

Chemistry 12

Solutions Manual Part B

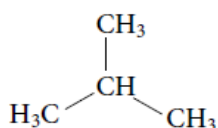
Unit 1 Organic Chemistry

Solutions to Practice Problems in Chapter 1 Structure and Physical Properties of Organic Compounds

Naming Alkanes

(Student textbook page 19)

1. Name the following molecule:



What Is Required?

You must name the given alkane.

What Is Given?

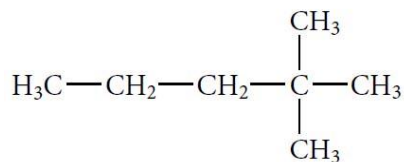
You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is three carbons long, so the root is prop-.
Find the suffix.	The compound is an alkane, so the suffix is -ane.
Find the prefix.	A methyl group is attached to carbon 2. (This is the case if you start numbering from either end.) The prefix is 2-methyl-.
Write the name.	The full name is 2-methylpropane.

Check Your Solution

The name indicates the largest chain is 3 carbons long, which it is. The name indicates there is a methyl group on the second carbon, which is correct. All bonds are single bonds.

2. Name the following molecule:



What Is Required?

You must name the given alkane.

What Is Given?

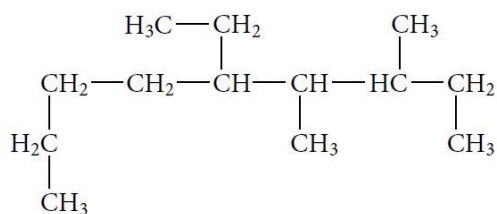
You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is five carbons long, so the root is pent-.
Find the suffix.	The compound is an alkane, so the suffix is -ane.
Find the prefix.	Numbering must start at the end nearest the side groups thus giving the side groups the lowest possible numbers. There are two methyl groups bonded to the number 2 carbon, so the prefix is preceded by 2,2-. The two groups are identical, so the multiplying prefix is di-. The complete prefix is 2,2-dimethyl-.
Write the name.	The full name is 2,2-dimethylpentane.

Check Your Solution

The name indicates the largest chain is 5 carbons long, which it is. The prefix indicates there are 2 methyl groups on the second carbon, which is correct. All bonds are single bonds.

3. Name the following molecule:



What Is Required?

You must name the given alkane.

What Is Given?

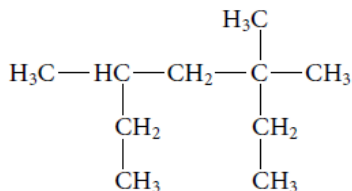
You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is nine carbons long, so the root is non-.
Find the suffix.	The compound is an alkane so the suffix is -ane.
Find the prefix.	The main chain is numbered so that the side groups have the lowest possible numbers. Use multiplying prefixes to identify identical groups. Name the side groups alphabetically, ignoring the multiplying prefixes such as di-. The prefix would be 5-ethyl-3,4-dimethyl-.
Write the name.	The full name is 5-ethyl-3,4-dimethylnonane.

Check Your Solution

The name indicates the largest chain is 9 carbons long, which it is. The prefix indicates there is an ethyl group on carbon 5 and 2 methyl groups on carbons 3 and 4, which is correct. The numbering is based on the alphabetic order of the side chains without the multiplying prefixes. All bonds are single bonds.

4. Name the following molecule:



What Is Required?

You must name the given alkane.

What Is Given?

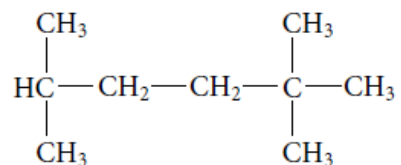
You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is seven carbons long, so the root is hept-.
Find the suffix.	The compound is an alkane, so the suffix is -ane.
Find the prefix.	There are three methyl groups bonded to the main chain. Number the main chain to give the side groups the lowest number. Use numbers separated by commas to indicate the location of the side chains and use multiplying prefixes to indicate the number of identical groups. The prefix would be 3,3,5-trimethyl-.
Write the name.	The full name is 3,3,5-trimethylheptane.

Check Your Solution

The name indicates the longest chain is seven carbons long, which it is. The prefix indicates there are three methyl groups, two on carbon 3, the other on carbon 5, which is correct. All bonds are single bonds.

5. Name the following molecule:



What Is Required?

You must name the given alkane.

What Is Given?

You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is six carbons long, so the root is hex-.
Find the suffix.	The compound is an alkane, so the suffix is -ane.
Find the prefix.	There are three methyl groups bonded to the main chain. Number the main chain to give the sum of the numbers of the side groups the lowest possible number. Use numbers separated by commas to indicate the location of the side chains and use multiplying prefixes to indicate the number of identical groups. The prefix would be 2,2,5-trimethyl- .
Write the name.	The full name is 2,2,5-trimethylhexane.

Check Your Solution

The name indicates the longest chain is six carbons long, which it is. The prefix indicates there are three methyl groups, two on carbon 2, the other on carbon 5, which is correct. All bonds are single bonds.

6. Identify any errors in the structure by drawing them. Rename the structure correctly.
2-ethylpropane

What Is Required?

You are to identify the errors in the name by drawing the structure and renaming it correctly.

What Is Given?

You are given an incorrectly named alkane.

Plan Your Strategy	Act on Your Strategy
Draw the root.	<p>The root in the incorrect name is prop- and is therefore three carbons long. It ends in -ane and therefore the structure has only single bonds.</p> $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$
Use the prefix to identify and draw the side groups.	<p>The prefix is 2-ethyl, so there is a two-carbon group bonded to the number 2 carbon of the propane main chain.</p> $\begin{array}{c} \text{H}_3\text{C}-\text{CH}-\text{CH}_3 \\ \\ \text{H}_2\text{C} \\ \\ \text{CH}_3 \end{array}$
Find the correct root and suffix. Name the main chain.	<p>The longest chain is four carbons long—not three, so the root name is but-, not prop-. The root name is butane.</p> $\begin{array}{c} \text{H}_3\text{C}-\overset{1}{\underset{3}{\text{CH}}}-\overset{2}{\underset{4}{\text{CH}}}-\text{CH}_3 \\ \\ \text{CH}_2 \\ \\ \text{CH}_3 \end{array}$
Identify the prefix. Number and name the side groups.	<p>There is only one side group, which is one carbon long. The methyl group would be given the lowest number, which is two.</p>
Write the name.	<p>The full name is 2-methylbutane.</p>

Check Your Solution

The four carbon atoms are the longest chain, which agrees with the root but-. The one carbon methyl group is numbered to give the lowest number on the main chain, so 2-methyl is correct. All the bonds are single bonds, so the suffix is correct.

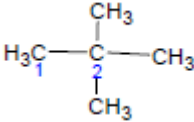
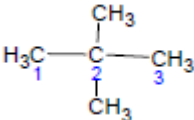
7. Identify any errors in the structure by drawing them. Rename the structure correctly.
2,2,2-trimethylethane

What Is Required?

You are to identify the errors in the name by drawing the structure and renaming it correctly.

What Is Given?

You are given an incorrectly named alkane.

Plan Your Strategy	Act on Your Strategy
Draw the root.	The root in the incorrect name is eth- and is therefore two carbons long. It ends in -ane, and, therefore, the structure has only single bonds. $\text{H}_3\text{C}-\text{CH}_3$
Use the prefix to identify and draw the side groups.	The prefix is 2,2,2-trimethyl, so there are 3 one-carbon groups bonded to the number 2 carbon of the ethane main chain. 
Find the correct root and suffix. Name the main chain.	The longest chain is three carbons long—not two, so the root name is prop-, not eth-. The root name is propane. 
Identify the prefix. Number and name the side groups.	There are two side groups that are one carbon long. The methyl groups would be given the lowest number, which is two—regardless of numbering from the left or right.
Write the name.	The full name is 2,2-dimethylpropane.

Check Your Solution

The three carbon atoms are the longest chain, which agrees with the root prop-. The one carbon methyl groups are numbered to give the lowest number on the main chain, so 2,2-dimethyl is correct. All the bonds are single bonds, so the suffix is correct.

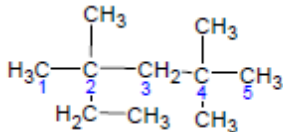
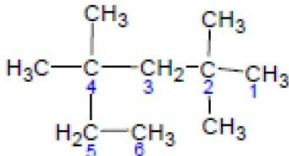
8. Identify any errors in the structure by drawing them. Rename the structure correctly.
2-ethyl-2,4,4-trimethylpentane

What Is Required?

You are to identify the errors in the name by drawing the structure and renaming it correctly.

What Is Given?

You are given an incorrectly named alkane.

Plan Your Strategy	Act on Your Strategy
Draw the root.	The root in the incorrect name is pent- and is therefore five carbons long. It ends in -ane, and, therefore, the structure has only single bonds. $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$
Use the prefix to identify and draw the side groups.	The prefix is 2-ethyl-2,4,4-trimethyl-, so there is a two-carbon group and a one-carbon group off the carbon 2 of the main chain. There are two one-carbon methyl groups bonded to the carbon 4 atom of the main chain. 
Find the correct root and suffix. Name the main chain.	The longest chain is six carbons long—not five, so the root name is hex-, not pent-. The root name is hexane. 
Identify the prefix. Number and name the side groups.	There are four side groups, each one carbon long. The main chain carbon atoms are numbers so that the methyl groups would have the lowest numbers, which are two and four.
Write the name.	The full name is 2,2,4,4-tetramethylhexane.

Check Your Solution

The six carbon atoms are the longest chain, which agrees with the root hex-. The main chain is numbered so the one-carbon methyl groups have the lowest possible numbers. Therefore, 2,2,4,4-tetramethyl is correct. All the bonds are single bonds, so the suffix is correct.

9. Name the compound.



What Is Required?

You must name the compound.

What Is Given?

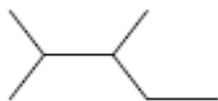
You are given the line structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is five carbons long as there are carbons at each change in direction and at the ends of a line. The root is pent-.
Find the suffix.	The compound is an alkane, so the suffix is -ane.
Find the prefix.	There are no side chains, so there are no prefixes.
Write the name.	The full name is pentane.

Check Your Solution

There are three direction changes in the line structural formula and two ends, so there are five carbons. There are no side branches and therefore no prefixes, so the name pentane is correct.

10. Name the compound.



What Is Required?

You must name a compound.

What Is Given?

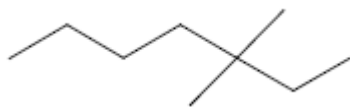
You are given the line structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is five carbons long as there are carbons at each change in direction and at the ends of a line. The root is pent-.
Find the suffix.	The compound is an alkane, so the suffix is -ane.
Find the prefix.	There are two one-carbon methyl groups bonded to the main chain. Numbering begins at the end that will give the side groups lowest possible numbers. The prefix is 2,3-dimethyl-.
Write the name.	The full name is 2,3-dimethylpentane.

Check Your Solution

There are three changes in direction and two ends indicating five carbons, which is correct. There are two side groups, each containing only one carbon atom so they are methyl groups. The name correctly describes the structure.

11. Name the compound.



What Is Required?

You must name the compound.

What Is Given?

You are given the line structural formula.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain is seven carbons long as there are carbons at each change in direction, an intersection of two lines and at the ends of a line. The root is hept-.
Find the suffix.	The compound is an alkane, so the suffix is -ane.
Find the prefix.	There are two one-carbon methyl groups bonded to the main chain. Numbering begins at the end that will give the lowest possible numbers. The prefix is 3,3-dimethyl-.
Write the name.	The full name is 3,3-dimethylheptane.

Check Your Solution

There are four direction changes, one intersection and two ends so there are seven carbons in the main chain. There are two methyl groups bonded to the third carbon. The name 3,3-dimethylheptane is correct.

Drawing an Alkane
(Student textbook page 21)

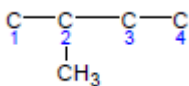
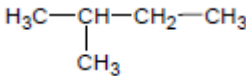
12. Draw the condensed formula for this structure: 2-methylbutane

What Is Required?

You must draw the condensed structural formula for an alkane.

What Is Given?

You are given the name of the alkane.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is but-, which indicates that there are four carbons in the main chain.
Identify the suffix.	The suffix is -ane, so the molecule is an alkane. There are only single bonds between carbon atoms.
Identify the prefix, and draw the side groups.	The prefix is 2-methyl-, which indicates that there is a one-carbon methyl group on carbon atom 2. 
Complete the condensed structural formula. Add enough hydrogen atoms to each carbon atom so that each has a total of four bonds.	

Check Your Solution

The four-carbon main chain agrees with the root but-. The one-carbon group attached to carbon 2 of the main chain agrees with the prefix 2-methyl-. All bonds are single bonds.

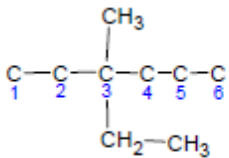
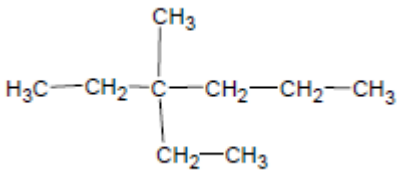
13. Draw the condensed formula for this structure: 3-ethyl-3-methylhexane

What Is Required?

You must draw the condensed structural formula for an alkane.

What Is Given?

You are given the name of the alkane.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex-, which indicates that there are six carbon atoms in the main chain.
Identify the suffix.	The suffix is -ane, so the molecule is an alkane. There are only single bonds between carbon atoms.
Identify the prefix, and draw the side groups.	<p>The prefix is 3-ethyl-3-methyl-, which indicates that there is a two-carbon ethyl group on carbon atom 3 and a one-carbon methyl group on carbon atom 3.</p> 
Complete the condensed structural formula. Add enough hydrogen atoms to each carbon atom so that each has a total of four bonds.	

Check Your Solution

The six-carbon main chain agrees with the root hex-. The two-carbon group and the one-carbon group attached to carbon 3 of the main chain agrees with the prefix 3-ethyl-3methyl-. All bonds are single bonds.

14. Draw the condensed formula for this structure: 2,2-dimethyl-3-propyloctane

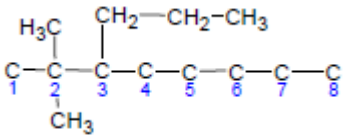
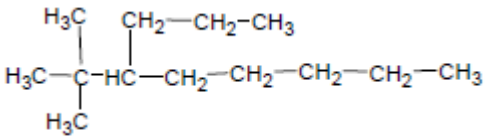
Note: This molecule should be named 4-tert-butylnonane.

What Is Required?

You must draw the condensed structural formula for an alkane.

What Is Given?

You are given the name of the alkane.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is oct-, which indicates that there are eight carbons in the main chain.
Identify the suffix.	The suffix is -ane, so the molecule is an alkane. There are only single bonds between carbon atoms.
Identify the prefix, and draw the side groups.	<p>The prefix is 2,2-dimethyl-3-propyl-, which indicates that there are two methyl groups on carbon atom 2 and a three-carbon propyl group on carbon atom 3.</p> 
Complete the condensed structural formula. Add enough hydrogen atoms to each carbon atom so that each has a total of four bonds.	

Check Your Solution

The eight-carbon main chain agrees with the root oct-, however the longest chain is nine carbons long and should be non-. The two carbon group and the one-carbon group attached to carbon 3 of the main chain agree with the prefix 3-ethyl-3-methyl-. However, if the nine-carbon group is the main chain, the prefix tertiary-butyl would be the appropriate prefix. All bonds are single bonds.

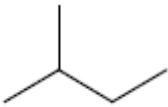
15. For each of the molecules in questions 12-14, draw a line structural formula.

What Is Required?

You are to draw a line structural formula for 2-methylbutane.

What Is Given?

You are given the name of the alkane.

Plan Your Strategy	Act on Your Strategy
Use the condensed structural formulas from question 12 to draw the line structural formulas.	<p>Use the condensed structural formula as a guide.</p> $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{HC}-\text{CH}_2-\text{CH}_3 \end{array}$ <p>Each end of a straight line represents a carbon atom, unless otherwise specified. Hydrogen atoms are not included as it is assumed each carbon atom is bonded to as many hydrogen atoms as to give it four bonds.</p> 

Check Your Solution

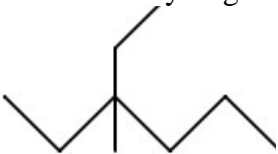
The four-carbon longest chain agrees with the term but-. The one-carbon methyl group attached to the carbon 2 atom agrees with the prefix 2-methyl-. All bonds are single bonds.

What Is Required?

You are to draw a line structural formula for 3-ethyl-3-methylhexane.

What Is Given?

You are given the name of the alkane.

Plan Your Strategy	Act on Your Strategy
<p>Use the condensed structural formulas from question 13 to draw the line structural formulas.</p>	<p>Use the condensed structural formula as a guide.</p> $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{CH}_2-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{H}_2\text{C} \\ \\ \text{CH}_3 \end{array}$ <p>Each bend, intersection, and end of a straight line represents a carbon atom, unless otherwise specified. Hydrogen atoms are not included as it is assumed each carbon atom is bonded to the number hydrogen atoms necessary to give it four bonds.</p> 

Check Your Solution

The six-carbon longest chain agrees with the term hex-. The two-carbon ethyl group and the one-carbon methyl- group attached to the carbon 3 atom agrees with the prefix 3-ethyl-3-methyl-. All bonds are single bonds.

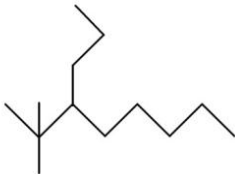
What Is Required?

You are to draw a line structural formula for 2,2-dimethyl-3-propyloctane.

Note: This molecule should be named **4-tert-butylnonane** or **4-(1,1-dimethylethyl)nonane**.

What Is Given?

You are given the name of the alkane.

Plan Your Strategy	Act on Your Strategy
Use the condensed structural formulas from question 14 to draw the line structural formulas.	<p>Use the condensed structural formula as a guide.</p> $\begin{array}{ccccccc} & \text{CH}_3 & & & & & \\ & & & & & & \\ \text{CH}_3 - & \text{C} - & \text{CH} - & \text{CH}_2 - & \text{CH}_2 - & \text{CH}_2 - & \text{CH}_2 - \text{CH}_3 \\ & & & & & & \\ & \text{CH}_3 & \text{CH}_2 & & & & \\ & & & & & & \\ & & \text{CH}_2 & & & & \\ & & & & & & \\ & & \text{CH}_3 & & & & \end{array}$ <p>Each bend, intersection, and end of a straight line represents a carbon atom, unless otherwise specified. Hydrogen atoms are not included as it is assumed each carbon atom is bonded to the number hydrogen atoms necessary to give it four bonds.</p> 

Check Your Solution

The eight-carbon main chain agrees with the root hex-, however, the longest chain is nine carbons long and should be non-. The two-carbon group and the one-carbon group attached to carbon 3 of the main chain agrees with the prefix 3-ethyl-3-methyl-. However, if the nine-carbon group is the main chain, the prefix tertiary-butyl- would be the appropriate prefix. All bonds are single bonds.

16. The name of this structure is incorrect. Draw the structure that the name describes. Rename the structure correctly.
4-methylbutane

What Is Required?

You are to identify the errors in the name by drawing the structure and then renaming it correctly.

What Is Given?

You are given an incorrectly named alkane.

Plan Your Strategy	Act on Your Strategy
Draw the root.	The root in the incorrect name is but- and is therefore four carbons long. It ends in -ane, and, therefore, the structure has only single bonds. $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
Use the prefix to identify and draw the side groups.	The prefix is 4-methyl-, so there is a one-carbon group bonded to carbon 4 of the main. $\begin{array}{ccccccc} \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_2 \\ & & 1 & & 2 & & 3 \\ & & & & & & \\ & & & & & & \text{CH}_3 \end{array}$
Find the correct root and suffix. Name the main chain.	The longest chain is five carbons long—not four, so the root name is pent-, not but-. The root name is pentane. $\begin{array}{ccccccc} \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_2 \\ & & 5 & & 4 & & 3 \\ & & & & & & \\ & & & & & & \text{CH}_3 \\ & & & & & & 1 \end{array}$
Identify the prefix. Number and name the side groups.	There are no side groups, so there are no prefixes.
Write the name.	The full name is pentane.

Check Your Solution

The five carbon atoms are the longest chain, which agrees with the root pent-. There are no side chains off the longest chain, so there is no prefix. All the bonds are single bonds so the suffix is correct.

17. The name of this structure is incorrect. Draw the structure that the name describes. Rename the structure correctly.
3-propylheptane

What Is Required?

You are to identify the errors in the name by drawing the structure and then renaming it correctly.

What Is Given?

You are given an incorrectly named alkane.

Plan Your Strategy	Act on Your Strategy
Draw the root.	<p>The root in the incorrect name is hept- and is therefore seven carbons long. It ends in -ane, and, therefore, the structure has only single bonds.</p> $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$
Use the prefix to identify and draw the side groups.	<p>The prefix is 3-propyl-, so there is a three-carbon group bonded to carbon 3 of the main chain.</p> $\begin{array}{ccccccccccc} \text{H}_3\text{C} & -\text{CH}_2 & -\text{HC} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \\ 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ & & & & & & \\ & & \text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 & & \end{array}$
Find the correct root and suffix. Name the main chain.	<p>The longest chain is eight carbons long—not seven, so the root name is oct-, not hept-. The root name is octane.</p> $\begin{array}{ccccccccccc} \text{H}_3\text{C} & -\text{CH}_2 & -\text{HC} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \\ & & 4 & 5 & 6 & 7 & 8 \\ & & & & & & \\ & & \text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \\ & & 3 & 2 & 1 & & \end{array}$
Identify the prefix. Number and name the side groups.	<p>There is one side group that is two carbons long. The main chain carbon atoms must start at the end nearest this two-carbon, or ethyl, side group. This numbering places the ethyl on carbon atom number 4.</p>
Write the name.	<p>The full name is 4-ethyloctane.</p>

Check Your Solution

The eight carbon atoms are the longest chain, which agrees with the root oct-. The main chain is numbered starting at the end nearest the ethyl group, so 4-ethyl- is the correct prefix. All the bonds are single bonds, so the suffix is correct.

18. The name of this structure is incorrect. Draw the structure that the name describes. Rename the structure correctly.
2,3,3 triethylpentane

What Is Required?

You are to identify the errors in the name by drawing the structure then and renaming it correctly.

What Is Given?

You are given an incorrectly named alkane.

Plan Your Strategy	Act on Your Strategy
Draw the root.	<p>The root in the incorrect name is pent- and is therefore five carbons long. It ends in -ane, and, therefore, the structure has only single bonds.</p> $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$
Use the prefix to identify and draw the side groups.	<p>The prefix is 2,3,3-triethyl-, so there is one two-carbon ethyl group bonded to carbon 2 and there are two ethyl groups bonded to the third carbon of the main chain.</p> $ \begin{array}{ccccccc} & \text{H}_3\text{C}-\text{CH}_2 & & \text{CH}_2-\text{CH}_3 & & & \\ & & & & & & \\ \text{H}_3\text{C}- & \text{CH} & - & \text{C} & - & \text{CH}_2-\text{CH}_3 \\ 1 & 2 & & 3 & & 4 & 5 \\ & & & & & & \\ & & & \text{CH}_2-\text{CH}_3 & & & \end{array} $
Find the correct root and suffix. Name the main chain.	<p>The longest chain is six carbons long—not five, so the root name is hex- not pent-. The root name is hexane.</p> $ \begin{array}{ccccccc} & \text{H}_3\text{C}-\text{CH}_2 & & \text{CH}_2-\text{CH}_3 & & & \\ & & & & & & \\ \text{H}_3\text{C}- & \text{CH} & - & \text{C} & - & \text{CH}_2-\text{CH}_3 \\ & 4 & & 3 & & 4 & 5 \\ & & & & & & \\ & & & \text{CH}_2-\text{CH}_3 & & & \\ & & & 2 & & 1 & \end{array} $
Identify the prefix. Number and name the side groups.	<p>There are two side groups that are two carbons long and one side group that is one carbon long. The main chain must be numbered so that the sum of the numbers in the prefix is as low as possible. This places the ethyl groups on carbon atom three and the methyl group on carbon atom four.</p>
Write the name.	<p>The full name is 3,3-diethyl-4-methylhexane.</p>

Check Your Solution

The longest chain has six carbon atoms, which agrees with the root hex-. The main chain is numbered to give the lowest sum of the numbers in the prefix, so 3,3-ethyl is correct. The one-carbon methyl group is 4- methyl-. All the bonds are single bonds, so the suffix is correct.

19. Draw the complete structural formula for the following molecule:
2-methylbutane

What Is Required?

You must draw the complete structural formula for a molecule.

What Is Given?

You are given the name of the molecule.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is but-, which indicates that there are four carbons in the main chain.
Identify the suffix.	The suffix is -ane, so the molecule is an alkane. There are only single bonds between carbon atoms. $\begin{array}{cccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 \end{array}$
Identify the prefix, and draw the side groups.	The prefix is 2-methyl-, which indicates that there is a one-carbon methyl group on carbon atom 2. $\begin{array}{cccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 \\ & & & & & & \\ & & \text{H}-\text{C}-\text{H} & & & & \\ & & & & & & \\ & & \text{H} & & & & \end{array}$
Complete the condensed structural formula. Add enough hydrogen atoms to each carbon atom so that each has a total of four bonds.	$\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{H} \\ & & & & & & & \\ \text{H}-\text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{H} \\ & & & & & & & \\ & \text{H} & & & & \text{H} & & \text{H} \\ & & & \text{H}-\text{C}-\text{H} & & & & \\ & & & & & & & \\ & & & \text{H} & & & & \end{array}$

Check Your Solution

All atoms are shown, which makes the structure complete. The four-carbon main chain agrees with the root but-. The one-carbon group attached to carbon 2 of the main chain agrees with the prefix 2-methyl-. All bonds are single bonds.

20. Draw the complete structural formula for the following molecule:
3,3,4-triethylnonane

What Is Required?

You must draw the complete structural formula for a molecule.

What Is Given?

You are given the name of the molecule.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is non-, which indicates that there are nine carbons in the main chain. $\begin{array}{ccccccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 & & 9 \end{array}$
Identify the prefix, and draw the side groups.	The prefix is 3,3,4-triethyl-, which indicates that there are three two-carbon ethyl groups on carbons 3, 3, and 4. $\begin{array}{ccccccccccc} & & & & \text{H} & & \text{H} & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & & & \\ & & & & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & & & 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 & & 9 \\ & & & & & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & \\ & & & & \text{H} & & \text{H} & & & & & & & & & & & \end{array}$
Complete the condensed structural formula. Add enough hydrogen atoms to each carbon atom so that each has a total of four bonds.	$\begin{array}{ccccccccccc} & & & & \text{H} & & \text{H} & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & \\ & & & & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & & & 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 & & 9 \\ & & & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & \\ & & & & \text{H}-\text{C}-\text{H} & & \text{H}-\text{C}-\text{H} & & & & & & & & & & & & \\ & & & & & & & & & & & & & & & & & \\ & & & & \text{H} & & \text{H} & & & & & & & & & & & \end{array}$

Check Your Solution

All atoms are shown, which makes the structure complete. The nine-carbon main chain agrees with the root non-. The two-carbon groups attached to carbon 3, 3, and 4 of the main chain agrees with the prefix 3,3,4-triethyl-. All bonds are single bonds.


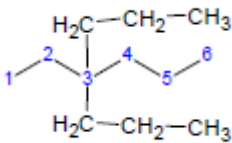
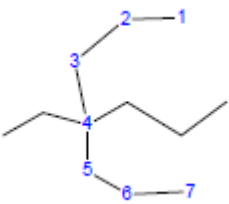
22. Draw the line structure for the incorrectly named molecule 3,3 dipropyl hexane. Name it correctly.

What Is Required?

You are to identify the errors in the name by drawing the line structural formula and renaming it correctly.

What Is Given?

You are given an incorrectly named alkane.

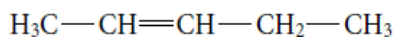
Plan Your Strategy	Act on Your Strategy
Draw the root.	<p>The root in the incorrect name is hex-, which indicates six carbons. It ends in -ane, and, therefore, the structure has only single bonds.</p> 
Use the prefix to identify and draw the side groups.	<p>The prefix is 3,3-dipropyl-, so there are two three-carbon propyl groups bonded to carbon three of the main chain.</p> 
Find the correct root and suffix. Name the main chain.	<p>The longest chain is seven carbons long—not six, so the root name is hept-, not hex-. The root name is heptane.</p> 
Identify the prefix. Number and name the side groups.	<p>There are two side groups. The ethyl and propyl groups would be numbered to give them the lowest number, which is four regardless of which end is numbered one. The prefix is ordered alphabetically disregarding multiplying prefixes.</p>
Write the name.	<p>The full name is 4-ethyl-4-propylheptane.</p>

Check Your Solution

The seven-carbon main chain agrees with the root hept-. The three-carbon group and the two-carbon groups attached to carbon 4 atom agree with the prefix 4-ethyl-4-propyl-. All bonds are single bonds.

Naming Alkenes
(Student textbook page 26)

23. Name the following alkene.



What Is Required?

You must name the alkene.

What Is Given?

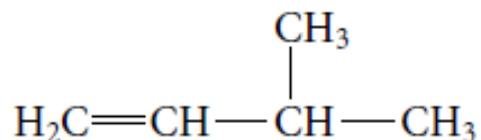
You are given the structural formula of the alkene.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest carbon chain has 5 carbons. The root is pent-.
Determine the suffix.	Assign numbers to the carbon chain from left to right so that the first carbon involved in the double bond has the lowest possible number. $\begin{array}{ccccccccc} \text{H}_3\text{C} & - & \text{CH} & = & \text{CH} & - & \text{CH}_2 & - & \text{CH}_3 \\ & & 1 & & 2 & & 3 & & 4 & & 5 \end{array}$ Because the molecule has one double bond between carbon 2 and 3, the suffix is -2-ene.
Write the name.	pent-2-ene

Check Your Solution

The length of the main chain and the position of the double bond agree with the given structure.

24. Name the following alkene.



What Is Required?

You must name the alkene.

What Is Given?

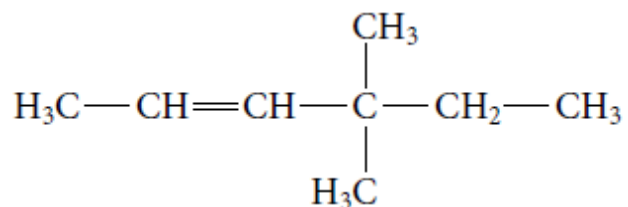
You are given the structural formula of the alkene.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain that contains the double bond has 4 atoms. The root is but-.
Determine the suffix.	Assign numbers to the carbon chain from left to right so that the first carbon involved in the double bond has the lowest possible number. $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_2\text{C}=\text{CH}-\text{CH}-\text{CH}_3 \\ \text{1} \quad \text{2} \quad \text{3} \quad \text{4} \end{array}$ Because the molecule has one double bond between carbon 1 and 2, the suffix is -1-ene.
Determine the prefix.	A methyl group is bonded to carbon atom 3. The prefix is 3-methyl.
Write the name.	3-methylbut-1-ene

Check Your Solution

The length of the main chain and the position and name of the side group agrees with the given structure.

25. Name the following alkene.



What Is Required?

You must name the alkene.

What Is Given?

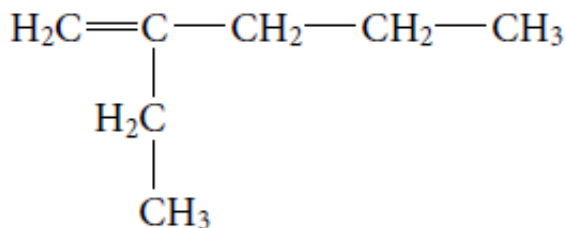
You are given the structural formula of the alkene.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain containing the double bond has 6 atoms. The root is hex-.
Determine the suffix.	Assign numbers to the carbon chain from left to right so that the first carbon involved in the double bond has the lowest possible number. <div style="text-align: center;">$\begin{array}{ccccccc} & & & \text{CH}_3 & & & \\ & & & & & & \\ \text{H}_3\text{C} & - & \text{CH} = & \text{CH} & - & \text{C} & - \text{CH}_2 - \text{CH}_3 \\ & 1 & 2 & 3 & & 4 & 5 & 6 \\ & & & & & & & \\ & & & & & \text{H}_3\text{C} & & \end{array}$</div> Because the molecule has one double bond between carbon 2 and 3, the suffix is -2-ene.
Determine the prefix.	Two methyl groups are bonded to carbon atom 4. The prefix is 4-dimethyl.
Write the name.	4-dimethylhex-2-ene

Check Your Solution

The length of the main chain and the position and name of the side groups agree with the given structure.

26. Name the following alkene.



What Is Required?

You must name the alkene.

What Is Given?

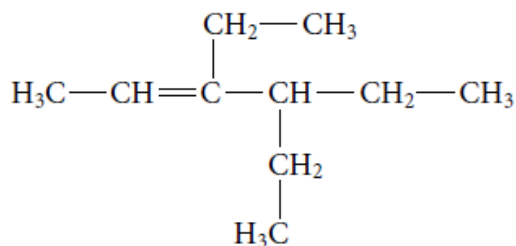
You are given the structural formula of the alkene.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain that includes the double bond has 5 carbons. The root is pent-.
Determine the suffix.	Assign numbers to the carbon starting at the end nearest the double bond. $\begin{array}{c} \text{H}_2\text{C}=\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \text{1} \quad \text{2} \quad \text{3} \quad \text{4} \quad \text{5} \\ \\ \text{H}_2\text{C} \\ \\ \text{CH}_3 \end{array}$ Because the molecule has one double bond between carbon 1 and 2, the suffix is -1-ene.
Determine the prefix.	An ethyl group is bonded to carbon atom 2. The prefix is 2-ethyl.
Write the name.	2-ethylpent-1-ene

Check Your Solution

The length of the main chain and the position and name of the side group agree with the given structure.

27. Name the alkene



What Is Required?

You must name the alkene.

What Is Given?

You are given the structural formula of the alkene.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain that includes the double bond has 6 carbons. The root is hex-.
Determine the suffix.	<p>Assign numbers to the carbon chain starting at the end nearest the double bond.</p> $ \begin{array}{c} \text{CH}_2-\text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{CH}=\text{C}-\text{CH}-\text{CH}_2-\text{CH}_3 \\ \begin{array}{ccccccc} 1 & 2 & 3 & 4 & 5 & 6 \\ & & & & & \\ & & & \text{CH}_2 & & \\ & & & & & \\ & & & \text{H}_3\text{C} & & \end{array} \end{array} $ <p>Because the molecule has one double bond between carbon 2 and 3, the suffix is -2-ene.</p>
Determine the prefix.	An ethyl group is bonded to carbon 3 and another is bonded to carbon 4. The prefix is 3,4-diethyl.
Write the name.	3,4-diethylhex-2-ene

Check Your Solution

The length of the main chain and the position and name of the side group agree with the given structure.

