing ***boiling points*** for the following compounds.

$CH_3CH_2CH_2CH_2CH_2CH_3$
hexane

$CH_3CH_2CH_2CH_2CH_2CH_2—OH$
1-hexanol

$CH_3CH_2CH_2—O—CH_2CH_2CH_3$
dipropyl ether

lowest boiling point

hexane

dipropyl ether

1-hexanol

highest boiling point

EXPLANATION: Stronger/more noncovalent interactions = higher boiling and melting points

- Because all of these molecules are about the same size, the strength of their London forces would be about equal.
- Hexane molecules are *not capable* of interacting with each other through hydrogen bonding. Furthermore, because hexane molecules are nonpolar, they *cannot* interact with each other through dipole-dipole forces. It is for this reason that hexane is predicted to have the *lowest boing point*.
- Because dipropyl ether molecules are polar, they can interact with each other through dipole-dipole forces. It is for this reason that dipropyl ether is ranked in the middle of the boiling point order. Dipropyl ether molecules are not capable of interacting with each other through hydrogen bonding; although they have lone pairs on an oxygen, they do not have a hydrogen that is covalently bonded to an O, N, or F.
- 1-Hexanol molecules are polar, so they can interact with each other through dipole-dipole forces and are also capable of interacting with each other through hydrogen bonding. It is for this reason that 1-hexanol is predicted to have the *highest boiling point*.

The boiling points of 1-hexanol, dipropyl ether, and hexane are 157 ^{o}C, 90 ^{o}C, and 69 ^{o}C, respectively.

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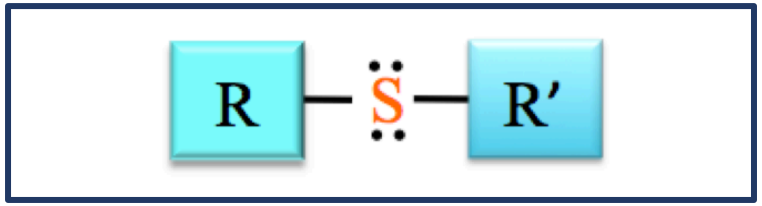
For more details: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

Go to next question

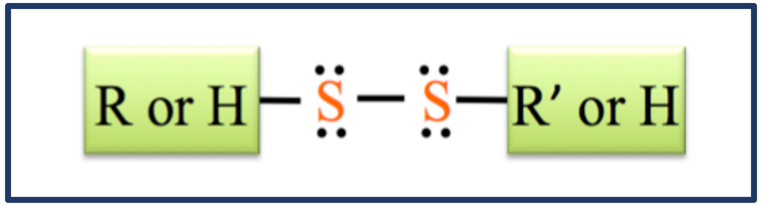
10.17) When the ***oxygen*** atom(s) of water, alcohol, ether, or peroxide is replaced by ***sulfur***, the resulting compound is called a **sulfur analog**.

Match each of the ***sulfur analog family names*** (on the **left**), with the ***general form of its structure*** (on the **right**):

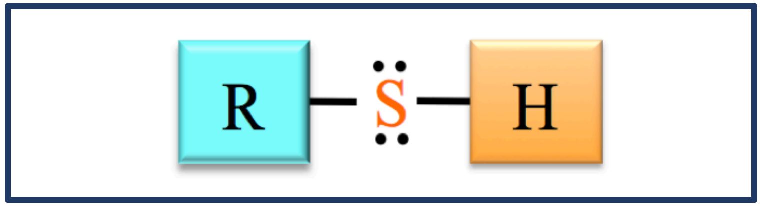
sulfide



thiol



disulfide



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Click here for a **hint**

Click here to **check your answer**

Go to next question

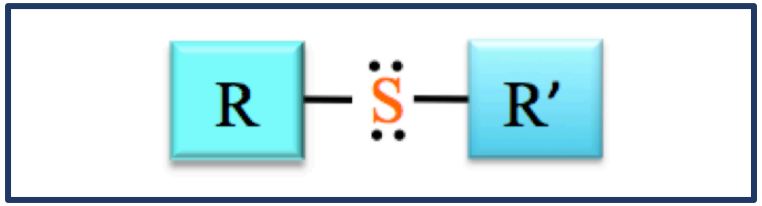
10.17) When the ***oxygen*** atom(s) of water, alcohol, ether, or peroxide is replaced by ***sulfur***, the resulting compound is called a **sulfur analog**.

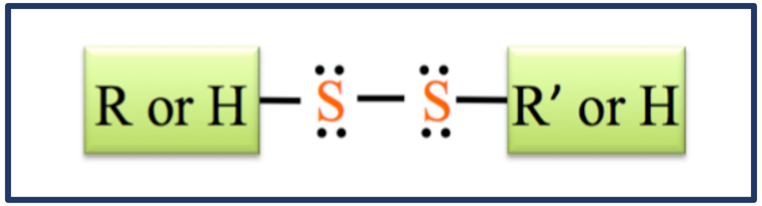
Match each of the ***sulfur analog family names*** (on the **left**), with the ***general form of its structure*** (on the **right**):

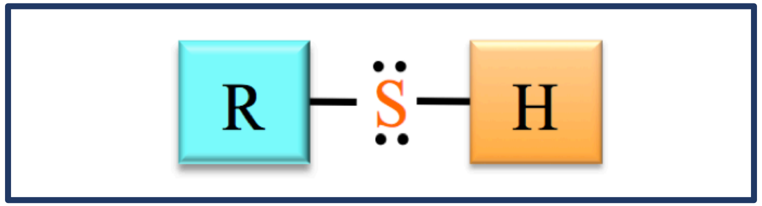
sulfide

thiol

disulfide







HINT:

A **thiol**, the sulfur analog of an *alcohol*, is obtained if the oxygen atom in an alcohol is replaced by sulfur.

A **sulfide**, the sulfur analog of an *ether*, is obtained if the oxygen atom in an ether is replaced by sulfur.

A **disulfide**, the sulfur analog of a *peroxide*, is obtained if the oxygen atoms in a peroxide are replaced by sulfur atoms.

For more help: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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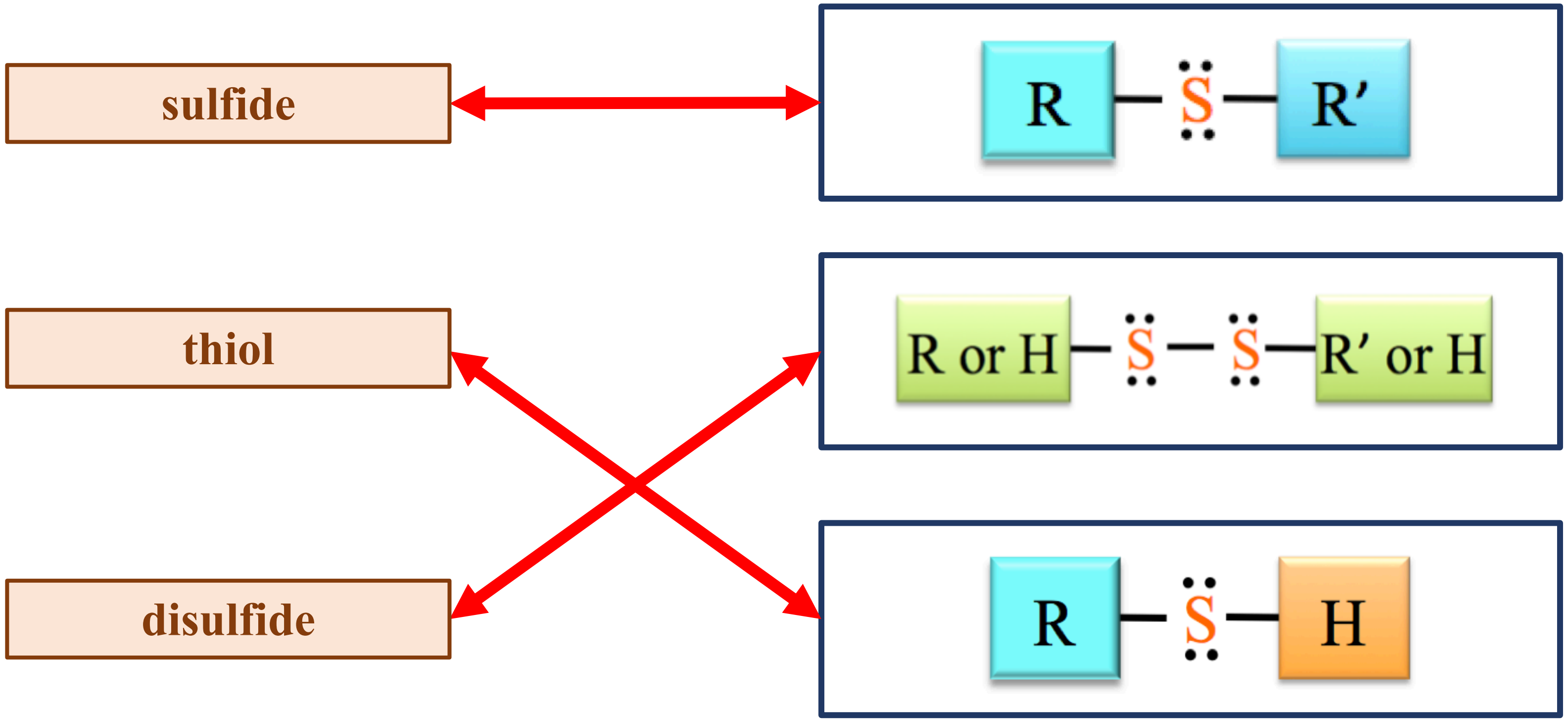
Click here to check your answer

Go to next question

10.17) When the ***oxygen*** atom(s) of water, alcohol, ether, or peroxide is replaced by ***sulfur***, the resulting compound is called a **sulfur analog**.

Match each of the ***sulfur analog family names*** (on the **left**), with the ***general form of its structure*** (on the **right**):



A **sulfide**, the sulfur analog of an *ether*, is obtained if the oxygen atom in an ether is replaced by sulfur.

A **disulfide**, the sulfur analog of a *peroxide*, is obtained if the oxygen atoms in a peroxide are replaced by sulfur atoms.

A **thiol**, the sulfur analog of an *alcohol*, is obtained if the oxygen atom in an alcohol is replaced by sulfur.

For more details: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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Go to next question

10.18) IUPAC naming is rarely used for ***small*** *ether* or *sulfide* molecules. Instead, "common names" are used for small ethers and sulfides, as described below:

Step 1. Identify the alkyl group names for the two alkyl (R) groups.

- If the two **R** groups are *identical* use the "di" prefix before alkyl group name.

Step 2. Construct the name of the ether by placing the alkyl groups in alphabetical order followed by the word "ether" or "sulfide."

- Use a space between the alkyl group names and before the word "ether" or "sulfide."

Name each of the molecules that are shown here.

$CH_3CH_2-O-CH_2CH_3$ $CH_3-O-CH_2CH_2CH_3$ $CH_3CH_2-S-CH_3$

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.18) IUPAC naming is rarely used for ***small*** *ether* or *sulfide* molecules. Instead, "common names" are used for small ethers and sulfides, as described below:

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- Use a space between the alkyl group names and before the word "ether" or "sulfide."

Name each of the molecules that are shown here.

$CH_3CH_2—O—CH_2CH_3$	$CH_3—O—CH_2CH_2CH_3$	$CH_3CH_2—S—CH_3$
HINT: __________ ether	**HINT: _______ _______ ether**	**HINT: _______ _______ sulfide**

For more help: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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Click here to **check your answer**

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10.18) IUPAC naming is rarely used for ***small*** *ether* or *sulfide* molecules. Instead, "common names" are used for small ethers and sulfides, as described below:

Step 1. Identify the alkyl group names for the two alkyl (R) groups.

- If the two **R** groups are *identical* use the "di" prefix before alkyl group name.

Step 2. Construct the name of the ether by placing the alkyl groups in alphabetical order followed by the word "ether" or "sulfide."

- Use a space between the alkyl group names and before the word "ether" or "sulfide."

Name each of the molecules that are shown here.

$CH_3CH_2-O-CH_2CH_3$ **diethyl ether**	$CH_3-O-CH_2CH_2CH_3$ **methyl propyl ether**	$CH_3CH_2-S-CH_3$ **ethyl methyl sulfide**

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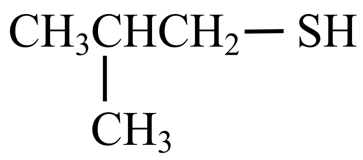
10.19) **Thiols** are systematically named in the same way as *alcohols* ***with only one exception***:

The term "**thiol**" is added to the *end the alkane name* that indicates the number of carbons in the parent chain (***instead of*** replacing the "e" from the alkane name with "ol," as we did for alcohols).

Name each of the molecules that are shown here.

$CH_3CH_2CH_2-SH$



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Name each of the molecules that are shown here.

$CH_3CH_2CH_2-SH$

CH_3CHCH_2-SH (with CH_3 attached to the CH)

HINT: Naming Thiols

Step 1: Find and name the parent chain.

- The *parent chain is the longest, continuous chain of carbon atoms that contains the point of attachment to the thiol group* (**SH**).

The term "**thiol**" is added to the *end the alkane name* that indicates the number of carbons in the parent chain.

Assign *position numbers* to the carbons in the parent chain. Position number **1** is assigned to the carbon at the ***end*** *of the parent chain* that is nearest **to the *thiol group*** (**SH**).

- For thiols with ***more than two carbons***, the position of *the point of attachment to the* ***thiol group*** must be indicated by adding a number before the parent chain.

Steps 2, **3**, and **4** are done the **same way** as you did when using systematic names for other organic molecules.

Step 2: Name any alkyl group substituents.
Step 3: Determine the *point of attachments* of alkyl groups to the parent chain.
Step 4: Construct the name of the thiol by placing the alkyl groups in alphabetical order and specifying their position number, followed by the name of the parent chain.

For more help: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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Click here to check your answer

Go to next question

10.19) **Thiols** are systematically named in the same way as *alcohols* ***with only one exception***:

The term "**thiol**" is added to the *end the alkane name* that indicates the number of carbons in the parent chain (***instead of*** replacing the "e" from the alkane name with "ol," as we did for alcohols).

Name each of the molecules that are shown here.

$CH_3CH_2CH_2-SH$

1-propanethiol

CH_3CHCH_2-SH (with CH_3 on C2)

2-methyl-1-propanethiol

EXPLANATION: Naming Thiols

Step 1: Find and name the parent chain.

- The *parent chain is the longest, continuous chain of carbon atoms that contains the point of attachment to the thiol group* (**SH**).

The term "**thiol**" is added to the *end the alkane name* that indicates the number of carbons in the parent chain.

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For more details: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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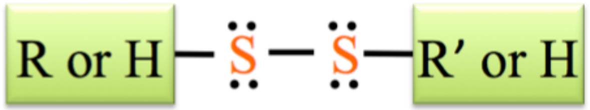
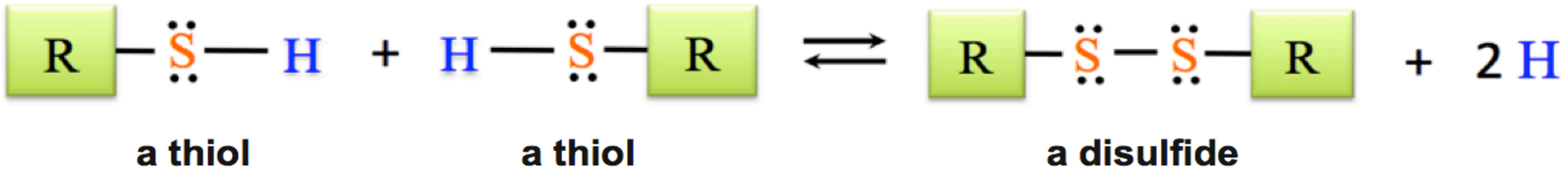
10.20) The general form of a ***disulfide*** is shown below.