28. Identify any errors in the structure below by drawing it. Rename the structure correctly.
but-3-ene

What Is Required?

You must identify any errors in the structure and rename it.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is but- so the main chain has 4 carbons.
Identify the suffix.	The suffix is -3-ene so there is a double bond after the third carbon atom. $\begin{array}{cccc} \text{C} & - & \text{C} & - & \text{C} & = & \text{C} \\ 1 & & 2 & & 3 & & 4 \end{array}$
Identify the prefix and draw the side groups.	There is no prefix so there are no side groups. The complete structure is: $\begin{array}{ccccccc} \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & = & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 \end{array}$
Identify any errors in the name.	The numbering of the carbon atoms does not start at the end nearest the double bond.
Correct the naming.	The correct numbering is: $\begin{array}{ccccccc} \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & = & \text{CH}_3 \\ 4 & & 3 & & 2 & & 1 \end{array}$ Therefore, the correct name is but-1-ene.

Check Your Solution

The length of the carbon chain agrees with the given structure, and the suffix is correct giving the lowest number to the first carbon involved in the double bond.

29. Identify any errors in the structure below by drawing it. Rename the structure correctly.
2,3-dimethylhept-4-ene

What Is Required?

You must identify any errors in the structure and rename it.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hept-. Therefore, the longest carbon chain has 7 carbon atoms.
Identify the suffix.	The suffix is -4-ene. Therefore, there is a double bond after carbon atom 4. $\begin{array}{ccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} = \text{C} - \text{C} - \text{C} \\ 1 & & 2 & & 3 & & 4 & 5 & 6 & 7 \end{array}$
Identify the prefix, draw the side groups and complete the structure.	The prefix is 2,3-dimethyl so there are methyl groups on carbon atoms 2 and 3. $\begin{array}{ccccccc} & \text{CH}_3 & & \text{CH}_3 & & & \\ & & & & & & \\ \text{CH}_3 - & \text{CH} & - & \text{CH} & - & \text{CH} = \text{CH} - & \text{CH}_2 - \text{CH}_3 \\ 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array}$
Identify any errors in the name.	The numbering of the carbon atoms does not start at the end nearest the double bond.
Make corrections and write the correct the name.	Renumber the carbon atoms starting at the right end of the chain. $\begin{array}{ccccccc} & \text{CH}_3 & & \text{CH}_3 & & & \\ & & & & & & \\ \text{H}_3\text{C} - & \text{CH} & - & \text{CH} & - & \text{CH} = \text{CH} - & \text{CH}_2 - \text{CH}_3 \\ 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{array}$ The correct name is 5,6-dimethylhept-3-ene.

Check Your Solution

The length of the carbon chain agrees with the given structure, and the suffix is correct.

30. Identify any errors in the structure below by drawing it. Rename the structure correctly.
3-ethyl-4-methylhex-4-ene

What Is Required?

You must identify any errors in the structure and rename it.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex- so the main chain has six carbon atoms.
Identify the suffix.	The suffix is -4-ene so there is a double bond after carbon atom 4. $\begin{array}{cccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & = & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix, draw the side groups and complete the structure.	The prefix is 3-ethyl-4-methyl so there is a two-carbon group on carbon atom 3 and a one-carbon group on carbon atom 4. $\begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & \text{CH}_3 & & \\ & & \text{CH}_2 & & & & \\ \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & - & \text{C} & = & \text{CH} & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify any errors in the name.	The numbering of the carbon atoms does not start at the end nearest the double bond.
Make corrections and write the correct the name.	Number the carbon atoms at the end nearest the double bond. $\begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & \text{CH}_3 & & \\ & & \text{CH}_2 & & & & \\ \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{CH} & - & \text{C} & = & \text{CH} & - & \text{CH}_3 \\ 6 & & 5 & & 4 & & 3 & & 2 & & 1 \end{array}$ The methyl group is not on carbon atom 3 and the ethyl group is on carbon atom 4. The correct name is 4-ethyl-3-methylhex-2-ene.

Check Your Solution

The length of the carbon chain and the position of the side groups agree with the given structure, and the suffix is correct.

31. Identify any errors in the structure below by drawing it. Rename the structure correctly.
5-methyl-2-propyl-hex-3-ene

What Is Required?

You must identify any errors in the structure and rename it.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex- so there are six carbon atoms in the main chain.
Identify the suffix.	The suffix is -3-ene so there is a double bond after carbon atom 3. $\begin{array}{cccccc} \text{C} & - & \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix, draw the side groups and complete the structure.	The prefix is 5-methyl-2-propyl- so there is a one-carbon group on carbon atom 5 and a three-carbon group of carbon atom 2. $\begin{array}{ccccccc} & & & & \text{CH}_3 & & \\ & & & & & & \\ & & & & \text{CH}_2 & & \\ & & & & & & \\ & & & & \text{CH}_2 & & \\ & & & & & & \\ \text{CH}_3 & - & \text{CH} & - & \text{CH} & = & \text{CH} & - & \text{C} & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify any errors in the name.	The main chain was incorrectly chosen. There is an eight carbon chain that is the correct main chain. With the correct main chain, the numbering must begin at the right end which is now nearest the double bond.
Make corrections and write the correct the name.	Renumber and then rename the correct main chain. $\begin{array}{ccccccc} & & & & 8 \text{CH}_3 & & \\ & & & & & & \\ & & & & 7 \text{CH}_2 & & \\ & & & & & & \\ & & & & 6 \text{CH}_2 & & \\ & & & & & & \\ \text{H}_3\text{C} & - & \text{CH} & - & \text{CH} & = & \text{CH} & - & \text{CH} & - & \text{CH}_3 \\ & & 5 & & 4 & & 3 & & 2 & & 1 \end{array}$ <p>The correct root now is oct-. There are one-carbon side groups on carbon atoms 2 and 5. The correct name is thus 2,5-dimethyloct-3-ene.</p>

Check Your Solution

The length of the carbon chain and the position of the side groups agree with the given structure, and the suffix is correct, giving the lowest number to the first carbon involved in the double bond.


32. Name the following compound.

**What Is Required?**

You must name a compound.

What Is Given?

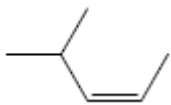
You are given the structural formula for the compound.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest carbon chain has 3 carbons. The root is prop-.
Determine the suffix.	<p>Assign numbers to the carbon chain starting at the end nearest the double bond.</p>  <p>Because the molecule has one double bond between carbon 1 and 2, the suffix is -1-ene. When the double bond is between carbon 1 and 2 and there are no side groups, the 1 does not need to be written and the suffix is just -ene.</p>
Write the name.	propene

Check Your Solution

The length of the main chain and the position of the double bond agree with the given structure.

33. Name the following compound.

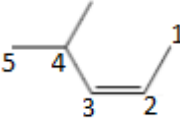


What Is Required?

You must name a compound.

What Is Given?

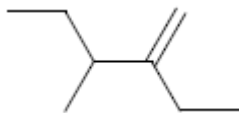
You are given the structural formula for the compound.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain contains 5 atoms. The root is pent-.
Determine the suffix.	Assign numbers to the carbon chain starting at the end nearest the double bond.  Because the molecule has one double bond between carbon 2 and 3, the suffix is -2-ene.
Determine the prefix.	A methyl group is bonded to carbon atom 4. The prefix is 4-methyl.
Write the name.	4-methylpent-2-ene

Check Your Solution

The length of the main chain and the position and name of the side group agree with the given structure.

34. Name the following compound:



What Is Required?

You must name a compound.

What Is Given?

You are given the structural formula for the compound.

Plan Your Strategy	Act on Your Strategy
Find the root.	The longest chain containing the double bond has 6 atoms. The root is hex-.
Determine the suffix.	Assign numbers to the carbon chain beginning at the end nearest the double bond. Because the molecule has one double bond between carbon 1 and 2, the suffix is -1-ene.
Determine the prefix.	An ethyl group is bonded to carbon atom 2, and a methyl group is bonded to carbon atom 3. The groups in the prefix must be in alphabetical order, and “e” comes before “m.” Therefore the prefix is 2-ethyl-3-methyl.
Write the name.	2-ethyl-3-methylpent-1-ene

Check Your Solution

The length of the main chain and the position and name of the side groups agree with the given structure.

Drawing Alkenes
(Student textbook page 27)

35. Draw the condensed structural formula for the following alkene.
 pent-2-ene

What Is Required?

You must draw a condensed structural formula.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is pent-, so there are 5 carbon atoms in the main chain.
Identify the suffix.	The suffix is -2-ene, so there is a double bond between carbon atom 2 and 3 in the main chain.
Draw and number the carbon chain.	$\begin{array}{ccccccc} \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 \end{array}$
Identify the prefix.	There is no prefix so the structure has no side groups.
Complete the structural formula. Add enough hydrogen atoms so that each carbon atom has a total of four bonds.	$\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$

Check Your Solution

The number of carbon atoms in the main chain and the position of the double bond in the condensed structural formula agree with the name.

36. Draw the condensed structural formula for the following alkene.
3-propylhept-2-ene

What Is Required?

You must draw a condensed structural formula.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hept-, so there are 7 carbon atoms in the main chain.
Identify the suffix.	The suffix is -2-ene, so there is a double bond between carbon atom 2 and 3 in the main chain.
Draw and number the carbon chain.	$\begin{array}{ccccccc} \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 \end{array}$
Identify the prefix and draw the side groups.	<p>The prefix is 3-propyl, so there is a propyl group on carbon atom 3.</p> $\begin{array}{ccccccc} & & & & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & & & \\ \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 \end{array}$
Complete the structural formula. Add enough hydrogen atoms so that each carbon atom has a total of four bonds.	$\begin{array}{ccccccc} & & & & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & & & \\ \text{H}_3\text{C} & - & \text{CH} & = & \text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \end{array}$

Check Your Solution

The number of carbon atoms in the main chain, the position of the double bond, and the type and position of the side group in the condensed structural formula agree with the name.

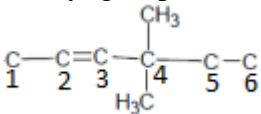
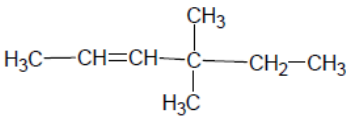
37. Draw the condensed structural formula for the following alkene.
4,4-dimethylhex-2-ene

What Is Required?

You must draw a condensed structural formula.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex-, so there are 6 carbon atoms in the main chain.
Identify the suffix.	The suffix is -2-ene, so there is a double bond between carbon atoms 2 and 3 in the main chain.
Draw and number the carbon chain.	$\begin{array}{cccccc} \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and draw the side groups.	<p>The prefix is 4,4-dimethyl, so there are two methyl groups on carbon atom 4.</p> 
Complete the structural formula. Add enough hydrogen atoms so that each carbon atom has a total of four bonds.	

Check Your Solution

The number of carbon atoms in the main chain, the position of the double bond, and the type and position of the side group in the condensed structural formula agree with the name.

38. Draw the condensed structural formula for the following alkene.
4-ethyl-2,5-dimethyloct-3-ene

What Is Required?

You must draw a condensed structural formula.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is oct-, so there are 8 carbon atoms in the main chain.
Identify the suffix.	The suffix is -3-ene, so there is a double bond between carbon atom 3 and 4 in the main chain.
Draw and number the carbon chain.	$\begin{array}{cccccccc} \text{C} & - & \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 \end{array}$
Identify the prefix and draw the side groups.	<p>The prefix is 4-ethyl-2,5-dimethyl, so there is an ethyl group on carbon atom 4, a methyl group on carbon atom 2, and another methyl group on carbon atom 5.</p>
Complete the structural formula. Add enough hydrogen atoms so that each carbon atom has a total of four bonds.	

Check Your Solution

The number of carbon atoms in the main chain, the position of the double bond, and the type and position of the side group in the condensed structural formula agree with the name.

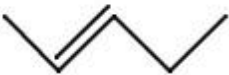
39. For each of the molecules listed in questions 35–38, draw a line structural formula.


What Is Required?

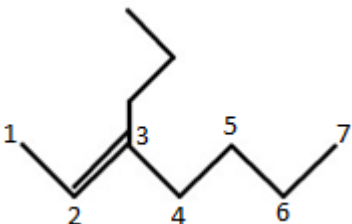
You need to draw a line structural formula.



What Is Given?

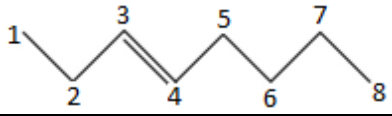
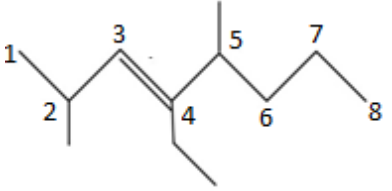
You are given the name of the compound and the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Use the condensed structural formulas from question 35 to draw the line structural formulas.	<p>Use the condensed structural formula as a guide.</p> $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$ <p>Each bend, intersection, and end of a straight line represents a carbon atom, unless otherwise specified. Hydrogen atoms are not included as it is assumed each carbon atom is bonded to the number hydrogen atoms necessary to give it four bonds.</p> 

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hept-, so there are 7 carbon atoms in the main chain.
Identify the suffix.	The suffix is -2-ene, so there is a double bond between carbon atom 2 and 3 in the main chain.
Draw and number the carbon chain.	<p>Each bend, intersection, and end of a straight line represents a carbon atom, unless otherwise specified. Hydrogen atoms are not included as it is assumed each carbon atom is bonded to the number hydrogen atoms necessary to give it four bonds.</p> <p>Draw 6 lines to represent 7 carbons. Between carbon 2 and 3 draw a double bond.</p> 

Identify the prefix and draw the side groups.	<p>The prefix is 3-propyl, so there is a propyl group on carbon atom 3.</p> 
---	--

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex-, so there are 6 carbon atoms in the main chain.
Identify the suffix.	The suffix is -2-ene, so there is a double bond between carbon atom 2 and 3 in the main chain.
Draw and number the carbon chain.	<p>Each bend, intersection, and end of a straight line represents a carbon atom, unless otherwise specified. Hydrogen atoms are not included as it is assumed each carbon atom is bonded to the number hydrogen atoms necessary to give it four bonds. Draw 5 lines representing 6 carbons.</p> 
Identify the prefix and draw the side groups.	<p>The prefix is 4,4-dimethyl, so there is 2 methyl groups on carbon atom 4.</p> 

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is oct-, so there are 8 carbon atoms in the main chain.
Identify the suffix.	The suffix is -3-ene, so there is a double bond between carbon atom 3 and 4 in the main chain.
Draw and number the carbon chain.	<p>Each bend, intersection, and end of a straight line represents a carbon atom, unless otherwise specified. Hydrogen atoms are not included as it is assumed each carbon atom is bonded to the number hydrogen atoms necessary to give it four bonds.</p> <p>Draw 7 lines representing 8 carbon atoms. Draw a double bond between carbon 3 and 4.</p> 
Identify the prefix and draw the side groups.	<p>The prefix is 4-ethyl-2,5-dimethyl so there is an ethyl group on carbon atom 4, a methyl group on carbon atom 2, and another methyl group on carbon atom 5.</p> 

Check Your Solution

The number of carbon atoms in the main chain, the position of the double bond, and the type and position of the side group in the line structural formula agree with the names and condensed structural formulae.

40. The name of this structure is incorrect. Draw the structure, and rename it correctly.
hex-4-ene

What Is Required?

You draw the structure and rename it correctly.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex- so there are six carbon atoms in the main chain.
Identify the suffix.	The suffix is -4-ene so there is a double bond between carbon atoms 4 and 5. $\begin{array}{cccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & = & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and draw the side groups. Complete the structure.	There is no prefix so there are no side groups. $\begin{array}{cccccc} \text{CH}_3 & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH} & = & \text{CH} & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify any errors in the name.	The numbering does not start at the end nearest the double bond.
Correct the naming.	Renumber the main chain and name the compound accordingly. $\begin{array}{cccccc} \text{CH}_3 & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH} & = & \text{CH} & - & \text{CH}_3 \\ 6 & & 5 & & 4 & & 3 & & 2 & & 1 \end{array}$ The correct name is hex-2-ene.

Check Your Solution

The length of the carbon chain and the position of the side groups agree with the given structure and the suffix is correct.

41. The name of this structure is incorrect. Draw the structure, and rename it correctly.
3-propylhept-5-ene

What Is Required?

You must draw the structure and rename it.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hept- so the main chain is seven carbon atoms long.
Identify the suffix.	The suffix is -5-ene so there is a double bond between carbon atoms 5 and 6. $\begin{array}{ccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & = & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 \end{array}$
Identify the prefix and draw the side groups. Complete the structure.	The prefix is 3-propyl- so there is a three-carbon side group on carbon atom 3. $\begin{array}{ccccccc} & & & & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & & & \\ \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH} & = & \text{CH} & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 \end{array}$
Identify any errors in the name.	The numbering does not start at the end nearest the double bond. The longest carbon chain containing the double bond is not seven carbon atoms long but is eight carbon atoms long. These changes make the prefix and suffix wrong.
Correct the naming.	$\begin{array}{ccccccc} & & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ & & 6 & & 7 & & 8 \\ \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH} & = & \text{CH} & - & \text{CH}_3 \\ & & 5 & & 4 & & 3 & & 2 & & 1 \end{array}$ <p>The double bond is now between carbon atoms 2 and 3. The root is now oct-, and the side group is two carbon atoms long and is on carbon atoms 5. The correct name is 5-ethyloct-2-ene.</p>

Check Your Solution

The length of the carbon chain and the position of the side groups agree with the given structure, and the suffix is correct.

42. The name of this structure is incorrect. Draw the structure, and rename it correctly.
3,3-dimethylprop-2-ene

What Is Required?

You must draw the structure and rename it.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is prop- so the main chain is three carbon atoms long.
Identify the suffix.	The suffix is -2-ene so there is a double bond between carbon atoms 2 and 3. $\begin{array}{c} \text{C} - \text{C} = \text{C} \\ \text{1} \quad \text{2} \quad \text{3} \end{array}$
Identify the prefix and draw the side groups. Complete the structure.	The prefix is 3,3-dimethyl so there are two methyl groups on carbon atom 3. $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} = \text{C} \\ \text{1} \quad \text{2} \quad \text{3} \\ \\ \text{CH}_3 \end{array}$
Identify any errors in the name.	The longest chain is not three carbon atoms long but is, instead, four carbon atoms long.
Correct the naming.	Because the main chain is four carbon atoms long, the root is but-. Numbering could start at either end of the chain because they are an equal number of carbon atoms from the double bond. However, the current numbering makes the side groups on carbon atom number 3. Because the numbering should keep the numbers of the side groups as low as possible while following the rules involving double bonds, the numbering must be changed. The only methyl group is now on carbon atom 2. $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} = \text{C} \\ \text{4} \quad \text{3} \quad \text{2} \\ \\ \text{CH}_3 \\ \text{1} \end{array}$ The correct name is 2-methylbut-2-ene.

Check Your Solution

The length of the carbon chain and the position of the side groups agree with the given structure and the suffix is correct.

43. Draw the complete structural formula for the following.

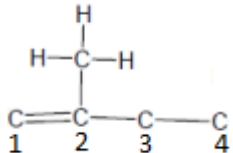
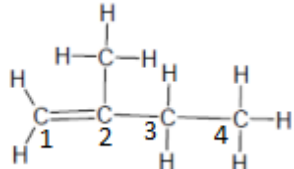
- a. 2-methylbut-1-ene
- b. 4-ethyl-4,5-dimethylhex-1-ene

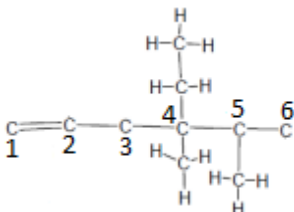
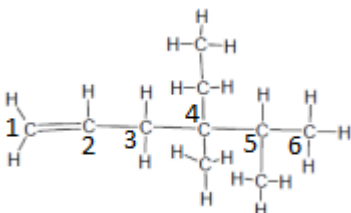
What Is Required?

You must draw the complete structural formula.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
a. Identify the root.	The root is but-, so there are 4 carbon atoms in the main chain.
Identify the suffix.	The suffix is -1-ene, so there is a double bond between carbon atoms 1 and 2 in the main chain.
Draw and number the carbon chain.	$\begin{array}{cccc} \text{C} & = & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 \end{array}$
Identify the prefix and draw the side groups.	<p>The prefix 2-methyl, so there is a methyl group on carbon atom 2.</p> 
Complete the structural formula. Add enough hydrogen atoms so that each carbon atom has a total of four bonds.	

b. Identify the root.	The root is hex-, so there are 6 carbon atoms in the main chain.
Identify the suffix.	The suffix is -1-ene, so there is a double bond between carbon atoms 1 and 2 in the main chain.
Draw and number the carbon chain.	$\begin{array}{cccccc} \text{C} & = & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and draw the side groups.	<p>The prefix is 4-ethyl-4,5-dimethyl, so there is an ethyl group on carbon atom 4, a methyl group on carbon atom 4, and another methyl group on carbon atom 5.</p> 
Complete the structural formula. Add enough hydrogen atoms so that each carbon atom has a total of four bonds.	

Check Your Solution

The number of carbon atoms in the main chain, the position of the double bond, and the type and position of the side group in the condensed structural formula agree with the name.

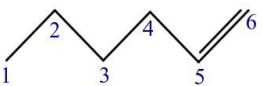
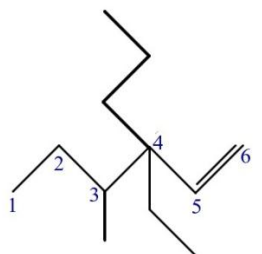
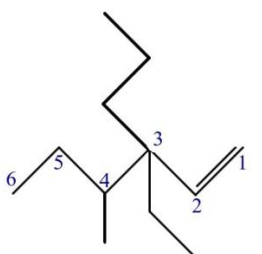
44. Draw the line structure for the incorrectly named molecule 3-methyl-4-ethyl-4-propyl-hex-5-ene. Name it correctly.

What Is Required?

You must draw the line structure and correctly name the molecule.

What Is Given?

You are given the name of the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex- so there are six carbon atoms in the main chain.
Identify the suffix.	The suffix is -5-ene so there is a double bond between carbon atoms 5 and 6. 
Identify the prefix and draw the side groups. Complete the structure.	The prefix is 3-methyl-4-ethyl-4-propyl- so there is methyl group of carbon atom 3, an ethyl group on carbon atom 4, and a propyl group, also on carbon atom 4. 
Identify any errors in the name.	The numbering does not begin at the end of the main chain closest to the double bond. Also, the prefix is not in alphabetical order. Reverse the numbering on the main chain. 
Correct the naming.	The root is still hex- but the suffix is -1-ene. The methyl group is bonded to carbon atom 4, the ethyl and propyl groups are bonded to carbon atom 3. Write the groups in the prefix in alphabetical order. The correct name is 3-ethyl-

	4-methyl-3-propylhex-1-ene.
--	-----------------------------

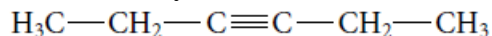
Check Your Solution

The length of the carbon chain and the position of the side groups agree with the given structure, and the suffix is correct.

Naming and Drawing Alkynes

(Student textbook page 30)

45. Name the alkyne.



What Is Required?

You must name the alkyne.

What Is Given?

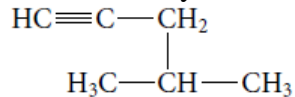
You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain has 6 carbon atoms, so the root is hex-.
Identify the suffix.	<p>Number the main chain, starting at the carbon atom nearest the triple bond. You can number from left to right or right to left and obtain the same result.</p> $\begin{array}{cccccc} \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{C} & \equiv & \text{C} & - & \text{CH}_2 & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$ <p>The compound has one triple bond between carbon atom 3 and 4, so the suffix is -3-yne.</p>
Identify the prefix.	There is no prefix so there are no side groups on the molecule.
Name the compound.	hex-3-yne

Check Your Solution

The number of carbon atoms in the main chain and the position of the triple bond agree with the name.

46. Name the alkyne.



What Is Required?

You must name the alkyne.

What Is Given?

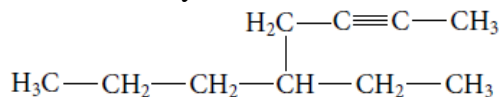
You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain has 5 carbon atoms, so the root is pent-.
Identify the suffix.	Number the main chain, starting at the end nearest the triple bond. $\begin{array}{c} 1 \quad 2 \quad 3 \\ \text{HC}\equiv\text{C}-\text{CH}_2 \\ \\ \text{H}_3\text{C}-\text{CH}-\text{CH}_3 \\ 4 \quad 5 \end{array}$ The compound has one triple bond between carbon atom 1 and 2, so the suffix is -1-yne.
Identify the prefix.	There is a methyl group bonded to carbon atom 4. The prefix is 4-methyl-.
Name the compound.	4-methylpent-1-yne

Check Your Solution

The number of carbon atoms in the main chain, the position of the triple bond, and the type and position of the side group agrees with the name.

47. Name the alkyne.



What Is Required?

You must name the alkyne.

What Is Given?

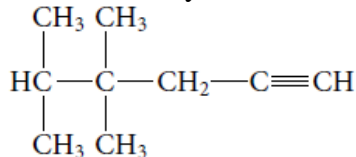
You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain has 8 carbon atoms, so the root is oct-.
Identify the suffix.	<p>Number the main chain, starting at the end nearest the triple bond.</p> $\begin{array}{ccccccc} & & & 4 & 3 & 2 & 1 \\ & & & \text{H}_2\text{C} & - & \text{C} \equiv \text{C} & - \text{CH}_3 \\ & & & & & & \\ \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_3 \\ & 8 & 7 & 6 & 5 & & & & & & \end{array}$ <p>The compound has one triple bond between carbon atoms 2 and 3, so the suffix is -2-yne.</p>
Identify the prefix.	There is an ethyl group bonded to carbon atom 5. The prefix is 5-ethyl.
Name the compound.	5-ethyloct-2-yne

Check Your Solution

The number of carbon atoms in the main chain, the position of the triple bond, and the type and position of the side group agree with the name.

48. Name the alkyne.



What Is Required?

You must name the alkyne.

What Is Given?

You are given the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain has 6 carbon atoms, so the root is hex-.
Identify the suffix.	<p>Number the main chain, starting at the end nearest the triple bond.</p> $ \begin{array}{ccccccc} & \text{CH}_3 & & \text{CH}_3 & & & \\ & & & & & & \\ \text{HC} & - & \text{C} & - & \text{CH}_2 & - & \text{C} \equiv \text{CH} \\ & & & & & & \\ & \text{CH}_3 & & \text{CH}_3 & & & \end{array} $ <p>The compound has one triple bond between carbon atoms 1 and 2, so the suffix is -1-yne.</p>
Identify the prefix.	There are two methyl groups bonded to carbon atom 4, and one methyl group bonded to carbon atom 5. The prefix is 4,4,5-trimethyl.
Name the compound	4,4,5-trimethylhex-1-yne

Check Your Solution

The number of carbon atoms in the main chain, the position of the triple bond, and the type and position of the side groups agree with the name.

49. Draw the condensed structural formula for the following molecules.


- but-2-yne
- 4,5-dimethylhex-1-yne
- 4-ethyl-4-methylhept-2-yne
- 2,5,7-trimethylnon-3-yne

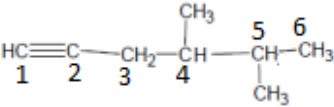
What Is Required?

You must draw the condensed structural formula for each molecule.

What Is Given?

You are given the name of the molecule.

Plan Your Strategy	Act on Your Strategy
a. but-2-yne Identify the root.	The root is but-, so the main chain has 4 carbon atoms.
Identify the suffix.	The suffix is -2-yne, so there is a triple bond between carbon atoms 2 and 3.
Draw and number the main chain.	$\begin{array}{cccc} \text{C} & - & \text{C} & \equiv & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 \end{array}$
Add enough hydrogen atoms to give each carbon atom four bonds.	

Plan Your Strategy	Act on Your Strategy
b. 4,5-dimethylhex-1-yne Identify the root.	The root is hex-, so the main chain has 6 carbon atoms.
Identify the suffix.	The suffix is -1-yne, so there is a triple bond between carbon atom 1 and 2.
Draw and number the main chain.	$\begin{array}{cccccc} \text{C} & \equiv & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and draw any side groups.	The prefix is 4,5-dimethyl, so there is a methyl group on carbon 4 and another on carbon 5.
Add enough hydrogen atoms to give each carbon atom four bonds.	

Plan Your Strategy	Act on Your Strategy
c. 4-ethyl-4-methylhept-2-yne Identify the root.	The root is hept-, so the main chain has 7 carbon atoms.
Identify the suffix.	The suffix is -2-yne, so there is a triple bond between carbon atoms 2 and 3.
Draw and number the main chain.	$\begin{array}{ccccccc} \text{C} & - & \text{C} & \equiv & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 \end{array}$
Identify the prefix and draw any side groups.	<p>The prefix is 4-ethyl-4-methyl, so there is an ethyl group on carbon 4 and a methyl group on carbon 4.</p> $\begin{array}{ccccccc} & & & & \text{CH}_3 & & \\ & & & & & & \\ & & & & \text{CH}_2 & & \\ \text{C} & - & \text{C} & \equiv & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 \\ & & & & & & \text{CH}_3 & & & & & & \end{array}$
Add enough hydrogen atoms to give each carbon atom four bonds.	$\begin{array}{ccccccc} & & & & \text{CH}_3 & & \\ & & & & & & \\ & & & & \text{CH}_2 & & \\ \text{CH}_3 & - & \text{C} & \equiv & \text{C} & - & \text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 \\ & & & & & & \text{CH}_3 & & & & & & \end{array}$

Plan Your Strategy	Act on Your Strategy
d. 2,5,7-trimethylnon-3-yne Identify the root.	The root is non-, so the main chain has 9 carbon atoms.
Identify the suffix.	The suffix is -3-yne, so there is a triple bond between carbon atoms 3 and 4.
Draw and number the main chain.	$\begin{array}{ccccccccccc} \text{C} & - & \text{C} & - & \text{C} & \equiv & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 & & 9 \end{array}$
Identify the prefix and draw any side groups.	<p>The prefix is 2,5,7-trimethyl, so there is a methyl group on carbon atoms 2, 5, and 7.</p> $\begin{array}{ccccccccccc} & & \text{CH}_3 & & & & \text{CH}_3 & & & & \text{CH}_3 & & & & & & \\ & & & & & & & & & & & & & & & & \\ \text{C} & - & \text{C} & - & \text{C} & \equiv & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 & & 9 \end{array}$
Add enough hydrogen atoms to give each carbon atom four bonds.	$\begin{array}{ccccccccccc} & & \text{CH}_3 & & & & \text{CH}_3 & & & & \text{CH}_3 & & & & & & \\ & & & & & & & & & & & & & & & & \\ \text{H}_3\text{C} & - & \text{HC} & - & \text{C} & \equiv & \text{C} & - & \text{CH} & - & \text{CH}_2 & - & \text{HC} & - & \text{CH}_2 & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 & & 9 \end{array}$

Check Your Solution

The number of carbon atoms in the main chains, the position of the triple bond, and the type and position of the side groups in all structures agree with the names.


50. For each of the molecules listed in question 49, draw a line structural formula.

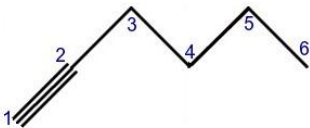
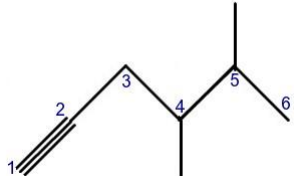
What Is Required?

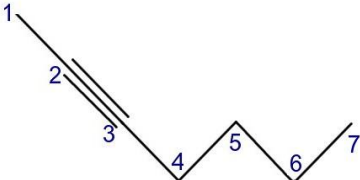
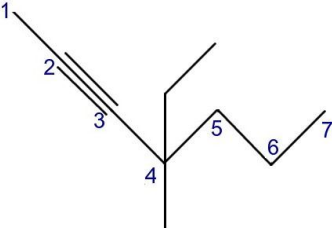
You need to draw the line structural formulas.

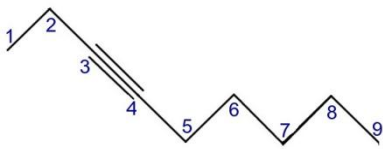
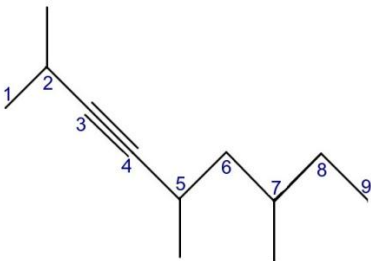
What Is Given?

You are given the name and the condensed structural formula.

Plan Your Strategy	Act on Your Strategy
a. but-2-yne Identify the root.	The root is but-, so the main chain has 4 carbon atoms.
Identify the suffix.	The suffix is -2-yne, so there is a triple bond between carbon atom 2 and 3.
Draw and number the main chain.	Draw 3 lines representing 4 carbon atoms. Draw a triple bond between carbon 2 and 3. 

Plan Your Strategy	Act on Your Strategy
b. 4,5-dimethylhex-1-yne Identify the root.	The root is hex-, so the main chain has 6 carbon atoms.
Identify the suffix.	The suffix is -1-yne, so there is a triple bond between carbon atom 1 and 2.
Draw and number the main chain.	Draw lines representing 6 carbon atoms. The triple bond and the adjoining line must be in a straight line. Draw a triple bond between carbon 1 and 2. 
Identify the prefix and draw any side groups.	The prefix is 4,5-dimethyl, so there is a methyl group on carbon 4 and another on carbon 5. 

Plan Your Strategy	Act on Your Strategy
<p>c. 4-ethyl-4-methylhept-2-yne Identify the root.</p>	<p>The root is hept-, so the main chain has 7 carbon atoms.</p>
<p>Identify the suffix.</p>	<p>The suffix is -2-yne, so there is a triple bond between carbon atoms 2 and 3.</p>
<p>Draw and number the main chain.</p>	<p>Draw lines representing seven carbon atoms. The triple bond and the two adjoining lines must be in a straight line. Draw a triple bond between carbon 2 and 3.</p> 
<p>Identify the prefix and draw any side groups.</p>	<p>The prefix is 4-ethyl-4-methyl, so there is an ethyl group on carbon 4 and a methyl group on carbon 4.</p> 

Plan Your Strategy	Act on Your Strategy
d. 2,5,7-trimethylnon-3-yne Identify the root.	The root is non-, so the main chain has 9 carbon atoms.
Identify the suffix.	The suffix is -3-yne, so there is a triple bond between carbon atom 3 and 4.
Draw and number the main chain.	<p>Draw lines representing 9 carbon atoms. The triple bond and the two adjoining lines must be in a straight line. Draw a triple bond between carbon 3 and 4.</p> 
Identify the prefix and draw any side groups.	<p>The prefix is 2,5,7-trimethyl, so there is a methyl group on carbon 2, 5, and 7.</p> 

Check Your Solution

The number of carbon atoms in the main chains, the position of the triple bond, and the type and position of the side groups in all line structures agree with the names and condensed structural formulas.

51. The following name is incorrect. Draw the structure that the name describes. After examining your drawing, rename the structure correctly.
3-methylprop-1-yne

What Is Required?

You must draw the structure and then rename it properly.

What Is Given?

You are given the incorrect name for the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is prop- so the main chain has three carbon atoms.
Identify the suffix.	The suffix is -1-yne so there is a triple bond between atoms 1 and 2. $\begin{array}{c} \text{C} \equiv \text{C} - \text{C} \\ \text{1} \quad \text{2} \quad \text{3} \end{array}$
Identify the prefix and draw the side groups.	The prefix is 3-methyl so there is a methyl group on carbon atom 3. $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH} \equiv \text{C} - \text{C} \text{H}_2 \\ \text{1} \quad \text{2} \quad \text{3} \end{array}$
Identify any errors in the name.	The side chain is really part of the main chain so it has four carbon atoms.
Correct the naming.	The correct name of the root is but- and there are no side groups, thus no prefixes. $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH} \equiv \text{C} - \text{C} \text{H}_2 \\ \text{1} \quad \text{2} \quad \text{3} \end{array}$ The correct name is but-1-yne.

Check Your Solution

The number of carbon atoms in the main chain and the position of the triple bond agree with the name.

52. The following name is incorrect. Draw the structure that the name describes. After examining your drawing, rename the structure correctly.
but-3-yne

What Is Required?

You must draw the structure and then rename it properly.

What Is Given?

You are given the incorrect name for the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is but- so the main chain has four carbon atoms.
Identify the suffix.	The suffix is -3-yne so there is a triple bond between carbon atoms 3 and 4. $\begin{array}{cccc} \text{C} & - & \text{C} & - & \text{C} & \equiv & \text{C} \\ 1 & & 2 & & 3 & & 4 \end{array}$
Identify the prefix and draw the side groups.	There is no prefix so there are no side groups. $\begin{array}{cccc} \text{CH}_3 & - & \text{CH}_2 & - & \text{C} & \equiv & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 \end{array}$
Identify any errors in the name.	The numbering does not start at the end nearest the triple bond.
Correct the naming.	Reverse the numbering. $\begin{array}{cccc} \text{CH}_3 & - & \text{CH}_2 & - & \text{C} & \equiv & \text{CH}_3 \\ 4 & & 3 & & 2 & & 1 \end{array}$ The correct name is but-1-yne.

Check Your Solution

The number of carbon atoms in the main chain and the position of the triple bonds agree with the name.

53. The following name is incorrect. Draw the structure that the name describes. After examining your drawing, rename the structure correctly.
2-methylpent-3-yne

What Is Required?

You must draw the structure and then rename it properly.

What Is Given?

You are given the incorrect name for the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is pent- so there are five carbon atoms in the main chain.
Identify the suffix.	The suffix is -3-yne so there is a triple bond between carbon atoms 3 and 4. $\begin{array}{ccccccc} \text{C} & - & \text{C} & - & \text{C} & \equiv & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 \end{array}$
Identify the prefix and draw the side groups.	The prefix is 2-methyl- so there is a methyl group on carbon atom 2. $\begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & & & \\ \text{CH}_3 & - & \text{CH} & - & \text{C} & \equiv & \text{C} & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 \end{array}$
Identify any errors in the name.	The numbering does not start at the end nearest the triple bond.
Correct the naming.	Reverse the numbering. This makes the suffix -2-yne, and places the methyl group on carbon atom 4. $\begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & & & \\ \text{CH}_3 & - & \text{CH} & - & \text{C} & \equiv & \text{C} & - & \text{CH}_3 \\ 5 & & 4 & & 3 & & 2 & & 1 \end{array}$ The correct name is 4-methylpent-2-yne.

Check Your Solution

The number of carbon atoms in the main chain, the position of the triple bonds and the name and position of the side group agree with the name.

54. The following name is incorrect. Draw the structure that the name describes. After examining your drawing, rename the structure correctly. 2-methyl-4-propyl-4-ethylhex-5-yne

What Is Required?

You must draw the structure and then rename it properly.

What Is Given?

You are given the incorrect name for the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hex-; there are six carbon atoms in the main chain.
Identify the suffix.	The suffix is -5-yne so there is a triple bond between carbon atoms 5 and 6. $\begin{array}{ccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & \equiv & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and draw the side groups.	The prefix is 2-methyl-4-propyl-4-ethyl- so there is a methyl group of carbon atom 2 and there are propyl and ethyl groups on carbon 4. $\begin{array}{ccccccc} & & & & \text{CH}_3 & & \\ & & & & & & \\ & & & & \text{CH}_2 & & \\ & & & & & & \\ \text{CH}_3 & - & \text{CH} & - & \text{CH}_2 & - & \text{C} & - & \text{C} & \equiv & \text{CH} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \\ & & & & & & & & & & \\ & & & & \text{CH}_2 & & & & & & \\ & & & & & & & & & & \\ & & & & \text{CH}_2 & & & & & & \\ & & & & & & & & & & \\ & & & & \text{CH}_3 & & & & & & \end{array}$
Identify any errors in the name.	The numbering does not start at the end nearest the triple bond. Changing the numbering will change the suffix and the numbers in the prefix. Also, the terms in the prefix were not in alphabetical order.
Correct the naming.	Reverse the numbering. $\begin{array}{ccccccc} & & & & \text{CH}_3 & & \\ & & & & & & \\ & & & & \text{CH}_2 & & \\ & & & & & & \\ \text{CH}_3 & - & \text{CH} & - & \text{CH}_2 & - & \text{C} & - & \text{C} & \equiv & \text{CH} \\ 6 & & 5 & & 4 & & 3 & & 2 & & 1 \\ & & & & & & & & & & \\ & & & & \text{CH}_2 & & & & & & \\ & & & & & & & & & & \\ & & & & \text{CH}_2 & & & & & & \\ & & & & & & & & & & \\ & & & & \text{CH}_3 & & & & & & \end{array}$ The suffix is now -2-yne. The prefix is 3-ethyl-5-methyl-3-propyl-. The correct name is 3-ethyl-5-methyl-3-propylhept-2-yne.

Check Your Solution

The number of carbon atoms in the main chain, the position of the triple bonds, and the name and position of the side groups agree with the name.

Naming and Drawing Cyclic Hydrocarbons (Student textbook page 34)

55. Name the cyclic hydrocarbon.



What Is Required?

You must write the name for the cyclic hydrocarbon.

What Is Given?

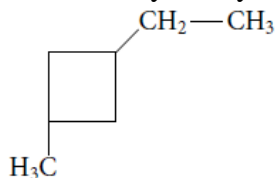
You are given the structural diagram.

Plan Your Strategy	Act on Your Strategy
Find the root.	The ring has 5 carbon atoms, so the root is cyclopent-.
Find the suffix.	There are no multiple bonds, so the structure is an alkane. Therefore the suffix is -ane.
Find the prefix.	There are no side groups thus there is no prefix.
Write the name.	cyclopentane.

Check Your Solution

The root, prefix, and suffix correctly describe the structure.

56. Name the cyclic hydrocarbon.



What Is Required?

You must write the name for the cyclic hydrocarbon.

What Is Given?

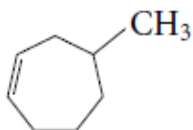
You are given the structural diagram.

Plan Your Strategy	Act on Your Strategy
Find the root.	The ring has 4 carbon atoms, which is the longest continuous chain, so the root is cyclobut-.
Find the suffix.	There are no multiple bonds, so the structure is an alkane. Therefore the suffix is -ane.
Find the prefix.	<p>The side groups have the same numbers no matter the direction in which the compound is numbered. Number in the direction that gives the side group that comes first alphabetically the lowest number. There is an ethyl and methyl group so the carbon with the ethyl group would receive the number 1.</p> <p>Therefore, the prefix is 1-ethyl-3-methyl.</p>
Write the name.	1-ethyl-3-methylcyclobutane

Check Your Solution

The root, prefix, and suffix correctly describe the structure.

57. Name the cyclic hydrocarbon.

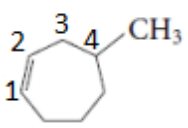


What Is Required?

You must write the name for the cyclic hydrocarbon.

What Is Given?

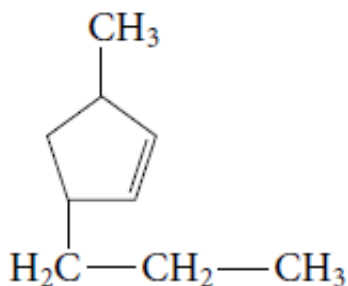
You are given the structural diagram.

Plan Your Strategy	Act on Your Strategy
Find the root.	The ring has 7 carbon atoms, which is the longest continuous chain, so the root is cyclohept-.
Find the suffix.	The ring has one double bond, so the structure is an alkene. The suffix is -ene.
Find the prefix.	<p>The carbon atoms on the two sides of the double bond must be numbers 1 and 2. The numbering must proceed so that the side group has the lowest possible number.</p>  <p>Since the numbering of the carbon atoms on the double bond must be 1 and 2, it is not necessary to specify these in the name. There is a methyl group on carbon atom 4, so the prefix is 4-methyl.</p>
Write the name.	4-methylcycloheptene

Check Your Solution

The root, prefix, and suffix correctly describe the structure.

58. Name the cyclic hydrocarbon.



What Is Required?

You must write the name for the cyclic hydrocarbon.

What Is Given?

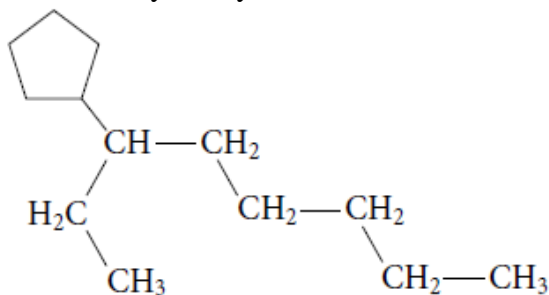
You are given the structural diagram.

Plan Your Strategy	Act on Your Strategy
Find the root.	The ring has 5 carbon atoms, which is the longest continuous chain, so the root is cyclopent-.
Find the suffix.	The ring has one double bond, so the structure is an alkene. The suffix is -ene.
Find the prefix.	<p>The carbon atoms on the two sides of the double bond must be numbers 1 and 2. The numbering must proceed so that the sum of the numbers of the side groups must be as small as possible. There is a methyl group and propyl group. In this structure, the side groups will be at carbon atoms 3 and 5 regardless of the direction of numbering. Therefore, number so that the first named side group has the lowest number.</p> <p>Since the numbering of the carbon atoms on the double bond must be 1 and 2, it is not necessary to specify these in the name. There is a methyl group on carbon atom 3 and a propyl group on carbon atom 5, so the prefix is 3-methyl-5-propyl.</p>
Write the name.	3-methyl-5-propylcyclopentene

Check Your Solution

The root, prefix, and suffix correctly describe the structure.

59. Name the cyclic hydrocarbon.



What Is Required?

You must write the name for the cyclic hydrocarbon.

What Is Given?

You are given the structural diagram.

Plan Your Strategy	Act on Your Strategy
Find the root.	<p>The longest continuous carbon chain in 8 atoms long.</p> <p>The main chain is the straight chain alkane, not the cyclic alkane. Therefore the root is oct-.</p>
Find the suffix.	The structure is an alkane, therefore the suffix is -ane.
Find the prefix.	<p>Number the chain giving the carbon attached to the side group the lowest number.</p> <p>The five carbon ring is a side group on carbon atom 3 of the main chain. It is named as if it were a straight chain alkyl group, except cyclo- is included in the prefix. Therefore, the prefix is 3-cyclopentyl.</p>
Write the name.	3-cyclopentyloctane

Check Your Solution

The root, prefix, and suffix correctly describe the structure.



60. Draw a condensed structural formula for the following compound.
methylcyclobutane

What Is Required?

You must draw the condensed structural formula of the compound.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is cyclobut-, so the structure is based on a four-carbon ring. 
Identify the suffix.	The suffix is -ane, so the ring has no double bonds.
Identify the prefix and draw the side groups.	The prefix is methyl, so there is a methyl group on carbon atom 1. The number is not found in the name because it is not necessary when there is only one side group. 

Check Your Solution

The size of the ring and the position of the side group agree with the name.

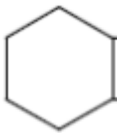
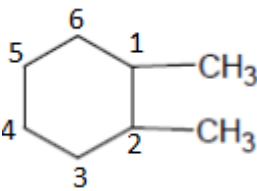
61. Draw a condensed structural formula for the following compound.
1,2-dimethylcyclohexane

What Is Required?

You must draw the condensed structural formula of the compound.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is cyclohex-, so the structure is based on a six-carbon ring. 
Identify the suffix.	The suffix is -ane, so the ring has no double bonds.
Identify the prefix and draw the side groups.	The prefix is 1,2-dimethyl, so there is a methyl group on carbon atom 1 and carbon atom 2. 

Check Your Solution

The size of the ring and the position of the side groups agree with the name.



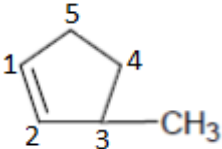
62. Draw a condensed structural formula for the following compound.
3-methylcyclopentene

What Is Required?

You must draw the condensed structural formula of the compound.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is cyclopent-, so the structure is based on a five-carbon ring. 
Identify the suffix.	The suffix is -ene, so the ring has one double bond. 
Identify the prefix and draw the side groups.	The prefix is 3-methyl, so there is a methyl group on carbon atom 3. The carbon atoms on the ends of the double bond are always numbered 1 and 2. 

Check Your Solution

The size of the ring and the position of the side groups agree with the name.

63. Draw a condensed structural formula for the following compound.

2-ethyl-3-propylcyclohexane


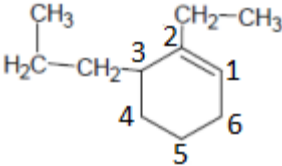
Note: this name is not a possible name for a cycloalkane because, on an alkane, the numbering of side groups would be 1 and 2. The numbering of 2 and 3 implies that there is a multiple bond. The answer will be written for 2-ethyl-3-propylcyclohexene.

What Is Required?

You must draw the condensed structural formula of the compound.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is cyclohex-, so the structure is based on a six-carbon ring.
Identify the suffix.	The suffix is -ene, so the ring has one double bond. 
Identify the prefix and draw the side groups.	The prefix is 2-ethyl-3-propyl, so there is an ethyl group on carbon atom 2 and a propyl group on carbon atom 3. The carbon atoms at the ends of the double bond are always numbered 1 and 2. 

Check Your Solution

The size of the ring and the position of the side groups agree with the name.

64. Draw a condensed structural formula for the following compound.
2-cyclobutylpentane

What Is Required?

You must draw the condensed structural formula of the compound.

What Is Given?

You are given the name of the compound.

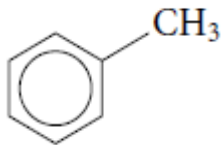
Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is pent-, so the structure is based on a five-carbon chain. $\text{CH}_3\text{—CH—CH}_2\text{—CH}_2\text{—CH}_3$
Identify the suffix.	The suffix is -ane, so the chain is an alkane.
Identify the prefix and draw the side groups.	The prefix is 2-cyclobutyl, so the side group is a 4-carbon ring. $ \begin{array}{ccccccc} 1 & & 2 & & 3 & & 4 & & 5 \\ \text{CH}_3 & \text{—} & \text{CH} & \text{—} & \text{CH}_2 & \text{—} & \text{CH}_2 & \text{—} & \text{CH}_3 \\ & & & & & & & & \\ & & \square & & & & & & \end{array} $

Check Your Solution

The size of the ring and the position of the side groups agree with the name.

Naming and Drawing Aromatic Hydrocarbons
(Student textbook page 38)

65. Name the following aromatic hydrocarbon.



What Is Required?

You must name the aromatic hydrocarbon.

What Is Given?

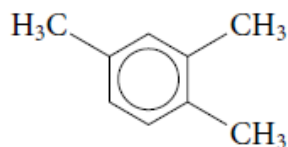
You are given the structural formula of the hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root for an aromatic hydrocarbon is -benzene.
Identify the prefix.	The side group has one carbon atom, so it is a methyl group. There is only one side group, so the carbon atoms in the benzene ring are not numbered.
Write the name.	The compound is methylbenzene.

Check Your Solution

The root and the prefix correctly describe the structure.

66. Name the following aromatic hydrocarbon.



What Is Required?

You must name the aromatic hydrocarbon.

What Is Given?

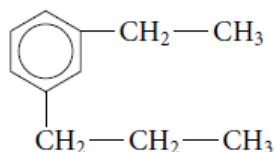
You are given the structural formula of the hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root for an aromatic hydrocarbon is -benzene.
Identify the prefix.	There are three methyl groups so the benzene ring must be numbered. Start at one of the methyl groups and number so that the sum of the numbers is as small as possible. The numbering places the methyl groups on carbon atoms 1, 2, and 4. The prefix is 1,2,4-trimethyl-.
Write the name.	The compound is 1,2,4-trimethylbenzene.

Check Your Solution

The carbon atoms are numbered to give the lowest numbers (1,2,4 rather than 1,3,4 or 1,2,5). The root and prefix correctly describe the structure.

67. Name the following aromatic hydrocarbon.



What Is Required?

You must name the aromatic hydrocarbon.

What Is Given?

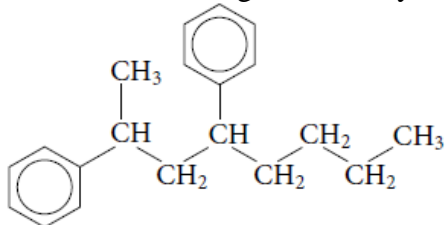
You are given the structural formula of the hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The hydrocarbon chains have fewer than six carbon atoms, so the root is -benzene.
Identify the prefix.	There are two side groups so the benzene ring must be numbered. Number the carbon atoms in benzene so that the sum of the numbers is as small as possible. There is an ethyl side group and a propyl side group. Let the ethyl group be carbon atom 1. The propyl group is on carbon atom 3. The prefix is 1-ethyl-3-propyl-.
Write the name.	The compound is 1-ethyl-3-propylbenzene.

Check Your Solution

The side groups are correctly identified and listed alphabetically, and the carbon atoms are numbered to give the lowest number. The prefix and root correctly describe the structure.

68. Name the following aromatic hydrocarbon.



What Is Required?

You must name the aromatic hydrocarbon.

What Is Given?

You are given the structural formula of the hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	There are eight carbon atoms in the hydrocarbon chain. Because there are more than six carbon atoms in the chain, it becomes the main chain, so the root is -octane.
Identify the prefix.	There is a benzene ring side group on carbon atom 2, and another on carbon atom 4. The prefix is 2,4-diphenyl-.
Write the name.	The compound is 2,4-diphenyloctane.

Check Your Solution

There are more than six carbon atoms in the hydrocarbon chain, so the benzene rings are side groups, and the carbon atoms are numbered to give the lowest numbering. The root and prefix correctly describe the structure.



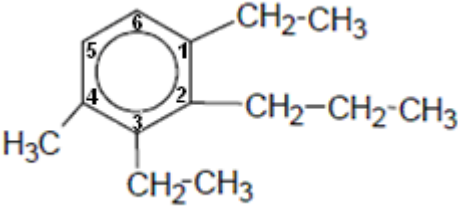
69. Draw the condensed structural formula for the following aromatic hydrocarbon.
1,3-diethyl-4-methyl-2-propylbenzene

What Is Required?

You must draw the condensed structural formula for the compound.

What Is Given?

You are given the name of the aromatic hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	<p>The root is benzene, so the structure is based on a benzene ring.</p> 
If there is more than one side group, number the carbon atoms in the ring.	<p>There are four side groups, so the ring must be numbered.</p> 
Identify the prefix, and draw the side groups to complete the structure.	<p>The prefix is 1,3-diethyl-4-methyl-2-propyl-, so there are two ethyl groups, one methyl group, and one propyl group on the benzene ring. The ethyl groups are on carbon atoms 1 and 3, the methyl group is on carbon atom 4, and the propyl group is on carbon atom 2.</p> 

Check Your Solution

There are ethyl groups on carbon atoms 1 and 3, a methyl group on carbon 4, and a propyl group on carbon 2. The structure is correct.


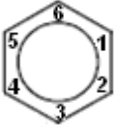
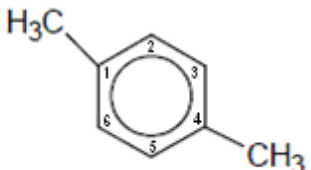
70. Draw the condensed structural formula for the following aromatic hydrocarbon.
1,4-dimethylbenzene, historically known as para-xylene or *p*-xylene

What Is Required?

You must draw the condensed structural formula for an aromatic hydrocarbon.

What Is Given?

You are given the name of the aromatic hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	<p>The root is benzene, so the structure is based on a benzene ring.</p> 
If there is more than one side group, number the carbon atoms in the ring.	<p>There are two side groups, so the ring must be numbered.</p> 
Identify the prefix and draw the side groups.	<p>The prefix is 1,4-dimethyl-, so there are two methyl groups, located on carbon atom 1 and carbon atom 4, respectively.</p> 

Check Your Solution

There are methyl groups on carbon atoms 1 and 4, so the structure is correct.


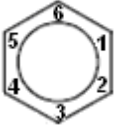
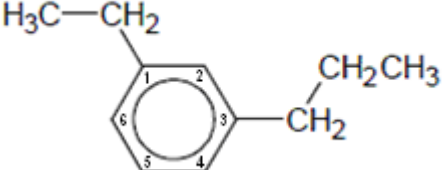
71. Draw the condensed structural formula for the following aromatic hydrocarbon.
1-ethyl-3-propylbenzene

What Is Required?

You must draw the condensed structural formula an aromatic hydrocarbon.

What Is Given?

You are given the name of the aromatic hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is benzene, so the structure is based on a benzene ring. 
If there is more than one side group, number the carbon atoms in the ring.	There are two side groups, so the ring must be numbered. 
Identify the prefix, and draw the side groups.	The prefix is 1-ethyl-3-propyl, so there is an ethyl group on carbon atom 1 and a propyl group on carbon atom 3. 

Check Your Solution

The proper side groups are located on the right carbon atoms, so the structure is correct.


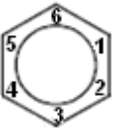
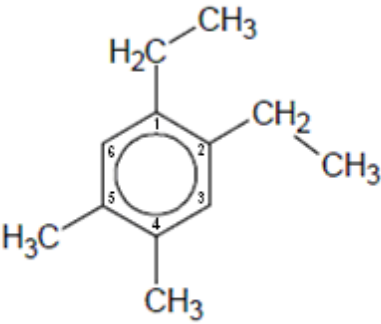
72. Draw the condensed structural formula for the following aromatic hydrocarbon.
1,2-diethyl-4,5-dimethylbenzene

What Is Required?

You must draw the condensed structural formula for an aromatic hydrocarbon.

What Is Given?

You are given the name of the aromatic hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	<p>The root is benzene, so the structure is based on a benzene ring.</p> 
If there is more than one side group, number the carbon atoms in the ring.	<p>There are four side groups, so the ring must be numbered.</p> 
Identify the prefix, and draw the side groups.	<p>The prefix is 1,2-diethyl-4,5-dimethyl-, so there are two ethyl groups and two methyl groups. The ethyl groups are on carbon atoms 1 and 2, and the methyl groups are on carbon atoms 4 and 5.</p> 

Check Your Solution

The ethyl and methyl side groups are on the proper carbon atoms, so the structure is correct.

73. Draw the condensed structural formula for the following aromatic hydrocarbon.
2-phenyl-5-propyloctane

What Is Required?

You must draw the condensed structural formula for the compound.

What Is Given?

You are given the name of the aromatic hydrocarbon.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is octane, so the structure is based on a hydrocarbon chain with eight carbon atoms. $\text{C} - \text{C} - \text{C} - \text{C} - \text{C} - \text{C} - \text{C} - \text{C}$
Number the carbon atoms in the main chain.	The hydrocarbon chain must be numbered. $\begin{array}{cccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 \end{array}$
Identify the prefix, and draw the side groups.	The prefix is 2-phenyl-5-propyl, so there is a phenyl group on carbon atom 2 and a propyl group on carbon atom 5. $\begin{array}{ccccccccccc} \text{CH}_3 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & & & & & & & & \\ & & \text{C}_6\text{H}_5 & & & & & & \text{CH}_2 & & & & & \\ & & & & & & & & & & & & & \\ & & & & & & & & \text{CH}_2 & & & & & \\ & & & & & & & & & & & & & \\ & & & & & & & & \text{CH}_3 & & & & & \end{array}$

Check Your Solution

The benzene ring appears as a side group on carbon atom 2, and the propyl group is on carbon atom 5. The structure is correct.


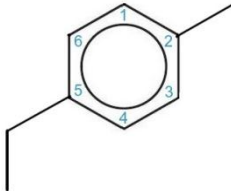
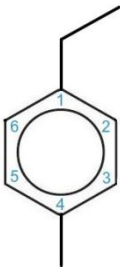
74. The molecule 2-methyl-5-ethylbenzene is named incorrectly. Draw the line structural formula for the molecule and name it correctly.

What Is Required?

You must determine the correct name and structure for the molecule.

What Is Given?

You are given the incorrect name.

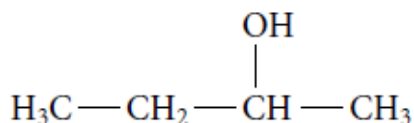
Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is benzene so the structure is based on the benzene ring.
Identify the suffix.	Because the root is benzene, there is no suffix. 
Identify the prefix and draw the side groups.	The prefix is 2-methyl-5-ethyl so the benzene ring must be numbered. There is a methyl group on carbon atom 2 and an ethyl group on carbon 5. 
Identify any errors in the name.	Numbering of the benzene ring must start at a side group. The order of the side groups was not alphabetical in the name.
Correct the naming.	The line structural formula should be:  The ethyl group is now on carbon atom 1 and the methyl group is on carbon atom 4. The correct name is 4-ethyl-1-methylbenzene.

Check Your Solution

Both the name and the structural formula follow the rules for naming and drawing aromatic hydrocarbons.

Naming and Drawing Alcohols (Student textbook page 45)

75. Name the alcohol.



What Is Required?

You must name the alcohol.

What Is Given?

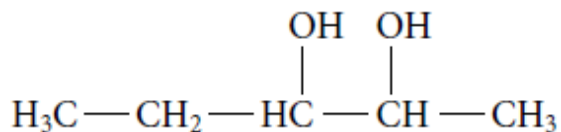
You are given the structural formula for the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The hydroxyl group is attached to a hydrocarbon chain that has four carbon atoms. Therefore, the parent alkane is butane.
Identify the suffix.	The numbering of the carbon atoms in the main chain must start at the end nearest the functional group. There is one hydroxyl group and it is bonded to carbon atom 2. The suffix is -2-ol.
Identify the prefix.	There are no other functional groups attached to the hydrocarbon chain, so there is no prefix.
Write the name.	The suffix begins with a vowel, so omit the -e on the end of the parent alkane. The name of the alcohol is butan-2-ol.

Check Your Solution

There are four carbon atoms in the main chain, with a hydroxyl group on carbon atom 2 and no other functional groups attached. The name correctly reflects the structure.

76. Name the alcohol.



What Is Required?

You must name the alcohol.

What Is Given?

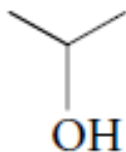
You are given the structural formula for the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The hydroxyl groups are attached to a hydrocarbon chain that has five carbon atoms. Therefore, the parent alkane is pentane.
Identify the suffix.	The numbering of the carbon atoms in the main chain must start at the end nearest the functional group. Therefore, there are hydroxyl groups on carbon atoms 2 and 3. The suffix is -2,3-diol.
Identify the prefix.	There are no other functional groups attached to the hydrocarbon chain, so there is no prefix.
Write the name.	The suffix begins with a consonant, so do not remove the -e on the end of the parent alkane. The name of the alcohol is pentane-2,3-diol.

Check Your Solution

There are five carbon atoms in the main chain, with two hydroxyl groups—one on carbon atom 2 and one on carbon atom 3. The name correctly reflects the structure.

77. Name the alcohol.



What Is Required?

You must name the alcohol.

What Is Given?

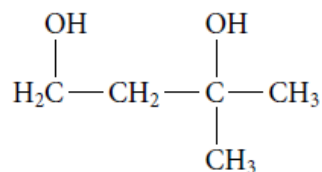
You are given the structural formula for the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The hydroxyl group is attached to a hydrocarbon chain that has three carbon atoms. Therefore, the parent alkane is propane.
Identify the suffix.	The numbering of the carbon atoms in the main chain must start at the end nearest the functional group. In this case, the hydroxyl group is in the centre so numbering could begin at either end. The hydroxyl group is on carbon atom 2. The suffix is -2-ol.
Identify the prefix.	There are no other functional groups attached to the hydrocarbon chain, so there is no prefix.
Write the name.	The suffix begins with a vowel, so omit the -e on the end of the parent alkane. The name of the alcohol is propan-2-ol.

Check Your Solution

There are three carbon atoms in the main chain, with a hydroxyl group on carbon atom 2 and no other functional groups. The name correctly reflects the structure.

78. Name the alcohol.



What Is Required?

You must name the alcohol.

What Is Given?

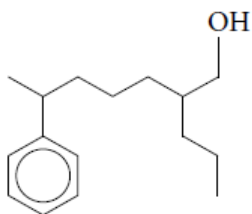
You are given the structural formula for the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The hydroxyl groups are attached to a hydrocarbon chain that has four carbon atoms. Therefore, the parent alkane is butane.
Identify the suffix.	The numbering of the carbon atoms in the main chain must start at the end nearest a functional group. Thus, there are hydroxyl groups on carbon atoms 1 and 3. The suffix is -1,3-diol.
Identify the prefix.	There is a methyl group attached to carbon atom 3, so the prefix is 3-methyl-.
Write the name.	The suffix begins with a consonant, so do not remove the -e on the end of the parent alkane. The name of the alcohol is 3-methylbutane-1,3-diol.

Check Your Solution

There are four carbon atoms in the main chain, with two hydroxyl groups—one on carbon atom 1 and one on carbon atom 3—and a methyl group on carbon atom 3. The name correctly reflects the structure.

79. Name the alcohol.



What Is Required?

You must name the alcohol.

What Is Given?

You are given the structural formula for the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The hydroxyl group is attached to a hydrocarbon chain that has seven carbon atoms. Therefore, the parent alkane is heptane. The numbering of the carbon atoms in the main chain must start at the end nearest the hydroxyl group.
Identify the suffix.	There is a hydroxyl group on carbon atom 1. The suffix is -1-ol.
Identify the prefix.	There is a propyl group attached to carbon atom 2, and a phenyl group attached to carbon atom 6. Hydrocarbon side groups are listed alphabetically in the prefix, so the prefix is 6-phenyl-2-propyl-.
Write the name.	The suffix begins with a vowel, so omit the -e on the end of the parent alkane. The name of the alcohol is 6-phenyl-2-propylheptan-1-ol.

Check Your Solution

There are seven carbon atoms in the main chain, with a hydroxyl group on carbon atom 1, a propyl group on carbon atom 2, and a phenyl group on carbon atom 6. The name correctly reflects the structure.

80. Draw the condensed structural formula for the following alcohol.
ethanol

What Is Required?

You must draw the condensed structural formula for an alcohol.

What Is Given?

You are given the name of the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is ethan-, so there are two carbon atoms in the main chain.
Draw and number the main chain.	$\text{C}_1 - \text{C}_2$
Identify the suffix and draw the side groups.	<p>The suffix is -ol, so the hydroxyl group must be on carbon atom 1.</p> $\begin{array}{c} \text{OH} \\ \\ \text{C}_1 - \text{C}_2 \end{array}$
Identify the prefix and draw the side groups.	There is no prefix, so there are no additional side groups.
Add enough hydrogen atoms to give each carbon atom four bonds.	$\begin{array}{c} \text{OH} \\ \\ \text{H}_2\text{C}_1 - \text{CH}_3_2 \end{array}$

Check Your Solution

The main chain has two carbon atoms, there is a hydroxyl group on carbon atom 1, and all of the carbon atoms have four bonds. The structure is in agreement with the name.


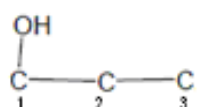
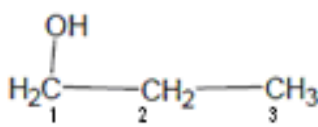
81. Draw the condensed structural formula for the following alcohol.
propan-1-ol

What Is Required?

You must draw the condensed structural formula for an alcohol.

What Is Given?

You are given the name of the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is propan-, so there are three carbon atoms in the main chain.
Draw and number the main chain.	
Identify the suffix and draw the side groups.	The suffix is -1-ol, so the hydroxyl group is on carbon atom 1. 
Identify the prefix and draw the side groups.	There is no prefix, so there are no additional side groups.
Add enough hydrogen atoms to give each carbon atom four bonds.	

Check Your Solution

The main chain has three carbon atoms, there is a hydroxyl group on carbon atom 1, and all of the carbon atoms have four bonds. The structure is in agreement with the name.


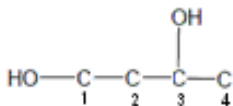
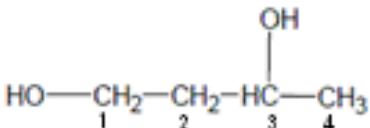
82. Draw the condensed structural formula for the following alcohol.
butane-1,3-diol

What Is Required?

You must draw the condensed structural formula for an alcohol.

What Is Given?

You are given the name of the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is but-, so there are four carbon atoms in the main chain.
Draw and number the main chain.	
Identify the suffix and draw the side groups.	<p>The suffix is -1,3-diol, so there are hydroxyl groups on carbon atoms 1 and 3.</p> 
Identify the prefix and draw the side groups.	There is no prefix, so there are no additional side groups.
Add enough hydrogen atoms to give each carbon atom four bonds.	

Check Your Solution

The main chain has four carbon atoms, there are hydroxyl groups on carbon atoms 1 and 3, and all of the carbon atoms have four bonds. The structure is in agreement with the name.

83. Draw the condensed structural formula for the following alcohol.
3,4-dimethylhexan-2-ol

What Is Required?

You must draw the condensed structural formula for an alcohol.

What Is Given?