The S-S bond is called a *disulfide bond*. Disulfides can be made from the reaction of two thiols. In this reaction, the thiols are oxidized to form a disulfide. The general form of the reaction is shown below.



Draw the condensed structure of the disulfide that is formed by the reaction of two *ethanethiol* molecules.

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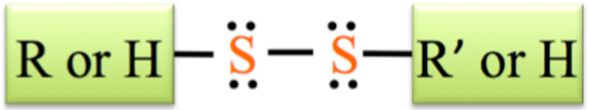
Click here for a **hint**

Click here to **check your answer**

Go to next question

10.20) The general form of a ***disulfide*** is shown below.



The S-S bond is called a *disulfide bond*. Disulfides can be made from the reaction of two thiols. In this reaction, the thiols are oxidized to form a disulfide. The general form of the reaction is shown below.

a thiol **a thiol** **a disulfide**

Draw the condensed structure of the disulfide that is formed by the reaction of two *ethanethiol* molecules.

HINT:

ethanethiol **ethanethiol**

For more help: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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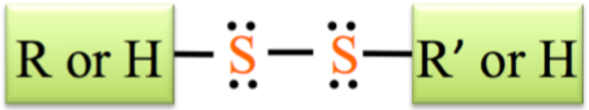
10.20) The general form of a ***disulfide*** is shown below.



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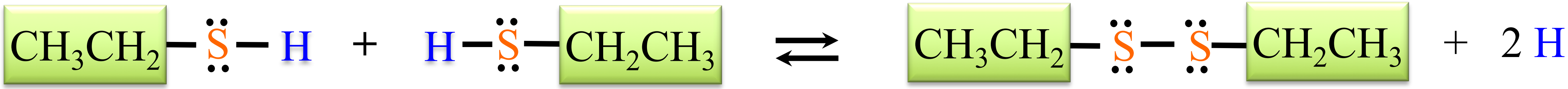
a thiol **a thiol** **a disulfide**

Draw the condensed structure of the disulfide that is formed by the reaction of two *ethanethiol* molecules.

ANSWER: $CH_3CH_2-S-S-CH_2CH_3$

ILLUSTRATIVE EXPLANATION:



ethanethiol **ethanethiol** **a disulfide**

You can recognize that the *thiol reactants* were **oxidized** because they *lose hydrogen* in the reaction.

For more details: See chapter 10 part 4 video or chapter 10 section 2 in the textbook.

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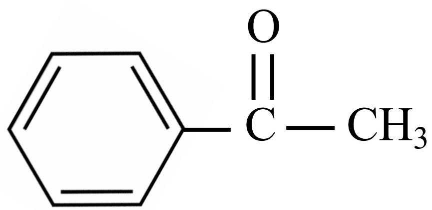
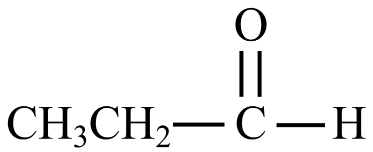
10.21) Place an asterisk (*) below the ***carbonyl carbon*** AND draw a box around the ***carbonyl group*** in each of these molecules.

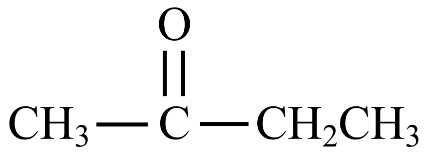
a)



b)



c)



Go back

Click here for a **hint**

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Go to next question

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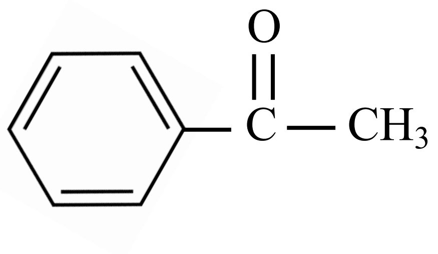
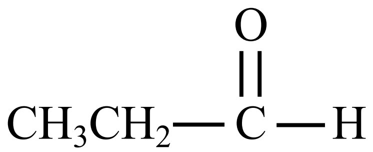
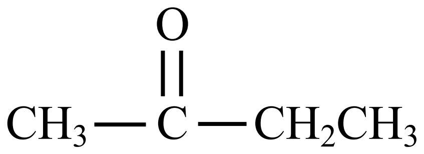
a)



b)



c)



EXPLANATION:

A ***carbonyl group*** is a carbon AND oxygen that are *double bonded to each other* (C=O).

The ***carbon*** in a *carbonyl group* is referred to as the "***carbonyl carbon***."

For more help: See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

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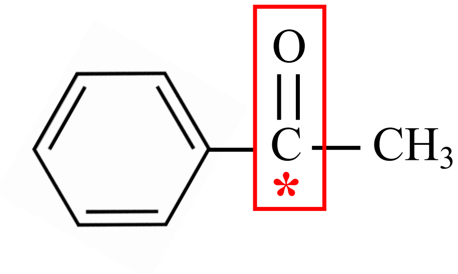
Click here to **check your answer**

Go to next question

10.21) Place an asterisk (*) below the ***carbonyl carbon*** AND draw a box around the ***carbonyl group*** in each of these molecules.

a)



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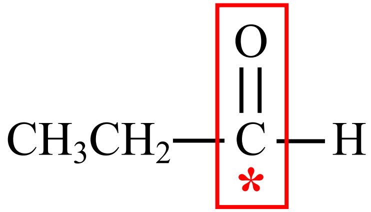

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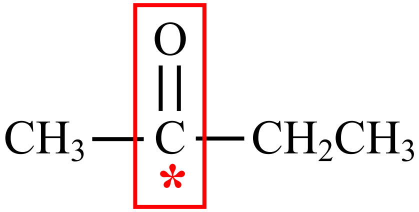

EXPLANATION:

A ***carbonyl group*** is a carbon AND oxygen that are *double bonded to each other* (C=O).

The ***carbon*** in a *carbonyl group* is referred to as the "***carbonyl carbon***."

For more details: See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

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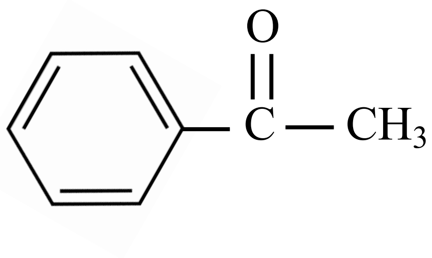
Go to next question

10.22) Classify each of the following molecules as either an **aldehyde** or a **ketone**.

a)



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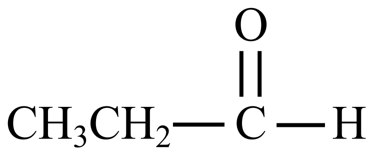

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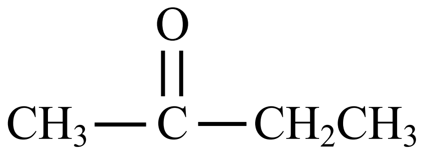


Go back

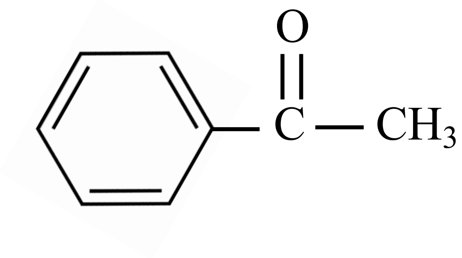
Click here for a **hint**

Click here to **check your answer**

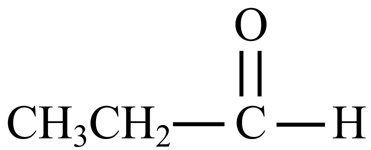
Go to next question

10.22) Classify each of the following molecules as either an **aldehyde** or a **ketone**.

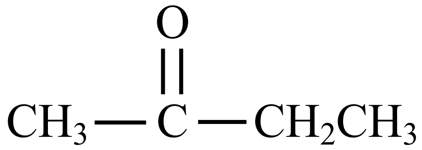
a)



b)



c)



HINT:

In **aldehydes**, the carbonyl carbon is bonded to **one R group** *and* one hydrogen (**H**), except for the simplest aldehyde, formaldehyde, which has the carbonyl carbon bonded to two hydrogens.

In **ketones**, the carbonyl carbon is bonded to **two R groups.**

For more help: See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

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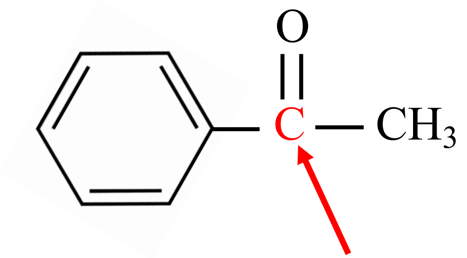
Click here to **check your answer**

Go to next question

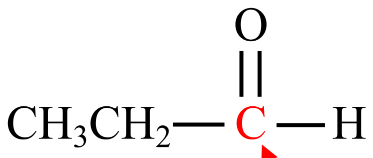
10.22) Classify each of the following molecules as either an **aldehyde** or a **ketone**.

a)



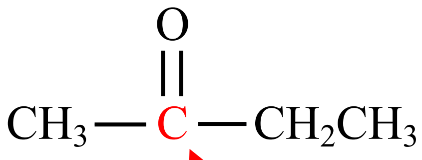
A **ketone** - the carbonyl carbon is bonded to ***two*** **R groups**.

b)



An **aldehyde** - the carbonyl carbon is bonded to ***one*** **R** group **and** ***one*** hydrogen.

c)



A **ketone** - the carbonyl carbon is bonded to ***two*** **R groups**.

EXPLANATION:

In **aldehydes**, the carbonyl carbon is bonded to **one R group** *and* one hydrogen (**H**), except for the simplest aldehyde, formaldehyde, which has the carbonyl carbon bonded to two hydrogens.

In **ketones**, the carbonyl carbon is bonded to **two R groups.**

For more details: See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

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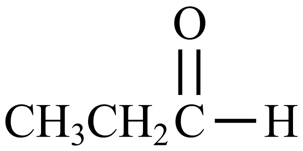
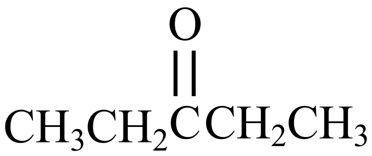
Go to next question

10.23) Write the ***systematic names*** for each of the molecules shown here.

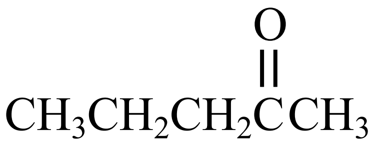
a)



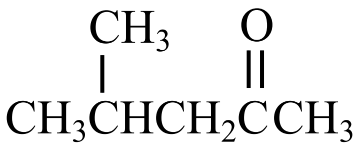
b)



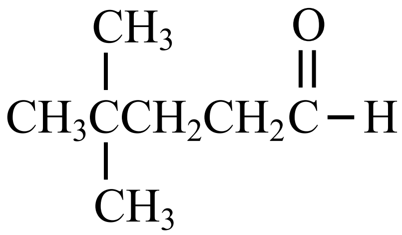
c)



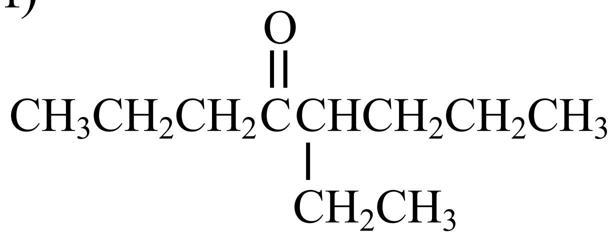
d)



e)



f)



Go back

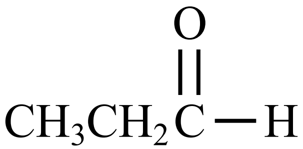
Click here for a **hint**

Click here to **check your answer**

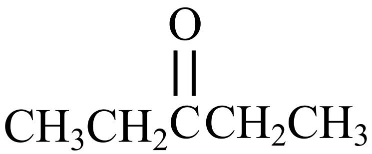
Go to next question

10.23) Write the ***systematic names*** for each of the molecules shown here.

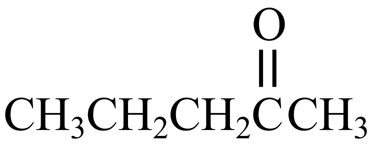
a)



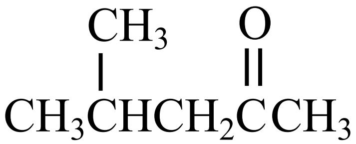
b)



c)



d)



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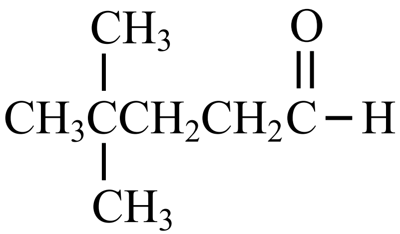

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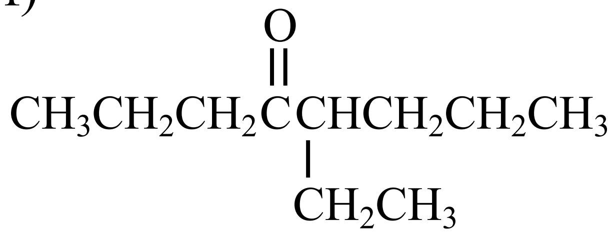


HINT: Naming Aldehydes and Ketones

Step 1: Find and name the *parent chain*.

The *parent chain is the longest, continuous chain of carbon atoms that **contains the carbonyl carbon***.

- **For aldehydes**, starting with the alkane name that corresponds to the number of carbon atoms in the parent chain, replace the "**e**" at the end of the alkane name with "**al**."

For ketones, starting with the alkane name that corresponds to the number of carbon atoms in the parent chain, replace the "**e**" at the end of the alkane name with "**one**." **For ketones *with more than four carbons***, the position of the ***carbonyl carbon*** must be indicated by adding a number as a prefix to the parent chain name.

- Position number **1** is assigned to the carbon at the ***end** of the parent chain* that is ***nearest* to the *carbonyl carbon*.**
- **Steps 2**, **3**, and **4** are done the **same way** as you did when using systematic names for other organic molecules.

Step 2: Name any alkyl group substituents.
Step 3: Determine the *point of attachments* of alkyl groups to the parent chain.
Step 4: Construct the name of the thiol by placing the alkyl groups in alphabetical order and specifying their position number, followed by the name of the parent chain.