You are given the name of the alcohol.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hexan-, so there are six carbon atoms in the main chain.
Draw and number the main chain.	$\begin{array}{cccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the suffix and draw the side groups.	<p>The suffix is -2-ol, so there is a hydroxyl group on carbon atom 2.</p> $\begin{array}{cccccc} & & \text{OH} & & & & \\ & & & & & & \\ \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and draw the side groups.	<p>The prefix is 3,4-dimethyl-, so there are two methyl groups attached to the main chain--one on carbon atom 3 and one on carbon atom 4.</p> $\begin{array}{cccccc} & & \text{OH} & & \text{CH}_3 & & \text{CH}_3 & & & & \\ & & & & & & & & & & \\ \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Add enough hydrogen atoms to give each carbon atom four bonds.	$\begin{array}{cccccc} & & \text{OH} & & \text{CH}_3 & & \text{CH}_3 & & & & \\ & & & & & & & & & & \\ \text{CH}_3 & - & \text{CH} & - & \text{CH} & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$

Check Your Solution

The main chain has six carbon atoms, there is a hydroxyl group on carbon atom 2, and there are methyl groups on carbon atoms 3 and 4. All carbon atoms in the structure have four bonds. The structure is in agreement with the name.

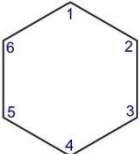
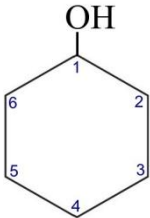
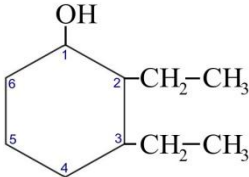
- 84.** Draw the condensed structural formula for the following alcohol.
2,3-diethylcyclohexanol

What Is Required?

You must draw the condensed structural formula for an alcohol.

What Is Given?

You are given the name of the alcohol.

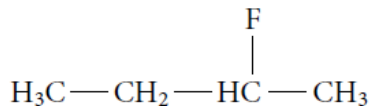
Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is cyclohexan-, so a six carbon aliphatic ring is the main chain.
Draw and number the main chain.	
Identify the suffix and draw the side groups.	<p>The suffix is -ol, so there is a hydroxyl group on carbon atom 1.</p> 
Identify the prefix and draw the side groups.	<p>The prefix is 2,3-diethyl-, so there are two ethyl groups attached to the ring—one on carbon atom 2 and one on carbon atom 3.</p> 
Add enough hydrogen atoms to give each carbon atom four bonds.	When drawing a cyclic structure, the carbon and hydrogen atoms in the main ring are not included. It is assumed that all of the bends are carbon atoms and that they all have enough hydrogen atoms to give each carbon atom four bonds. The structure is complete.

Check Your Solution

The main chain is a cyclic ring with six carbon atoms, there is a hydroxyl group on carbon atom 1, and there are ethyl groups on carbon atoms 2 and 3. The structure is in agreement with the name.

Naming and Drawing Haloalkanes (Student textbook page 49)

85. Name the following haloalkane.



What Is Required?

You must name a haloalkane.

What Is Given?

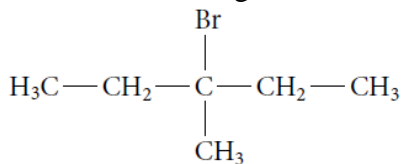
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The chain has four carbon atoms, so the root is butane.
Identify the prefix.	<p>Number the main chain, starting at the end nearest the halogen functional group.</p> $\begin{array}{cccc} & & \text{F} & \\ & & & \\ \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{HC} & - & \text{CH}_3 \\ 4 & & 3 & & 2 & & 1 \end{array}$ <p>There is a fluorine atom on carbon atom 2. The prefix is 2-flouro-.</p>
Name the compound.	2-fluorobutane

Check Your Solution

The halogen received numbering priority, and the number technique provides the lowest possible series of numbers.

86. Name the following haloalkane.



What Is Required?

You must name a haloalkane.

What Is Given?

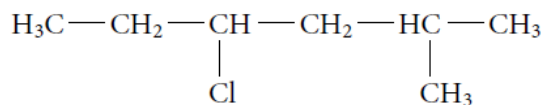
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The chain has five carbon atoms, so the root is pentane.
Identify the prefix.	<p>Number the main chain, starting at the end nearest the halogen functional group. In this case, the halogen atom has the same numbering whether numbered left to right or right to left.</p> $\begin{array}{c} \text{Br} \\ \\ \text{H}_3\text{C}-\text{CH}_2-\text{C}-\text{CH}_2-\text{CH}_3 \\ \\ \text{CH}_3 \\ \text{1} \quad \text{2} \quad \text{3} \quad \text{4} \quad \text{5} \end{array}$ <p>There is a bromine atom on carbon atom 3 and a methyl group on carbon atom 3. The prefix is 3-bromo-3-methyl-.</p>
Name the compound.	3-bromo-3-methylpentane

Check Your Solution

The halogen received numbering priority and the number technique provides the lowest possible series of numbers.

87. Name the following haloalkane.



What Is Required?

You must name the haloalkane.

What Is Given?

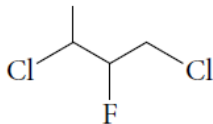
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The chain has six carbon atoms, so the root is hexane.
Identify the prefix	<p>The halogen atom has numbering priority, so the structure should be numbered starting at the end nearest the halogen.</p> $\begin{array}{ccccccc} 1 & 2 & 3 & 4 & 5 & 6 \\ \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{CH} & - & \text{CH}_2 & - & \text{HC} & - & \text{CH}_3 \\ & & & & & & & & & & \\ & & & & \text{Cl} & & & & \text{CH}_3 & & \end{array}$ <p>There is a chlorine atom on carbon atom 3 and a methyl group on carbon atom 5. The prefix is 3-chloro-5-methyl-.</p>
Name the compound.	3-chloro-5-methylhexane

Check Your Solution

The halogen received numbering priority, and the number technique provides the lowest possible series of numbers.

88. Name the following haloalkane.

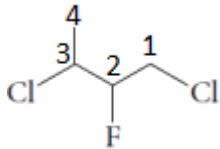


What Is Required?

You must name a haloalkane.

What Is Given?

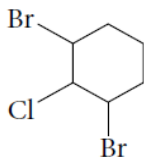
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The chain has four carbon atoms, so the root is butane.
Identify the prefix.	<p>Number the main chain, starting at the end nearest a halogen functional group. The halogens have the lowest numbering when the structure is numbered from right to left.</p>  <p>There is a chlorine atom on carbon atoms 1 and 3 and a fluorine atom on carbon atom 2. The prefix is 1,3-dichloro-2-fluoro-.</p>
Name the compound.	1,3-dichloro-2-fluorobutane

Check Your Solution

The halogen received numbering priority, and the number technique provides the lowest possible series of numbers.

89. Name the following haloalkane.

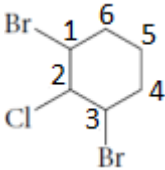


What Is Required?

You must name a haloalkane.

What Is Given?

You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The structure is based on a six-membered ring, so the root is cyclohexane.
Identify the prefix.	<p>The numbering should start with a halogen atom and then continue next to the halogen atom so that the sum of the numbers in the prefix is as small as possible.</p>  <p>There is a bromine atom on carbon atom 1 and 3 and a chlorine atom on carbon atom 2. The prefix is 1,3-dibromo-2-chloro-.</p>
Name the compound.	1,3-dibromo-2-chlorocyclohexane

Check Your Solution

The halogen received numbering priority, and the number technique provides the lowest possible series of numbers.

90. Draw the condensed structural formula for the following haloalkane.
1-iodopropane

What Is Required?

You must draw a condensed structural formula for a haloalkane.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is propane, so there are three carbon atoms in the main chain.
Draw and number the main chain.	$\overset{1}{\text{C}} - \overset{2}{\text{C}} - \overset{3}{\text{C}}$
Identify the prefix and add the side groups and hydrogen atoms.	The prefix is 1-iodo, so there is an iodine atom on carbon 1. $\overset{1}{\text{CH}_2} - \overset{2}{\text{CH}_2} - \overset{3}{\text{CH}_3}$ I

Check Your Solution

The length of the main chain and the position of the side group agree with the name.

- 91.** Draw the condensed structural formula for the following haloalkane.
2-chloro-1-fluoroethane

What Is Required?

You must draw a condensed structural formula for a haloalkane.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is ethane, so there are two carbon atoms in the main chain.
Draw and number the main chain.	$\begin{array}{cc} \text{C} & - & \text{C} \\ 1 & & 2 \end{array}$
Identify the prefix and add the side groups and hydrogen atoms.	<p>The prefix is 2-chloro-1-fluoro-, so there is a chlorine atom on carbon 2 and a fluorine atom on carbon 1.</p> $\begin{array}{ccc} 1 & & 2 \\ \text{H}_2\text{C} & - & \text{CH}_2 \\ & & \\ \text{F} & & \text{Cl} \end{array}$

Check Your Solution

The length of the main chain and the position of the side groups agree with the name.

92. Draw the condensed structural formula for the following haloalkane.
3-bromo-2,2-dimethylpentane

What Is Required?

You must draw a condensed structural formula for a haloalkane.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is pentane, so there are five carbon atoms in the main chain.
Draw and number the main chain.	$\begin{array}{ccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 \end{array}$
Identify the prefix and add the side groups and hydrogen atoms.	<p>The prefix is 3-bromo-2,2-dimethyl so there is a bromine atom on carbon 3 and a two methyl groups on carbon 2.</p> $\begin{array}{ccccccc} & & \text{CH}_3 & \text{Br} & & & \\ & & & / & & & \\ \text{CH}_3 & - & \text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 & & 5 \\ & & & & & & & & \\ & & \text{CH}_3 & & & & & & \end{array}$

Check Your Solution

The length of the main chain and the position of the side groups agree with the name.

93. Draw the condensed structural formula for the following haloalkane.
2,4-dibromo-3-chlorohexane

What Is Required?

You must draw a condensed structural formula for a haloalkane.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is hexane, so there are six carbon atoms in the main chain.
Draw and number the main chain.	$\begin{array}{cccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and add the side groups and hydrogen atoms.	<p>The prefix is 2,4-dibromo-3-chloro, so there is a bromine atom on carbon 2 and 4 and a chlorine atom on carbon 3.</p>

Check Your Solution

The length of the main chain and the position of the side groups agree with the name.

94. Draw the condensed structural formula for the following haloalkane.
1,4-difluoro-3-propylcycloheptane

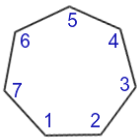
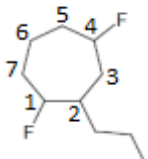
NOTE: Name should be 1,4-difluoro-2-propylcycloheptane

What Is Required?

You must draw a condensed structural formula for a haloalkane.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is cycloheptane, so the structure is based on a seven-membered ring.
Draw and number the main chain.	
Identify the prefix and add the side groups and hydrogen atoms.	The prefix is 1,4-difluoro-2-propyl, so there is a fluorine atom on carbon 1 and 4 and a propyl group on carbon 3. 

Check Your Solution

The size of the ring and the position of the side groups agree with the name.

95. Identify any errors in the following names by drawing a line structure. Give the correct name for each haloalkane.

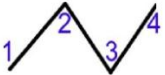
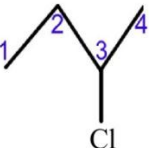
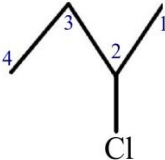
- a. 3-chlorobutane
- b. 4-chloro-3-bromohexane
- c. 2,4-dichlorocyclopentane
- d. 3-chloro-2,2-dimethylbutane


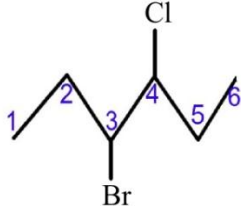
What Is Required?

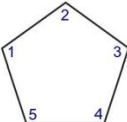
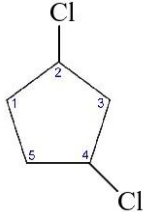
You must draw the line structure according to the name given and then determine the correct name.

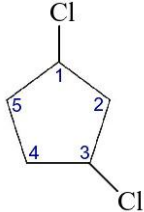
What Is Given?

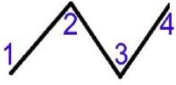
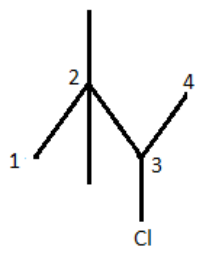
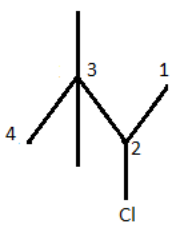
You are given an incorrect name for the structure.

Plan Your Strategy	Act on Your Strategy
a. 3-chlorobutane Identify the root.	The root is but- so the main chain has four carbon atoms.
Identify the suffix.	The suffix is -ane so the main chain has all single bonds. 
Identify the prefix and draw the side groups.	The prefix is 3-chloro- so there is a chlorine atom on carbon atom 3. 
Identify any errors in the name.	The numbering does not begin at the end nearest the functional group.
Correct the naming.	Reverse the numbering and change the prefix to 2-chloro-.  The correct name is 2-chlorobutane.

Plan Your Strategy	Act on Your Strategy
b. 4-chloro-3-bromohexane Identify the root.	The root is hex- so the main chain has six carbon atoms.
Identify the suffix.	The suffix is -ane so the main chain has only single bonds. 
Identify the prefix and draw the side groups.	The prefix is 4-chloro-3-bromo- so there is a chlorine atom on carbon atom 4 and a bromine atom on carbon atom 3. 
Identify any errors in the name.	The prefixes are not written alphabetically. The structure is correct.
Correct the naming.	The correct name is 3-bromo-4-chlorohexane.

Plan Your Strategy	Act on Your Strategy
c. 2,4-dichlorocyclopentane Identify the root.	The root is cyclopent- so the main chain is a five membered ring.
Identify the suffix.	The suffix is -ane so the ring has only single bonds. 
Identify the prefix and draw the side groups.	The prefix is 2,4-dichloro- so there is a chlorine atom on carbon atoms 2 and 4. 
Identify any errors in the name.	The numbering does not start at a functional group.

Correct the naming.	<p>Start the numbering at a chlorine atom and number the ring in the direction of the second chlorine atom.</p>  <p>The correct name is 1,3-dichlorocyclopentane.</p>
---------------------	--

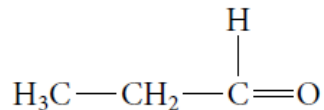
Plan Your Strategy	Act on Your Strategy
d. 3-chloro-2,2-dimethylbutane Identify the root.	The root is but- so the main chain has four carbon atoms.
Identify the suffix.	The suffix is -ane so the main chain has only single bonds. 
Identify the prefix and draw the side groups.	The prefix is 3-chloro-2,2-dimethyl- so there is a chlorine on carbon atom 3 and two methyl groups on carbon atom 2. 
Identify any errors in the name.	The numbering does not start at the end nearest the halogen side group.
Correct the naming.	<p>Reverse the numbering.</p>  <p>The chlorine atom is now on carbon atom 2 and the methyl groups are on carbon atom 3. The correct name is 2-chloro-3,3-dimethylbutane</p>

Check Your Solution

The new names all use correct numbering of the main chain by giving priority to the carbons with the halogen side group and order the prefixes alphabetically.

Naming and Drawing Aldehydes (Student textbook page 52)

96. Name the following aldehyde.



What Is Required?

You must name an aldehyde.

What Is Given?

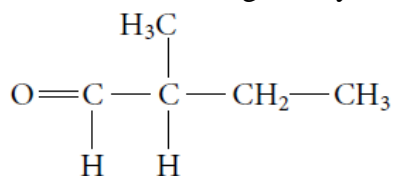
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	There are three carbon atoms in the longest chain including the formyl group, so the root is propan-. <div style="text-align: center;"> <p>The diagram shows the skeletal structure of propanal. It consists of a horizontal chain of three carbon atoms. The rightmost carbon atom is double-bonded to an oxygen atom above it. This carbon is labeled with a blue number '1' below it. The middle carbon atom is labeled with a blue number '2' below it. The leftmost carbon atom is labeled with a blue number '3' below it. A hydrogen atom is shown above the third carbon atom.</p> </div>
Identify the suffix.	The compound is an aldehyde, so the suffix is -al. There are no numbers on the suffix because the formyl group is always on carbon 1.
Identify the prefix.	There are no side groups.
Write the name.	propanal

Check Your Solution

The compound has a formyl group at the beginning of the main chain, so it is an aldehyde. The length of the chain agrees with the name.

97. Name the following aldehyde.



What Is Required?

You must name the aldehyde.

What Is Given?

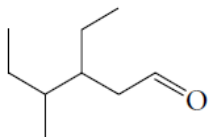
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	There are four carbon atoms in the longest chain, including the formyl group, so the root is butan-. $\begin{array}{c} \text{H}_3\text{C} \\ \\ \text{O}=\overset{1}{\text{C}}-\overset{2}{\text{C}}-\overset{3}{\text{CH}_2}-\overset{4}{\text{CH}_3} \\ \quad \\ \text{H} \quad \text{H} \end{array}$
Identify the suffix.	The compound is an aldehyde so the suffix is -al. There are no numbers on the suffix because the formyl group is always on carbon 1.
Identify the prefix.	There is a methyl group on carbon 2, so the prefix is 2-methyl-.
Write the name.	2-methylbutanal

Check Your Solution

The compound has a formyl group at the beginning of the main chain, so it is an aldehyde. The length of the chain and the name and position of the side group agree with the name.

98. Name the following aldehyde.



What Is Required?

You must name the aldehyde.

What Is Given?

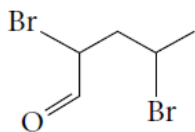
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	There are six carbon atoms in the longest chain, including the formyl group, so the root is hex-.
Identify the suffix.	The first part of the suffix is an- because there are no double bonds within the main chain. The compound is an aldehyde, so the final part of the suffix is -al. There are no numbers on the suffix because the formyl group is always on carbon 1.
Identify the prefix.	There is an ethyl group on carbon 3 and a methyl group on carbon 4, so the prefix is 3-ethyl-4-methyl-.
Write the name.	3-ethyl-4-methylhexanal

Check Your Solution

The compound has a formyl group at the beginning of the main chain, so it is an aldehyde. The length of the chain and the name and position of the side groups agree with the name.

99. Name the following aldehyde.



What Is Required?

You must name the aldehyde.

What Is Given?

You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	There are five carbon atoms in the longest chain including the formyl group, so the root is pent-.
Identify the suffix.	There are no double bonds so an- is included in the suffix. The compound is an aldehyde so the end of the suffix is -al. There are no numbers on the suffix because the formyl group is always on carbon 1.
Identify the prefix.	There is a bromine atom on carbon 2 and 4, so the prefix is 2,4-dibromo-.
Write the name.	2,4-dibromopentanal

Check Your Solution

The compound has a formyl group at the beginning of the main chain, so it is an aldehyde. The length of the chain and the name and position of the side groups agree with the name.

- 100.** Draw the condensed structural formula for the following aldehyde.
3-methylbutanal

What Is Required?

You must draw the condensed structural formula for an aldehyde.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw the main chain.	The root is but-, so there are four carbons in the main chain. The beginning of the suffix is an- so there are only single bonds in the main chain. $\begin{array}{cccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 \end{array}$
Identify the suffix.	The suffix is -al, so it is an aldehyde. The carbon atom in the formyl group is always carbon atom 1. So, add a hydrogen atom and oxygen atom to carbon atom 1. $\begin{array}{ccccccc} & \text{O} & & & & & \\ & // & & & & & \\ \text{H} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & 1 & & 2 & & 3 & & 4 \end{array}$
Identify the prefix and add any side groups and necessary hydrogen atoms to complete the structure	The prefix is 3-methyl-, so there is a methyl group on carbon 3. $\begin{array}{ccccccc} & \text{O} & & & \text{CH}_3 & & \\ & // & & & & & \\ \text{H} & - & \text{C} & - & \text{CH}_2 & - & \text{CH} & - & \text{CH}_3 \\ & 1 & & 2 & & 3 & & 4 \end{array}$

Check Your Solution

The compound has the suffix -al, so it is an aldehyde. The length of the chain and the name and position of the side group agree with the name.

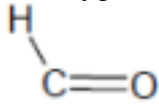
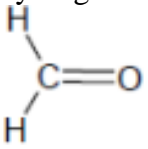
- 101.** Draw the condensed structural formula for the following aldehyde.
methanal (commonly known as formaldehyde)

What Is Required?

You must draw the condensed structural formula for an aldehyde.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw the main chain.	The root is meth-, so there is one carbon in the main chain. With only one carbon atom, there can be no bonds at all so an- is included in the name. C 1
Identify the suffix.	The suffix is -al, so it is an aldehyde. Add a hydrogen atom and oxygen atom to carbon atom 1. 
Identify the prefix and add any side groups and necessary hydrogen atoms to complete the structure.	There is no prefix. Finish the structure by adding another hydrogen atom to carbon atom so that it has 4 bonds. 

Check Your Solution

The compound has the suffix -al, so it is an aldehyde. The length of the chain agrees with the name.

- 102.** Draw the condensed structural formula for the following aldehyde.
2-methylpropanal

What Is Required?

You must draw the condensed structural formula for an aldehyde.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw the main chain.	<p>The root is prop-, so there are three carbon atoms in the main chain. The suffix starts with an- so there are only single bonds within the main chain.</p> $\begin{array}{c} \text{C} - \text{C} - \text{C} \\ 1 \quad 2 \quad 3 \end{array}$
Identify the suffix.	<p>The suffix is -al, so it is an aldehyde. The carbon atom in the formyl group is always carbon atom 1. So, add a hydrogen atom and oxygen atom to carbon atom 1.</p> $\begin{array}{c} \text{O} \\ \parallel \\ \text{H} - \text{C} - \text{C} - \text{C} \\ 1 \quad 2 \quad 3 \end{array}$
Identify the prefix and add any side groups and necessary hydrogen atoms to complete the structure.	<p>The prefix is 2-methyl-, so there is a methyl group on carbon atom 2.</p> $\begin{array}{c} \text{O} \quad \text{CH}_3 \\ \parallel \quad \\ \text{H} - \text{CH} - \text{CH} - \text{CH}_3 \\ 1 \quad 2 \quad 3 \end{array}$

Check Your Solution

The compound has the suffix -al, so it is an aldehyde. The length of the chain and the name and position of the side group agree with the name.

- 103.** Draw the condensed structural formula for the following aldehyde.
2-chloroethanal

What Is Required?

You must draw the condensed structural formula for an aldehyde.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw the main chain.	The root is ethan-, so there are two carbons with only single bonds in the main chain. $\begin{array}{cc} \text{C} & - & \text{C} \\ 1 & & 2 \end{array}$
Identify the suffix.	The suffix is -al, so it is an aldehyde. The carbon atom in the formyl group is always carbon atom 1. So, add a hydrogen atom and oxygen atom to carbon atom 1. $\begin{array}{c} \text{O} \\ \parallel \\ \text{H} - \text{C} - \text{C} \\ 1 \quad 2 \end{array}$
Identify the prefix and add any side groups and necessary hydrogen atoms to complete the structure.	The prefix is 2-chloro-, so there is a chlorine atom on carbon atom 2. $\begin{array}{c} \text{O} \quad \text{Cl} \\ \parallel \quad \\ \text{H} - \text{C} - \text{CH}_2 \\ 1 \quad 2 \end{array}$

Check Your Solution

The compound has the suffix -al, so it is an aldehyde. The length of the chain and the name and position of the side group agree with the name.

- 104.** Draw the condensed structural formula for the following aldehyde.
4,4-diethylhexanal

What Is Required?

You must draw the condensed structural formula for a compound.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw the main chain.	The root is hexan-, so there are six carbon atoms and no double bonds in the main chain. $\begin{array}{cccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the suffix.	The suffix is -al, so it is an aldehyde. The carbon atom in the formyl group is always carbon atom 1. So, add a hydrogen atom and oxygen atom to carbon atom 1. $\begin{array}{ccccccc} & \text{O} & & & & & \\ & \parallel & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the prefix and add any side groups and necessary hydrogen atoms to complete the structure.	The prefix is 4,4-diethyl-, so there are two ethyl groups on carbon 4. $\begin{array}{ccccccc} & & & & \text{CH}_3 & & \\ & & & & & & \\ & & & & \text{CH}_2 & & \\ & & & & & & \\ \text{O} & & & & \text{C} & - & \text{CH}_2 & - & \text{CH}_3 \\ \parallel & & & & & & 5 & & 6 \\ \text{H} & - & \text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{C} & - & \text{CH}_2 & - & \text{CH}_3 \\ & 1 & & 2 & & 3 & & 4 & & 5 & & 6 \\ & & & & & & & & & & & \\ & & & & \text{CH}_2 & & & & & & & \\ & & & & & & & & & & & \\ & & & & \text{CH}_3 & & & & & & & \end{array}$

Check Your Solution

The compound has the suffix -al, so it is an aldehyde. The length of the chain and the name and position of the side group agree with the name.

105. Explain why the following aldehydes are named incorrectly or cannot exist.

a. 2-ethanal

b. 5-ethylhexanal

c. cyclobutanal

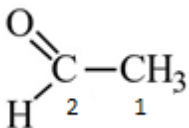
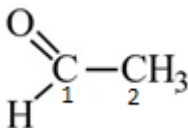
d. 1-fluoropentanal

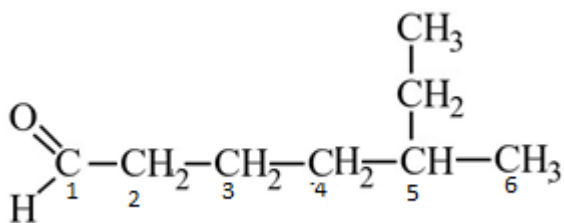
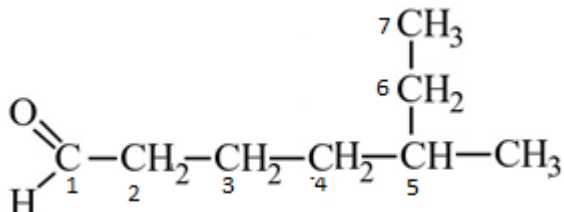
What Is Required?

You must explain why the aldehydes are named incorrectly or why they cannot exist.

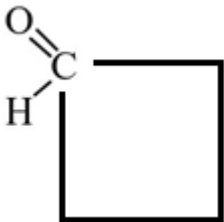
What Is Given?

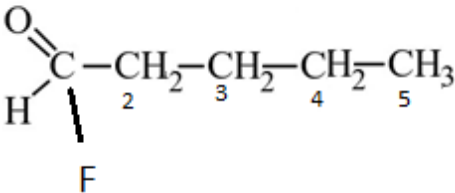
You are given the names of the aldehydes.

Plan Your Strategy	Act on Your Strategy
a. 2-ethanal Draw the structure according to the name.	Number the structure according to the name. 
Renumber the structure correctly.	Numbering priority goes to the carbon in the formyl group, so that carbon must be number 1. 
Name the structure correctly.	The root is ethan-, and the suffix is -al, so the name is ethanal.

Plan Your Strategy	Act on Your Strategy
b. 5-ethylhexanal Draw the structure according to the name.	Number the structure according to the name. 
Renumber the structure correctly.	The longest carbon chain is actually seven carbons long. 
Name the structure	The root is heptan-, and the suffix is -al. The prefix is 5-

correctly.	methyl. The name is 5-methylheptanal.
------------	---------------------------------------

Plan Your Strategy	Act on Your Strategy
c. cyclobutanal Draw the structure according to the name.	Draw the structure according to the name. 
Identify the problem.	An aldehyde must be able to contain a formyl group, but that is impossible because then the carbon in the formyl group would have 5 bonds and carbon can only form 4 bonds. Therefore, this compound cannot exist.

Plan Your Strategy	Act on Your Strategy
d. 1-fluoropentanal Draw the structure according to the name.	Draw the structure according to the name. 
Identify the problem.	If the fluorine atom and the rest of the chain is bonded to the formyl carbon, then carbon 1 will have 5 bonds. This is impossible because carbon can only have 4 bonds. Therefore, this compound cannot exist.

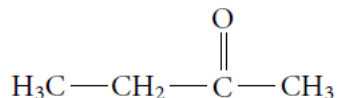
Check Your Solution

Any structure that gives a carbon atom more than four bonds cannot exist thus two of the names describe structures that cannot exist. In one of the compounds, the name did not begin with the carbon atom in the formyl group and in another the main chain had not been correctly described. These errors were corrected and proper names were given.

Naming and Drawing Ketones

(Student textbook page 56)

106. Name the following ketone.



What Is Required?

You must name a ketone.

What Is Given?

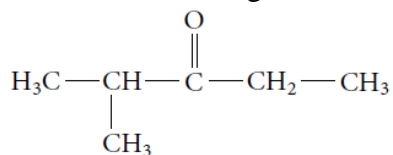
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain containing the carbonyl carbon is four carbon atoms long and has only single bonds. The root is butan-.
Identify the suffix.	Numbering of the main chain begins at the end nearest the carbonyl carbon so it is carbon atom 2. The compound is a ketone, so the suffix is -2-one. $\begin{array}{ccccccc} & & \text{O} & & & & \\ & & \parallel & & & & \\ \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{C} & - & \text{CH}_3 \\ 4 & & 3 & & 2 & & 1 \end{array}$
Identify the prefix.	There are no side groups.
Write the name.	butan-2-one

Check Your Solution

There is a carbonyl group in the structure and not at the end, so it is a ketone. The length of the chain in the name correctly reflects the structure.

107. Name the following ketone.



What Is Required?

You must name a ketone.

What Is Given?

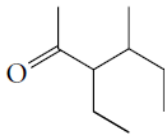
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain containing the carbonyl carbon is five carbon atoms long and has only single bonds. The root is pentan-.
Identify the suffix.	Numbering of the main chain begins at the end nearest the carbonyl carbon so it is carbon atom 3. In this compound, the carbonyl carbon is in the centre of the chain so numbering could start at either end. However, because there is a side group, numbering should be chosen to make the sum of the numbers of side chains and functional groups as small as possible. The compound is a ketone, so the suffix is -3-one. $\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\underset{\text{CH}_3}{\underset{\text{1}}{\text{2}}}-\underset{\text{3}}{\text{C}}-\underset{\text{4}}{\text{CH}_2}-\underset{\text{5}}{\text{CH}_3} \end{array}$
Identify the prefix.	There is a methyl group on carbon atom 2, so the prefix is 2-methyl.
Write the name.	2-methylpentan-3-one

Check Your Solution

There is a carbonyl group in the structure, and not at the beginning, so it is a ketone. The length of the chain in the name and the name and position of the side group correctly reflects the structure.

108. Name the following ketone.

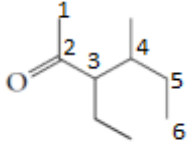


What Is Required?

You must name a ketone.

What Is Given?

You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain containing the carbonyl carbon is six carbon atoms long and has only single bonds. The root is hexan-.
Identify the suffix.	The carbonyl carbon is carbon atom 2, and the compound is a ketone, so the suffix is -2-one. 
Identify the prefix.	There is an ethyl group on carbon atom 3 and a methyl group on carbon atom 4, so the prefix is 3-ethyl-4-methyl.
Write the name.	3-ethyl-4-methyl-hexan-2-one

Check Your Solution

There is a carbonyl group internal to the main chain, so it is a ketone. The name of the length of the chain and the name and position of the side groups correctly reflects the structure.

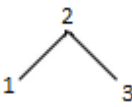
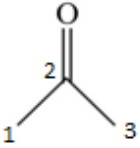
- 109.** Draw the line structural formula for the following ketone.
propanone (commonly known acetone)

What Is Required?

You must draw a line structural formula for a ketone.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw and number the carbon atoms in the main chain.	The root is propan-, so the main chain is 3 carbons long and has only single bonds. 
Identify the suffix and add any necessary structures to the main chain.	The suffix is -one, which means the compound is a ketone. The oxygen must be bonded to carbon 2 in order for it to be a ketone. If the oxygen atom was on either end, it would be an aldehyde. 

Check Your Solution

The compound is a ketone, the length of the chain and the position of the carbonyl carbon agree with the name.

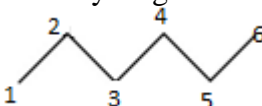
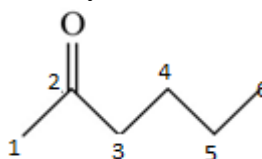
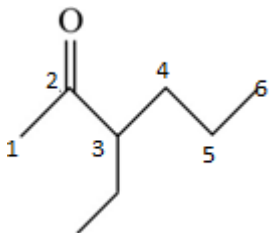
- 110.** Draw the line structural formula for the following ketone.
3-ethylhexan-2-one

What Is Required?

You must draw a line structural formula for a ketone.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw and number the carbon atoms in the main chain.	The root is hexan-, so the main chain is 6 carbons long and has only single bonds. 
Identify the suffix and add any necessary structures to the main chain.	The suffix is -2-one, which means the compound is a ketone. Add the oxygen atom to carbon atom 2 to make it a carbonyl carbon. 
Identify the prefix and add any necessary structures to the main chain.	The prefix is 3-ethyl, so there is an ethyl group on carbon atom 3. 

Check Your Solution

The compound is a ketone, the length of the chain, the position of the carbonyl carbon, and the position of the side group agree with the name.

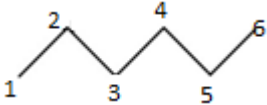
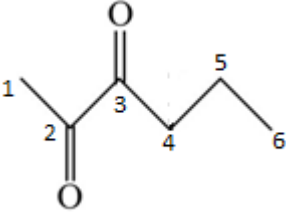
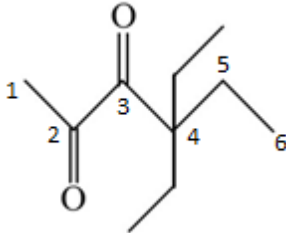
- 111.** Draw the line structural formula for the following ketone.
4,4-diethylhexane-2,3-dione

What Is Required?

You must draw a line structural formula for a ketone.

What Is Given?

You are given the name of the compound.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw and number the carbon atoms in the main chain.	The root is hexan-, so the main chain is 6 carbons long and has only single bonds. 
Identify the suffix and add any necessary structures to the main chain.	The suffix is -2,3-dione, which means the compound is a ketone having two carbonyl carbon atoms. Add the oxygen atom to carbon atom 2 and carbon 3 to make them each carbonyl carbon. 
Identify the prefix and add any necessary structures to the main chain.	The prefix is 4,4-diethyl so there are two ethyl groups on carbon atom 4. 

Check Your Solution

The compound is a ketone, the length of the chain, the position of the carbonyl carbon, and the position of the side group agree with the name.

- 112.** Explain why the following ketone is named incorrectly or cannot exist. If it can exist, give the proper name.
propan-1-one

What Is Required?

You must explain how the ketone is named incorrectly and name it correctly or explain why it cannot exist.

What Is Given?