For more help:
See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

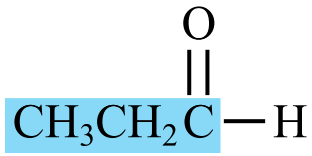
Go back

Click here to check your answer

Go to next question

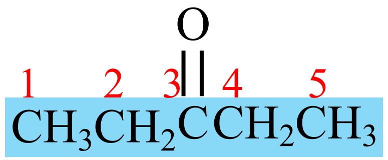
10.23) Write the ***systematic names*** for each of the molecules shown here.

a)



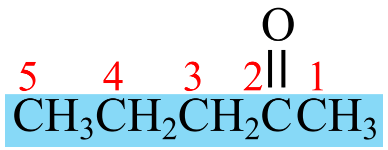
propanal

b)



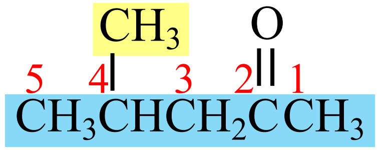
3-pentanone

c)



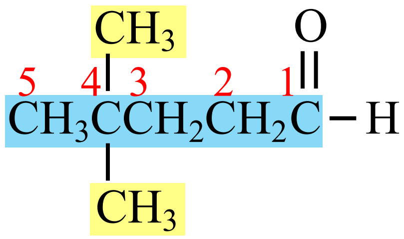
2-pentanone

d)



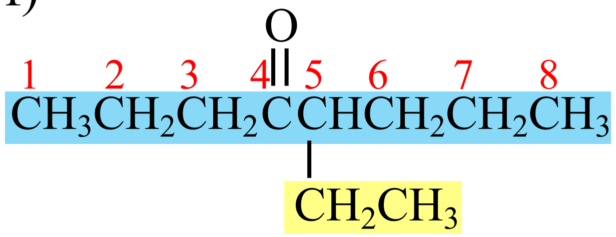
4-methyl-2-pentanone

e)



4,4-dimethylpentanal

f)



5-ethyl-4-octanone

EXPLANATION: Naming Aldehydes and Ketones

Step 1: Find and name the *parent chain*.

The *parent chain is the longest, continuous chain of carbon atoms that* ***contains the carbonyl carbon***.

- **For aldehydes**, starting with the alkane name that corresponds to the number of carbon atoms in the parent chain, replace the "**e**" at the end of the alkane name with "**al**."

For ketones, starting with the alkane name that corresponds to the number of carbon atoms in the parent chain, replace the "**e**" at the end of the alkane name with "**one**." **For ketones *with more than four carbons***, the position of the ***carbonyl carbon*** must be indicated by adding a number as a prefix to the parent chain name.

- Position number **1** is assigned to the carbon at the *end of the parent chain* that is ***nearest* to the *carbonyl carbon*.**
- **Steps 2**, **3**, and **4** are done the **same way** as you did when using systematic names for other organic molecules.

Step 2: Name any alkyl group substituents.
Step 3: Determine the *point of attachments* of alkyl groups to the parent chain.
Step 4: Construct the name of the thiol by placing the alkyl groups in alphabetical order and specifying their position number, followed by the name of the parent chain.

For more details:
See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

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Go to next question

10.24) Draw the *condensed* ***and*** *skeletal* structure for each of these molecules.

a) 5-methyl-2-hexanone

b) 4,5-dimethylheptanal

c) 3-methyl-2-octanone

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.24) Draw the *condensed* ***and*** *skeletal* structure for each of these molecules.

a) 5-methyl-2-hexanone

HINT:

For this molecule, there are ***six carbons*** in the parent chain. The ***carbonyl carbon*** is the carbon at position number **2** of the parent chain.

b) 4,5-dimethylheptanal

c) 3-methyl-2-octanone

For more help: See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

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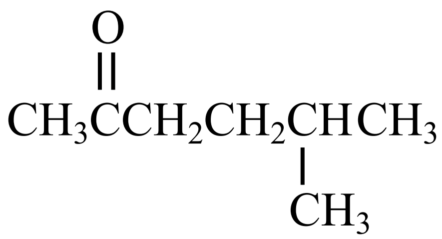
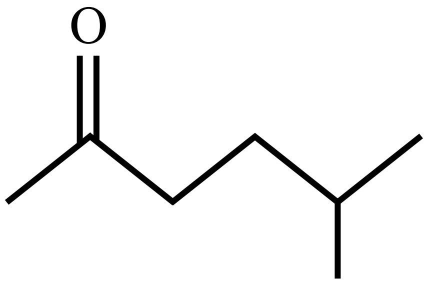
Click here to **check your answer**

Go to next question

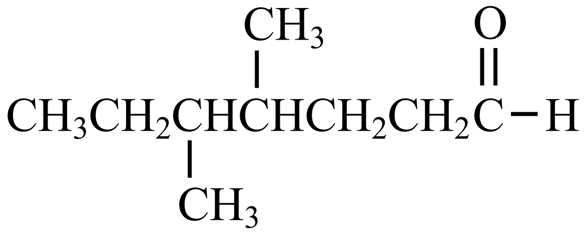
10.24) Draw the *condensed* ***and*** *skeletal* structure for each of these molecules.

a) 5-methyl-2-hexanone

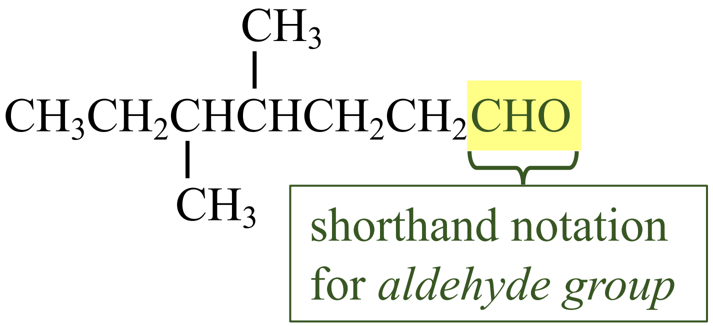


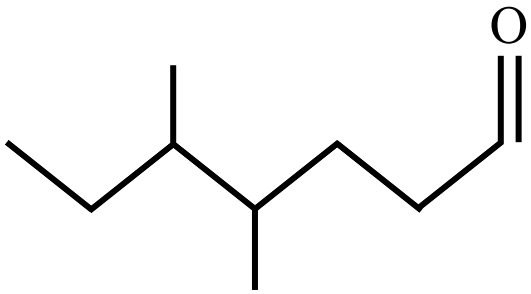


b) 4,5-dimethylheptanal

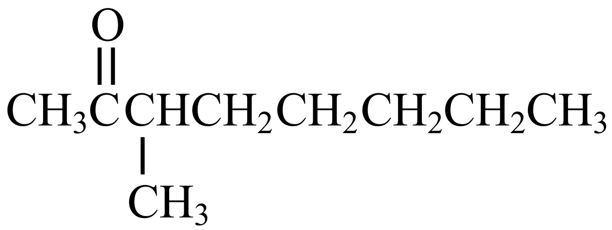


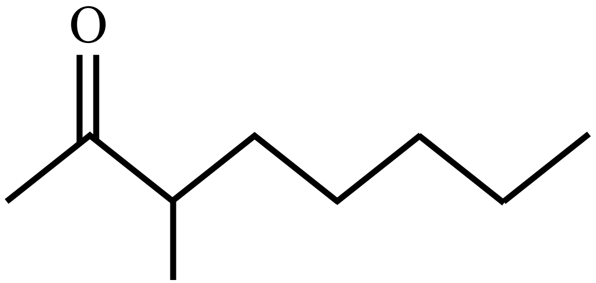
or





c) 3-methyl-2-octanone





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For more details: See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

Go to next question

10.25) Determine whether each of the following statements are **true** or **false**.

a) A cyclic ketone is a molecule in which a carbonyl carbon occupies a position between two other carbons in a ring structure.

b) A cyclic aldehyde is a molecule in which a carbonyl carbon occupies a position between two other carbons in a ring structure.

c) For ketones with more than four carbons, the position of the carbonyl carbon must be indicated by adding a number as a prefix to the parent chain name.

d) Smaller aldehyde and ketone molecules have significant water solubility because of their ability to interact with water through hydrogen bonding and dipole-dipole interactions.

e) Aldehyde molecules are attracted to each other through hydrogen bonding.

f) Ketone molecules are attracted to each other through dipole-dipole forces.

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Click here for a **hint**

Click here to **check your answer**

Go to next question

10.25) Determine whether each of the following statements are **true** or **false**.

a) A cyclic ketone is a molecule in which a carbonyl carbon occupies a position between two other carbons in a ring structure.

b) A cyclic aldehyde is a molecule in which a carbonyl carbon occupies a position between two other carbons in a ring structure.

HINT: Consider the location of an aldehyde's carbonyl group in the parent chain.

c) For ketones with more than four carbons, the position of the carbonyl carbon must be indicated by adding a number as a prefix to the parent chain name.

HINT: What is the maximum number of carbons in a ketone's parent chain before there is no longer only one, unique, possible parent chain?

d) Smaller aldehyde and ketone molecules have significant water solubility because of their ability to interact with water through hydrogen bonding and dipole-dipole interactions.

HINT: Consider the structural features that are required for hydrogen bonding and dipole-dipole interactions.

e) Aldehyde molecules are attracted to each other through hydrogen bonding.

f) Ketone molecules are attracted to each other through dipole-dipole forces.

For more help:
See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

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Click here to check your answer

Go to next question

10.25) Determine whether each of the following statements are **true** or **false**.

a) A cyclic ketone is a molecule in which a carbonyl carbon occupies a position between two other carbons in a ring structure.

true - Examples of *cyclic ketones* are cyclopentanone and cyclohexanone.

b) A cyclic aldehyde is a molecule in which a carbonyl carbon occupies a position between two other carbons in a ring structure.

false - Because an aldehyde's carbonyl group is at the *end of the parent chain*, it is impossible for it to be in a ring structure.

c) For ketones with more than four carbons, the position of the carbonyl carbon must be indicated by adding a number as a prefix to the parent chain name.

true - When a ketone has *three or fewer* carbons in the parent chain, there is only one, unique, possible parent chain.

d) Smaller aldehyde and ketone molecules have significant water solubility because of their ability to interact with water through hydrogen bonding and dipole-dipole interactions.

true - Aldehyde and ketone molecules have oxygen atoms with lone pairs that can hydrogen bond with a water molecule's hydrogen which is covalently bonded to oxygen.

e) Aldehyde molecules are attracted to each other through hydrogen bonding.

false - Although aldehydes molecules have oxygen atoms with lone pairs, they *cannot* interact with each other through hydrogen bonding because they do not have a hydrogen which is covalently bonded to oxygen, nitrogen, or fluorine.

f) Ketone molecules are attracted to each other through dipole-dipole forces.

true - Ketones (and aldehydes) have one or more "highly polar" bonds and are therefore polar. Polar molecules can interact with each other through dipole-dipole forces.

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For more details: See chapter 10 part 5 video or chapter 10 section 4 in the textbook.

Go to next question

10.26) The **dehydration** of **any** *primary* **(1°)**, ***symmetric*** secondary (**2°**), or ***symmetric*** tertiary (**3°**) alcohol only produces a **single** alkene product. When an **asymmetric alcohol** undergoes a dehydration reaction, there are ***two different alkene molecules produced***. Asymmetric alcohols are 2° or 3° alcohols in which the alkyl groups bonded to the carbon carbon carrying the OH are not identical. The de*hydration* of an asymmetric alcohol ***does not produce equal amounts of both alkene products***.

- It is possible to predict the major and minor products for the dehydration of an alcohol; in the ***major product***, the double bond is formed between the *carbon that was carrying the* **OH** and the adjacent carbon that ***originally carried fewer hydrogens***. The ***minor product*** is formed between the *carbon that was carrying the* **OH** and the adjacent carbon that ***originally carried more hydrogens***.

QUESTION: Draw the condensed structure of the ***major*** **and** ***minor products*** for the dehydration of the alcohol shown below.

OH
|
$CH_3CH_2CH_2CH_2CHCH_3$

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.26) The **dehydration** of **any** *primary* **(1°)**, ***symmetric*** secondary (2°), or ***symmetric*** tertiary (3°) alcohol only produces a **single** alkene product. When an **asymmetric alcohol** undergoes a dehydration reaction, there are ***two different alkene molecules produced***. Asymmetric alcohols are 2° or 3° alcohols in which the alkyl groups bonded to the carbon carbon carrying the OH are not identical. The de*hydration* of an asymmetric alcohol ***does not produce equal amounts of both alkene products***.

- It is possible to predict the major and minor products for the dehydration of an alcohol; in the ***major product***, the double bond is formed between the *carbon that was carrying the* **OH** and the adjacent carbon that ***originally carried fewer hydrogens***. The ***minor product*** is formed between the *carbon that was carrying the* **OH** and the adjacent carbon that ***originally carried more hydrogens***.

QUESTION: Draw the condensed structure of the ***major*** **and** ***minor products*** for the dehydration of the alcohol shown below.

$$CH_3CH_2CH_2CH_2CH(OH)CH_3$$

HINT:

In the formation of the ***major*** alkene product, the ***adjacent carbon*** that originally contained *fewer hydrogens* will lose another hydrogen when the double bond is formed. The *adjacent carbons* are shown in blue or green font in the structure shown here.

- An easy way to remember this alcohol dehydration rule is with the old saying, "the poor get poorer," where hydrogen atoms (H) represent money.

The ***minor product*** is formed between the *carbon that was carrying the* **OH** and the adjacent carbon that ***originally carried more hydrogens***.

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For more help: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

Click here to check your answer

Go to next question

10.26) The **dehydration** of **any** *primary* **(1°)**, ***symmetric*** secondary (**2°**), or ***symmetric*** tertiary (**3°**) alcohol only produces a **single** alkene product. When an **asymmetric alcohol** undergoes a dehydration reaction, there are ***two different alkene molecules produced***. Asymmetric alcohols are 2° or 3° alcohols in which the alkyl groups bonded to the carbon carbon carrying the OH are not identical. The de*hydration* of an asymmetric alcohol ***does not produce equal amounts of both alkene products***.

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QUESTION: Draw the condensed structure of the ***major*** **and** ***minor products*** for the dehydration of the alcohol shown below.

$$CH_3CH_2CH_2CH_2CH(OH)CH_3 \rightleftharpoons CH_3CH_2CH_2CH{=}CHCH_3 + CH_3CH_2CH_2CH_2CH{=}CH_2 + H_2O$$

Major Product
The double bond is formed ***more often*** between the **carbon (C)** that is "carrying" the **OH** and the adjacent carbon (C) that originally carried *fewer* hydrogen atoms.

Minor Product
The double bond is formed ***less often*** between the **carbon (C)** that is "carrying" the **OH** and the adjacent carbon (C) that originally carried *more* hydrogen atoms.

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For more details: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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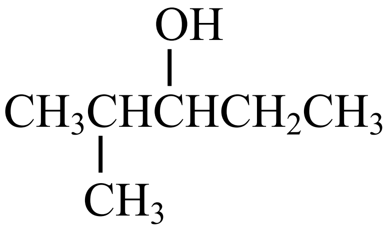
10.27) Draw the condensed structure of the ***major*** **<u>and</u>** ***minor products*** for the dehydration of the alcohol shown below.



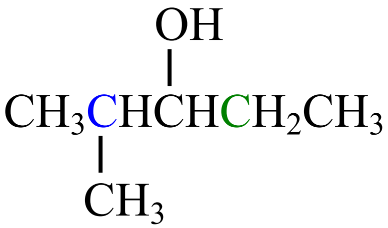
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.27) Draw the condensed structure of the ***major*** **and** ***minor products*** for the dehydration of the alcohol shown below.



HINT:

In the formation of the ***major*** alkene product, the ***adjacent carbon*** that originally contained *fewer hydrogens* will lose another hydrogen when the double bond is formed. The *adjacent carbons* are shown in blue or green font in the structure shown here.

- An easy way to remember this alcohol dehydration rule is with the old saying, "the poor get poorer," where hydrogen atoms (H) represent money.

The ***minor product*** is formed between the *carbon that was carrying the* **OH** and the adjacent carbon that ***originally carried more hydrogens***.