You are given the name of the ketone.

Plan Your Strategy	Act on Your Strategy
Draw the structure according to the name.	<p>An oxygen atom is placed on carbon atom 1 of a three carbon (prop-) main chain.</p> $ \begin{array}{c} \text{O} \\ \parallel \\ \text{HC} - \text{CH}_2 - \text{CH}_3 \\ \underset{1}{\quad} \quad \underset{2}{\quad} \quad \underset{3}{\quad} \end{array} $
Identify the reason it cannot exist.	<p>When you analyze the structure that has been drawn from the name propan-1-one, you can see that you have drawn an aldehyde. The carbonyl carbon of a ketone must be bonded to two other carbon atoms. That is, it must be within the main chain and not at the end of a chain. Therefore, this name is incorrect because it describes the aldehyde, propanal.</p>

Check Your Solution

The ketone cannot exist because a ketone can never have a numerical assignment of 1. A compound with a carbonyl carbon at the end of a chain and bonded to a hydrogen atom, is an aldehyde.

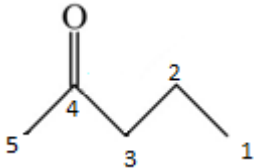
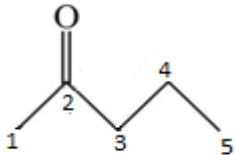
- 113.** Explain why the following ketone is named incorrectly or cannot exist. If it can exist, give the proper name.
pentan-4-one

What Is Required?

You must explain how the ketone is named incorrectly and name it correctly or explain why it cannot exist.

What Is Given?

You are given the name of the ketone.

Plan Your Strategy	Act on Your Strategy
Draw the structure and number it according to the name.	
Number the structure correctly.	<p>The structure should be numbered in order to give the carbonyl carbon the lowest possible number (2).</p>  <p>The original name describes a structure that was incorrectly numbered.</p>
Write the correct name.	The root is pentan- and the suffix is -2-one. The name is pentan-2-one.

Check Your Solution

The structure is a ketone, and the lowest numbering has now been given to the carbonyl carbon. The name now correctly represents the structure.

- 114.** Explain why the following ketone is named incorrectly or cannot exist. If it can exist, give the proper name.

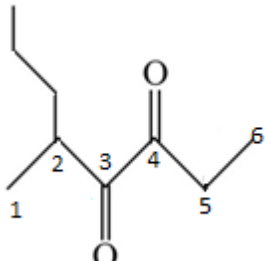
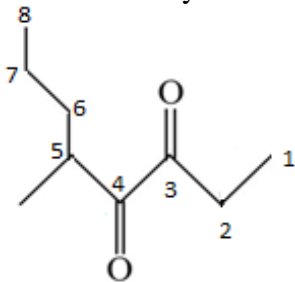
2-propylhexan-3,4-dione

What Is Required?

You must explain how the ketone is named incorrectly and name it correctly or explain why it cannot exist.

What Is Given?

You are given the name of the ketone.

Plan Your Strategy	Act on Your Strategy
Draw the structure and number it according to the name.	
Number the structure correctly.	<p>Number the structure so that the main chain is the longest carbon chain containing the carbonyl carbons. Number so that the carbonyl carbons receive the lowest numbering.</p>  <p>The original name did not use the longest chain as the main chain, leading to an incorrect side group and incorrect numbering.</p>
Name the structure.	<p>The longest chain is 8 carbon atoms long and has only single bonds, so the root is octane-. There is a carbonyl group on carbon atoms 3 and 4, so the structure is a ketone and the suffix is -3,4-dione. There is a methyl group on carbon atom 5, so the prefix is 5-methyl-. The correct name is 5-methyloctane-3,4-dione.</p>

Check Your Solution

The name correctly reflects the longest carbon chain present in the structure. The name and position of the side group and the name of the carbonyl are now correct.

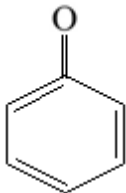
- 115.** Explain why the following ketone is named incorrectly or cannot exist. If it can exist, give the proper name.
benzen-1-one

What Is Required?

You must explain how the ketone is named incorrectly and name it correctly or why it cannot exist.

What Is Given?

You are given the name of the ketone.

Plan Your Strategy	Act on Your Strategy
Draw the structure according to the name.	The name indicates that there is a carbonyl carbon in a benzene ring. 
Explain why the structure cannot exist.	In this structure the carbonyl carbon is forming 5 bonds, but carbon can only have 4 bonds. Therefore this structure cannot exist.

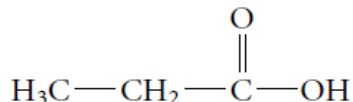
Check Your Solution

This structure cannot exist because carbon atoms can only form 4 bonds and for this structure to exist the carbonyl carbon would have to have 5 bonds.

Naming and Drawing Carboxylic Acids

(Student textbook page 61)

116. Name the following carboxylic acid.



What Is Required?

You must name a carboxylic acid.

What Is Given?

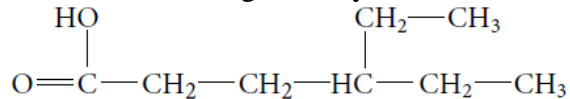
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest carbon chain that includes the carbonyl group is 3 carbon atoms long and has only single bonds. The root is propan-.
Identify the suffix.	The compound is a carboxylic acid, so the suffix is -oic acid.
Identify the prefix.	There are no side groups.
Name the compound.	propanoic acid

Check Your Solution

The compound is a carboxylic acid. The length of the carbon chain and position of the carboxyl group agree with the structure.

117. Name the following carboxylic acid.



What Is Required?

You must name a carboxylic acid.

What Is Given?

You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest carbon chain that includes the carbonyl group is 6 carbon atoms long and has only single bonds. The root is hexan-.
Identify the suffix.	The compound is a carboxylic acid, so the suffix is -oic acid.
Identify the prefix.	There is an ethyl group on carbon atom 4, so the prefix is 4-ethyl.
Name the compound.	4-ethylhexanoic acid

Check Your Solution

The compound is a carboxylic acid. The length of the carbon chain, position of the carboxyl group, and the name and position of the side group agree with the structure.

- 118.** Draw the condensed structural formula for the following carboxylic acid.
butanoic acid (common name: butyric acid)

What Is Required?

You must draw a condensed structural formula for the carboxylic acid.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw and number the carbon chain.	The root is butan-, so the main carbon chain has four carbon atoms with only single bonds. $\begin{array}{ccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 4 & & 3 & & 2 & & 1 \end{array}$
Identify the suffix. Add the necessary atoms to the structure and number the carbon atoms.	The suffix is -oic acid, so it is a carboxylic acid. Add a double bonded oxygen atom and a hydroxyl group to the carbon atom at the end. The carbonyl carbon atom is always number 1. $\begin{array}{ccccccc} & & & & \text{O} & & \\ & & & & & & \\ \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{OH} \\ 4 & & 3 & & 2 & & 1 \end{array}$
Identify the prefix.	There is no prefix so there are no side groups.
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	$\begin{array}{ccccccc} & & & & \text{O} & & \\ & & & & & & \\ \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{C} & - & \text{OH} \\ 4 & & 3 & & 2 & & 1 \end{array}$

Check Your Solution

The compound is a carboxylic acid. The length of the main chain and the position of the carbonyl carbon agree with the name.

- 119.** Draw the condensed structural formula for the following carboxylic acid.
4-ethyloctanoic acid

What Is Required?

You must draw a condensed structural formula for a carboxylic acid.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw and number the carbon chain.	The root is octan-, so the main carbon chain has eight carbon atoms. $\begin{array}{cccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 \end{array}$
Identify the suffix. Add the necessary atoms to the structure.	The suffix is -oic acid, so it is a carboxylic acid. Add a double-bonded oxygen atom and a hydroxyl group to carbon atom number 1. $\begin{array}{cccccccc} \text{HO} & & 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 \\ & & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & \parallel & & & & & & & & & & & & & & \\ & & \text{O} & & & & & & & & & & & & & & \end{array}$
Identify the prefix.	The prefix is 4-ethyl, so there is an ethyl group on carbon atom 4. $\begin{array}{cccccccc} & & & & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & \\ \text{HO} & & 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 \\ & & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & \parallel & & & & & & & & & & & & & \\ & & \text{O} & & & & & & & & & & & & & \end{array}$
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	$\begin{array}{cccccccc} & & & & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & \\ \text{HO} & & 1 & & 2 & & 3 & & 4 & & 5 & & 6 & & 7 & & 8 \\ & & \text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{HC} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ & & \parallel & & & & & & & & & & & & & \\ & & \text{O} & & & & & & & & & & & & & \end{array}$

Check Your Solution

The compound is a carboxylic acid. The length of the main chain, the position of the carboxyl group, and the position of the side group agree with the name.

- 120.** Draw the condensed structural formula for the following carboxylic acid.
3-methyl-4-phenylhexanoic acid

What Is Required?

You must draw a condensed structural formula for a carboxylic acid.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw and number the carbon chain.	<p>The root is hexan-, so the main carbon chain has six carbon atoms.</p> $\begin{array}{cccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 & & 6 \end{array}$
Identify the suffix. Add the necessary atoms to the structure.	<p>The suffix is -oic acid, so it is a carboxylic acid. Add a double-bonded oxygen atom and a hydroxyl group to the carbon atom number 1.</p> $\begin{array}{cccccc} \text{HO} & & 1 & & 2 & & 3 & & 4 & & 5 & & 6 \\ & & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & \parallel & & & & & & & & & & \\ & & \text{O} & & & & & & & & & & \end{array}$
Identify the prefix.	<p>The prefix is 3-methyl-4-phenyl, so there is a methyl group on carbon atom 3 and a phenyl group on carbon atom 4.</p> $\begin{array}{cccccc} \text{HO} & & 1 & & 2 & & \text{CH}_3 & & 4 & & 5 & & 6 \\ & & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & \parallel & & & & & & & & & & \\ & & \text{O} & & & & & & \text{C}_6\text{H}_5 & & & & \end{array}$
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	$\begin{array}{cccccc} & & \text{O} & & \text{CH}_3 & & 4 & & 5 & & 6 \\ & & \parallel & & & & & & & & \\ \text{HO} & - & \text{C} & - & \text{CH}_2 & - & \text{CH} & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_3 \\ & & 1 & & 2 & & 3 & & & & & & \\ & & & & & & & & & & & & \\ & & & & & & \text{C}_6\text{H}_5 & & & & & & \end{array}$

Check Your Solution

The compound is a carboxylic acid. The length of the main chain, the position of the carboxyl group, and the position of the side groups agree with the name.

- 121.** Draw the condensed structural formula for the following carboxylic acid.
pentandioic acid (common name: glutaric acid)

What Is Required?

You must draw a condensed structural formula for a carboxylic acid.

What Is Given?

You are given the name.

Plan Your Strategy	Act on Your Strategy
Identify the root and draw and number the carbon chain.	The root is pentan-, so the main carbon chain has five carbon atoms with only single bonds. $\begin{array}{ccccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ 1 & & 2 & & 3 & & 4 & & 5 \end{array}$
Identify the suffix. Add the necessary atoms to the structure.	The suffix is -dioic acid, so it is a carboxylic acid. Add a double-bonded oxygen atom and a hydroxyl group to both carbon atoms at the two ends of the structure. $\begin{array}{ccccccc} & \text{O} & & & & & \text{O} \\ & // & & & & & // \\ \text{HO} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{OH} \\ & & & & & & & & & & & & \end{array}$
Identify the prefix.	There is no prefix so there are no side groups.
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	$\begin{array}{ccccccc} & \text{O} & & & & & \text{O} \\ & // & & & & & // \\ \text{HO} & - & \text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{C} & - & \text{OH} \\ & & & & & & & & & & & & \end{array}$

Check Your Solution

The compound is a carboxylic acid. The length of the main chain and the position of the carboxyl groups agree with the name.

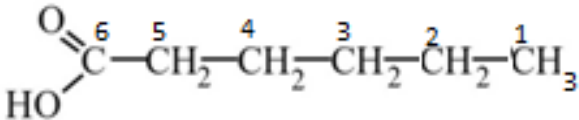
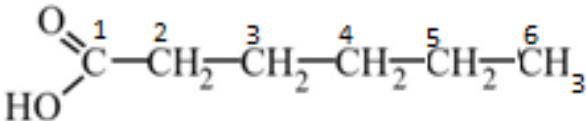
122. Explain why the following carboxylic acid is named incorrectly or cannot exist. If it can exist, give the proper name.
hexan-6-oic acid

What Is Required?

You must explain how the carboxylic acid is named incorrectly and then name it correctly or explain why it cannot exist.

What Is Given?

You are given the name of a carboxylic acid.

Plan Your Strategy	Act on Your Strategy
Draw the structure and number it according to the name.	
Identify any errors.	The carboxyl carbon is always given the number 1. The suffix should not include a number for the carboxyl carbon because it is always number one. (A dicarboxylic acid will have a carboxyl group at both ends of the chain.)
Number the structure correctly.	Number the structure to give the carboxyl carbon the number 1. 
Name the structure correctly.	The root is still hexan-, and the suffix is -oic acid. The name is hexanoic acid.

Check Your Solution

The carboxyl carbon now has the lowest numbering, and the name agrees with the structure.

- 123.** Explain why the following carboxylic acid is named incorrectly or cannot exist. If it can exist, give the proper name.
butan-2-oic acid

What Is Required?

You must explain how the carboxylic acid is named incorrectly and then name it correctly or explain why it cannot exist.

What Is Given?

You are given the name of a carboxylic acid.

Plan Your Strategy	Act on Your Strategy
Draw the structure and number it according to the name.	$ \begin{array}{ccccccc} & & \text{O} & & & & \\ & & & & & & \\ \text{CH}_3 & - & \text{C} & - & \text{CH}_2 & - & \text{CH}_3 \\ 1 & & 2 & & 3 & & 4 \\ & & & & & & \\ & & \text{OH} & & & & \end{array} $
Identify any errors.	If you try to put the carboxyl carbon in the middle of the chain, it would have five bonds which is not possible.
Explain why the structure is not possible.	In this structure, carbon atom 2 has 5 bonds, but carbon can only have 4 bonds. This is the reason that the carboxylic acid group must always be on the end of a carbon chain. Therefore, this structure cannot exist.

Check Your Solution

This structure cannot exist because the carboxylic acid group must always be on the end of the carbon chain and a carbon atom can only form 4 bonds.

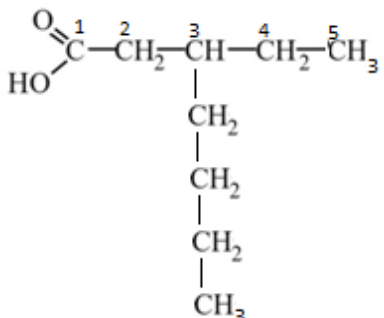
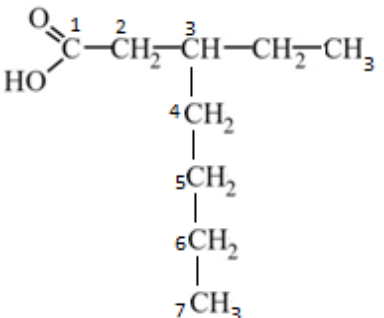
- 124.** Explain why the following carboxylic acid is named incorrectly or cannot exist. If it can exist, give the proper name.
3-butylpentanoic acid

What Is Required?

You must explain how the carboxylic acid is named incorrectly and then name it correctly or explain why it cannot exist.

What Is Given?

You are given the name of a carboxylic acid.

Plan Your Strategy	Act on Your Strategy
Draw the structure and number it according to the name.	
Identify any errors.	The main chain was not identified correctly. It has to be the longest chain that includes the carboxyl group.
Number the structure correctly.	<p>Number the structure so the main chain has the longest carbon chain in the structure and starts at the carboxyl carbon.</p>  <p>The name given did not use the longest chain as the main chain.</p>
Name the structure correctly.	The main chain has 7 carbon atoms, so the root is heptan-. The structure is a carboxylic acid so the suffix is -oic acid. There is an ethyl group on carbon atom 3, so the prefix is 3-ethyl. The correct name is 3-ethylheptanoic acid.

Check Your Solution

The name now includes the longest carbon chain as the main chain, and the side group agrees with the name.

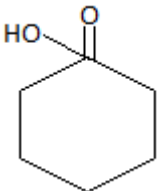
- 125.** Explain why the following carboxylic acid is named incorrectly or cannot exist. If it can exist, give the proper name.
cyclohexanoic acid

What Is Required?

You must explain how the carboxylic acid is named incorrectly and then name it correctly or explain why it cannot exist.

What Is Given?

You are given the name of a carboxylic acid.

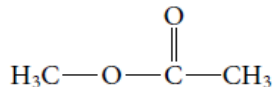
Plan Your Strategy	Act on Your Strategy
Draw the structure.	
Explain why the structure is not possible.	In this structure, the carboxylic acid would have 5 bonds, but carbon atoms can only have 4 bonds. Therefore, this structure cannot exist.

Check Your Solution

The structure cannot exist because carbon can only form four bonds and, therefore, a carboxylic acid cannot exist inside a cyclic hydrocarbon.

Naming and Drawing Esters (Student textbook page 65)

126. Name the following ester.



What Is Required?

You must name an ester.

What Is Given?

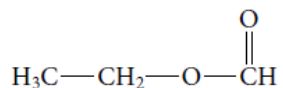
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	<p>The carbonyl carbon atom ($>\text{C}=\text{O}$) is part of a two-carbon group.</p> $\text{H}_3\text{C}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ <p>Thus, the parent acid is ethanoic acid. The root is ethan-.</p>
Identify the suffix.	The compound is an ester, so the suffix is -oate.
Identify the prefix.	<p>The prefix is the name of the alkyl group derived from the parent alcohol. It has one carbon atom, so it is a methyl group. The prefix is methyl-.</p> $\text{H}_3\text{C}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
Write the name.	methylethanoate

Check Your Solution

The compound is an ester. The length of the chain and the alkyl group in the name correctly represent the structure.

127. Name the following ester.



What Is Required?

You must name an ester.

What Is Given?

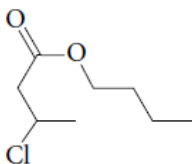
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The $>\text{C}=\text{O}$ carbon atom is part of a one-carbon group. $\text{H}_3\text{C}-\text{CH}_2-\text{O}-\overset{\text{O}}{\parallel}\text{CH}$ Thus, the parent acid is methanoic acid. The root is methan-.
Identify the suffix.	The compound is an ester, so the suffix is -oate.
Identify the prefix.	The prefix is the name of the alkyl group derived from the parent alcohol. It has two carbon atoms, so it is an ethyl group. The prefix is ethyl. $\text{H}_3\text{C}-\text{CH}_2-\text{O}-\overset{\text{O}}{\parallel}\text{CH}$
Write the name.	ethylmethanoate

Check Your Solution

The compound is an ester. The length of the chain and the alkyl group in the name correctly represent the structure.

128. Name the following ester.

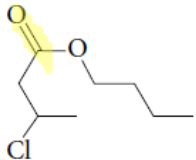
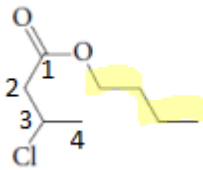


What Is Required?

You must name the ester.

What Is Given?

You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	<p>The $>C=O$ carbon atom is part of a four-carbon group.</p>  <p>Thus, the parent acid is butanoic acid. The root is butan-.</p>
Identify the suffix.	<p>The compound is an ester, so the suffix is -oate.</p>
Identify the prefix.	<p>The prefix has two parts. The first part is based on the name of the alkyl group derived from the parent alcohol. It has four carbon atoms, so it is a butyl group. The prefix is butyl-.</p>  <p>The second part of the prefix is based on the chlorine atom on the main carbon chain on the carbon 3 atom main chain. Thus, the second part of the prefix is 3-chloro-. The prefix is butyl-3-chloro-.</p>
Write the name.	butyl 3-chlorobutanoate

Check Your Solution

The compound is an ester. The length of the chain, the alkyl group, and the side group on the main chain in the name correctly represent the structure.


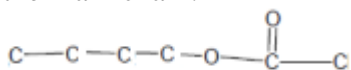
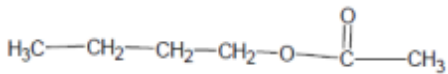
- 129.** Draw the condensed structural formula for the following ester.
butyl ethanoate

What Is Required?

You must draw a condensed structural formula.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is ethan-, so the main carbon chain has two carbon atoms.
Identify the suffix. Draw the basic structure described by the root and the suffix.	The suffix is -oate, so the compound is an ester and related to ethanoic acid. This means that the carbon atom on the end of the main chain is a carbonyl carbon. 
Identify the prefix. Draw the basic part of the structure described by the prefix.	The prefix is butyl, which is related to the alcohol, butanol. Thus the second part of the structure has four carbon atoms bonded, through an oxygen atom, to the carbonyl carbon of the main chain. 
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	

Check Your Solution

If the ester bond was broken by the insertion of water, the products would be ethanoic acid and butanol. This is in agreement with the name.

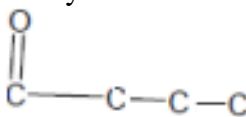

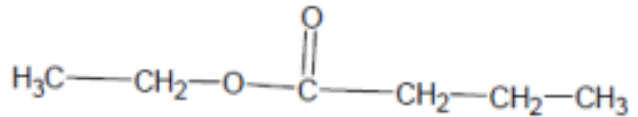
- 130.** Draw the condensed structural formula for the following ester.
ethyl butanoate

What Is Required?

You must draw a condensed structural formula of an ester.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is butan-, so the carbon chain has four carbon atoms.
Identify the suffix. Draw the basic structure described by the root and the suffix.	<p>The suffix is -oate, so the compound is an ester and related to butanoic acid. This means that the carbon atom on the end of the main chain is a carbonyl carbon.</p> 
Identify the prefix. Draw the basic part of the structure described by the prefix.	<p>The prefix is ethyl-, which is related to the alcohol, ethanol. Thus the second part of the structure has two carbon atoms bonded through an oxygen atom, to the carbonyl carbon of the main chain.</p> 
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	

Check Your Solution

If the ester bond was broken by the insertion of water, the products would be butanoic acid and ethanol. This is in agreement with the name.


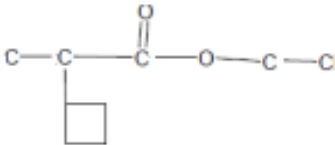
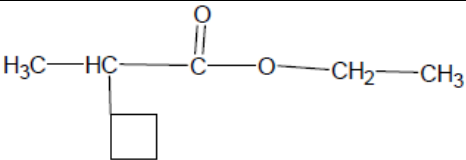
- 131.** Draw the condensed structural formula for the following ester.
ethyl 2-cyclobutylpropanoate

What Is Required?

You must draw a condensed structural formula for an ester.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is propan-, so the main carbon chain has three carbon atoms with only single bonds.
Identify the suffix. Draw the basic structure described by the root and the suffix.	The suffix is -oate, so the compound is an ester and related to propanoic acid. This means that the carbon atom on the end of the main chain is a carbonyl carbon. 
Identify the prefix. Draw the basic part of the structure described by the prefix.	The prefix is ethyl 2-cyclobutyl-, which is related to the alcohol, ethanol. Thus, the second part of the structure has two carbon atoms bonded, through an oxygen atom, to the carbonyl carbon of the main chain. The second part of the prefix is 2-cyclobutyl, so there is a cyclobutyl group on carbon atom 2. 
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	

Check Your Solution

If the ester bond was broken by the insertion of water, the products would be 2-cyclobutylpropanoic acid and ethanol. This is in agreement with the name.


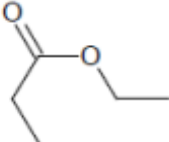
132. Draw the line structure of the ester formed from the following reaction.
propanoic acid and ethanol

What Is Required?

You must draw a line structure of an ester.

What Is Given?

You are given the name of the carboxylic acid and alcohol reactants.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is related to the carboxylic acid, which is propanoic acid. The root is propan-, so the main carbon chain has three carbon atoms with only single bonds.
Identify the suffix. Draw the structure described by the root and the suffix.	The compound is an ester, so the suffix is -oate and related to propanoic acid. This means that the carbon atom on the end of the main chain is a carbonyl carbon. 
Identify the prefix. Draw the structure described by the prefix.	The prefix is related to the alcohol, ethanol. The prefix is ethyl-. Thus the second part of the structure has two carbon atoms bonded, through an oxygen atom, to the carbonyl carbon of the main chain. 

Check Your Solution

When a carboxylic acid and alcohol react, an ester is formed. The carboxylic acid forms the chain with the carbonyl carbon, and the alcohol forms the chain bonded, through an oxygen atom, to the carbonyl carbon of the main chain.

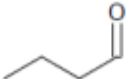
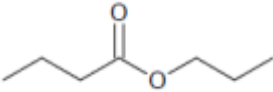
- 133.** Draw the line structure of the ester formed from the following reaction.
butanoic acid and propanol

What Is Required?

You must draw a line structure of an ester.

What Is Given?

You are given the name of the carboxylic acid and alcohol reactants.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is related to the carboxylic acid, which is butanoic acid. The root is butan-, so the main carbon chain has four carbon atoms with only single bonds.
Identify the suffix. Draw the structure described by the root and the suffix.	The compound is an ester, so the suffix is -oate and related to butanoic acid. This means that the carbon atom on the end of the main chain is a carbonyl carbon. 
Identify the prefix. Draw the structure described by the prefix.	The prefix is related to the alcohol, which is propanol. The prefix is propyl-. Thus, the second part of the structure has three carbon atoms bonded, through an oxygen atom, to the carbonyl carbon of the main chain. 

Check Your Solution

When a carboxylic acid and alcohol react, an ester is formed. The carboxylic acid forms the chain with the carbonyl carbon, and the alcohol forms the chain bonded, through an oxygen atom, to the carbonyl carbon of the main chain.

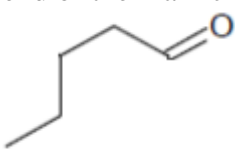
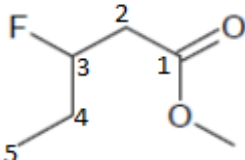
- 134.** Draw the line structure of the ester formed from the following reaction.
3-fluoropentanoic acid and methanol

What Is Required?

You must draw a line structure of an ester.

What Is Given?

You are given the name of the carboxylic acid and alcohol reactants.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is related to the carboxylic acid, which is 3-fluoropentanoic acid. The root is pentan-, so the carbon chain has five carbons.
Identify the suffix. Draw the structure described by the root and the suffix.	The compound is an ester, so the suffix is -oate and related to pentanoic acid. This means that the carbon atom on the end of the main chain is a carbonyl carbon. 
Identify the prefix. Draw the structure described by the prefix and number the main chain carbon atoms.	There are two parts to the prefix. The first part of the prefix is related to the alcohol, which is methanol. The prefix is methyl-. Thus, the second part of the structure has one carbon atom bonded, through an oxygen atom, to the carbonyl carbon of the main chain. The second part of the prefix is -3-flouro-. There is a fluorine atom on carbon atom 3 of the main chain. 

Check Your Solution

When a carboxylic acid and alcohol react, an ester is formed. The carboxylic acid forms the main chain with the carbonyl carbon, and the alcohol forms the chain bonded, through an oxygen atom, to the carbonyl carbon of the main chain.


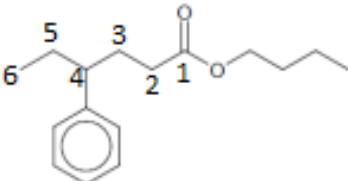
- 135.** Draw the line structure of the ester formed from the following reaction.
butanol and 4-phenylhexanoic acid

What Is Required?

You must draw a line structure of an ester.

What Is Given?

You are given the name of the carboxylic acid and alcohol reactants.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is related to the carboxylic acid, which is 4-phenylhexanoic acid. The root is hexan-, so the carbon chain has six carbons with only single bonds.
Identify the suffix. Draw the structure described by the root and the suffix.	The compound is an ester, so the suffix is -oate and related to hexanoic acid. This means that the carbon atom on the end of the main chain is a carbonyl carbon. 
Identify the prefix. Draw the structure described by the prefix and number the main chain carbon atoms.	There are two parts to the prefix. The first part of the prefix is related to the alcohol, which is butanol. The prefix is butyl-. Thus, the second part of the structure has four carbon atoms bonded, through an oxygen atom, to the carbonyl carbon of the main chain. The second part of the prefix is -4-phenyl-. There is a phenyl group on carbon atom 4. 

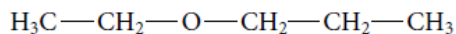
Check Your Solution

When a carboxylic acid and alcohol react, an ester is formed. The carboxylic acid forms the main chain with the carbonyl carbon, and the alcohol forms the chain bonded, through an oxygen atom, to the carbonyl carbon of the main chain.

Naming and Drawing Ethers

(Student textbook page 69)

136. Name the following ether.



What Is Required?

You must name an ether.

What Is Given?

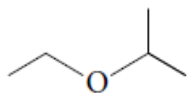
You are given a structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain bonded to the oxygen atom is three carbon atoms long. Therefore, the parent alkane is propane. $\text{H}_3\text{C} - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
Identify the prefix.	The oxygen atom of the alkoxy group is bonded to carbon atom 1 of the main chain. The alkoxy group is two carbon atoms long so the prefix is 1-ethoxy-. $\text{H}_3\text{C} - \text{CH}_2 - \text{O} - \underset{\text{1}}{\text{CH}_2} - \underset{\text{2}}{\text{CH}_2} - \underset{\text{3}}{\text{CH}_3}$
Write the name.	1-ethoxypropane

Check Your Solution

The name of the main chain and the name of the alkoxy group agree with the structure.

137. Name the following ether.



What Is Required?

You must name an ether.

What Is Given?

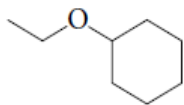
You are given a structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain bonded to the oxygen atom is three carbon atoms long. The parent alkane is propane.
Identify the prefix.	Number the main chain carbon atoms, starting at the end nearest the alkoxy group. The oxygen atom of the alkoxy group is bonded to carbon atom 2 of the main chain. The alkoxy group is two carbon atoms long, so the prefix is 2-ethoxy-.
Write the name.	2-ethoxypropane

Check Your Solution

The name of the main chain and the name of the alkoxy group agree with the structure.

138. Name the following ether.

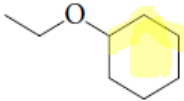
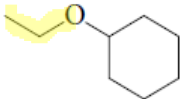


What Is Required?

You must name the ether.

What Is Given?

You are given a structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest chain bonded to the oxygen atom is a six-membered cyclic hydrocarbon. The parent alkane is cyclohexane. 
Identify the prefix.	The oxygen atom of the alkoxy group is bonded to carbon atom 1 of the main chain. The alkoxy group is two carbon atoms long, so the prefix is ethoxy-.  Because it is assumed that, when a cyclic hydrocarbon has only one side group, that group is bonded to carbon atom 1, the number 1 is not included in the name.
Write the name.	ethoxycyclohexane

Check Your Solution

The name of the main chain and the name of the alkoxy group agree with the structure.


139. Draw the condensed structural formula for the following ether.
methoxyethane

What Is Required?

You must draw a condensed structural formula.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The parent alkane is ethane, so the main carbon chain has two carbon atoms.
Identify the prefix.	The prefix is methoxy-. Thus a methyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon 1.
Draw the skeleton of the structure containing the oxygen atom and number the main chain carbon atoms.	
Identify the second part of the prefix. Add necessary groups to the structure.	There is no second part of the prefix so no groups can be added.
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	$\text{H}_3\text{C}-\text{O}-\text{CH}_2-\text{CH}_3$

Check Your Solution

The length and positioning of the main chain and alkoxy group correctly represent the structure.

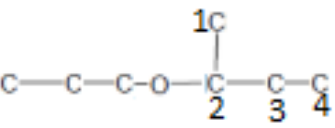
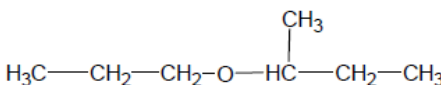
- 140.** Draw the condensed structural formula for the following ether.
2-propoxybutane

What Is Required?

You must draw a condensed structural formula for an ether.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The parent alkane is butane, so the main carbon chain has four carbon atoms.
Identify the prefix.	The prefix is 2-propoxy-. Thus a propyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon 2.
Draw the skeleton of the structure containing the oxygen atom and number the main chain carbon atoms.	
Identify the second part of the prefix. Add necessary groups to the structure.	There is no second part of the prefix so no groups can be added.
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	

Check Your Solution

The length and positioning of the main chain and alkoxy group correctly represent the structure.

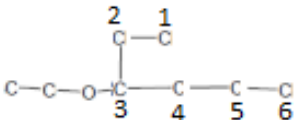
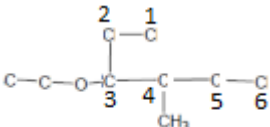
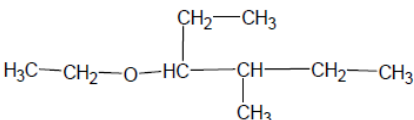
- 141.** Draw the condensed structural formula for the following ether.
3-ethoxy-4-methylhexane

What Is Required?

You must draw a condensed structural formula for an ether.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The parent alkane is hexane, so the main carbon chain has six carbon atoms.
Identify the first part of the prefix.	The first part of the prefix is 3-ethoxy-. Thus an ethyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon 3.
Draw the skeleton of the structure containing the oxygen atom and number the main chain carbon atoms.	
Identify the second part of the prefix. Add necessary groups to the structure.	
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	

Check Your Solution

The length and positioning of the main chain, alkoxy group and side group correctly represent the structure.

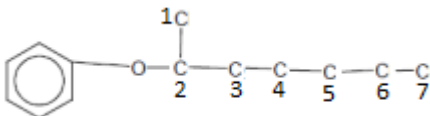
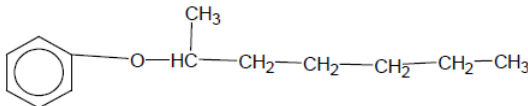
- 142.** Draw the condensed structural formula for the following ether.
2-phenoxyheptane

What Is Required?

You must draw a condensed structural formula for an ether.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The parent alkane is heptane, so the main carbon chain has seven carbon atoms.
Identify the first part of the prefix.	The first part of the prefix is 2-phenoxy-. Thus a phenyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon 2.
Draw the skeleton of the structure containing the oxygen atom and number the main chain carbon atoms.	
Identify the second part of the prefix. Add necessary groups to the structure.	There is no second part of the prefix so no more groups should be added.
Add enough hydrogen atoms to give each carbon atom a total of four bonds.	

Check Your Solution

The length and positioning of the main chain and alkoxy group correctly represent the structure.

- 143.** Explain why the following ether is named incorrectly or cannot exist. If it can exist, give the correct name.
ethoxymethane

What Is Required?