For more help: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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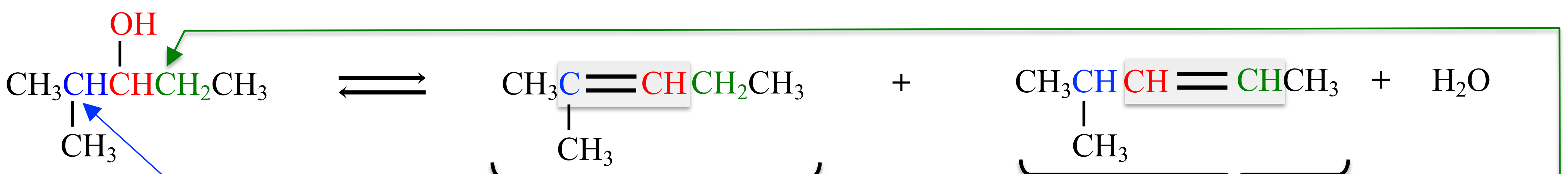
Click here to **check your answer**

Go to next question

10.27) Draw the condensed structure of the ***major* and *minor products*** for the dehydration of the alcohol shown below.



Major Product
The double bond is formed ***more often*** between the **carbon (C)** that is "carrying" the **OH** and the adjacent carbon (C) that originally carried *fewer* hydrogen atoms.

Minor Product
The double bond is formed ***less often*** between the **carbon (C)** that is "carrying" the **OH** and the adjacent carbon (C) that originally carried *more* hydrogen atoms.

EXPLANATION:

In the formation of the ***major*** alkene product, the ***adjacent carbon*** that originally contained *fewer hydrogens* will lose another hydrogen when the double bond is formed.

- An easy way to remember this alcohol dehydration rule is with the old saying, "the poor get poorer," where hydrogen atoms (H) represent money.

The ***minor product*** is formed between the *carbon that was carrying the* **OH** and the adjacent carbon that ***originally carried more hydrogens***.

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For more details: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

Go to next question

10.28)

i) The ***oxidation*** of an organic compound in a reaction can be identified by the addition of oxygen and/or loss of _____________.

a) hydroxide
b) an R group
c) chirality
d) hydrogen

ii) Oxidation of a primary (1^o) alcohol produces a(n) _____________.

a) aldehyde
b) ketone
c) alkene
d) alkane

iii) Oxidation of a secondary (2^o) alcohol produces a(n) _____________.

a) aldehyde
b) ketone
c) alkene
d) alkane

iv) Using a strong oxidizing agent, the initial oxidation product of a primary (1^o) alcohol can be further oxidized to a(n) __________.

a) ether
b) ketone
c) carboxylic acid
d) ester

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.28)

i) The ***oxidation*** of an organic compound in a reaction can be identified by the addition of oxygen and/or loss of ______________.

HINT:
a) hydroxide
b) ~~an R group~~
c) ~~chirality~~
d) hydrogen

ii) Oxidation of a primary (1°) alcohol produces a(n) _______________.

HINT:
a) aldehyde
b) ~~ketone~~
c) alkene
d) alkane

iii) Oxidation of a secondary (2°) alcohol produces a(n) _______________.

HINT:
a) aldehyde
b) ketone
c) ~~alkene~~
d) alkane

iv) Using a strong oxidizing agent, the initial oxidation product of a primary (1°) alcohol can be further oxidized to a(n) __________.

HINT:
a) ~~ether~~
b) ketone
c) carboxylic acid
d) ester

For more help: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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Click here to **check your answer**

Go to next question

10.28)

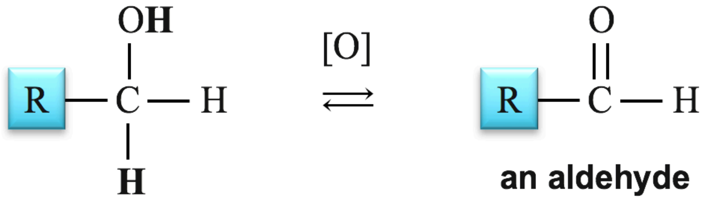
i) The ***oxidation*** of an organic compound in a reaction can be identified by the addition of oxygen and/or loss of ______________.

a) hydroxide
b) an R group
c) chirality
d) hydrogen

ii) Oxidation of a primary (1°) alcohol produces a(n) _______________.

a) aldehyde
b) ketone
c) alkene
d) alkane

The oxidation of a primary alcohol produces an **aldehyde** because the hydroxyl group is attached to a carbon *at an end of the parent chain*, and therefore the carbonyl group in the product is *at the end of the chain*.



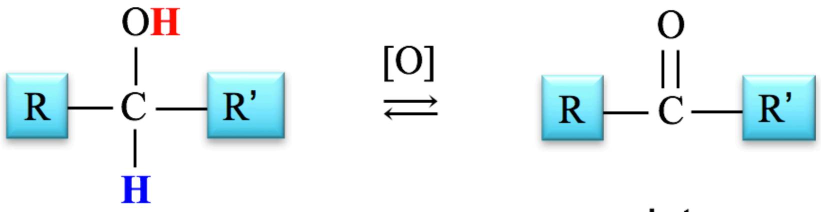
an aldehyde

a primary (1°) alcohol

iii) Oxidation of a secondary (2°) alcohol produces a(n) _______________.

a) aldehyde
b) ketone
c) alkene
d) alkane

The oxidation of a secondary alcohol produces a **ketone** because the hydroxyl group is attached to a carbon *that is **not** at the end of the parent chain*, and therefore the carbonyl group in the product is ***not** at the end of the parent chain.*

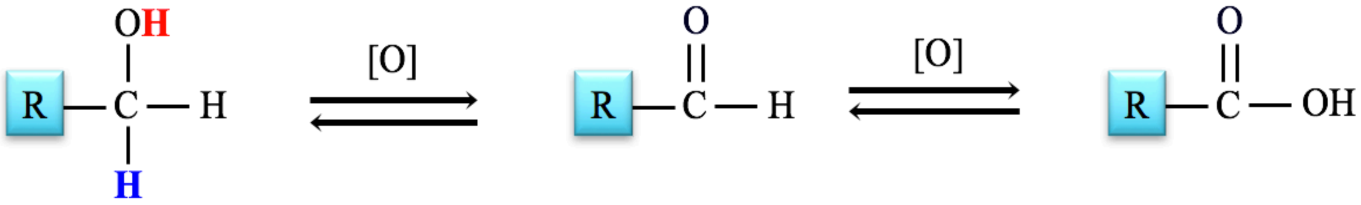


a secondary (2°) alcohol

a ketone

iv) Using a strong oxidizing agent, the initial oxidation product of a primary (1°) alcohol can be further oxidized to a(n) __________.

a) ether
b) ketone
c) carboxylic acid
d) ester



primary (1°) alcohol

aldehyde

carboxylic acid

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For more details: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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10.29) A strong oxidizing agent, such as the permanganateate ion (MnO_4^-), will first oxidize a primary alcohol to an aldehyde, and then it will oxidize the aldehyde to produce a carboxylic acid.

Draw the condensed structure of the ***aldehyde*** that is initially formed, and then draw the condensed structure of the ***carboxylic acid*** that is subsequently formed in the oxidation of ethanol when MnO_4^- is used as the oxidizing agent.

$$\underset{\text{ethanol}}{CH_3CH_2OH} \underset{}{\overset{[O]}{\rightleftharpoons}} \text{an aldehyde} \overset{[O]}{\rightleftharpoons} \text{a carboxylic acid}$$

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Click here for a **hint**

Click here to **check your answer**

Go to next question

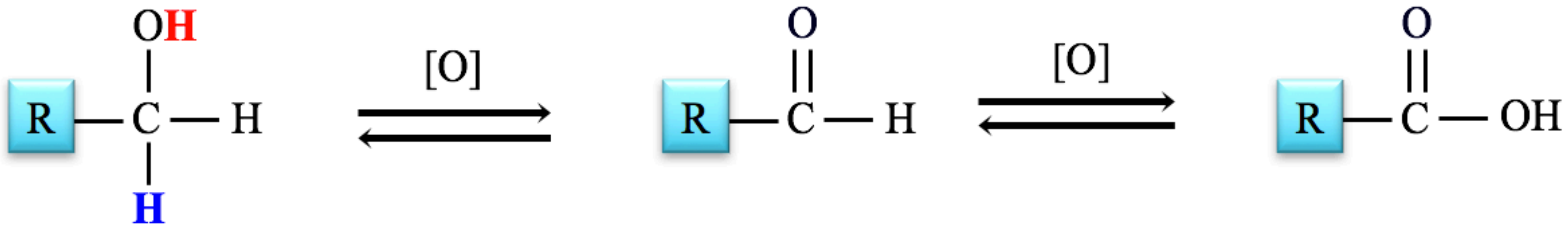
10.29) A strong oxidizing agent, such as the permanganateate ion (MnO_4^-), will first oxidize a primary alcohol to an aldehyde, and then it will oxidize the aldehyde to produce a carboxylic acid.

Draw the condensed structure of the ***aldehyde*** that is initially formed, and then draw the condensed structure of the ***carboxylic acid*** that is subsequently formed in the oxidation of ethanol when MnO_4^- is used as the oxidizing agent.

CH_3CH_2OH (ethanol) $\xrightleftharpoons{[O]}$ an aldehyde $\xrightleftharpoons{[O]}$ a carboxylic acid

HINT:

The general form for the sequence of oxidation reactions for primary alcohols is shown below.



primary (1°) alcohol — aldehyde — carboxylic acid

Consider the general form of the reactions to predict the products. What is represented by the letter "**R**" in this problem? Be careful; **IT IS NOT** "CH_3CH_2."

For more help: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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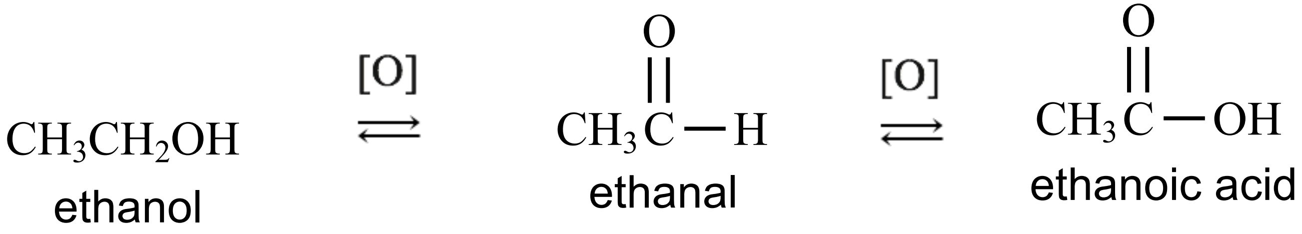
Go to next question

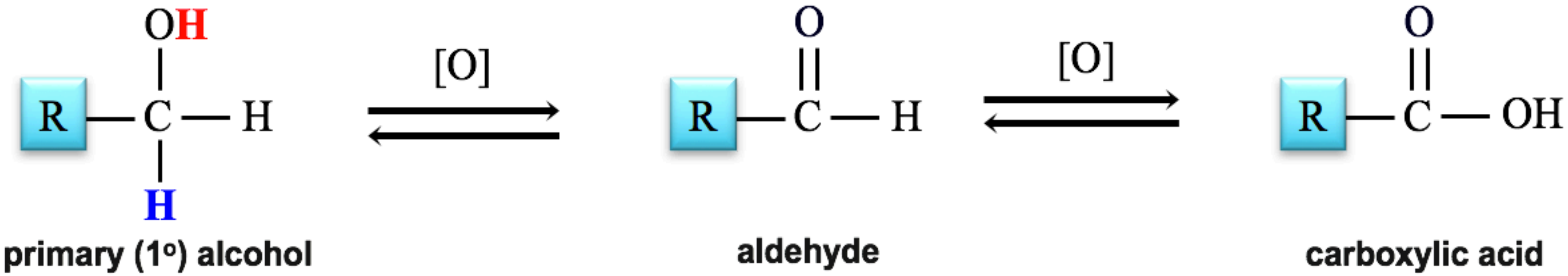
10.29) A strong oxidizing agent, such as the permanganateate ion (MnO_4^-), will first oxidize a primary alcohol to an aldehyde, and then it will oxidize the aldehyde to produce a carboxylic acid.

Draw the condensed structure of the ***aldehyde*** that is initially formed, and then draw the condensed structure of the ***carboxylic acid*** that is subsequently formed in the oxidation of ethanol when MnO_4^- is used as the oxidizing agent.



EXPLANATION:

The general form for the sequence of oxidation reactions for primary alcohols is shown below.



The general form for the reactions is used to predict the products. In the equation here, **R** represents "CH_3," not "CH_3CH_2."

For more details: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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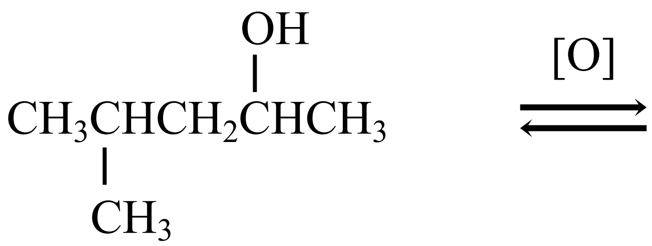
10.30) Draw the condensed structure ***and*** name the organic molecule that is produced in the oxidation of the alcohol shown here.



IMPORTANT NOTE:

The "**[O]**," drawn above (or below) the arrows in a chemical equation, is often used to indicate that the reactant is being *oxidized,* and should not be confused with the presence of a catalyst.

When oxidation is indicated by using "**[O]**," then the identity of the oxidizing agent - which is actually a reactant - and the destination of the hydrogens are often omitted from the chemical equation.

- When doing so, it is acceptable - and expected - that the equation is not balanced.

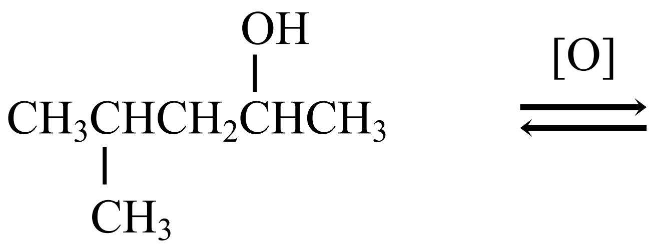
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.30) Draw the condensed structure ***and*** name the organic molecule that is produced in the oxidation of the alcohol shown here.



HINT:
This reaction involves the oxidation of a *secondary* alcohol. Find the general form for the oxidation of a secondary alcohols in your lecture notes. Consider the general form for the reaction to predict the products.

For more help: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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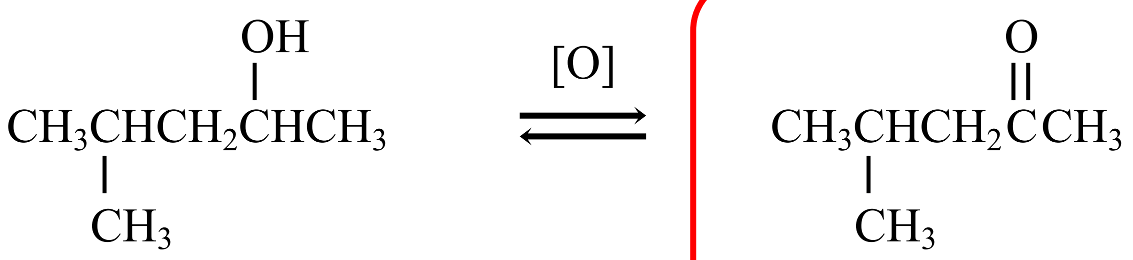
Go to next question

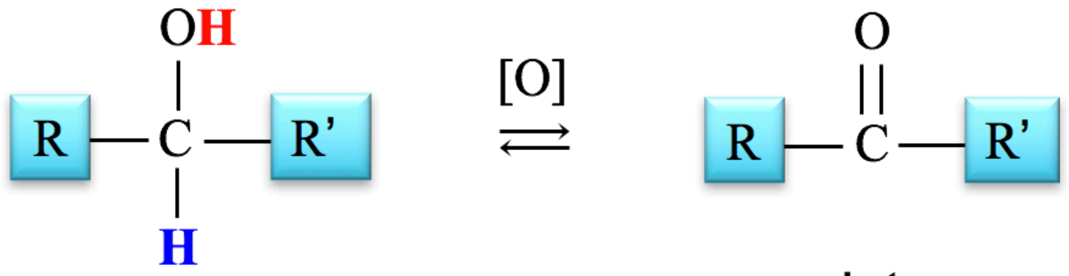
10.30) Draw the condensed structure ***and*** name the organic molecule that is produced in the oxidation of the alcohol shown here.



4-methyl-2-pentanone

EXPLANATION:

The general form of the reaction for the oxidation of a secondary alcohol is shown below.



a secondary (2°) alcohol **a ketone**

The oxidation of a secondary alcohol produces a ***ketone***. A ***ketone*** is produced because the hydroxyl group of a secondary alcohol is attached to a carbon *that is **not** at the end of the parent chain*, and therefore the carbonyl group in the product is ***not** at the end of the parent chain.*

For more details: See chapter 10 part 6 video or chapter 10 section 5 in the textbook.

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Go to next question

10.31)

i) The oxidation of an aldehyde produces a(n) ________________.

a) primary alcohol
b) secondary alcohol
c) ketone
d) carboxylic acid

ii) Reduction of aldehydes and ketones is the reverse of the oxidation of ____________ reactions.

a) alcohols
b) carboxylic acids
c) esters
d) alkenes

iii) The reduction of an aldehyde produces a(n) ________________.

a) primary alcohol
b) secondary alcohol
c) ketone
d) carboxylic acid

iv) The reduction of an ketone produces a(n) ________________.

a) primary alcohol
b) secondary alcohol
c) aldehyde
d) carboxylic acid

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.31)

i) The oxidation of an aldehyde produces a(n) _________________.

HINT:
- ~~a) primary alcohol~~
- ~~b) secondary alcohol~~
- c) ketone
- d) carboxylic acid

ii) Reduction of aldehydes and ketones is the reverse of the oxidation of ______________ reactions.

HINT:
- a) alcohols
- b) carboxylic acids
- ~~c) esters~~
- ~~d) alkenes~~

iii) The reduction of an aldehyde produces a(n) _________________.

HINT:
- a) primary alcohol
- b) secondary alcohol
- c) ketone
- ~~d) carboxylic acid~~

iv) The reduction of an ketone produces a(n) _________________.

HINT:
- a) primary alcohol
- b) secondary alcohol
- c) aldehyde
- ~~d) carboxylic acid~~

For more help: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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Click here to **check your answer**

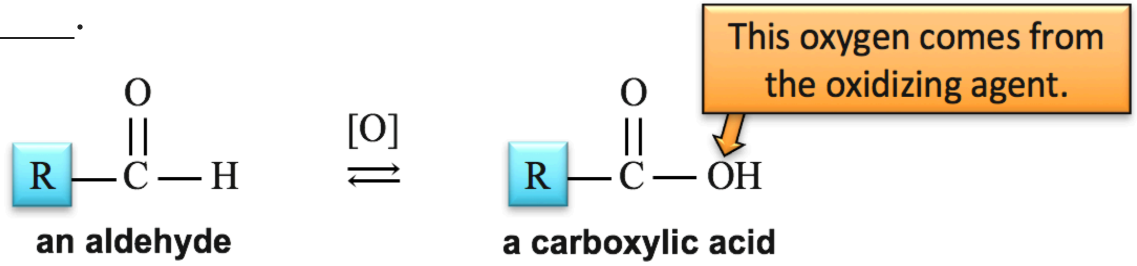
Go to next question

10.31)

i) The oxidation of an aldehyde produces a(n) _______________.

a) primary alcohol
b) secondary alcohol
c) ketone
d) carboxylic acid

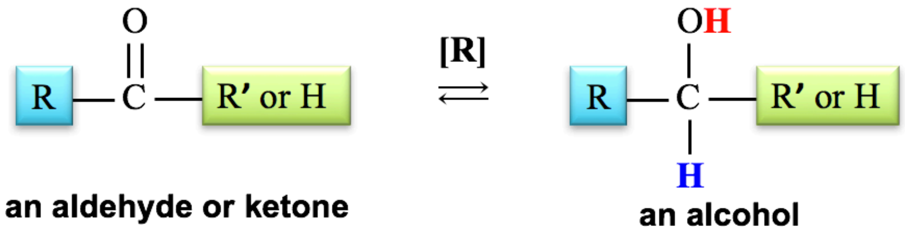
The general form of the equation for the oxidation of an aldehyde is shown here:



ii) Reduction of aldehydes and ketones is the reverse of the oxidation of ____________ reactions.

a) alcohols
b) carboxylic acids
c) esters
d) alkenes

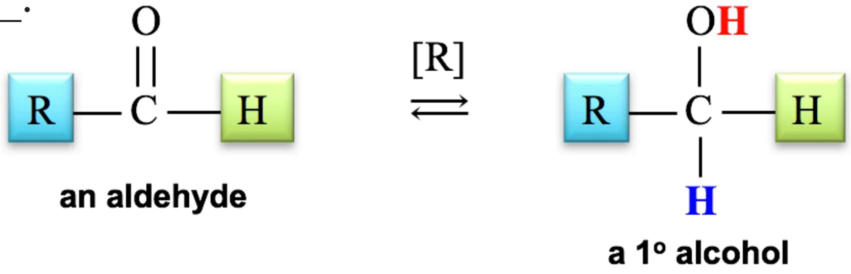
The general form of the equation for the reduction of aldehydes or ketones is shown here:



iii) The reduction of an aldehyde produces a(n) _______________.

a) primary alcohol
b) secondary alcohol
c) ketone
d) carboxylic acid

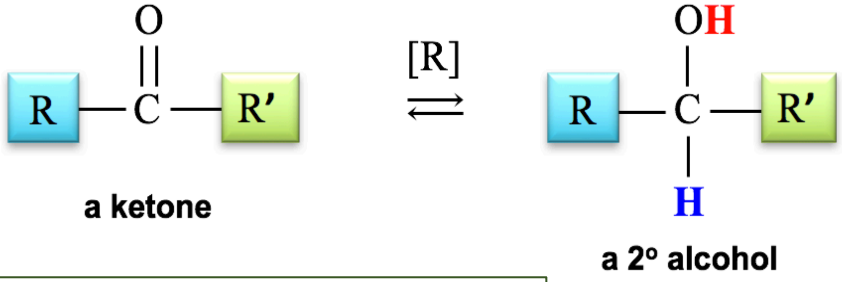
The general form of the equation for the reduction of aldehydes is shown here:



iv) The reduction of an ketone produces a(n) _______________.

a) primary alcohol
b) secondary alcohol
c) aldehyde
d) carboxylic acid

The general form of the equation for the reduction of ketones is shown here:



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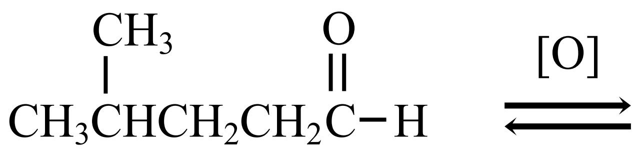
For more details: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

Go to next question

10.32) Draw the condensed structure ***and*** name the organic molecule that is produced in the oxidation of the molecule shown here.



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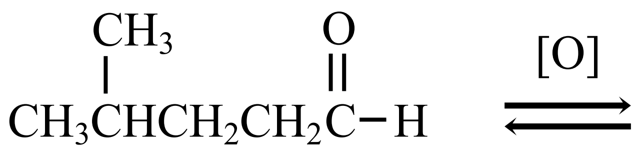
Go to next question

10.32) Draw the condensed structure ***and*** name the organic molecule that is produced in the oxidation of the molecule shown here.



HINT:

This reaction involves the ***oxidation*** of an *aldehyde*. Find the general form for the oxidation of an aldehyde in your lecture notes. Consider the general form of the reaction to predict the products.

For more help: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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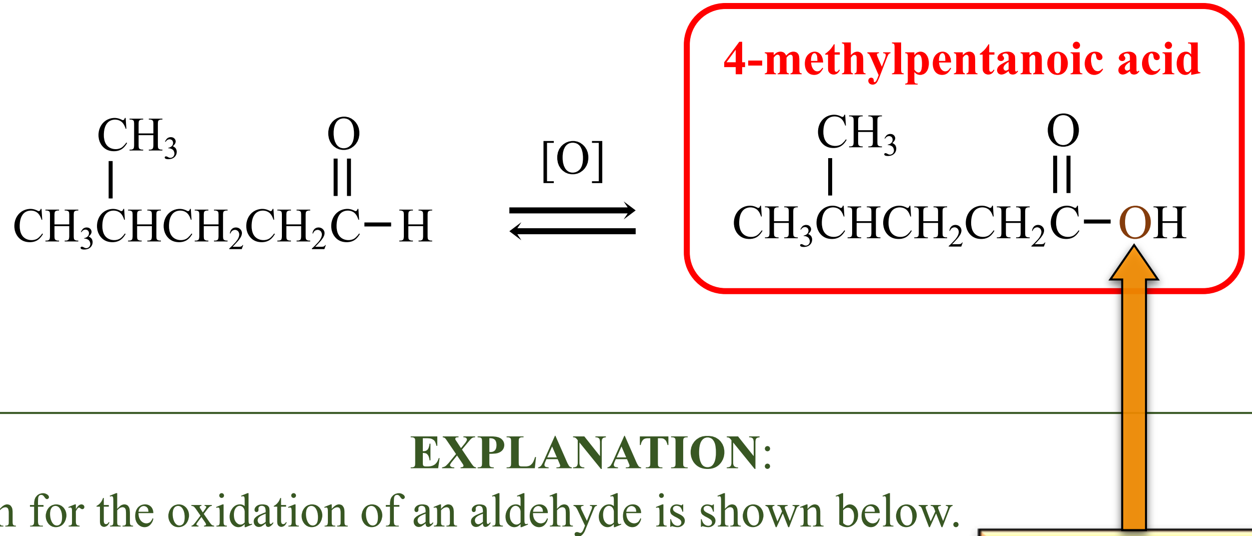
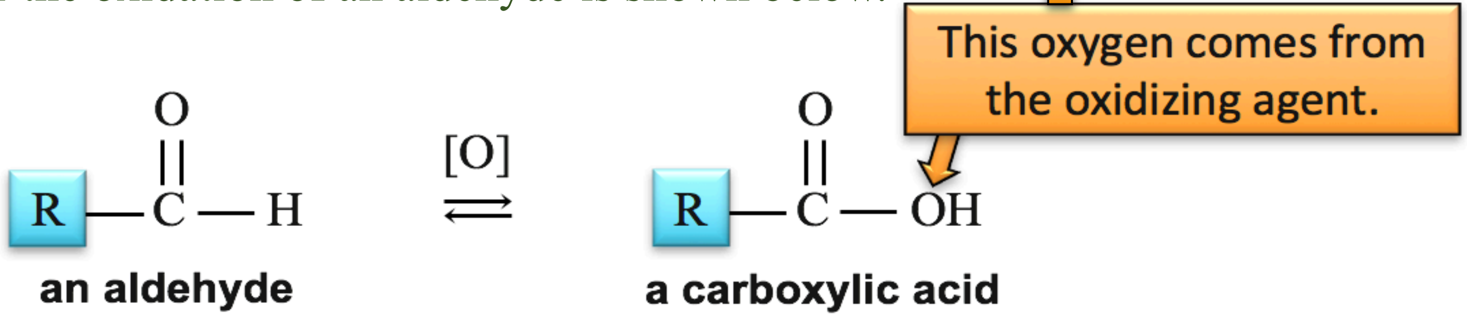
Go to next question

10.32) Draw the condensed structure ***and*** name the organic molecule that is produced in the oxidation of the molecule shown here.



EXPLANATION:

The general form of the reaction for the oxidation of an aldehyde is shown below.



The oxidation of an aldehyde produces a ***carboxylic acid***. The general form for the reaction is used to predict the products.

For more details: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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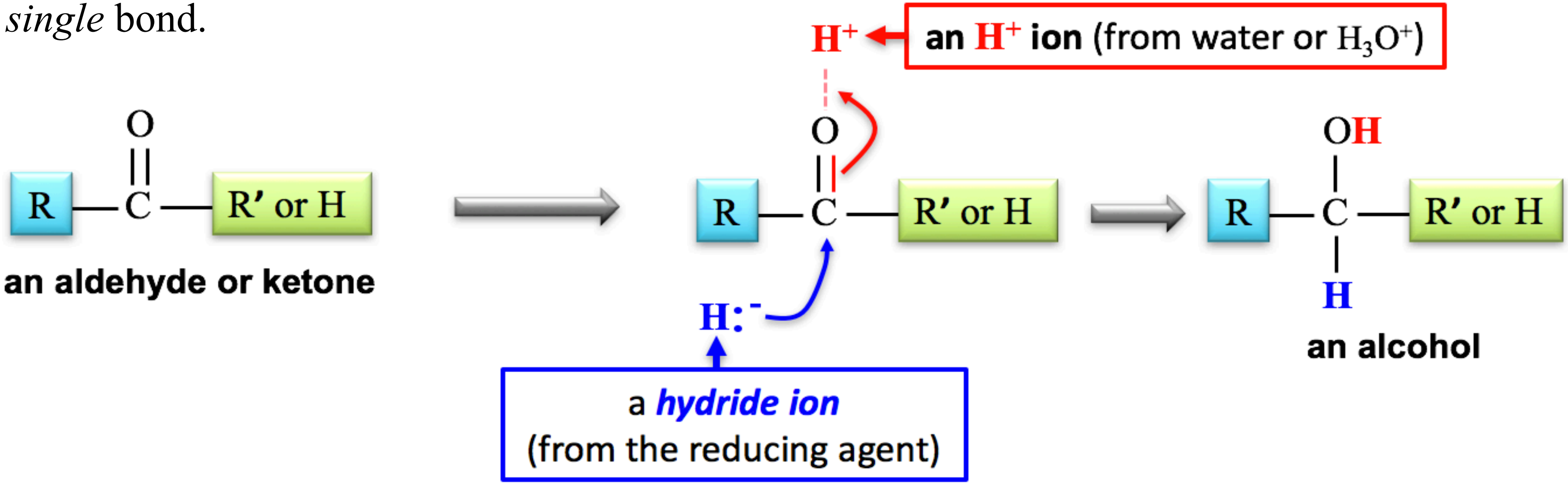
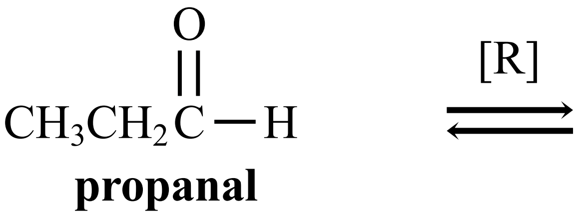
10.33) Reduction of aldehydes or ketones involves the formation of a bond to the *carbonyl carbon* by a ***hydride ion*** (**H:⁻**), accompanied by the bonding of an **H^+** ion to the carbonyl-oxygen atom, and the conversion of the carbon-oxygen *double* bond into a *single* bond.



QUESTION: Draw the condensed structure ***and*** name the organic molecule that is produced in the reduction of propanal.