You must explain why the ether cannot exist or if it can exist you must name it correctly.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is methane, so the main chain is one carbon atom long.
Identify the prefix.	The prefix is ethoxy- so an ethyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon atom 2
Identify the problem.	The alkoxy group chain is longer than the main chain. The main chain must always be the longest chain.
Name the structure correctly.	The root is ethane and the prefix is methoxy-. The name is methoxyethane.

Check Your Solution

The main chain contains the longest chain. The name now correctly represents the structure.

- 144.** Explain why the following ether is named incorrectly or cannot exist. If it can exist, give the correct name.
3-propoxybutane

What Is Required?

You must explain why the ether cannot exist or if it can exist you must name it correctly

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is butane, so the main chain is four carbon atoms long.
Identify the prefix.	The prefix is 3-propoxy-, so a propyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon atom 3.
Identify the problem.	<div style="text-align: center;"> $\begin{array}{c} 4 \text{ CH}_3 \\ \\ 3 \text{ CH}_2 \\ \\ \text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{O} - \underset{\text{2}}{\text{CH}} - \underset{\text{1}}{\text{CH}_3} \end{array}$ </div> <p>The main chain was numbered incorrectly. Numbering should begin at the end nearest the alkoxy group. The alkoxy group is actually bonded to carbon atom 2.</p>
Name the structure correctly.	The root is butane and the prefix is 2-propoxy-. The name is 2-propoxybutane.

Check Your Solution

The numbering of the main chain gives the lowest possible number to the alkoxy group. The name correctly reflects the structure.

- 145.** Explain why the following ether is named incorrectly or cannot exist. If it can exist, give the correct name.

4-methoxy-4-methylbutane

What Is Required?

You must explain why the ether cannot exist or, if it can exist, you must name it correctly.

What Is Given?

You are given a name.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is butane, so the main chain is four carbon atoms long.
Identify the prefix.	The prefix is 4-methoxy-4-methyl-, so a methyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon atom 4. There is a methyl group on the main chain at carbon atom 4.
Identify the problem by drawing the structure.	$ \begin{array}{c} 5 \text{ CH}_3 \\ \\ 4 \text{ CH}_2 \\ \\ 3 \text{ CH}_2 \\ \\ \text{CH}_3 - \text{O} - \text{CH} - \text{CH}_3 \\ \quad \quad 2 \quad \quad 1 \end{array} $ <p>The main chain was numbered incorrectly. There is no side group; the main chain is actually 5 carbon atoms long.</p>
Name the structure correctly.	The root is pentane, and the prefix is 2-methoxy-. The name is 2-methoxypentane.

Check Your Solution

The main chain is the longest hydrocarbon chain bonded to the oxygen atom. The name correctly represents the structure.

- 146.** Explain why the following ether is named incorrectly or cannot exist. If it can exist, give the correct name.
2-ethoxybenzene

What Is Required?

You must explain why the ether cannot exist or, if it can exist, you must name it correctly.

What Is Given?

You are given a name.

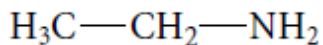
Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is benzene, so the main chain is a six-membered aromatic-hydrocarbon ring.
Identify the prefix.	The prefix is 2-ethoxy, so an ethyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon atom 2.
Identify the problem by drawing the structure.	Since all the carbon atoms in the benzene ring are the same, the alkoxy group should be given the lowest possible number which is one. Because it is assumed that, when a hydrocarbon ring structure has only one side group, it is bonded to carbon atom 1, the number is not included in the name.
Name the structure correctly.	The name is ethoxybenzene.

Check Your Solution

The lowest possible number has been given to the alkoxy group. The name now correctly reflects the structure.

Naming and Drawing Amines (Student textbook page 74)

147. Name the following amine.



What Is Required?

You must name the amine.

What Is Given?

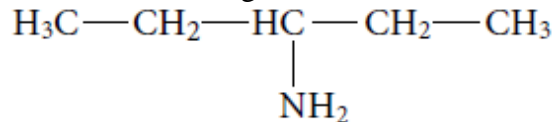
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest carbon chain has two carbon atoms, so the parent alkane is ethane. The root is ethan-.
Identify the suffix.	<p>Number the carbon atoms starting with the carbon atom nearest the nitrogen atom.</p> $\text{H}_3\text{C} - \text{CH}_2 - \text{NH}_2$ <p style="text-align: center;">2 1</p> <p>Carbon atom 1 is bonded to the nitrogen, so the suffix is -amine. This is a primary amine so the name is complete.</p>
Identify the prefix.	This is a primary amine and there are no side groups so the name is complete.
Write the name.	ethanamine

Check Your Solution

The compound has a nitrogen atom bonded to carbon atom 1 of a two-carbon chain. The two carbon atoms are bonded by a single bond. There are no side groups. The name reflects this.

148. Name the following amine.



What Is Required?

You must name the amine.

What Is Given?

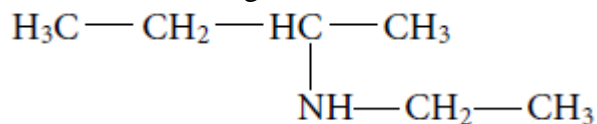
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest carbon chain has five carbon atoms, so the parent alkane is pentane. The root is pentan-.
Identify the suffix.	<p>Number the carbon atoms starting at the end of the main chain nearest the nitrogen atom.</p> $\begin{array}{c} \overset{1}{\text{H}_3\text{C}}-\overset{2}{\text{CH}_2}-\overset{3}{\text{HC}}-\overset{4}{\text{CH}_2}-\overset{5}{\text{CH}_3} \\ \\ \text{NH}_2 \end{array}$ <p>Carbon atom 3 is bonded to the nitrogen, so the suffix is -3-amine.</p>
Identify the prefix.	This is a primary amine and there are no side groups so the name is complete.
Write the name.	pentan-3-amine

Check Your Solution

The compound has a nitrogen atom bonded to carbon atom 3 of a five-carbon chain. There are no side groups. All carbon-carbon bonds are single bonds. The name reflects this.

149. Name the following amine.



What Is Required?

You must name the amine.

What Is Given?

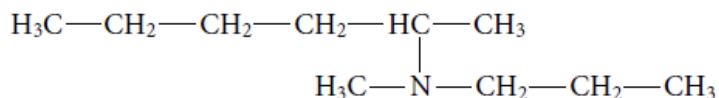
You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest carbon chain has four carbon atoms, so the parent alkane is butane. The root is butan-.
Identify the suffix.	<p>Number the carbon atoms starting at the end of the main chain nearest the nitrogen atom.</p> $\begin{array}{c} 4 \qquad 3 \qquad 2 \qquad 1 \\ \text{H}_3\text{C} - \text{CH}_2 - \text{HC} - \text{CH}_3 \\ \\ \text{NH} - \text{CH}_2 - \text{CH}_3 \end{array}$ <p>Carbon atom 2 is bonded to the nitrogen, so the suffix is -2-amine.</p>
Identify the prefix.	There is an ethyl group bonded to the nitrogen atom. So, the prefix is N-ethyl.
Write the name.	N-ethylbutan-2-amine

Check Your Solution

The compound has a nitrogen atom bonded to carbon atom 2 of a four-carbon chain. All carbon-carbon bonds are single bonds. There is an ethyl group bonded to the nitrogen. The name reflects this.

150. Name the following amine.



What Is Required?

You must name the amine.

What Is Given?

You are given the structure.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The longest carbon chain has six carbon atoms, so the parent alkane is hexane. The root is hexan-.
Identify the suffix.	<p>Number the carbon atoms starting at the end of the main chain nearest the nitrogen atom.</p> $\begin{array}{c} \text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{HC}-\text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{N}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array}$ <p>Carbon atom 2 is bonded to the nitrogen, so the suffix is -2-amine.</p>
Identify the prefix.	There is a propyl and methyl group bonded to the nitrogen atom. So, the prefix is N-methyl-N-propyl-.
Write the name.	N-methyl-N-propylhexan-2-amine

Check Your Solution

The compound has a nitrogen atom bonded to carbon atom 2 of a six-carbon chain. There is a methyl group and a propyl group bonded to the nitrogen. All carbon-carbon bonds are single bonds. The name reflects this.

- 151.** Draw the condensed structural formula for the following amine.
methanamine

What Is Required?

You must draw a condensed structural formula for an amine.

What Is Given?

You are given the name of the amine.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is methan-, so the longest chain is one carbon atom long.
Identify the suffix that indicates the position at which the nitrogen atom is bonded to the main chain. Draw the skeleton of the nitrogen atom and the main chain.	The suffix is -amine, which means that carbon atom 1 is bonded to the nitrogen atom $\text{C} - \text{N}$ 1
Identify the prefix.	There is no prefix so there are no other groups bonded to the amine.
Add enough hydrogen atoms so that the nitrogen has a total of three bonds and each carbon has a total of four bonds.	$\text{H}_3\text{C} - \text{NH}_2$

Check Your Solution

The longest carbon chain is one carbon atom long, and it is bonded to the nitrogen atom. The structure agrees with the name.

- 152.** Draw the condensed structural formula for the following amine.
N-propylbutan-1-amine

What Is Required?

You must draw a condensed structural formula for an amine.

What Is Given?

You are given the name of the amine.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is butan-, so the longest chain is four carbon atoms long and has only single bonds.
Identify the suffix that indicates the position at which the nitrogen atom is bonded to the main chain. Draw the skeleton of the nitrogen atom and the main chain.	The suffix is -1-amine, which means that carbon atom 1 is bonded to the nitrogen atom. $\begin{array}{ccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{N} \\ 4 & & 3 & & 2 & & 1 & & \end{array}$
Identify the prefix and draw the necessary structures.	The prefix is N-propyl, so there is a propyl group on the nitrogen atom. $\begin{array}{ccccccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{N} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ 4 & & 3 & & 2 & & 1 & & & & & & & & \end{array}$
Add enough hydrogen atoms so that the nitrogen has a total of three bonds and each carbon has a total of four bonds.	$\text{}^4\text{H}_3\text{C} - \text{}^3\text{CH}_2 - \text{}^2\text{CH}_2 - \text{}^1\text{CH}_2 - \text{NH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$

Check Your Solution

The longest carbon chain is four carbon atoms long, and carbon atom 1 is bonded to the nitrogen atom. There is a propyl group bonded to the nitrogen. All carbon-carbon bonds are single bonds. The structure agrees with the name.

- 153.** Draw the condensed structural formula for the following amine.
hexan-1,4-diamine

What Is Required?

You must draw a condensed structural formula for an amine.

What Is Given?

You are given the name of the amine.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is hexan-, so the longest chain is six carbon atoms long and has only single bonds.
Identify the suffix which indicates the position at which the nitrogen atom is bonded to the main chain. Draw the skeleton of the nitrogen atom and the main chain.	<p>The suffix is -1,4-diamine, which means that carbon atom 1 and carbon atom 4 are bonded to a nitrogen atom.</p> $ \begin{array}{cccccc} 1 & & 2 & & 3 & & 4 & & 5 & & 6 \\ \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & & & & & & & & & \\ \text{N} & & & & & & \text{N} & & & & \end{array} $
Identify the prefix and draw the necessary structures.	There is no prefix so there are no side groups.
Add enough hydrogen atoms so that the nitrogen has a total of three bonds and each carbon has a total of four bonds.	$ \begin{array}{cccccc} 1 & & 2 & & 3 & & 4 & & 5 & & 6 \\ \text{H}_2\text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{HC} & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & & & & & \\ \text{NH}_2 & & & & & & \text{NH}_2 & & & & \end{array} $

Check Your Solution

The longest carbon chain is six carbon atoms long and carbon atom 1 and 4 are bonded to nitrogen atoms. All carbon-carbon bonds are single bonds. The structure agrees with the name.

- 154.** Draw the condensed structural formula for the following amine.
N-ethyl-N-methylheptan-3-amine

What Is Required?

You must draw a condensed structural formula for an amine.

What Is Given?

You are given the name of the amine.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is heptan-, so the longest chain is seven carbon atoms long and has only single bonds.
Identify the suffix that indicates the position at which the nitrogen atom is bonded to the main chain. Draw the skeleton of the nitrogen atom and the main chain.	<p>The suffix is -3-amine, which means that carbon atom 3 is bonded to a nitrogen atom.</p> $ \begin{array}{ccccccc} 7 & & 6 & & 5 & & 4 & & 3 & & 2 & & 1 \\ \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & & & & & & & & & & & \\ & & & & & & & & \text{N} & & & & \end{array} $
Identify the prefix and draw the necessary structures.	<p>The prefix is N-ethyl-N-methyl-, so there is an ethyl and a methyl group bonded to the nitrogen.</p> $ \begin{array}{ccccccc} 7 & & 6 & & 5 & & 4 & & 3 & & 2 & & 1 \\ \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\ & & & & & & & & & & & & \\ & & & & & & & & \text{H}_3\text{C} - \text{N} - \text{CH}_2 - \text{CH}_3 & & & & \end{array} $
Add enough hydrogen atoms so that the nitrogen has a total of three bonds and each carbon has a total of four bonds.	$ \begin{array}{ccccccc} 7 & & 6 & & 5 & & 4 & & 3 & & 2 & & 1 \\ \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & & & & & & & \\ & & & & & & & & \text{H}_3\text{C} - \text{N} - \text{CH}_2 - \text{CH}_3 & & & & \end{array} $

Check Your Solution

The longest carbon chain is seven carbon atoms long, and carbon atom 3 is bonded to the nitrogen atom. All carbon-carbon bonds are single bonds. There is a methyl and an ethyl group bonded to the nitrogen. The structure agrees with the name.

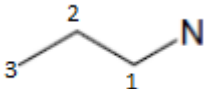
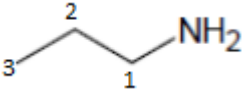
- 155.** Draw the line structure for the following amine.
propan-1-amine

What Is Required?

You must draw a line structure for an amine.

What Is Given?

You are given the name of the amine.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is propan-, so the longest chain is three carbon atoms long and has only single bonds.
Identify the suffix that indicates the position at which the nitrogen atom is bonded to the main chain. Draw the main chain and the nitrogen atom.	The suffix is -1-amine, which means that carbon atom 1 is bonded to a nitrogen atom. 
Identify the prefix and draw the necessary structures.	There is no prefix.
Add enough hydrogen atoms so that the nitrogen has a total of three bonds.	Hydrogen atoms are not included in line structures but are assumed to be present to account for all necessary bonds for carbon atoms. 

Check Your Solution

The longest carbon chain is three carbon atoms long, and carbon atom 1 is bonded to the nitrogen atom. All carbon-carbon bonds are single bonds. The structure agrees with the name.

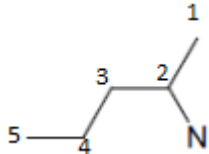
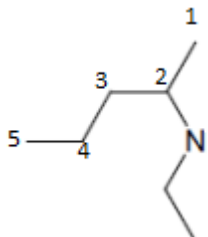
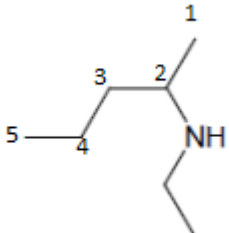
156. Draw the line structure for the following amine.
N-ethyl-pentan-2-amine

What Is Required?

You must draw a line structure.

What Is Given?

You are given the name of an amine.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is pentan-, so the longest chain is five carbon atoms long and has only single bonds.
Identify the suffix that indicates the position at which the nitrogen atom is bonded to the main chain. Draw the main chain and the nitrogen atom.	The suffix is -2-amine, which means that carbon atom 2 is bonded to a nitrogen atom. 
Identify the prefix and draw the necessary structures.	The prefix is N-ethyl-, so there is an ethyl group bonded to the nitrogen atom. 
Add enough hydrogen atoms so that the nitrogen has a total of three bonds	Hydrogen atoms are not included in line structures but are assumed to be present to account for all necessary bonds for carbon atoms. 

Check Your Solution

The longest carbon chain is five carbon atoms long, and carbon atom 2 is bonded to the nitrogen atom. The nitrogen has an ethyl group bonded to it. All carbon-carbon bonds are single bonds. The structure agrees with the name.

157. Draw the line structure for the following amine.

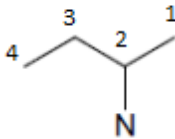
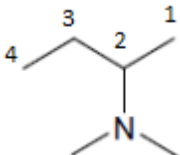
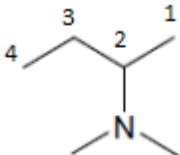
N,N-dimethylbutan-2-amine

What Is Required?

You must draw a line structure for an amine.

What Is Given?

You are given the name of the amine.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is butan-, so the longest chain is four carbon atoms long and has only single bonds.
Identify the suffix that indicates the position at which the nitrogen atom is bonded to the main chain. Draw the main chain and the nitrogen atom.	The suffix is -2-amine, which means that carbon atom 2 is bonded to a nitrogen atom. 
Identify the prefix and draw the necessary structures.	The prefix is N,N-dimethyl-, so there are two methyl groups bonded to the nitrogen atom. 
Add enough hydrogen atoms so that the nitrogen has a total of three bonds.	Hydrogen atoms are not included in line structures but are assumed to be present to account for all necessary bonds for carbon atoms. 

Check Your Solution

The longest carbon chain is four carbon atoms long, and carbon atom 2 is bonded to the nitrogen atom. The nitrogen has two methyl groups bonded to it. All carbon-carbon bonds are single bonds. The structure agrees with the name.

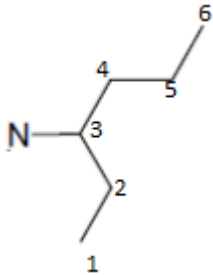
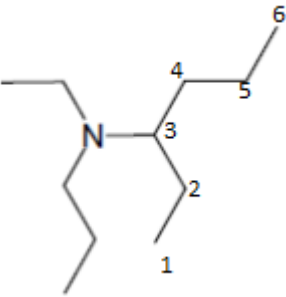
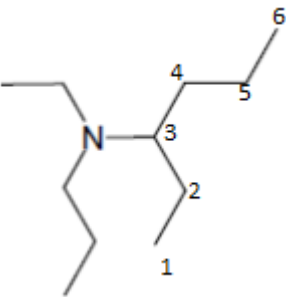
- 158.** Draw the line structure for the following amine.
N-ethyl-N-propylhexan-3-amine

What Is Required?

You must draw a line structure for an amine.

What Is Given?

You are given the name of the amine.

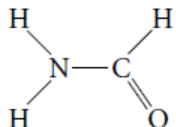
Plan Your Strategy	Act on Your Strategy
Identify the root of the name.	The root is hexan-, so the longest chain is six carbon atoms long and has only single bonds.
Identify the suffix that indicates the position at which the nitrogen atom is bonded to the main chain. Draw the main chain and the nitrogen atom.	The suffix is -3-amine, which means that carbon atom 3 is bonded to a nitrogen atom. 
Identify the prefix and draw the necessary structures.	The prefix is N-ethyl-N-propyl-, so there is an ethyl and a propyl group bonded to the nitrogen atom. 
Add enough hydrogen atoms so that the nitrogen has a total of three bonds.	Hydrogen atoms are not included in line structures but are assumed to be present to account for all necessary bonds for carbon atoms. 

Check Your Solution

The longest carbon chain is six carbon atoms long, and carbon atom 3 is bonded to the nitrogen atom. The nitrogen atom has an ethyl and a propyl group bonded to it. All carbon-carbon bonds are single bonds. The structure agrees with the name.

Naming and Drawing Amides (Student textbook page 79)

159. Name the following amide.



What Is Required?

You must name an amide.

What Is Given?

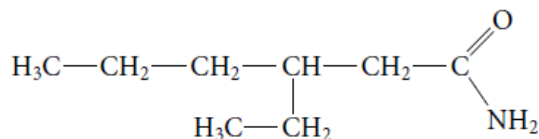
You are given the structure of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The carbon chain containing the carbonyl group has one carbon atom, so the root is methan-.
Identify the suffix.	The compound contains a -CON- functional group, so the suffix is -amide.
Identify the prefix.	There are no side groups on the main chain or the nitrogen atom so there is no prefix.
Write the name.	methanamide

Check Your Solution

The compound contains a -CON- functional group. The $>\text{C}=\text{O}$ group is part of a one-carbon chain. The name correctly reflects the structure.

160. Name the following amide.



What Is Required?

You must name an amide.

What Is Given?

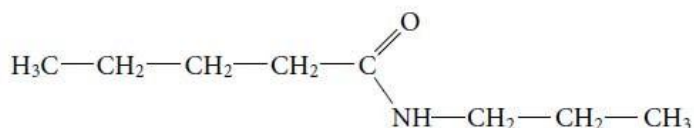
You are given the structure of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The carbon chain containing the carbonyl group has six carbon atoms and only single bonds, so the root is hexan-. $\begin{array}{ccccccc} 6 & 5 & 4 & 3 & 2 & 1 & \\ \text{H}_3\text{C} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH} & -\text{CH}_2 & -\text{C} & \begin{array}{l} \text{O} \\ \parallel \\ \text{NH}_2 \end{array} \\ & & & & & & \\ & & & \text{H}_3\text{C}-\text{CH}_2 & & & \end{array}$
Identify the suffix.	The compound contains a -CON- functional group, so the suffix is -amide.
Identify the prefix.	There is an ethyl group bonded to carbon atom 3, so the prefix is 3-ethyl.
Write the name.	3-ethylhexanamide

Check Your Solution

The compound contains a -CON- functional group. The $>\text{C}=\text{O}$ group is part of a six-carbon chain. There is an ethyl group bonded to the main chain at carbon atom 3. All carbon-carbon bonds are single bonds. The name correctly reflects the structure.

161. Name the following amide.



What Is Required?

You must name an amide.

What Is Given?

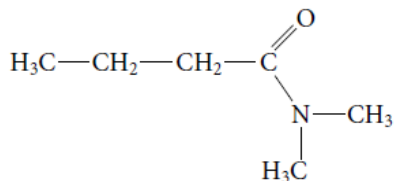
You are given the structure of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root.	<p>The carbon chain containing the carbonyl group has five carbon atoms and only single bonds, so the root is pentan-.</p> $\begin{array}{ccccccc} 5 & 4 & 3 & 2 & 1 & & \\ \text{H}_3\text{C} & -\text{CH}_2- & \text{CH}_2- & \text{CH}_2- & \text{C} & & \\ & & & & \text{=O} & & \\ & & & & \text{NH}-\text{CH}_2-\text{CH}_2-\text{CH}_3 & & \end{array}$
Identify the suffix.	The compound contains a -CON- functional group, so the suffix is -amide.
Identify the prefix.	There is a propyl group bonded to the nitrogen atom, so the prefix is N-propyl.
Write the name.	N-propylpentanamide

Check Your Solution

The compound contains a -CON- functional group. The >C=O group is part of a five-carbon chain. There is a propyl group bonded to the nitrogen atom. All carbon-carbon bonds are single bonds. The name correctly reflects the structure.

162. Name the following amide.

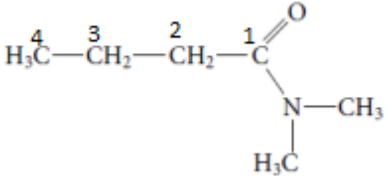


What Is Required?

You must name an amide.

What Is Given?

You are given the structure of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The carbon chain containing the carbonyl group has four carbon atoms and only single bonds, so the root is butan-. 
Identify the suffix.	The compound contains a -CON- functional group, so the suffix is -amide.
Identify the prefix.	There are two methyl groups bonded to the nitrogen atom, so the prefix is N,N-dimethyl-.
Write the name.	N,N-dimethylbutanamide

Check Your Solution

The compound contains a -CON- functional group. The $>\text{C}=\text{O}$ group is part of a four-carbon chain. There are two methyl groups bonded to the nitrogen atom. All carbon-carbon bonds are single bonds. The name correctly reflects the structure.

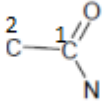
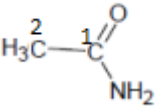
- 163.** Draw the condensed structural formula for the following amide.
ethanamide

What Is Required?

You must draw a condensed structural formula for an amide.

What Is Given?

You are given the name of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name. Draw the structure that is described by the root and suffix.	The root is ethan-, indicating that there are two carbon atoms, bonded by a single bond, in the chain containing the carbonyl carbon of the amide group. 
Identify the prefix and draw necessary structures.	There is no prefix.
Add enough hydrogen atoms to give the nitrogen atom a total of three bonds and each carbon atom a total of four bonds.	

Check Your Solution

The chain containing the carbonyl carbon has two carbon atoms bonded by a single bond. The carbonyl carbon atom is bonded to a nitrogen atom. There are no side groups on the main chain or the nitrogen atom. The structure agrees with the name.

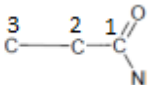
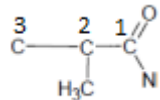
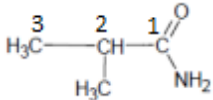
- 164.** Draw the condensed structural formula for the following amide.
2-methylpropanamide

What Is Required?

You must draw a condensed structural formula for an amide.

What Is Given?

You are given the name of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name. Draw the structure that is described by the root and suffix.	The root is propan-, indicating that there are three carbon atoms, bonded by single bonds, in the chain containing the carbonyl carbon of the amide group. 
Identify the prefix and draw necessary structures.	The prefix is 2-methyl-. There is a methyl group bonded to carbon atom 2. 
Add enough hydrogen atoms to give the nitrogen atom a total of three bonds and each carbon atom a total of four bonds.	

Check Your Solution

The chain containing the carbonyl carbon atom has three carbon atoms. The carbonyl carbon atom is bonded to a nitrogen atom. There is a methyl group bonded to carbon atom 2 of the main chain. All carbon-carbon bonds are single bonds. The structure agrees with the name.

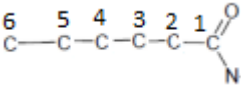
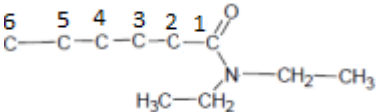
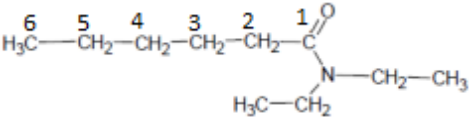
- 165.** Draw the condensed structural formula for the following amide.
N,N-diethylhexanamide

What Is Required?

You must draw a condensed structural formula for an amide.

What Is Given?

You are given the name of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name. Draw the structure that is described by the root and suffix.	<p>The root is hexan-, indicating that there are six carbons, bonded by single bonds, in the chain containing the carbonyl carbon of the amide group.</p> 
Identify the prefix and draw necessary structures.	<p>The prefix is N,N-diethyl-. There are two ethyl groups bonded to the nitrogen atom.</p> 
Add enough hydrogen atoms to give the nitrogen atom a total of three bonds and each carbon atom a total of four bonds.	

Check Your Solution

The chain containing the carbonyl carbon has six carbon atoms. The carbonyl carbon atom is bonded to a nitrogen atom. All carbon-carbon bonds are single bonds. There are two ethyl groups also bonded to the nitrogen atom. The structure agrees with the name.

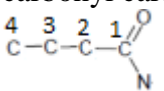
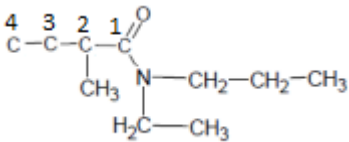
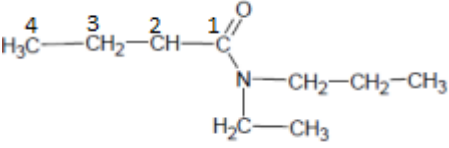
166. Draw the condensed structural formula for the following amide.
N-ethyl-N-propyl-2-methylbutanamide

What Is Required?

You must draw a condensed structural formula for an amide.

What Is Given?

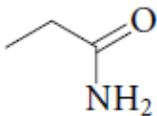
You are given the name of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root of the name. Draw the structure that is described by the root and suffix.	The root is butan-, indicating that there are four carbon atoms, bonded by single bonds, in the chain containing the carbonyl carbon of the amide group. 
Identify the prefix and draw necessary structures.	The prefix is N-ethyl-N-propyl-2-methyl-. There is an ethyl and a propyl group bonded to the nitrogen atom and a methyl group bonded to carbon atom 2 of the main chain. 
Add enough hydrogen atoms to give the nitrogen atom a total of three bonds and each carbon atom a total of four bonds.	

Check Your Solution

The chain containing the carbonyl carbon has four carbon atoms. The carbonyl carbon atom is bonded to a nitrogen atom. There are an ethyl and propyl group also bonded to the nitrogen atom. There is a methyl group bonded to carbon atom 2 of the main chain. All carbon-carbon bonds are single bonds. The structure agrees with the name.

167. Name the following amide.

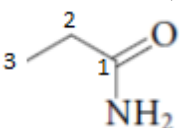


What Is Required?

You must name an amide.

What Is Given?

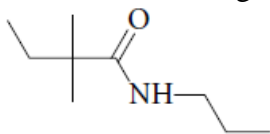
You are given the structure of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The carbon chain containing the carbonyl carbon has three carbon atoms, bonded by single bonds, so the root is propan- 
Identify the suffix.	The compound contains a -CON- functional group so the suffix is -amide.
Identify the prefix.	There are no side groups on the main chain or on the nitrogen atom so there is no prefix.
Write the name.	propanamide

Check Your Solution

The compound contains a -CON- functional group. The $>\text{C}=\text{O}$ group is part of a three-carbon chain. There are no side groups. All carbon-carbon bonds are single bonds. The name correctly reflects the structure.

168. Name the following amide.



What Is Required?

You must name an amide.

What Is Given?

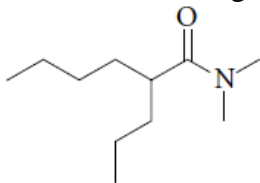
You are given the structure of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The carbon chain containing the carbonyl carbon has four carbon atoms bonded by single bonds, so the root is butan-.
Identify the suffix.	The compound contains a -CON- functional group so the suffix is -amide.
Identify the prefix.	There is a propyl group bonded to the nitrogen atom so the first part of the prefix is N-propyl. There are two methyl groups bonded to carbon atom 2 of the main chain so the second part of the prefix is 2,2-dimethyl. The prefix is N-propyl-2,2-dimethyl.
Write the name.	N-propyl-2,2-dimethylbutanamide

Check Your Solution

The compound contains a -CON- functional group. The $>\text{C}=\text{O}$ group is part of a four-carbon chain. There are two methyl groups bonded to the carbon atom 2 of the main chain, and a propyl group bonded to the nitrogen atom. All carbon-carbon bonds are single bonds. The name correctly reflects the structure.

169. Name the following amide.

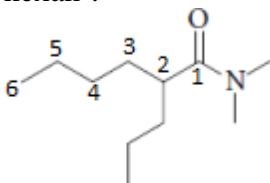


What Is Required?

You must name an amide.

What Is Given?

You are given the structure of the amide.

Plan Your Strategy	Act on Your Strategy
Identify the root.	The carbon chain containing the carbonyl carbon has six carbon atoms, all bonded by single bonds, so the root is hexan-. 
Identify the suffix.	The compound contains a -CON- functional group so the suffix is -amide.
Identify the prefix.	There are two methyl groups bonded to the nitrogen atom so the first part of the prefix is N,N-dimethyl-. There is a propyl group bonded to carbon atom 2 of the main chain, so the second part of the prefix is -2-propyl-. The prefix is N,N-dimethyl-2-propyl-.
Write the name	N,N-dimethyl-2-propylhexanamide

Check Your Solution

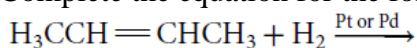
The compound contains a -CON- functional group. The $>\text{C}=\text{O}$ group is part of a six-carbon chain. There are two methyl groups bonded to the nitrogen atom and a propyl group bonded to the carbon atom 2 of the main chain. All carbon-carbon bonds are single bonds. The name correctly reflects the structure.

Solutions to Practice Problems in Chapter 2 Reactions of Organic Compounds

Addition Reactions

(Student textbook pages 99-100)

1. Complete the equation for the following addition reaction:



What Is Required?

You must determine the product for the reaction.

What Is Given?

You are given the reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur when an alkene is combined with a small, diatomic molecule, H_2 , in the presence of a platinum or palladium catalyst.	addition reaction
Write the new product: change the double bond between carbon 2 and 3 to a single bond Add a hydrogen atom to carbon 2 and 3 with a single bond	$\text{H}_3\text{CCH}=\text{CHCH}_3 + \text{H}_2 \xrightarrow{\text{Pt or Pd}}$ $\begin{array}{c} \text{H}_3\text{C}-\text{CH}-\text{CH}-\text{CH}_3 \\ \quad \\ \text{H} \quad \text{H} \end{array}$

Check Your Solution

The type of reaction is an addition reaction. The double bond between the carbon atoms is replaced with a single bond between the carbon atoms and a single bond between the carbon and hydrogen atoms.

2. Complete the equation for the following reaction if:



- A minimal amount of Br_2 is present
- An excess of Br_2 is present

What Is Required?

You must determine the product for the reaction when a minimal amount of bromine is present and when an excess of bromine is present.

What Is Given?

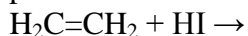
You are given the reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur when an alkyne is combined with the diatomic molecule Br_2 .	addition reaction
Write the product that results in a minimal amount of bromine: change the triple bond between carbon 3 and 4 to a double bond add a bromine atom to carbon 3 and 4 with a single bond	With a minimal amount of bromine, only one molecule of bromine will add to the triple bond. $\text{H}_3\text{CCH}_2\text{C}\equiv\text{CCH}_3 + \text{Br}_2 \rightarrow$ $\text{H}_3\text{C}-\text{CH}_2-\underset{\text{Br}}{\text{C}}=\underset{\text{Br}}{\text{C}}-\text{CH}_3$
Write the product that results in an excess of bromine: change the triple bond between carbon 3 and 4 to a single bond add a two bromine atoms to carbon 3 using single bonds and two bromine atoms to carbon 4 using single bonds	With an excess of bromine, a maximum number of bromine atoms (two) will add to the triple bond. $\text{H}_3\text{CCH}_2\text{C}\equiv\text{CCH}_3 + \text{Br}_2 \rightarrow$ $\text{H}_3\text{C}-\text{CH}_2-\underset{\text{Br}}{\text{C}}-\underset{\text{Br}}{\text{C}}-\text{CH}_3$

Check Your Solution

The type of reaction is an addition reaction. In a minimum amount of bromine the triple bond between carbon 3 and 4 is replaced by a double bond. Carbon 3 and 4 each form a new single bond to a bromine atom. In an excess of bromine the triple bond between carbon 3 and 4 is replaced by a single bond. Carbon 3 and 4 each form two new single bonds to bromine atoms.

3. For the following reaction, determine the product and explain why only one product is possible.



What Is Required?

You need to determine the product for the reaction and explain why only one product is possible.

What Is Given?