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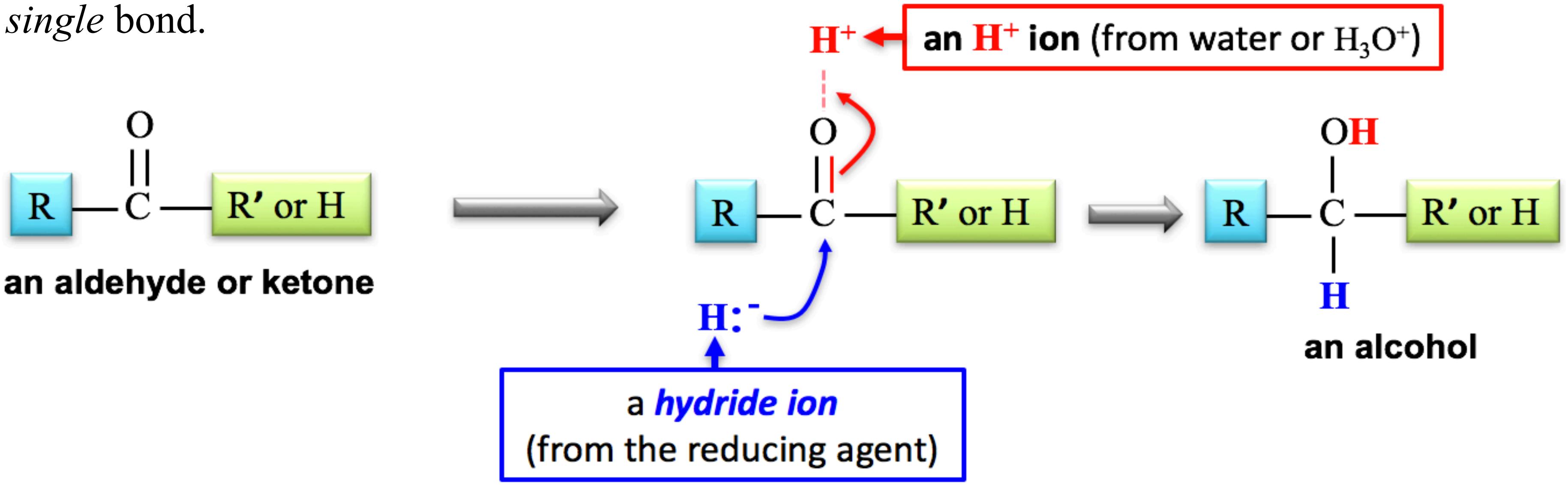
Click here for a **hint**

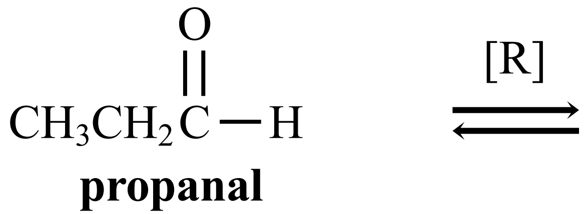
Click here to **check your answer**

Go to next question

10.33) Reduction of aldehydes or ketones involves the formation of a bond to the *carbonyl carbon* by a ***hydride ion*** (**H:$^-$**), accompanied by the bonding of an **H$^+$** ion to the carbonyl-oxygen atom, and the conversion of the carbon-oxygen *double* bond into a *single* bond.



QUESTION: Draw the condensed structure ***and*** name the organic molecule that is produced in the reduction of propanal.



HINT:

This reaction involves the ***reduction*** of an *aldehyde*. To predict the product of this reaction, either use the illustration above or find the general form for the reduction of an aldehyde in your lecture notes.

For more help: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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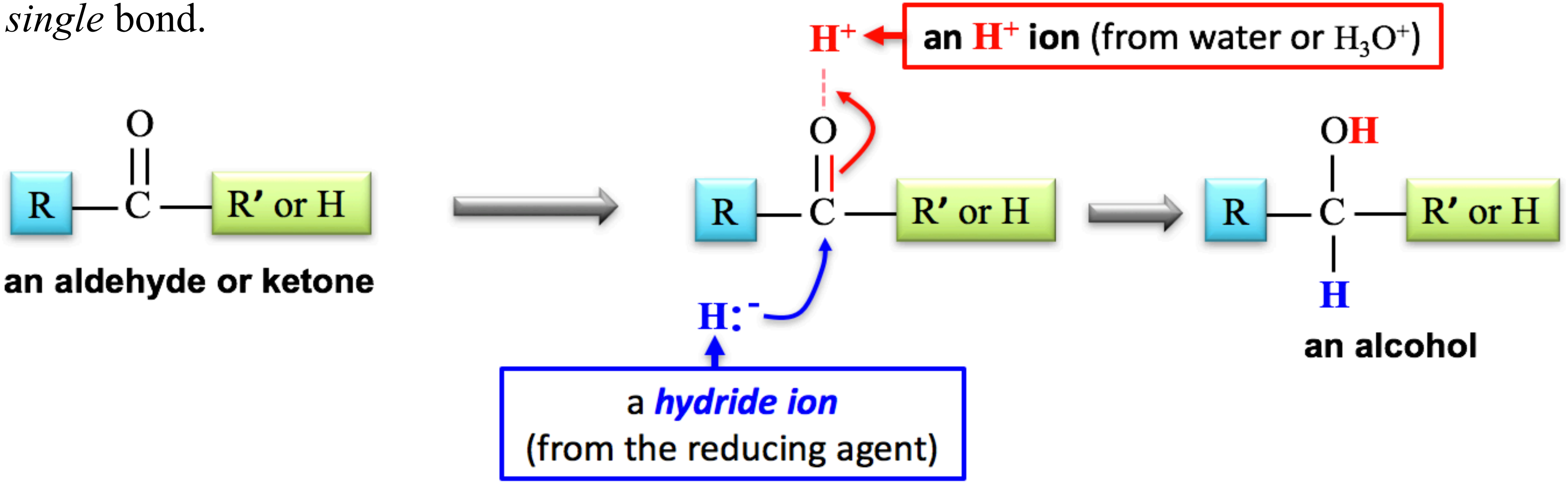
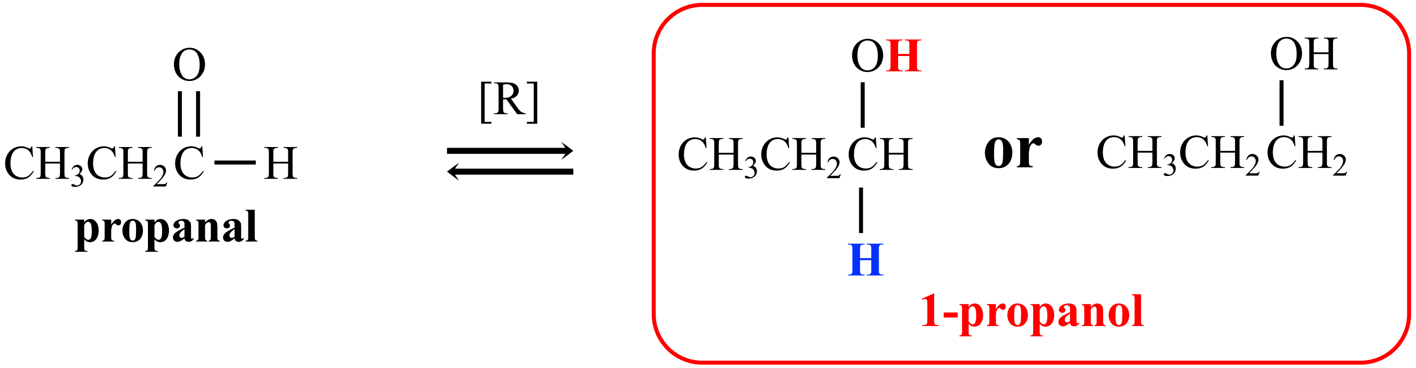
Click here to check your answer

Go to next question

10.33) Reduction of aldehydes or ketones involves the formation of a bond to the *carbonyl carbon* by a ***hydride ion*** (**H:⁻**), accompanied by the bonding of an **H^+** ion to the carbonyl-oxygen atom, and the conversion of the carbon-oxygen *double* bond into a *single* bond.

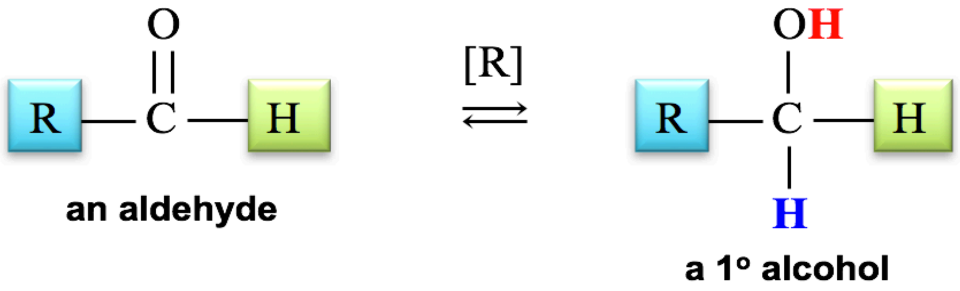


QUESTION: Draw the condensed structure ***and*** name the organic molecule that is produced in the reduction of propanal.



EXPLANATION:

Aldehydes are reduced to ***primary alcohols.***



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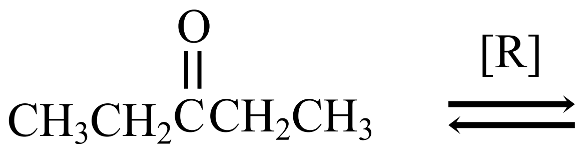
For more details: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

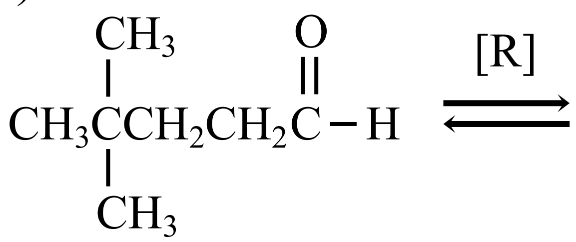
Go to next question

10.34) Draw the condensed structure ***and*** name the organic molecule that is produced in the reduction of each of these molecules.

a)



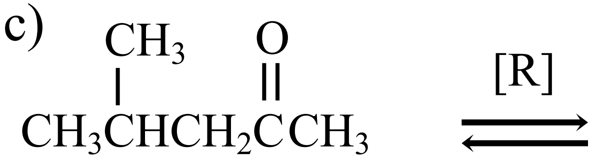
b)



NOTE: As was the case for "**[O]**," an "**[R]**" is often written above the arrows in a chemical equation to indicate that the reactant is being *reduced*.

- When reduction is indicated by using "**[R]**," then the identity of the reducing agent reactant and the source of the hydrogens (or destination of oxygens) are often omitted from the chemical equation. In this case, the equation need not be balanced.

c)



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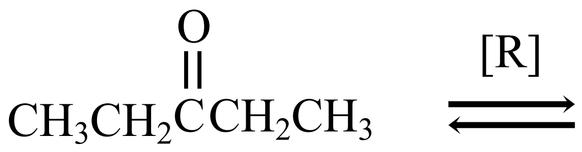
Click here for a **hint**

Click here to **check your answer**

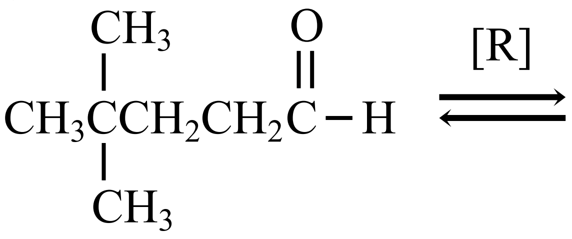
Go to next question

10.34) Draw the condensed structure ***and*** name the organic molecule that is produced in the reduction of each of these molecules.

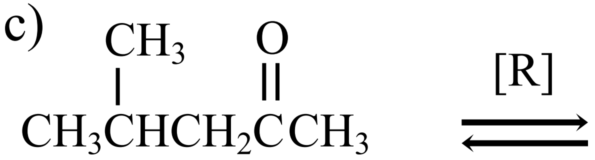
a)



b)



c)



HINT:

These reactions involves the ***reduction*** of *aldehydes* and *ketones*. Find the general forms of these reductions in your lecture notes.

Consider the general form of the reaction to predict the products.

For more help: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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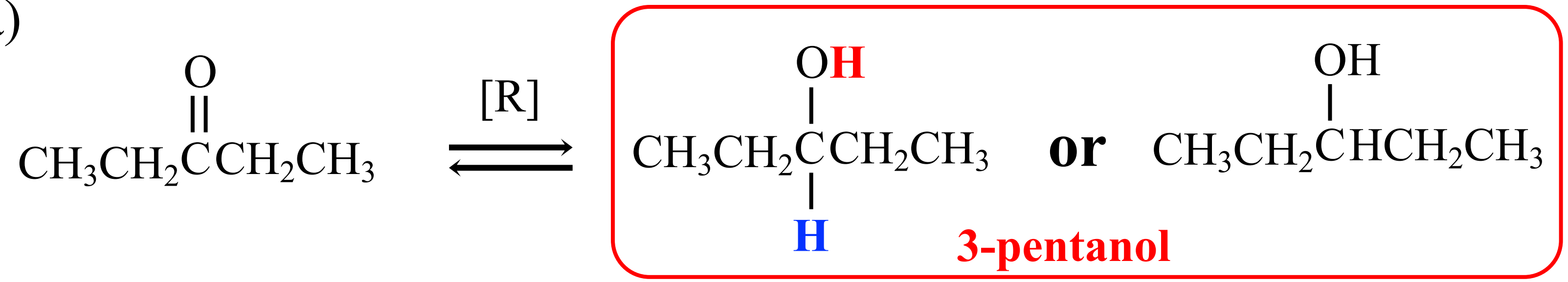
Click here to **check your answer**

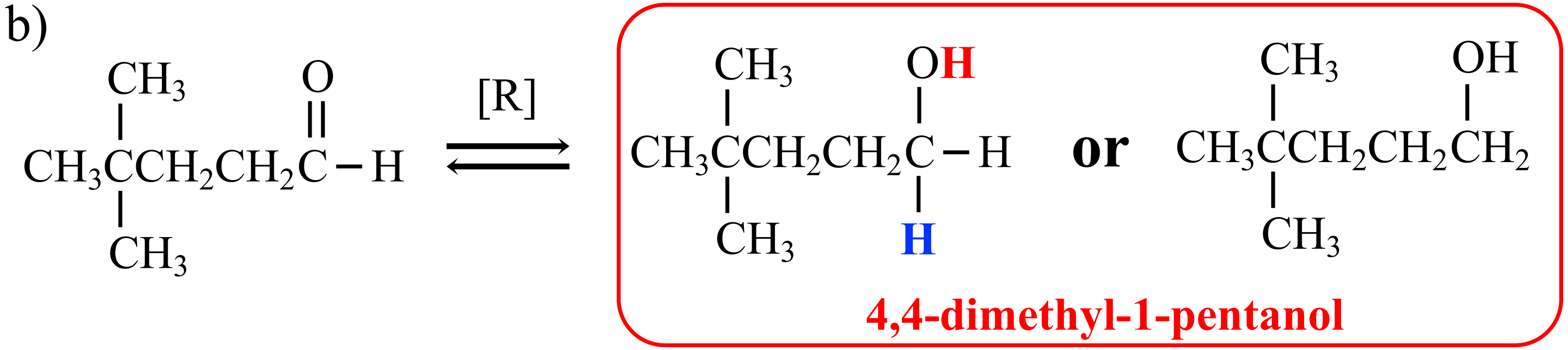
Go to next question

10.34) Draw the condensed structure ***and*** name the organic molecule that is produced in the reduction of each of these molecules.