You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur when an alkene is combined with a small molecule, HI.	addition reaction
Write the first possible product: replace the double bond with a single bond create a single bond between carbon 1 and the iodine atom and a single bond between carbon 2 and hydrogen	$\text{H}_2\text{C}=\text{CH}_2 + \text{HI} \rightarrow \text{H}_2\text{CH}-\text{CIH}_2$
Write the second possible product: replace the double bond with a single bond create a single bond between carbon 2 and the iodine atom and a single bond between carbon 1 and hydrogen	$\text{H}_2\text{C}=\text{CH}_2 + \text{HI} \rightarrow \text{H}_2\text{CI}-\text{CHH}_2$
Name the products to explain how both these products are the same.	Both these products would be named iodoethane. There is no difference in structure if iodine is added to carbon 1 or carbon 2 because numbering always starts at the end of the carbon chain nearest the substituted halogen.

Check Your Solution

The type of reaction is an addition reaction. The double bond between the carbon atoms is replaced with a single bond between the carbon atoms and single bonds between the carbon atoms and the addition hydrogen and iodine atoms. When iodine is added to either of the two carbon atoms the same product is formed because the molecule is symmetrical before the reaction, therefore only one is possible.

4. For the following reaction, determine the product(s) and indicate the more abundant product if more than one is formed.



What Is Required?

You need to determine the product for the reaction and identify the more abundant product if more than one is formed.

What Is Given?

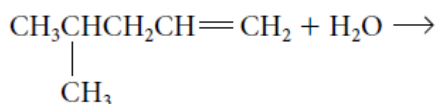
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur when the diatomic molecule, Cl_2 , is added to an alkene.	addition reaction
Determine the product (there is only one product because no matter which chlorine atom you add to either carbon 2 or 3 the same product will be formed): the double bond between carbon 2 and 3 is replaced by a single bond a single bond is formed between carbon 2 and a chlorine atom and carbon 3 and a chlorine atom	$\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3 + \text{Cl}_2 \rightarrow$ $\begin{array}{ccccccc} \text{CH}_3 & -\text{CH} & - & \text{CH} & -\text{CH}_2 & -\text{CH}_3 \\ & & & & & \\ & \text{Cl} & & \text{Cl} & & \end{array}$

Check Your Solution

The type of reaction is an addition reaction. The double bond between carbon 2 and 3 is replaced by a single bond. Carbon 2 and 3 each forms a new single bond with a chlorine atom.

5. For the following reaction, determine the product(s) and indicate the more abundant product if more than one is formed.



What Is Required?

You need to determine the product for the reaction and identify the more abundant product if more than one is formed.

What Is Given?

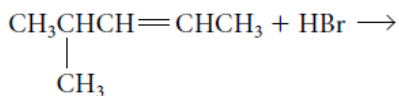
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that occurs when a small molecule, HOH, is added to an alkene.	addition reaction
Determine the first product: replace the double bond between carbon 1 and 2 with a single bond create a single bond between carbon 1 and a hydrogen atom create a single bond between carbon 2 and hydroxide (OH)	$\begin{array}{c} \text{CH}_3\text{CHCH}_2\text{CH}=\text{CH}_2 + \text{H}_2\text{O} \longrightarrow \\ \\ \text{CH}_3 \end{array}$ $\begin{array}{c} \text{OH} \\ \\ \text{CH}_3-\text{CH}-\text{CH}_2-\text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$
Determine the second product: replace the double bond between carbon 1 and 2 with a single bond create a single bond between carbon 2 and a hydrogen atom create a single bond between carbon 1 and hydroxide (OH)	$\begin{array}{c} \text{CH}_3\text{CHCH}_2\text{CH}=\text{CH}_2 + \text{H}_2\text{O} \longrightarrow \\ \\ \text{CH}_3 \end{array}$ $\begin{array}{c} \text{OH} \\ \\ \text{CH}_3-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_2 \\ \\ \text{CH}_3 \end{array}$
Determine the most abundant product.	The most abundant product is the first product because the hydrogen atom of the small molecule (H-OH) tends to bond to the carbon atom of the double bond that is already bonded to the most hydrogen atoms.

Check Your Solution

The reaction is an addition reaction. Two products are formed. The first product is formed by replacing the double bond with a single bond, forming a single bond between carbon 1 and a hydrogen atom and forming a single bond between carbon 2 and OH. The second product is formed by replacing the double bond with a single bond, forming a single bond between carbon 2 and a hydrogen atom and forming a single bond between carbon 1 and OH. The first product is more abundant because it is more stable. OH will bond to the higher branched carbon (carbon 2).

6. For the following reaction, determine the product(s) and indicate the more abundant product if more than one is formed.



What Is Required?

You need to determine the product for the reaction and identify the more abundant product if more than one is formed.

What Is Given?

You are given the reactants of the reaction.

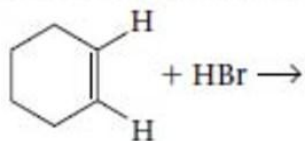
Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between an alkene and a small molecule, HBr.	addition reaction
Determine the first product: replace the double bond between carbon 2 and 3 with a single bond create a single bond between carbon 3 and a bromine atom create a single bond between carbon 2 and a hydrogen atom	$\begin{array}{c} \text{CH}_3\text{CHCH}=\text{CHCH}_3 + \text{HBr} \longrightarrow \\ \\ \text{CH}_3 \end{array}$ $\begin{array}{c} \text{Br} \\ \\ \text{CH}_3-\text{CH}-\text{CH}-\text{CH}_2-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$
Determine the second product: replace the double bond between carbon 2 and 3 with a single bond create a single bond between carbon 2 and a bromine atom create a single bond between carbon 3 and a hydrogen atom	$\begin{array}{c} \text{CH}_3\text{CHCH}=\text{CHCH}_3 + \text{HBr} \longrightarrow \\ \\ \text{CH}_3 \end{array}$ $\begin{array}{c} \text{Br} \\ \\ \text{CH}_3-\text{CH}-\text{CH}_2-\text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$
Determine the more abundant product.	The more abundant product would be the one in which the hydrogen atom of the small molecule (HBr) tends to bond to the carbon atom of the double bond that is already bonded to the most hydrogen atoms. However, both carbons are bonded to the same number of H atoms before the reaction, therefore neither product is more abundant than the other.

Check Your Solution

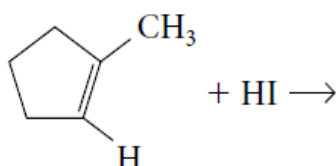
The reaction is an addition reaction. Two products are formed in this reaction. Both products are formed by replacing the double bond between carbon 2 and 3 with a single bond. The first product creates a single bond between carbon 3 and a bromine atom and a single bond between carbon 2 and a hydrogen atom. The second product creates a single bond between carbon 2 and a bromine atom and a single bond between carbon 3 and a hydrogen atom. Both products are equally abundant because both carbons are bonded to the same number of H atoms before the reaction.

7. Determine the products for the following reactions.

a.



b.



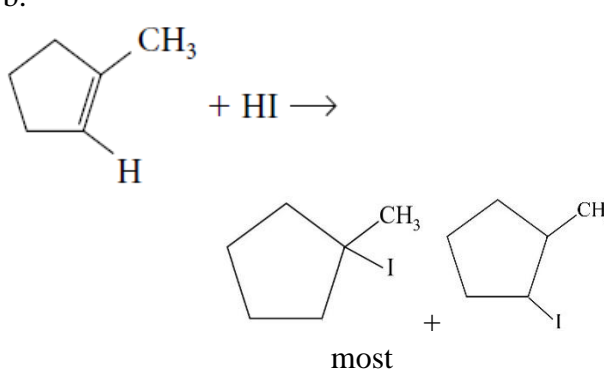
What Is Required?

You need to determine the product for each reaction.

What Is Given?

You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between: a. an alkene and a small molecule, HBr b. an alkene and a small molecule, HI	Both are addition reactions.
Determine the product(s) of the reactions. a. Only one product is formed by replacing the double bond between carbon 1 and 2 with a single bond and creating a single bond between carbon 1 and a bromine atom and a single bond between carbon 2 and a hydrogen atom	a. <p>Reaction of cyclohexene with HBr to form bromocyclohexane:</p> <chem>C1=CCCCC1.Br>>BrC1CCCCC1</chem>

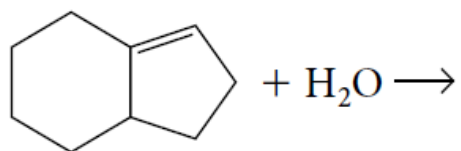
<p>b. Determine the first product: replace the double bond between carbon 1 and 2 with a single bond create a single bond between carbon 1 and an iodine atom create a single bond between carbon 2 and a hydrogen atom Determine the second product: replace the double bond between carbon 1 and 2 with a single bond create a single bond between carbon 1 and an iodine atom create a single bond between carbon 2 and a hydrogen atom</p>	<p>b.</p> 
<p>Determine the more abundant product for b.</p>	<p>The more abundant product for b. is the first product because the the hydrogen atom of the small molecule (HI) tends to bond to the carbon atom of the double bond that is already bonded to the most hydrogen atoms.</p>

Check Your Solution

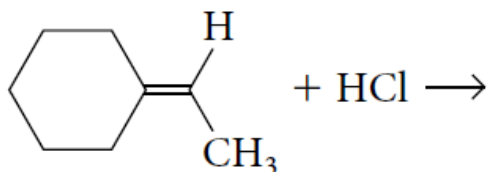
Both reactions are addition reactions. In the first reaction only one product is formed. The double bond between carbon 1 and 2 are replaced by a single bond and bromine is added to either carbon 1 or 2. In the second reaction two products are formed. For both products the double bond between carbon 1 and 2 is replaced with a single bond. For the first product a single bond is created between carbon 1 and iodine and carbon 2 and hydrogen. For the second product a single bond is created between carbon 2 and iodine and carbon 1 and hydrogen. The first product is more abundant because the small molecule (HI) tends to bond to the carbon atom of the double bond that is already bonded to the most hydrogen atoms.

8. Determine the major products for the following addition reactions.

a.



b.



What Is Required?

You need to determine the major product for each reaction.

What Is Given?

You are given the reactants of the reactions.

a.

Plan Your Strategy	Act on Your Strategy
<p>Replace the double bond with a single bond.</p> <p>Choose the carbon atom (that was in the double bond) that was bonded to the most hydrogen atoms and create a single bond between it and the H of the HOH. Add a bond to the other carbon and the OH.</p>	

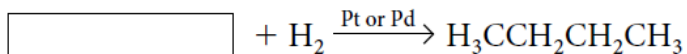
b. Plan Your Strategy	Act on Your Strategy
<p>Replace the double bond with a single bond.</p> <p>Choose the carbon (that was in the double bond) that was bonded to the most hydrogen atoms and create a single bond between it and the H of the HCl. Create a single bond between the other carbon atom and Cl.</p>	

Check Your Solution

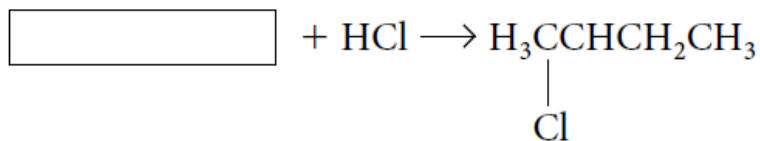
Both reactions are addition reactions. In both reactions the double bond is replaced by a single bond. For the first reaction, the major product is formed when the hydroxyl forms a single bond to the more substituted carbon that participated in the double bond and a hydrogen atom forms a single bond to the less substituted carbon that participated in the double bond. For the second reaction, the major product is formed when the chlorine atom forms a single bond to the more substituted carbon that participated in the double bond and a hydrogen atom forms a single bond to the less substituted carbon that participated in the double bond.

9. Determine the reactants for the following reactions.

a.



b.



What Is Required?

You need to determine the missing reactant of the reaction.

What Is Given?

You are given the product, a small reactant and the conditions of the reaction.

a.

Plan Your Strategy	Act on Your Strategy
Determine the type(s) of reactant(s) that would react with H_2 to form an alkane.	alkenes and alkanes, addition reaction
Determine which pairs carbons could have had hydrogen atoms added to them.	Carbon 1 and 2 (carbon 3 and 4 would yield same result as 1 and 2) and carbon 2 and 3
Write all possible reactants by replacing the single bond between the two carbon atoms with a double bond and removing a single bond to a hydrogen atom from each of those two carbons	$\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\text{CH}_3$, or $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_3$, or $\text{HC}\equiv\text{C}-\text{CH}_2-\text{CH}_3$, or $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{CH}_3$

b.

Plan Your Strategy	Act on Your Strategy
Determine the type of reactant that would react with HCl to yield a haloalkane and the type of reaction that would occur.	alkene, addition reaction
Determine which pairs of carbons reacted with HCl by identifying the C atom that Cl is bonded to in the product.	Carbon 1 and 2
Write the reactant by removing a single bond between carbon 1 and the chlorine atom and a single bond between carbon 2 and a hydrogen atom and by replacing the single bond between carbon 1 and 2 with a double bond.	$\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3$

Check Your Solution

For the first question, multiple reactants are possible. Alkenes and alkynes can form alkanes when H_2 is added to them in the presence of platinum or palladium. All possible alkenes and alkynes are given. For the second question only one reactant is possible. An alkene forms a substituted alkane in an addition reaction with a small molecule, in this case HCl . Since Cl was bonded to carbon 1 in the product the double bond must have been between carbon 1 and 2.

To ensure you have the correct solution follow through with the reaction with reactant you determined and the small molecule given and make sure your product is the same as the one given in the question.

10. Determine the product for the following reaction.
(Hint: Draw the structure of sulfuric acid.)



What Is Required?

You need to determine the product of the reaction.

What Is Given?

You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that would occur between an alkene and sulfuric acid.	addition reaction
Draw the structure of sulfuric acid to determine how it would add to the alkene.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{O}-\text{S}-\text{O}-\text{H} \\ \parallel \\ \text{O} \end{array}$
Replace the double bond between carbon 2 and 3 with a single bond. Create a single bond between carbon 2 and OSO_3H and a single bond between carbon 3 and hydrogen (you could also create a single bond between carbon 3 and OSO_3H and a single bond between carbon 2 and hydrogen and yield the same product).	$\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}_2-\text{CH}_3 \\ \\ \text{O}-\text{SO}_3\text{H} \end{array}$

Check Your Solution

The type of reaction is an addition reaction. The double bond between carbon 2 and 3 would be replaced by a single bond. The same way water breaks into H and OH when participating in an addition reaction, sulfuric acid breaks into H and OSO_3H . Hydrogen creates a single bond to either carbon 3 and OSO_3H creates a single bond to carbon 2.

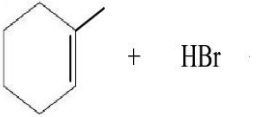
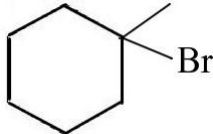
11. For the following reaction, draw the reactants and product that would form.
1-methylcyclohexene + hydrobromic acid \rightarrow

What Is Required?

You must draw the reactants and determine the product of the reaction.

What Is Given?

You are given the names of the reactants.

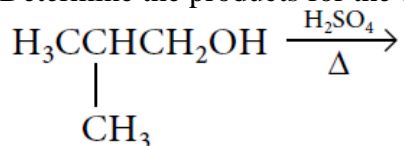
Plan Your Strategy	Act on Your Strategy
Draw the reactants of the reaction.	
Determine the type of reaction that will occur between an alkene and a small molecule, HBr.	addition reaction
Determine the product: replace the double bond with a single bond create a single bond between the carbon atom from the double bond that already had the most hydrogen atoms. create a single bond between the other carbon of the double bond and a bromine atom Recall that H atoms are usually not drawn in line diagrams.	

Check Your Solution

The type of reaction is an addition reaction. To form the product the double bond between carbon 2 and 3 is replaced by a single bond. A single bond is created between carbon 1 (the more substituted carbon participating in the double bond) and a bromine atom and between carbon 2 and a hydrogen atom.

Elimination Reactions
(Student textbook page 102)

12. Determine the products for the elimination reaction.



What Is Required?

You need to determine the product for the reaction.

What Is Given?

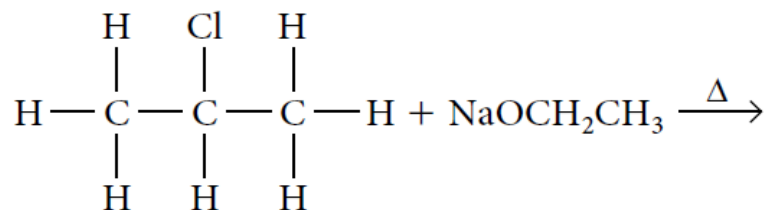
You are given the reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
<p>Determine the products: Sulfuric acid typically removes a water molecule. remove the single bond between carbon 2 (the carbon atom adjacent to the carbon bonded to the hydroxyl group) and the hydrogen atom remove the single bond between carbon 1 and the hydroxyl group create a single bond between the hydroxide ion and hydrogen ion, forming water replace the single bond between carbon 1 and 2 with a double bond to form an alkene</p>	$\begin{array}{c} \text{H}_3\text{CCHCH}_2\text{OH} \\ \\ \text{CH}_3 \end{array} \xrightarrow[\Delta]{\text{H}_2\text{SO}_4}$ $\begin{array}{c} \text{CH}_3-\text{C}=\text{CH}_2 \\ \\ \text{CH}_3 \end{array} + \text{H}_2\text{O}$

Check Your Solution

The type of reaction is an elimination reaction. A double bond forms between carbon 1 and 2. The hydroxyl group is removed, along with a hydrogen atom which was bonded in order for the double bond to form. The hydroxide ion and hydrogen ion combine to form water.

13. Determine the products for the elimination reaction.



What Is Required?

You need to determine the product for the reaction.

What Is Given?

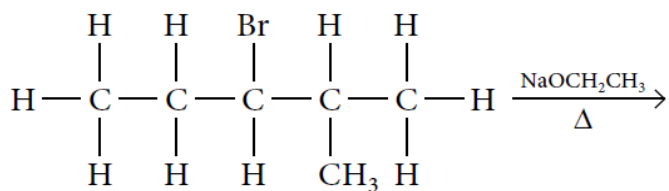
You are given then reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
<p>Sodium ethoxide typically removes a halogen and a hydrogen atom.</p> <ul style="list-style-type: none"> remove the single bond between carbon 2 and the chlorine atom remove the single bond between carbon 1 and the hydrogen atom replace the single bond between carbon 2 and 1 with a double bond create a single bond between the sodium ion and chlorine atom create a single bond between the ethoxide ion and the hydrogen ion 	$ \begin{array}{c} \text{H} \quad \text{Cl} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} + \text{NaOCH}_2\text{CH}_3 \xrightarrow{\Delta} $ $ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}=\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} + \text{HOCH}_2\text{CH}_3 + \text{NaCl} $

Check Your Solution

The reaction is an elimination reaction. In the presence of heat and a strong base the haloalkane underwent an elimination reaction and formed an alkene, ethanol and a salt.

14. Determine the number of possible products for the following reaction. Explain your reasoning.



What Is Required?

You need to determine the number of possible products for the following reaction.

What Is Given?

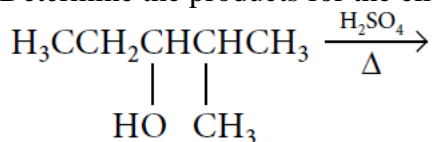
You are given the reactants and condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between a haloalkane when heated with a strong base.	elimination reaction
Determine the number minor products that form other than the alkene in an elimination reaction.	2 (ethanol and sodium bromide)
Determine the number of alkenes that can form: a double bond can be formed between carbon 3 and 4. This only results in one possible isomer a double bond can form between carbon 3 and 2. This results in two possible isomers, cis and trans	3 (2-methylpent-2-ene, cis-2-methylpent-3-ene, and trans-2-methylpent-3-ene)
Determine the total amount of products.	5 possible products

Check Your Solution

This reaction is an elimination reaction. When the haloalkane reacts with a strong base under heat at least three products are formed, an alkene, ethanol and a salt. More than one alkene is possible in this reaction. One possible alkene results when a double bond forms between carbon 3 and 4 and two possible alkenes form when a double bond forms between carbon 3 and 2.

15. Determine the products for the elimination reaction.



What Is Required?

You need to determine the products for the reaction.

What Is Given?

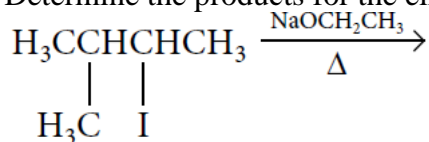
You are given the reactants and the conditions of the reaction.

Plan Your Strategy	Act on Your Strategy
<p>Determine the possible products, Product 1:</p> <p>remove the single bond between hydroxyl group and carbon 3 remove the single bond between the hydrogen and carbon 2 create a double bond between carbon 2 and 3 this has one possible isomer</p> <p>Product 2</p> <p>remove the single bond between hydroxyl group and carbon 3 remove the single bond between the hydrogen and carbon 4 create a double bond between carbon 3 and 4 this has two possible isomers</p> <p>Product 3</p> <p>create a single bond between the hydrogen ion and the hydroxyl ion</p>	<p>2-methylpent-2-ene</p> <p>cis-2-methylpent-3-ene</p> <p>trans-2-methylpent-3-ene and water</p>

Check Your Solution

The reaction is an elimination reaction. When the alcohol reacted with a strong base an alkene and water were formed. When a double bond forms between carbon 2 and 3 only one isomer is possible but when a double bond forms between carbon 3 and 4 two isomers are possible.

16. Determine the products for the elimination reaction.



What Is Required?

You need to determine the products for the reaction.

What Is Given?

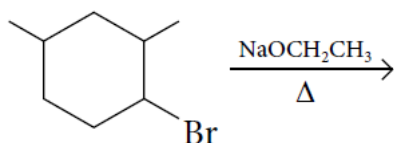
You are given the reactants and the conditions of the reaction.

Plan Your Strategy	Act on Your Strategy
<p>Determine the products that will occur: Sodium ethoxide typically removes a halogen atom and a hydrogen atom, leaving a double bond.</p> <p>Product 1 remove the single bond between the iodine atom and carbon 2 remove the single bond between the hydrogen atom and carbon 1 replace the single bond between carbon 1 and 2 with a double bond only one possible isomer</p> <p>Product 2 remove the single bond between the iodine atom and carbon 2 remove the single bond between the hydrogen atom and carbon 3 replace the single bond between carbon 2 and 3 with a double bond only one possible isomer</p> <p>Products 3 and 4 create a single bond between the iodine ion and the sodium ion create a single bond between the hydrogen ion and ethoxide ion</p>	<p>product 1: 2-methylbut-2-ene</p> <p>product 2: 3-methylbut-1-ene</p> <p>products 3 and 4: sodium bromide and ethanol</p>

Check Your Solution

The reaction is an elimination reaction. When the haloalkane was heated with a strong base ethanol, a salt, and an alkene was formed. There were two possible alkenes.

17. Determine the major product of the reaction.



What Is Required?

You need to determine the product of the reaction.

What Is Given?

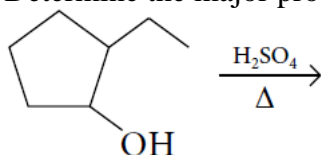
You are given the reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between a haloalkane when heated with a strong base.	elimination reaction
Determine the major product: Sodium ethoxide typically removes a halogen atom and a hydrogen atom, leaving a double bond. remove the single bond between the bromine atom and carbon 1 remove the single bond between the hydrogen atom and the most substituted carbon adjacent to carbon 1. This is carbon 2 replace the single bond between carbon 1 and 2 with a double bond	 2,4-dimethylcyclohexene

Check Your Solution

The reaction is an elimination reaction. The major product will be the most stable alkene. This forms when the double bond forms between the halogenated carbon and the carbon adjacent to it which is more substituted.

18. Determine the major product of the reaction.



What Is Required?

You need to determine the major product of the reaction.

What Is Given?

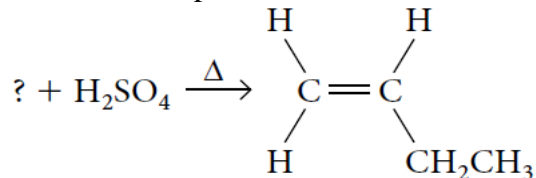
You are given the reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur when an alcohol is heated in the presence of a strong acid.	elimination reaction
Determine the major product remove the single bond between carbon 1 and the hydroxyl group remove the single bond between the hydrogen atom and the most substituted carbon adjacent to carbon 1. This is carbon 2 replace the single bond between carbon 1 and 2 with a double bond	<p>1-ethylcyclopentene</p>

Check Your Solution

The reaction is an elimination reaction. The major product will be the alkene. Since more than one alkene is possible the major one occurs when the double bond forms between the carbon bonded to the hydroxyl group and the more substituted carbon adjacent to the carbon bonded to the hydroxyl group.

19. Determine the possible reactants of the reaction.



What Is Required?

You need to determine all possible missing reactants of the reaction.

What Is Given?

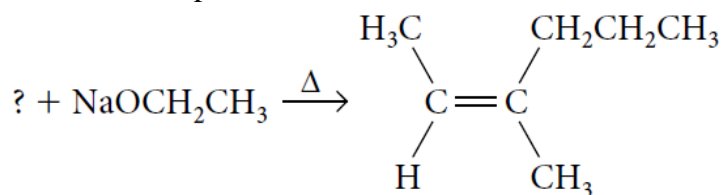
You are given a reactant, the product and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that would form an alkene when heated in the presence of a strong acid.	elimination reaction
Determine the possible type of reactant.	The reactant must be an alcohol because they undergo elimination reactions in the presence of a strong acid.
<p>Determine the possible reactants: replace the double bond between carbon 1 and 2 with a single bond (of the product)</p> <p>Reactant 1 add a single bond between carbon 1 and a hydroxyl group add a single bond between carbon 2 and a hydrogen atom</p> <p>Reactant 2 add a single bond between carbon 2 and a hydroxyl group add a single bond between carbon 1 and a hydrogen atom</p>	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> $\begin{array}{c} \text{HO} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{CH}_2-\text{CH}_3 \end{array}$ <p>butan-1-ol</p> </div> <div style="text-align: center;"> $\begin{array}{c} \text{H} \quad \text{OH} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{CH}_2-\text{CH}_3 \end{array}$ <p>butan -2-ol</p> </div> </div> <p style="text-align: center;">and</p>

Check Your Solution

The type of reaction is an elimination reaction. When alcohols are heated in the presence of a strong acid an alkene forms, therefore the reactant is an alcohol. Two reactants are possible because the alcohol could form a single bond with either carbon which is participating in the double bond.

20. Determine the possible reactants of the reaction.



What Is Required?

You need to determine all possible missing reactants of the reaction.

What Is Given?

You are given the product, a reactant and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that would form an alkene when heated in the presence of a strong base.	elimination reaction
Determine the type of reactant.	The reactant must be a haloalkane because they undergo elimination reaction in the presence of a strong base such as sodium ethoxide.
<p>Determine the possible reactants:</p> <p>replace the double bond between carbon 2 and 3 with a single bond (of the product)</p> <p>Reactant 1</p> <p>add a single bond between carbon 2 and a halogen atom (X)</p> <p>add a single bond between carbon 3 and a hydrogen atom</p> <p>Reactant 2</p> <p>add a single bond between carbon 3 and a halogen atom (X)</p> <p>add a single bond between carbon 2 and a hydrogen atom</p>	$\begin{array}{c} \text{CH}_3 - \underset{\text{X}}{\text{CH}} - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \end{array} \quad \begin{array}{c} \text{X} \\ \\ \text{CH}_3 - \text{CH}_2 - \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$ <p>Where X = F, Cl, Br, or I</p>

Check Your Solution

The reaction is an elimination reaction. Haloalkanes form alkenes when heated with a strong base therefore the reactant must be a haloalkane. Two different structures are possible because the halogen can form a bond with either carbon that is participating in the double bond in the product.

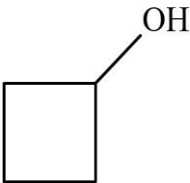

21. Determine the major product that would form from the following reaction.
1-cyclobutanol + sulfuric acid \rightarrow

What Is Required?

You need to determine the major product of the reaction.

What Is Given?

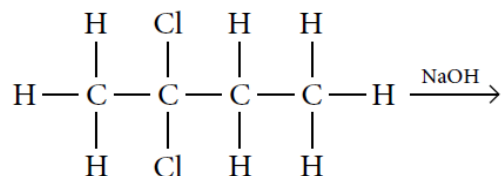
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that would occur when an alcohol is in the presence of a strong acid.	elimination reaction
Draw the reactant alcohol.	
Determine the major product: remove the single bond between carbon 1 and the hydroxyl group remove the single bond between a carbon adjacent to carbon 1 and a hydrogen atom replace the single bond between carbon 1 and the adjacent carbon with a double bond	

Check Your Solution

The reaction is an elimination reaction. When an alcohol reacts with a strong acid an alkene is formed. The double bond will form between the carbon that is bonded to the hydroxyl group and the adjacent carbon that is more substituted. In this case both carbons are equally substituted.

22. Predict the final products of the following reaction.
(Hint: Eliminate both Cl atoms.)



What Is Required?

You need to determine the product for the reaction.

What Is Given?

You are given the reactants of the reaction.

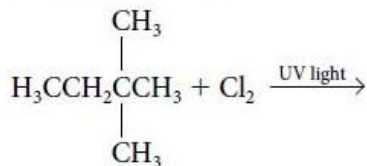
Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur when a haloalkane reacts with a strong base.	elimination reaction (twice)
Determine all possible products. Product 1 remove both single bonds between carbon 2 and the chlorine atoms remove two single bonds between carbon 1 and the hydrogen atoms replace the single bond between carbon 1 and 2 and replace it with a triple bond Product 2 remove both single bonds between carbon 2 and the chlorine atoms remove two single bonds between carbon 3 and the hydrogen atoms replace the single bond between carbon 2 and 3 and replace it with a triple bond	but-1-yne $\text{HC}\equiv\text{C}-\text{CH}_2\text{CH}_3$ and but-2-yne, $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{CH}_3$

Check Your Solution

The reaction is an elimination reaction. However, two elimination reactions occur to the same bond creating an alkyne instead of an alkene. There are two possible products because there are two carbons adjacent to the carbon bonded to the chlorine atoms.

Substitution Reactions
(Student textbook page 104)

23. Determine one possible product for the following substitution reaction.



What Is Required?

You need to determine one possible product for the reaction.

What Is Given?

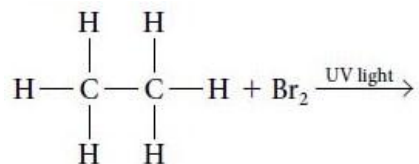
You are given the reactants and conditions of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction.	substitution reaction
This reaction is not specific. Any number, from one to all, of the hydrogen atoms could be replaced with a chlorine atom.	Depending on the amount of chlorine any or all of the hydrogen atoms could be replaced by chlorine. A few examples are: <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> $\begin{array}{c} \text{Cl} \\ \\ \text{Cl}-\text{C}-\text{CH}_2-\text{C}-\text{CH}_3 \\ \\ \text{Cl} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{CH}_2-\text{C}-\text{CH}_3 \\ \\ \text{CH}_2 \\ \\ \text{Cl} \end{array}$ </div> </div>

Check Your Solution

The type of reaction is a substitution reaction. When an alkane reacts with halogens in the presence of UV light a mixture of products is possible in which any variety of hydrogens are replaced by chlorine.

24. Determine how many possible products (not including HBr) may be formed in the following reaction.



What Is Required?

You need to find the number of possible products for the reaction.

What Is Given?

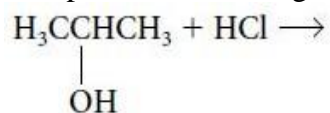
You are given the reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction will occur when an alkane reacts with a halogen in the presence of UV light.	substitution reaction
Draw all possible substitutions, starting with one hydrogen being replaced by one chlorine. Rule out any structures that are the same.	<p>There are 9 possible products.</p> <div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="text-align: center;"> $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{Br} \quad \text{H} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{Br} \quad \text{H} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{Br} \quad \text{H} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{Br} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{Br} \\ \quad \\ \text{H} \quad \text{Br} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{H} \quad \text{Br} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{Br} \\ \quad \\ \text{H} \quad \text{Br} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{Br} \quad \text{Br} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{Br} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{Br} \quad \text{Br} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{Br} \\ \quad \\ \text{H} \quad \text{Br} \end{array}$ </div> <div style="text-align: center;"> $\begin{array}{c} \text{Br} \quad \text{Br} \\ \quad \\ \text{Br}-\text{C}-\text{C}-\text{Br} \\ \quad \\ \text{Br} \quad \text{Br} \end{array}$ </div> </div>

Check Your Solution

The reaction is a substitution reaction. A bromine atom can replace any and all hydrogen atoms if enough bromine is present.

25. Complete the following substitution reaction.



What Is Required?

You need to determine the products for the reaction.

What Is Given?

You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
<p>Determine the products.</p> <p>When hydrohalogen acid react with alcohols, the halogen substitutes for the hydroxyl group.</p> <p>Product 1</p> <p>remove the single bond between carbon 2 and the hydroxyl group</p> <p>remove the single bond between the hydrogen and chlorine atom</p> <p>create a single bond between carbon 3 and the chloride ion</p> <p>Product 2</p> <p>create a single bond between the hydroxide ion and the hydrogen ion</p>	$\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}_3 \\ \\ \text{Cl} \end{array} + \text{H}-\text{OH}$

Check Your Solution

The alcohol reacted with the acid containing a halogen in a substitution reaction. The hydroxyl group was replaced with the halogen producing a haloalkane and water.

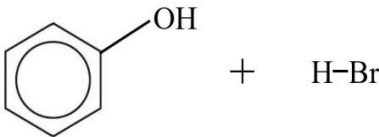
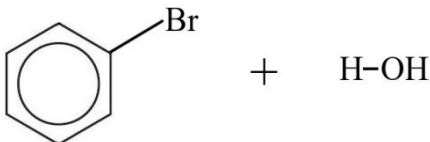
26. Complete the following substitution reaction.
phenol + HBr \rightarrow

What Is Required?

You need to determine the products for the reaction.

What Is Given?

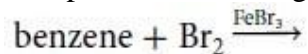
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Draw out the reactants.	
<p>Determine the products. When hydrobromic acid reacts with an alcohol, the bromide ion replaces the hydroxyl group.</p> <p>Product 1 remove the single bond between carbon 1 and the hydroxyl group remove the single bond between the hydrogen atom and bromine atom create a single bond between carbon 1 and the bromide ion</p> <p>Product 2 create a single bond between the hydrogen ion and the hydroxide ion</p>	

Check Your Solution

The alcohol reacted with the acid containing a halogen in a substitution reaction. The hydroxyl group was replaced with the halogen producing a halogenated benzene ring and water.

27. Complete the following substitution reaction.

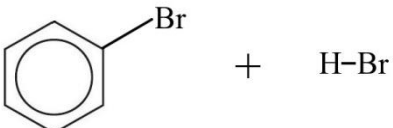


What Is Required?

You need to determine the products for the reaction.

What Is Given?

You are given the reactants and condition of the reaction.

Plan Your Strategy	Act on Your Strategy
<p>Determine the products. When benzene reacts with a halogen molecule in the presence of the catalyst, FeBr_3, it forms a halobenzene and a hydrohalogen acid.</p> <p>Product 1</p> <p>remove the single bond between a hydrogen atom and a carbon atom in the benzene ring</p> <p>remove the single bond between the two bromine atoms</p> <p>create a single bond between the carbon you removed the hydrogen from and a bromide ion</p> <p>Product 2</p> <p>create a single bond between the hydrogen ion and the bromide ion</p>	

Check Your Solution

The aromatic hydrocarbon reacted with the diatomic halogen in a substitution reaction. A hydrogen was replaced with the halogen producing a halogenated benzene ring and an acid.

28. Complete the following substitution reaction.
2-chloropropane + $\text{OH}^- \rightarrow$

What Is Required?

You need to determine the products for the reaction.

What Is Given?

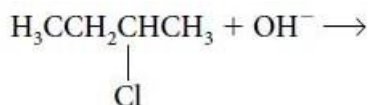
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the products. When a haloalkane reacts with a hydroxide ion, the hydroxide replaces the halogen on the alkane. Product 1 remove the single bond between carbon 2 and the chlorine atom creating a chloride ion Product 2 create a single bond between carbon 2 and the hydroxide ion	$\begin{array}{c} \text{OH} \\ \\ \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \end{array} + \text{Cl}^-$

Check Your Solution

The halogenated alkane and hydroxide ion underwent a substitution reaction resulting in an alcohol and a chloride ion.

29. For the following reaction, determine the products and explain how you decided between a substitution reaction and an elimination reaction.



What Is Required?

You need to determine the products of the reaction and explain your reasoning for the type of reaction that occurs.

What Is Given?

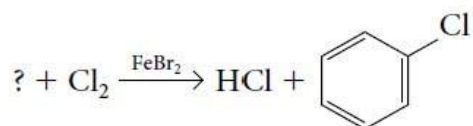
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction and give reasoning.	Substitution reaction. A base such as $\text{NaOCH}_2\text{CH}_3$ would give an elimination reaction but a hydroxide ion results in a substitution reaction.
Determine the products. Product 1 remove the single bond between carbon 2 and the chlorine atom Product 2 create a single bond between carbon 2 and the hydroxide ion	$\text{CH}_3\text{—CH}_2\text{—}\underset{\text{OH}}{\text{CH}}\text{—CH}_3 + \text{Cl}^-$

Check Your Solution

The halogenated alkane and hydroxide ion underwent a substitution reaction resulting in an alcohol and a chloride ion.

30. Determine the missing reactants for the following equation.




What Is Required?

You need to determine the missing reactant of the reaction.

What Is Given?

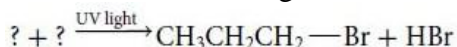
You are given the products, a reactant, and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that would yield a halogenated aromatic hydrocarbon and a hydrohalogen acid.	substitution reaction
Do the reverse of a substitution reaction to obtain reactant. remove the single bond between carbon 1 and the chlorine atom (in the products) remove the single bond between the hydrogen atom and the chlorine atom (in the products) create a single bond between the two chloride ions create a single bond between carbon 1 in the benzene ring and the hydrogen ion	

Check Your Solution

The type of reaction is a substitution reaction. The reactant must be a benzene ring. Both chlorines from Cl_2 are accounted for in the products in HCl and chlorobenzene. Therefore, the H in HCl must have come from the benzene ring as a reactant and during substitution reactions a halogen ion can replace a hydrogen atom.

31. Determine the missing reactants for the following equation.



What Is Required?

You need to find the reactants for the reaction.

What Is Given?

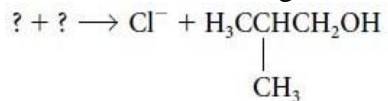
You are given the products and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that would yield a halogenated alkane and an acid that contains a halogen when UV light is present.	substitution reaction
Determine the type of reactants that would be involved in the reaction.	alkane and bromine
Determine the reactants by doing the reverse of the substitution reaction. Reactant 1 remove the single bond between carbon 1 and the bromine atom (in the product) remove the single bond between the hydrogen and bromine atom (in the product) create a single bond between carbon 1 and the hydrogen ion Reactant 2 create a single bond between the two bromide ions	$\text{CH}_3 - \text{CH}_2 - \text{CH}_3 + \text{Br} - \text{Br}$

Check Your Solution

The reaction is a substitution reaction. When an alkane and bromine undergo a substitution reaction in the presence of UV light the products are a halogenated alkane and hydrogen bromide.

32. Determine the missing reactants for the following equation.



What Is Required?

You need to find the missing reactants from the reaction.

What Is Given?

You are given the products of the reaction.

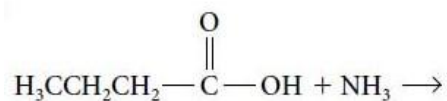
Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that would yield a chloride ion and an alcohol.	substitution reaction
Do the reverse of a substitution reaction to obtain the reactants. Reactant 1 remove the single bond between the carbon 1 and the hydroxyl group Reactant 2 create a single bond between carbon 1 and the chloride ion	$\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2\text{Cl} + \text{OH}^-$

Check Your Solution

When a halogenated alkane reacts with a hydroxide ion in a substitution reaction the products are an alcohol and a halogen ion.

Esterification Reactions
(Student textbook pages 108-9)

33. Identify this reaction as an esterification reaction or a condensation reaction and determine the products.



What Is Required?

You need to identify the type reaction and determine the products.

What Is Given?

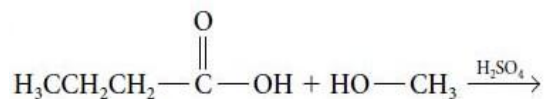
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between a carboxylic acid and ammonia.	condensation reaction
Determine the two products. Product 1 remove the single bond between carbon 1 of the carboxylic acid and the hydroxyl group remove a single bond between the nitrogen and one of its hydrogen atoms create a single bond between carbon one and amine ion Product 2 create a single bond between the hydrogen ion and hydroxide ion	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{NH}_2 + \text{H}-\text{OH}$

Check Your Solution

The reaction is a condensation reaction. The carboxylic acid and ammonia reacted to form an amide and water.

34. Identify this reaction as an esterification reaction or a condensation reaction and determine the products.



What Is Required?

You need to identify the type reaction and determine the products.

What Is Given?

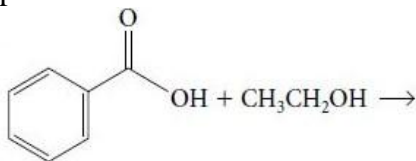
You are given the reactants and the condition of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between a carboxylic acid and an alcohol in the presence of a strong acid.	esterification reaction
Determine the products. Product 1 remove the single bond between the hydrogen atom and the oxygen atom in the carboxylic acid in the alcohol, remove the single bond between the oxygen atom and the carbon atom create an ester bond between the oxygen in the carboxyl group and the carbon atom in the methyl group Product 2 create a single bond between the hydrogen ion and the hydroxide ion	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_3 + \text{H}-\text{OH}$

Check Your Solution

When a carboxylic acid reacts with an alcohol in the presence of a strong acid an ester and water are formed through an esterification reaction.

35. Identify this reaction as an esterification reaction or a condensation reaction and determine the products.



What Is Required?

You need to identify the type reaction and determine the products.

What Is Given?

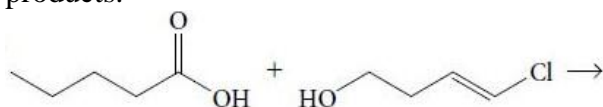
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between a carboxylic acid and an alcohol in the presence of a strong acid.	esterification reaction
<p>Determine the products.</p> <p>Product 1 remove the single bond between the hydrogen atom and the oxygen atom in the carboxylic acid in the alcohol, remove the hydroxyl group create an ester bond between oxygen from which the hydrogen atom was removed and the carbon atom from the alcohol</p> <p>Product 2 create a single bond between the hydrogen ion and the hydroxide ion</p>	

Check Your Solution

When a carboxylic acid reacts with an alcohol in the presence of a strong acid an ester and water are formed through an esterification reaction.

36. Identify this reaction as an esterification reaction or a condensation reaction and determine the products.



What Is Required?

You need to identify the type reaction and determine the products.

What Is Given?

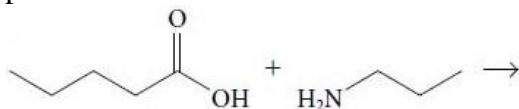
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between a carboxylic acid and an alcohol in the presence of a strong acid.	esterification reaction
<p>Determine the products.</p> <p>Product 1 remove the single bond between the hydrogen atom and the oxygen atom in the carboxylic acid in the alcohol, remove the hydroxyl group create an ester bond between the oxygen from which the hydrogen atom was removed and the carbon atom from the alcohol</p> <p>Product 2 create a single bond between the hydrogen ion and the hydroxyl group</p>	

Check Your Solution

When a carboxylic acid reacts with an alcohol in the presence of a strong acid an ester and water are formed through an esterification reaction.

37. Identify this reaction as an esterification reaction or a condensation reaction and determine the products.



What Is Required?

You need to identify the type reaction and determine the products.

What Is Given?

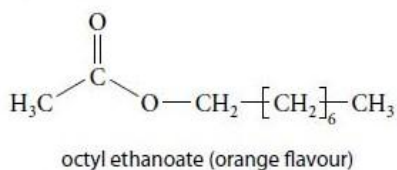
You are given the reactants of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine the type of reaction that will occur between a carboxylic acid and ammonia.	condensation reaction
<p>Determine the two products.</p> <p>Product 1 remove the single bond between carbon 1 of the carboxylic acid and the hydroxyl group remove a single bond between the nitrogen and one of its hydrogen atoms create a single bond between carbon one and the amine group</p> <p>Product 2 create a single bond between the hydrogen ion and hydroxide ion</p>	$\text{CH}_3(\text{CH}_2)_4\text{CONHCH}_2\text{CH}_2\text{CH}_3 + \text{H-OH}$

Check Your Solution

The reaction is a condensation reaction. The carboxylic acid and ammonia reacted to form an amide and water.

38. Name and draw the condensed structural formula of the reactants needed to produce the ester.



What Is Required?

You need to determine and name the reactants needed to make the ester.

What Is Given?

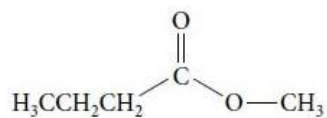
You are given the product.

Plan Your Strategy	Act on Your Strategy
<p>A carboxylic acid and an alcohol are needed to make an ester. Work backwards to find these reagents.</p> <p>Remove the ester linkage (the bond between the oxygen and the carbon bonded to two hydrogens).</p> <p>Add a hydroxyl group to the carbon atom to make an alcohol.</p> <p>Add a single bond between the carbon double bonded to an oxygen and a hydroxide ion.</p>	$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH} + \text{HO}-\text{CH}_2-(\text{CH}_2)_6-\text{CH}_3$ <p>ethanoic acid and octanol</p>

Check Your Solution

In an esterification reaction an ester is the product. The reactants are a carboxylic acid and an alcohol.

39. Name and draw the condensed structural formula of the reactants needed to produce the ester.



methyl butanoate (apple flavour)

What Is Required?

You need to determine and name the reactants needed to make the ester.

What Is Given?

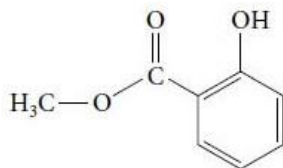
You are given the product.

Plan Your Strategy	Act on Your Strategy
<p>A carboxylic acid and an alcohol are needed to make an ester. Work backwards to find these reagents. Remove the ester linkage (the bond between the oxygen and the carbon bonded to two hydrogen atoms). Add a hydroxyl group to the carbon atom to make an alcohol. Add a single bond between the carbon double bonded to an oxygen atom and a hydroxyl group.</p>	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\parallel{\text{C}}}-\text{OH} + \text{HO}-\text{CH}_3$ <p>butanoic acid and methanol</p>

Check Your Solution

In an esterification reaction, an ester is the product. The reactants are a carboxylic acid and an alcohol.

40. Name and draw the condensed structural formula of the reactants needed to produce the ester.



methyl salicylate (oil of wintergreen)

What Is Required?

You need to determine and name the reactants needed to make the ester.

What Is Given?

You are given the product.

Plan Your Strategy	Act on Your Strategy
<p>A carboxylic acid and an alcohol are needed to make an ester. Work backwards to find these reagents.</p> <p>Remove the ester linkage (the bond between the oxygen and the carbon bonded to two hydrogen atoms).</p> <p>Add a hydroxyl group to the carbon atom to make an alcohol.</p> <p>Add a single bond between the carbon double bonded to an oxygen atom and a hydroxyl group.</p>	<div style="text-align: center;"> </div> <p>methanol and salicylic acid</p>

Check Your Solution

In an esterification reaction an ester is the product. The reactants are a carboxylic acid and an alcohol.

41. Name and draw the condensed structural formula of the reactants needed to produce the ester, 2-hydroxypropyl 3,3-dimethylheptanoate.

What Is Required?

You need to determine and name the reactants needed to make the ester.

What Is Given?

You are given the product.

Plan Your Strategy	Act on Your Strategy
<p>A carboxylic acid and an alcohol are needed to make an ester. Work backwards to find these reagents.</p> <p>Remove the ester linkage (the bond between the oxygen and the carbon bonded to two hydrogen atoms).</p> <p>Add a hydroxyl group to the carbon atom to make an alcohol.</p> <p>Add a single bond between the carbon double bonded to an oxygen atom and a hydroxyl group.</p>	$\text{CH}_3\text{--CH}_2\text{--CH}_2\text{--CH}_2\text{--}\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}\text{--CH}_2\text{--}\overset{\text{O}}{\parallel}\text{C--OH} + \text{HO--CH}_2\text{--}\overset{\text{OH}}{\text{CH}}\text{--CH}_3$ <p>3,3-dimethylheptanoic acid + propan-1,2-diol</p>

Check Your Solution

In an esterification reaction an ester is the product. The reactants are a carboxylic acid and an alcohol.

42. Name and draw the condensed structural formula of the reactants needed to produce the ester, propyl butanoate.

What Is Required?

You need to determine and name the reactants needed to make the ester.

What Is Given?

You are given the product.

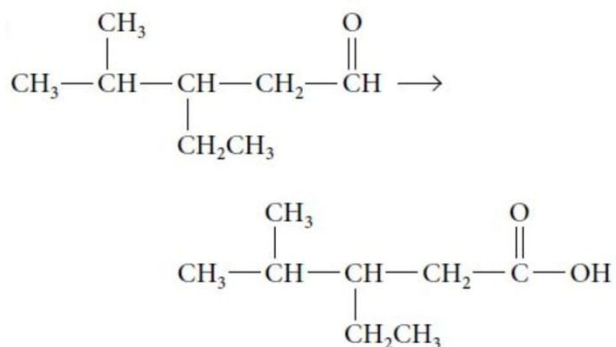
Plan Your Strategy	Act on Your Strategy
<p>A carboxylic acid and an alcohol are needed to make an ester. Work backwards to find these reagents. Remove the ester linkage (the bond between the oxygen and the carbon bonded to two hydrogen atoms). Add a hydroxyl group to the carbon atom to make an alcohol. Add a single bond between the carbon double bonded to an oxygen atom and a hydroxyl group.</p>	$\text{CH}_3\text{---CH}_2\text{---CH}_2\text{---}\overset{\text{O}}{\underset{\text{ }}{\text{C}}}\text{---OH} + \text{HO---CH}_2\text{---CH}_2\text{---CH}_3$ <p>butanoic acid + propan-1-ol</p>

Check Your Solution

In an esterification reaction an ester is the product. The reactants are a carboxylic acid and an alcohol.

Oxidation and Reduction Reactions
(Student textbook page 113)

43. Identify each reaction as an oxidation or a reduction. The oxidizing and reducing agents are not shown.



What Is Required?

You need to determine if the reaction is an oxidation or reduction.

What Is Given?

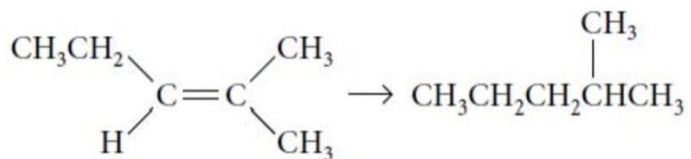
You are given the reactant and product of the reaction.

Plan Your Strategy	Act on Your Strategy
Count the number of C – O bonds in the reactant.	2
Count the number of C – O bonds in the product.	3
Determine the type of reaction.	Oxidation, because more C – O bonds were formed.

Check Your Solution

In an oxidation reaction more bonds between C and O are formed or, fewer bonds between C and H are formed.

44. Identify each reaction as an oxidation or a reduction. The oxidizing and reducing agents are not shown.



What Is Required?

You need to determine if the reaction is an oxidation or reduction.

What Is Given?

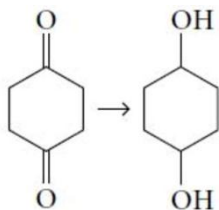
You are given the reactant and product of the reaction.

Plan Your Strategy	Act on Your Strategy
Count the number of C – H bonds in the reactant.	12
Count the number of C – H bonds in the product.	14
Determine the type of reaction.	Reduction, because more C – H bonds were formed.

Check Your Solution

In a reduction reaction the product forms more C – H bonds or fewer C – O bonds.

45. Identify each reaction as an oxidation or a reduction. The oxidizing and reducing agents are not shown.



What Is Required?

You need to determine if the reaction is an oxidation or reduction.

What Is Given?

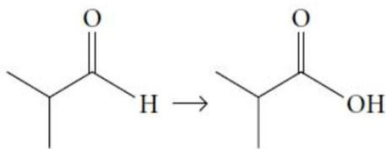
You are given the reactant and product of the reaction.

Plan Your Strategy	Act on Your Strategy
Count the number of C – O bonds in the reactant.	4
Count the number of C – O bonds in the product.	2
Determine the type of reaction.	Reduction, because fewer C – O bonds are formed.

Check Your Solution

In a reduction reaction the product forms more C – H bonds or fewer C – O bonds.

46. Identify each reaction as an oxidation or a reduction. The oxidizing and reducing agents are not shown.



What Is Required?

You need to determine if the reaction is an oxidation or reduction

What Is Given?

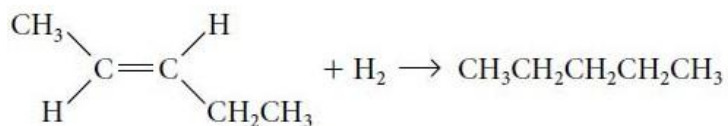
You are given the reactant and product of the reaction

Plan Your Strategy	Act on Your Strategy
Count the number of C – O bonds in the reactant.	2
Count the number of C – O bonds in the product.	3
Determine the type of reaction.	Oxidation, because more C – O bonds are formed.

Check Your Solution

In an oxidation reaction, more bonds between C and O are formed, or, fewer bonds between C and H are formed.

47. Classify this reaction in two different ways: for example, as oxidation and as an elimination reaction.



What Is Required?

You need to classify the reaction in two different ways.

What Is Given?

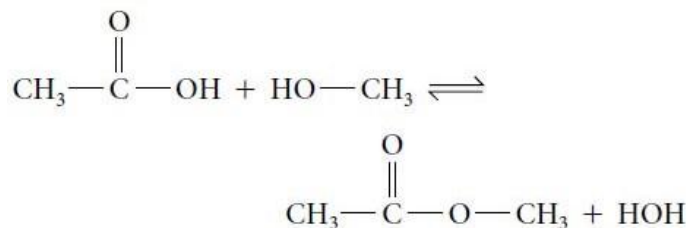
You are given the reactants and the product of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine a reaction where alkenes react with small molecules to form alkanes.	addition
Determine the reaction in which the product has more C – H bonds than the reactant.	reduction

Check Your Solution

In an addition reaction alkenes can react with hydrogen to form alkanes. Alkenes can also be reduced to alkanes.

48. Classify this reaction in two different ways: for example, as oxidation and as an elimination reaction.



What Is Required?

You need to classify the reaction in two different ways.

What Is Given?

You are given the reactants and the product of the reaction.

Plan Your Strategy	Act on Your Strategy
Determine a reaction in which a carboxylic acid and an alcohol react to give an ester and water.	esterification
Determine the reaction in which a hydrogen atom is removed from one reactant and a hydroxyl group is removed from another, and water is formed. The two reactants are then joined together.	condensation

Check Your Solution

In a condensation reaction two large molecules come together to form a single larger molecule and water. An esterification reaction is simply a special case of a condensation reaction in which a carboxylic acid and an alcohol react to form an ester and water.

49. Write a balanced equation to show the complete combustion of the hydrocarbon given.
methane, CH₄

What Is Required?

You need to write a balanced equation for the combustion of methane.

What Is Given?

You are given the reactant, methane.

Plan Your Strategy	Act on Your Strategy
Write a skeleton equation where methane reacts with oxygen to produce carbon dioxide, water and energy.	$\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{energy}$
Balance the equation.	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{energy}$

Check Your Solution

When complete combustion occurs the reaction is always hydrocarbon (fuel) and oxygen yields carbon dioxide, water, and energy (usually in the form of heat).

50. Write a balanced equation to show the complete combustion of the hydrocarbon given.
but-2-ene, C₄H₈

What Is Required?

You need to write a balanced equation for the combustion of but-2-ene.

What Is Given?

You are given the reactant, but-2-ene.

Plan Your Strategy	Act on Your Strategy
Write a skeleton equation where but-2-ene reacts with oxygen to produce carbon dioxide, water, and energy.	$\text{C}_4\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{energy}$
Balance the equation.	$\text{C}_4\text{H}_8 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O} + \text{energy}$

Check Your Solution

When complete combustion occurs the reaction is between a hydrocarbon and oxygen and yields carbon dioxide, water, and energy (usually in the form of heat).

51. Write a balanced equation to show the complete combustion of the hydrocarbon given.
propane, C_3H_8

What Is Required?

You need to write a balanced equation for the combustion of propane.

What Is Given?

You are given the reactant, propane.

Plan Your Strategy	Act on Your Strategy
Write a skeleton equation where propane reacts with oxygen to produce carbon dioxide, water, and energy.	$C_3H_8 + O_2 \rightarrow CO_2 + H_2O + \text{energy}$
Balance the equation.	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O + \text{energy}$

Check Your Solution

When complete combustion occurs the reaction is between a hydrocarbon and oxygen and yields carbon dioxide, water, and energy (usually in the form of heat).

52. Although cellular respiration in the body is a complex process, the overall reaction can be reduced to the equivalent of a combustion reaction. Write and balance the chemical equation for the complete combustion of glucose, $C_6H_{12}O_6$.

What Is Required?

You need to write a balanced equation for the combustion of glucose.

What Is Given?

You are given the reactant, glucose.

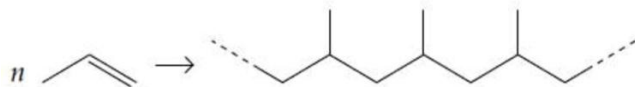
Plan Your Strategy	Act on Your Strategy
Write a skeleton equation where glucose reacts with oxygen to produce carbon dioxide, water, and energy.	$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + \text{energy}$
Balance the equation.	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$

Check Your Solution

When complete combustion occurs the reaction is between a hydrocarbon and oxygen and yields carbon dioxide, water and energy (usually in the form of heat).

Classifying a Polymerization Reaction
(Student textbook page 121)

53. Identify the reaction as addition or condensation polymerization.



What Is Required?

You need to identify the reaction as an addition polymerization or a condensation polymerization.

What Is Given?

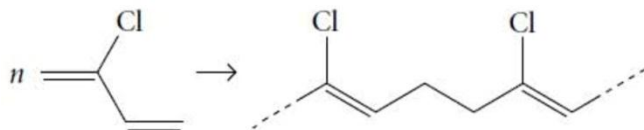
You are given the reactant and the product.

Plan Your Strategy	Act on Your Strategy
Determine the reaction in which: alkene monomers join together to form a polymer includes reduction of double bonds to single bonds	addition polymerization

Check Your Solution

Addition polymerization occurs when alkene monomers join through multiple addition reactions to form a polymer. A main characteristic is the reduction in the number of double bonds found in the polymer since the addition reaction reduces the double bonds to single bonds.

54. Identify the reaction as addition or condensation polymerization.



What Is Required?

You need to identify the reaction as an addition polymerization or a condensation polymerization.

What Is Given?

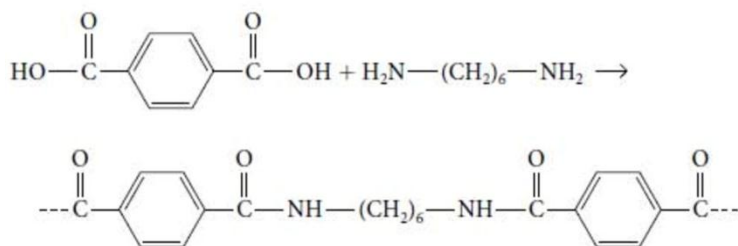
You are given the reactant and the product.

Plan Your Strategy	Act on Your Strategy
Determine the reaction in which: alkene monomers join together to form a polymer includes reduction of double bonds to single bonds	addition polymerization

Check Your Solution

Addition polymerization occurs when alkene monomers join through multiple addition reactions to form a polymer. A main characteristic is the reduction in the number of double bonds found in the polymer since the addition reaction reduces the double bonds to single bonds.

55. Identify the reaction as addition or condensation polymerization.



What Is Required?

You need to identify the reaction as an addition polymerization or a condensation polymerization.

What Is Given?

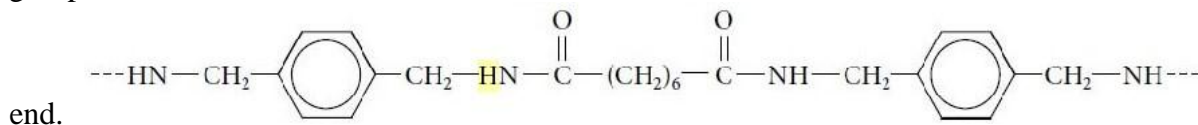
You are given the reactant and the product.

Plan Your Strategy	Act on Your Strategy
Determine the reaction in which a hydrogen atom and a hydroxyl group are removed from each monomer when they are joined to make a polymer.	condensation polymerization

Check Your Solution

In condensation polymerization, monomers are combined through multiple condensation reactions to form a polymer.

56. Classify the polymer as a polyester or polyamide and draw the structure of the monomer.
 NOTE: There was a missing H in the original diagram which is shown here, shaded in yellow.
 The result gives two monomers, one with an amino group on each end and one with carboxyl groups on each



What Is Required?

You need to classify the polymer as a polyester or polyamide.
 You need to draw the monomer.

What Is Given?

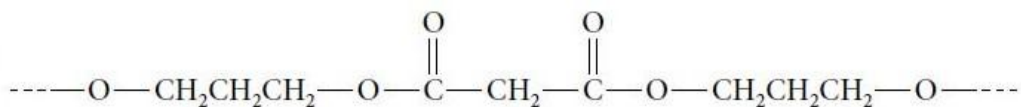
You are given the structure of the polymer.

Plan Your Strategy	Act on Your Strategy
Identify the linkages between monomers.	amide linkages (N – C = O)
Identify the polymer.	polyamide
To determine the identity of the monomers, show the ester or amide linkages in the polymer.	There are two amide linkages.
To draw the monomers, break the amide linkages and add an OH to the C and an H to the N.	The result gives two monomers, one with an amino group on each end and one with carboxyl groups on each end.

Check Your Solution

Polyamides are formed when monomers combine in condensation reactions forming amide linkages. The polymer consists of two monomers that each have a functional group on both ends.

57. Classify the polymer as a polyester or polyamide and draw the structure of the monomer.

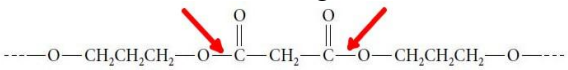


What Is Required?

You need to classify the polymer as a polyester or polyamide.

What Is Given?

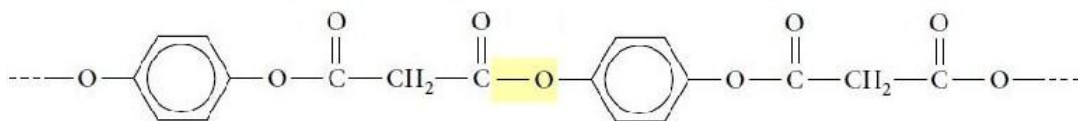
You are given the structure of the polymer.

Plan Your Strategy	Act on Your Strategy
Identify the linkages between monomers.	ester linkages ($\text{O} - \text{C} = \text{O}$)
Identify the polymer.	polyester
To determine the identity of the monomers, show the ester or amide linkages in the polymer.	There are two ester linkages. 
To draw the monomers, break the ester linkages and add an OH to the carbonyl carbon and an H to the O.	There are two monomers, one with a hydroxyl group on each end and one with a carboxyl group on each end. $\text{HO---CH}_2\text{CH}_2\text{CH}_2\text{---OH}$ $\text{HO---}\overset{\text{O}}{\parallel}\text{C---CH}_2\text{---}\overset{\text{O}}{\parallel}\text{C---OH}$

Check Your Solution

Polyesters are formed when monomers combine together through condensation reactions forming ester linkages.

- 58.** Classify the polymer as a polyester or polyamide and draw the structure of the monomer.
NOTE: There was a missing O in the original diagram which is shown here, shaded in yellow.



What Is Required?

You need to identify the polymer as a polyester or polyamide and determine the structure of the monomer.

What Is Given?

You are given the structure of the polymer.

Plan Your Strategy	Act on Your Strategy
Identify the type of linkages.	ester
Determine the type of polymer.	polyester
To determine the identity of the monomers, show the ester or amide linkages in the polymer.	
To draw the monomers, break the ester linkages and add an OH to the carbonyl carbon and an H to the O.	<p>There are two monomers, one with a hydroxyl group on each end and one with a carboxyl group on each end.</p> <p> $\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ </p> <p> </p>

Check Your Solution

Polyesters are formed when monomers with a carboxyl group and an alcohol group as functional groups, combine to form a polymer through ester linkages.

59. How could you convert 1-bromoethane into polyethene? Write an equation for each step.

What Is Required?

You need to write chemical equations for the reactions that would convert 1-bromoethane into polyethene.

What Is Given?

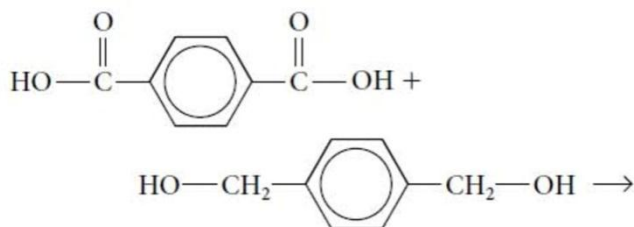
You are given a reactant and the final product.

Plan Your Strategy	Act on Your Strategy
*work backwards from polyethene to 1-bromoethane Identify the monomer of polyethene.	ethane
1-bromoethane is a haloalkane. Identify the reaction which can convert a haloalkane into an alkene (ethene).	elimination reaction
Write out the reaction followed by the polymerization reaction.	$\begin{array}{c} \text{H}_2\text{C}-\text{CH}_2 + \text{Na}-\text{OCH}_2\text{CH}_3 \rightarrow \\ \quad \\ \text{H} \quad \text{Br} \\ \text{CH}_2=\text{CH}_2 + \text{HOCH}_2\text{CH}_3 \end{array}$ $n \text{CH}_2=\text{CH}_2 \rightarrow \text{---CH}_2\text{---CH}_2\text{---CH}_2\text{---}$ $\text{CH}_2\text{---}$

Check Your Solution

Haloalkanes can be converted to alkenes when reacted with a strong base. The alkene can then be a monomer to an addition polymerization reaction.

60. Draw the product of the polymerization reaction. Include at least two linkages.

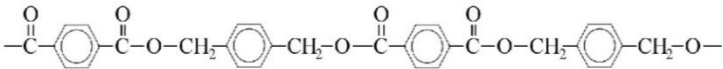


What Is Required?

You need to determine the product of the polymerization reaction.

What Is Given?

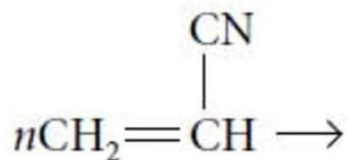
You are given the two monomers.

Plan Your Strategy	Act on Your Strategy
Identify the type of polymerization.	condensation polymerization
Draw the structure. create ester linkages between the two polymers, water would also be a product	

Check Your Solution

Monomers that contain multiple alcohol functional groups can join via ester linkages in a condensation polymerization reaction.

61. Draw the product of the polymerization reaction. Include at least two linkages.



What Is Required?

You need to determine the product for the polymerization reaction.

What Is Given?

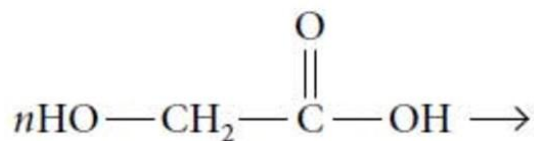
You are given the monomer.

Plan Your Strategy	Act on Your Strategy
Determine the type of polymerization reaction.	addition polymerization
Draw the product. Join two monomers together by replacing the double bond with a single bond and creating a single bond between a CH and a CH ₂ of two different monomers.	$\cdots - \text{CH}_2 - \underset{\text{CN}}{\underset{ }{\text{CH}}} - \text{CH}_2 - \underset{\text{CN}}{\underset{ }{\text{CH}}} - \text{CH}_2 - \underset{\text{CN}}{\underset{ }{\text{CH}}} - \cdots$

Check Your Solution

Addition polymerization is a reaction in which alkene monomers are joined through multiple addition reactions to form a polymer.

62. Draw the product of the polymerization reaction. Include at least two linkages.



What Is Required?

You need to determine the product for the polymerization reaction.

What Is Given?

You are given the monomer.

Plan Your Strategy	Act on Your Strategy
Determine the type of polymerization reaction.	condensation polymerization
Draw the product. remove the -OH group from the carboxyl group of one monomer remove the hydrogen atom from the hydroxyl group of another monomer create a single bond between the carbon and the oxygen of the two monomers creating an ester linkage	$\cdots-\text{O}-\text{CH}_2-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{O}-\text{CH}_2-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{O}-\text{CH}_2-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-\cdots$

Check Your Solution

In condensation polymerization, monomers are combined through multiple condensation reactions to form a polymer.