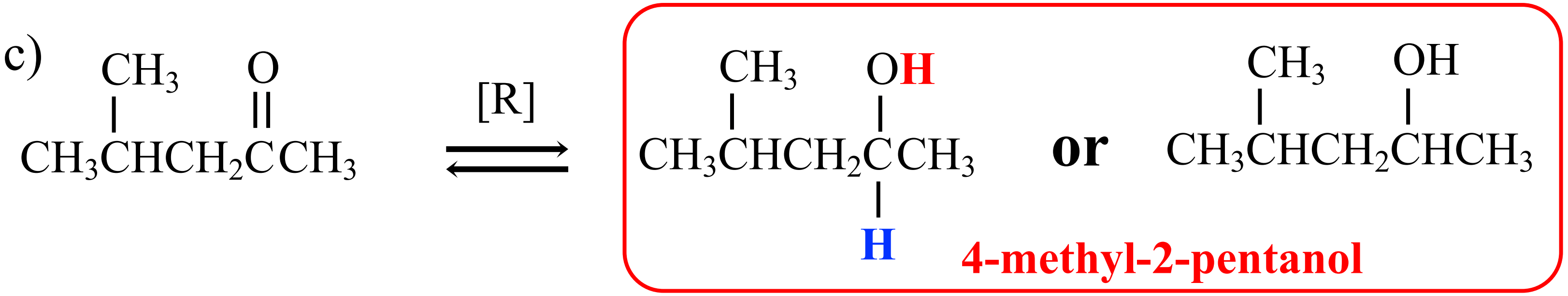
a)



b)

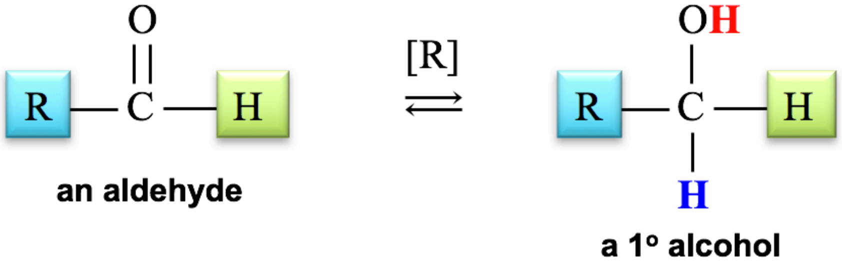


c)

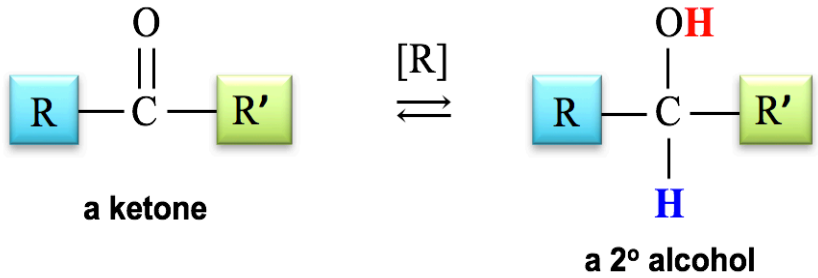


EXPLANATION:

Aldehydes are reduced to ***primary alcohols.***



Ketones are reduced to ***secondary alcohols.***



For more details: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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Go to next question

10.35) Draw the general form for a **hemiacetal** and an **acetal**.

general form of a hemiacetal

general form of an acetal

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

10.35) Draw the general form for a **hemiacetal** and an **acetal**.

general form of a hemiacetal

general form of an acetal

HINT:

A **hemiacetal** is a molecule that contains ***both*** an **OR** group *and* **OH** group that are bonded to the ***same*** carbon.

An **acetal** is a molecule that contains ***two*** **OR** groups, where *both* **OR** groups are bonded to the ***same*** carbon.

For more help: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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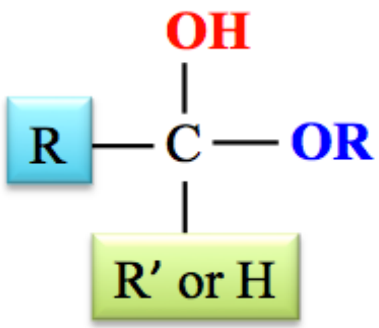
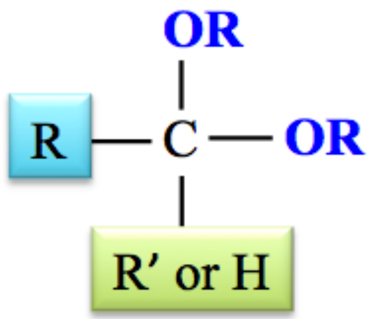
Click here to **check your answer**

Go to next question

10.35) Draw the general form for a **hemiacetal** and an **acetal**.



general form of a hemiacetal



general form of an acetal

EXPLANATION:

A **hemiacetal** is a molecule that contains ***both*** an **OR** group *and* **OH** group that are bonded to the ***same*** carbon.

An **acetal** is a molecule that contains ***two*** **OR** groups, where *both* **OR** groups are bonded to the ***same*** carbon.

For more details: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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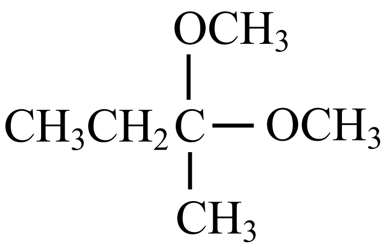
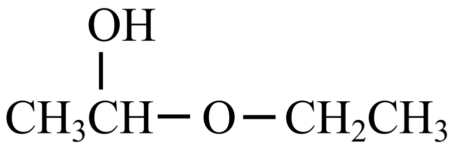
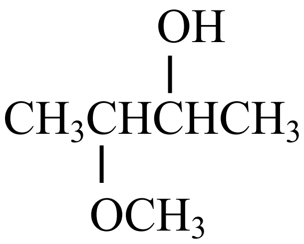
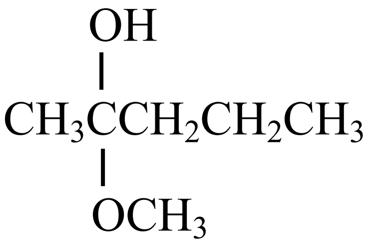
Go to next question

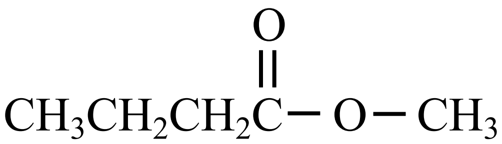
10.36) Identify each of the molecules below as a **hemiacetal**, an **acetal**, or **neither**.

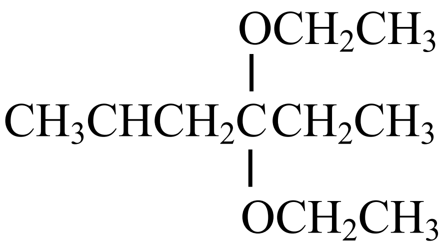
a) 

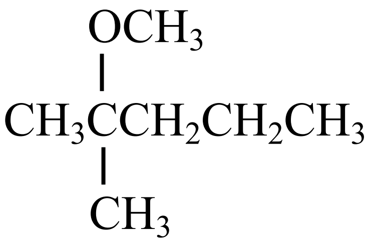
b) 

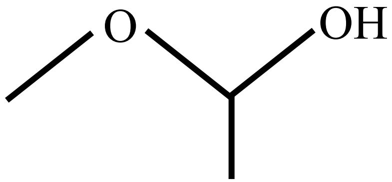
c) 

d) 

e) 

f) 

g) 

h) 

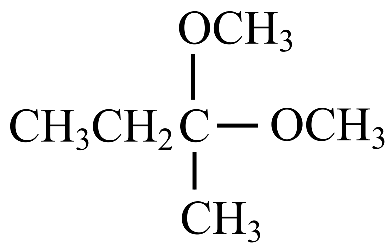
Go back

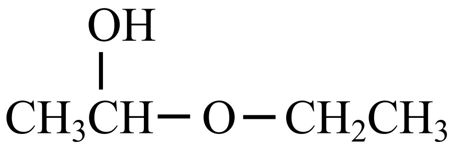
Click here for a **hint**

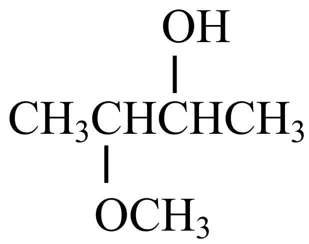
Click here to **check your answer**

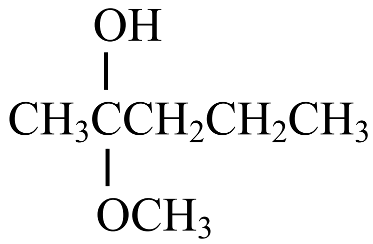
Go to next question

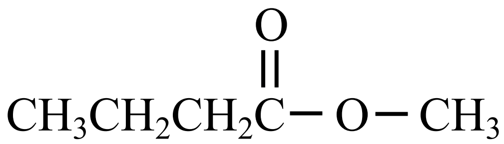
10.36) Identify each of the molecules below as a **hemiacetal**, an **acetal**, or **neither**.

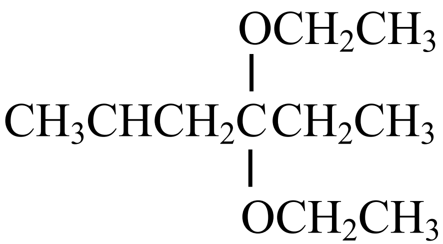
a) 

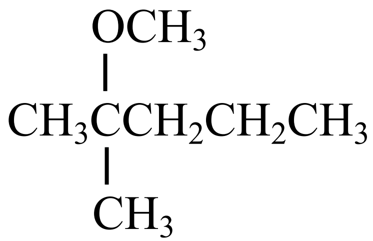
b) 

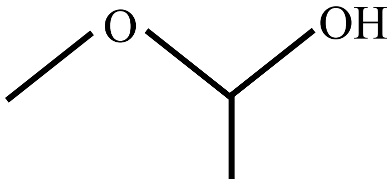
c) 

d) 

e) 

f) 

g) 

h) 

HINT:

A **hemiacetal** is a molecule that contains ***both*** an **OR** group *and* **OH** group that are bonded to the ***same*** carbon.

An **acetal** is a molecule that contains ***two*** **OR** groups, where *both* **OR** groups are bonded to the ***same*** carbon.

Go back

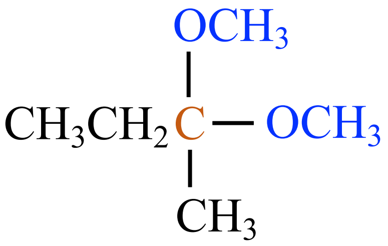
For more help: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

Click here to **check your answer**

Go to next question

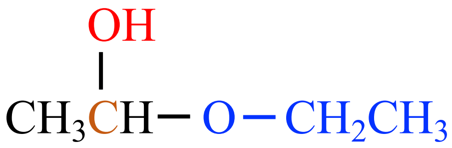
10.36) Identify each of the molecules below as a **hemiacetal**, an **acetal**, or **neither**.

a)



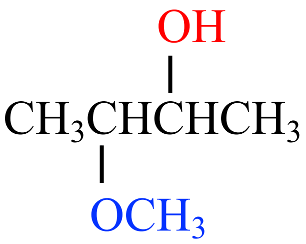
acetal

b)



hemiacetal

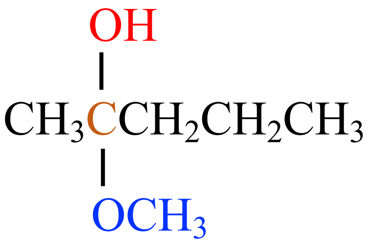
c)



neither

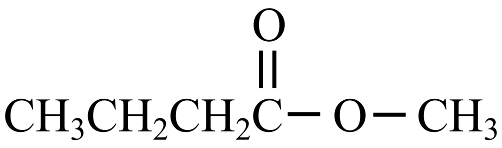
Although this molecule contains ***both*** an **OR** group *and* **OH** group, they are **NOT** bonded to the ***same*** **carbon**

d)



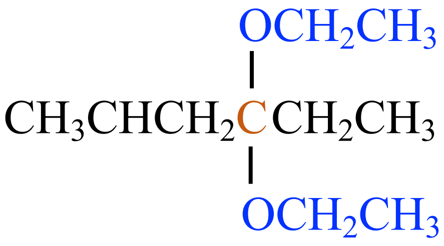
hemiacetal

e)



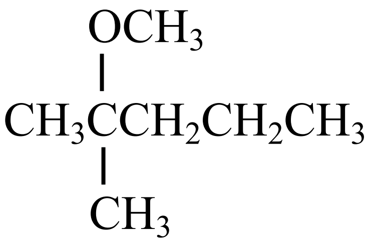
neither

f)



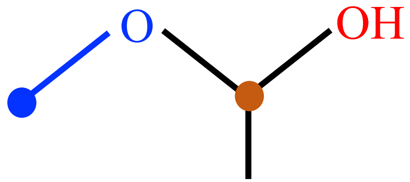
acetal

g)



neither

h)



hemiacetal

EXPLANATION:

A **hemiacetal** is a molecule that contains ***both*** an **OR** group *and* **OH** group that are bonded to the ***same*** **carbon**.

An **acetal** is a molecule that contains ***two*** **OR** groups, where *both* **OR** groups are bonded to the ***same*** **carbon**.

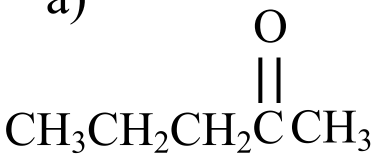
Go back

For more details: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

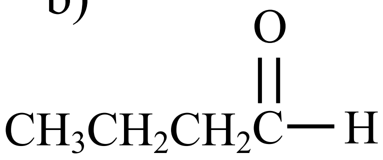
Go to next question

10.37) Draw the ***hemiacetal*** and ***acetal*** that is formed when each of the molecules below reacts with ethanol (CH_3CH_2OH).

a)



b)



Go back

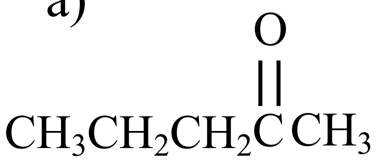
Click here for a **hint**

Click here to **check your answer**

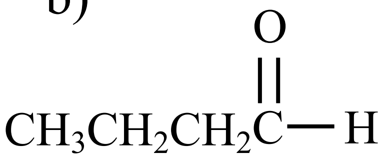
Go to next question

10.37) Draw the ***hemiacetal*** and ***acetal*** that is formed when each of the molecules below reacts with ethanol (CH_3CH_2OH).

a)

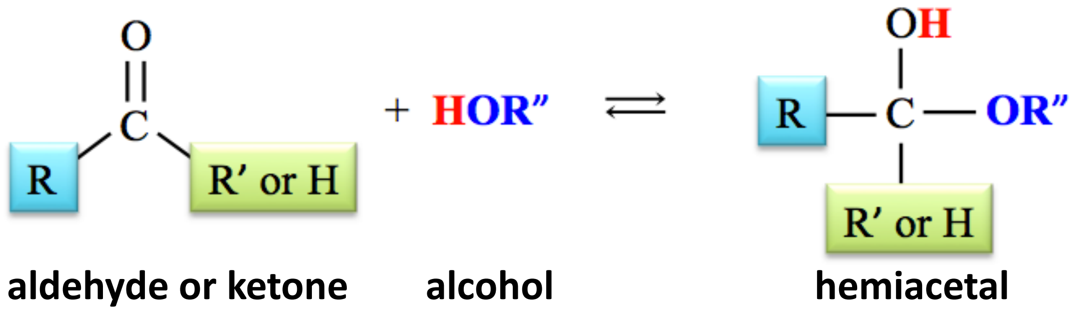


b)



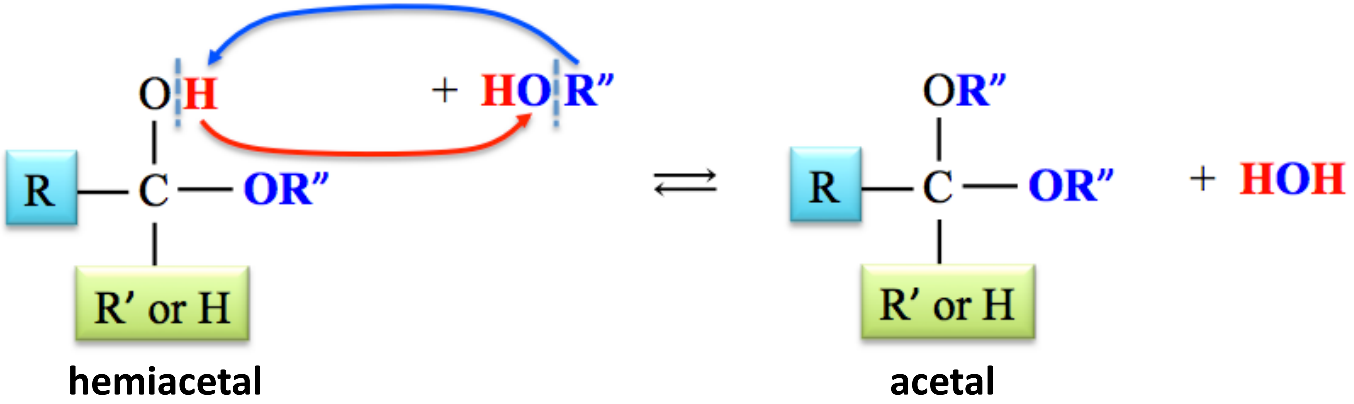
HINT:

An ***aldehyde or a ketone*** will react with an ***alcohol*** to form a **hemiacetal** as shown in the illustration below:



The **OR"** from the ***alcohol*** forms a bond to the *carbonyl-carbon* of the aldehyde or ketone, the **H** from the ***alcohol*** bonds to the *carbonyl-oxygen*, and the carbonyl group's double bond is changed to a single bond. One way to predict the structure of the hemiacetal is to consider the general form described above. An alternative method to predict the structure of the hemiacetal that is formed would be for you to "*add the alcohol across the carbonyl group,*" as described in the video and textbook.

The ***hemiacetal*** that is formed can react with a second ***alcohol molecule*** to form an **acetal** and an $\mathbf{H_2O}$ molecule. The structure of the ***acetal*** that is produced is drawn by ***exchanging*** the **R"** group *of the **alcohol*** and the **H** from the *hemiacetal's* hydroxyl group (**OH**), as shown on the right.



For more help: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

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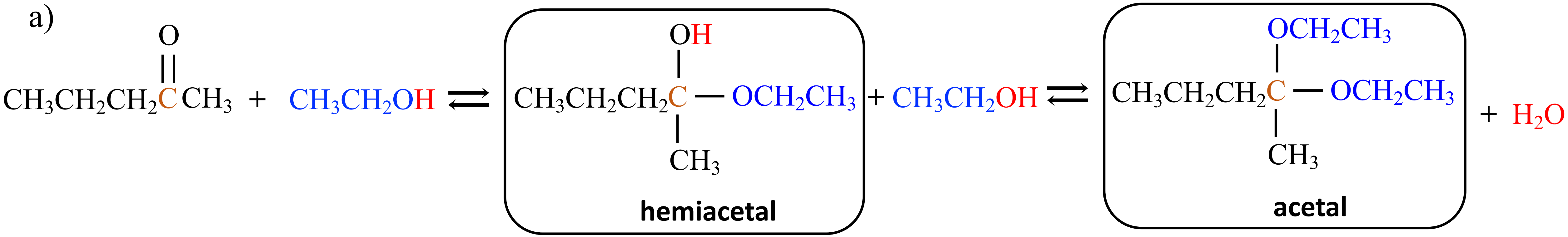
Click here to check your answer

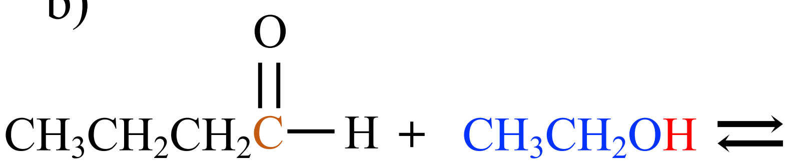
Go to next question

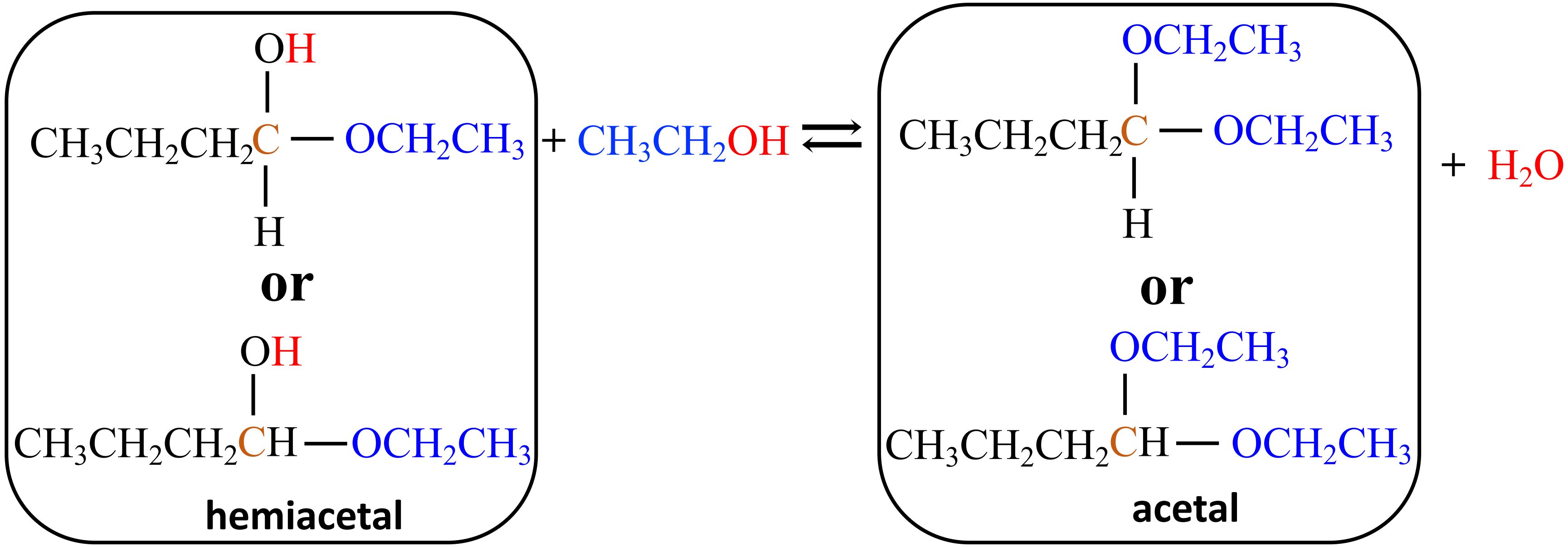
10.37) Draw the ***hemiacetal*** <u>and</u> ***acetal*** that is formed when each of the molecules below reacts with ethanol (CH_3CH_2OH).

a)



b)





An ***aldehyde or a ketone*** will react with an ***alcohol*** to form a **hemiacetal**. The **OR″** from the ***alcohol*** forms a bond to the *carbonyl-carbon* of the aldehyde or ketone, the **H** from the ***alcohol*** bonds to the *carbonyl-oxygen*, and the carbonyl group's double bond is changed to a single bond.

The ***hemiacetal*** that is formed can react with a second ***alcohol molecule*** to form an **acetal** and an **H_2O** molecule. The structure of the ***acetal*** that is produced is drawn by ***exchanging*** the **R″** group *of the **alcohol*** and the **H** from the *hemiacetal's* hydroxyl group.

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For more details: See chapter 10 part 7 video or chapter 10 section 5 in the textbook.

Go to next question

10.38) Synthetic organic chemistry involves using starting compounds and one or more chemical reactions to make a new molecule. Pharmaceutical drugs can be either synthesized or extracted from natural sources. If you started with 4-heptanone and wanted to synthesize 3-heptene, **write the series of chemical reactions you would use**. You can use whatever other chemicals you need, but you must start with 4-heptanone.

$$CH_3CH_2CH_2\overset{\overset{\displaystyle O}{\|}}{C}CH_2CH_2CH_3$$

4-heptanone

$$CH_3CH_2CH{=}CHCH_2CH_2CH_3$$

3-heptene

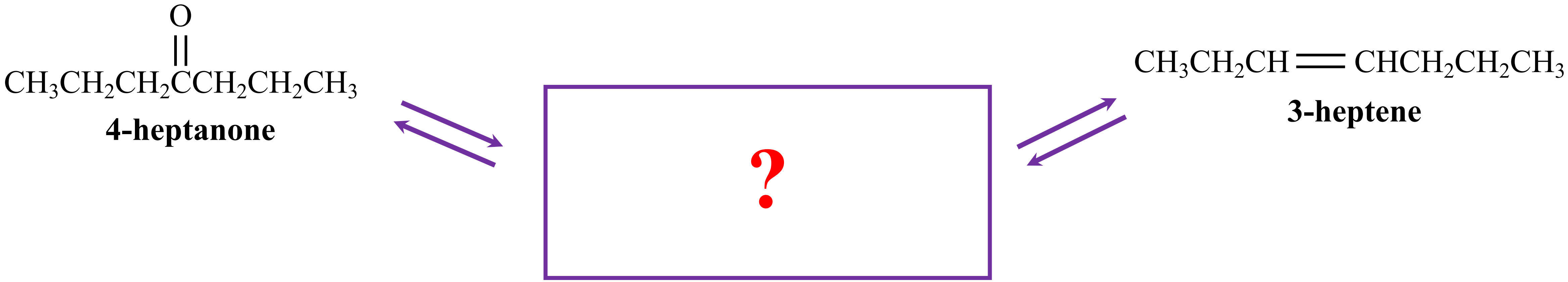
Go back

Click here for a **hint**

Click here to **check your answer**

This is the last question.

10.38) Synthetic organic chemistry involves using starting compounds and one or more chemical reactions to make a new molecule. Pharmaceutical drugs can be either synthesized or extracted from natural sources. If you started with 4-heptanone and wanted to synthesize 3-heptene, **write the series of chemical reactions you would use**. You can use whatever other chemicals you need, but you must start with 4-heptanone.



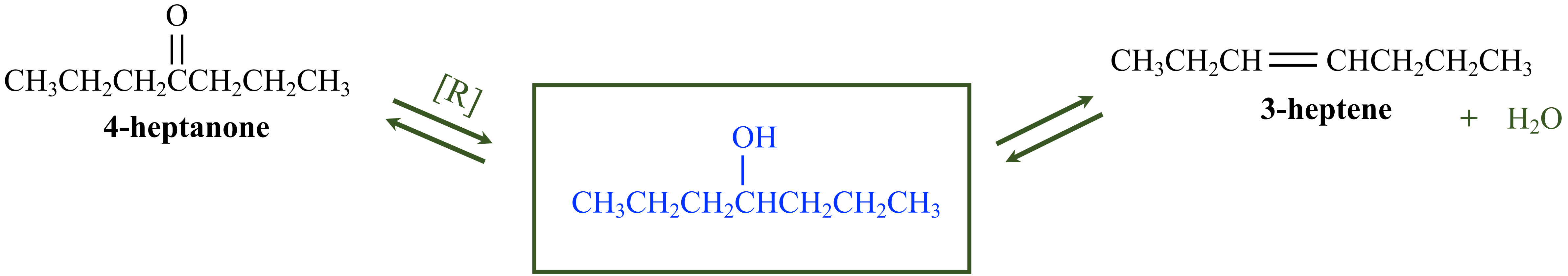
HINT: 3-heptene can be synthesized from 4-heptanone in a series of **two reactions**. You may wish to try working backwards; do you know of a reaction that ***produces*** an alkene?

Go back

Click here to **check your answer**

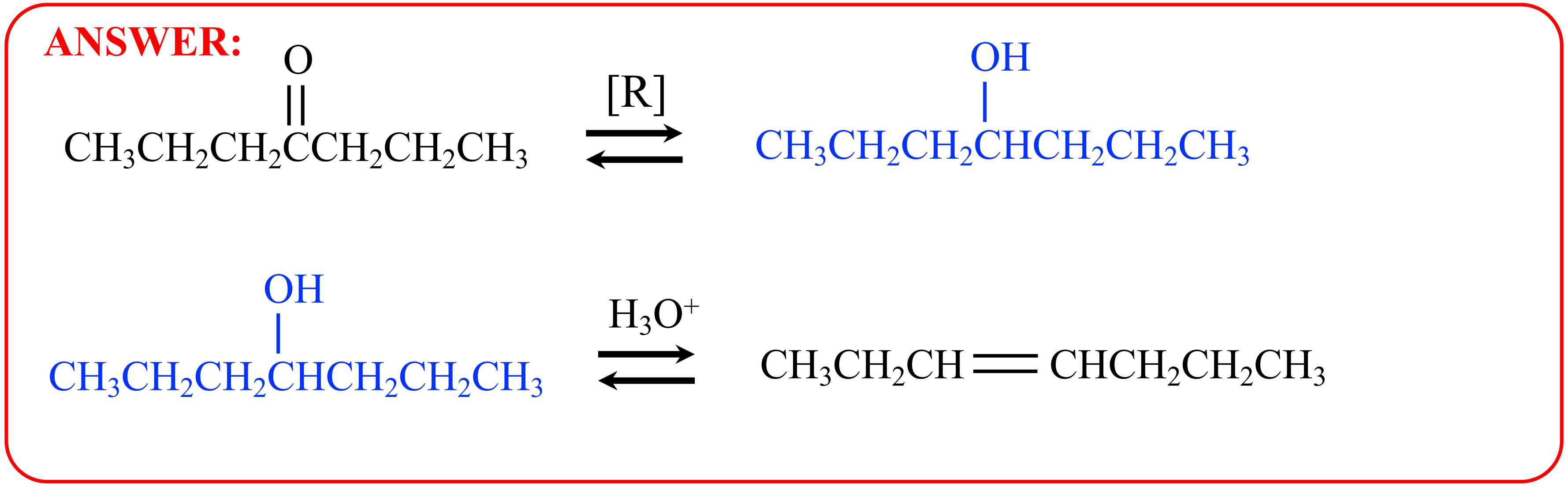
This is the last question.

10.38) Synthetic organic chemistry involves using starting compounds and one or more chemical reactions to make a new molecule. Pharmaceutical drugs can be either synthesized or extracted from natural sources. If you started with 4-heptanone and wanted to synthesize 3-heptene, **write the series of chemical reactions you would use**. You can use whatever other chemicals you need, but you must start with 4-heptanone.



First reaction:
(reduction of a ketone)

Second reaction:
(dehydration of an alcohol)



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This is the last question.