

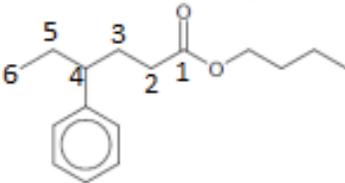
135. Draw the line structure of the ester formed from the following reaction.  
butanol and 4-phenylhexanoic acid

**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.

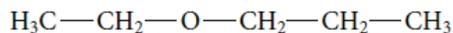
Plan Your Strategy	Act on Your Strategy
Identify the root.	The root is related to the carboxylic acid, which is 4-phenylhexanoic acid. The root is hexan-, so the carbon chain has six carbons with only single bonds.
Identify the suffix. Draw the structure described by the root and the suffix.	The compound 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?**

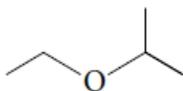
You are given a structure.

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-. $\text{H}_3\text{C}-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_3$ <div style="display: flex; justify-content: center; gap: 20px; margin-top: 5px;"> <span>1</span> <span>2</span> <span>3</span> </div>
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.

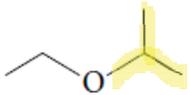
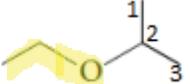


**What Is Required?**

You must name an ether.

**What Is Given?**

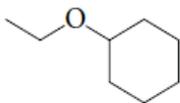
You are given a structure.

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.

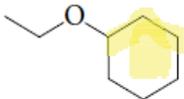
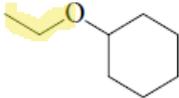


**What Is Required?**

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.

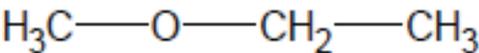
139. Draw the condensed structural formula for the following ether.  
methoxyethane

**What Is Required?**

You must draw a condensed structural formula.

**What Is Given?**

You are given a name.

<b>Plan Your Strategy</b>	<b>Act on Your Strategy</b>
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.	 <p style="text-align: center;">C — O — C — C                                   1      2</p>
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.	 <p style="text-align: center;">H<sub>3</sub>C — O — CH<sub>2</sub> — CH<sub>3</sub></p>

**Check Your Solution**

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

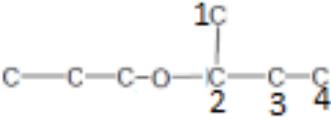
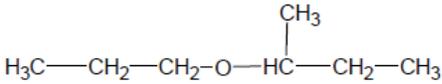
140. Draw the condensed structural formula for the following ether.  
2-propoxybutane

**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.	The second part of the prefix is 4-methyl-, so there is a methyl group on carbon atom 4 of the main chain.
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.

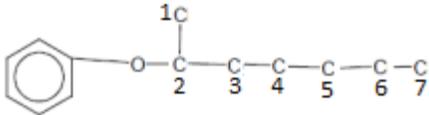
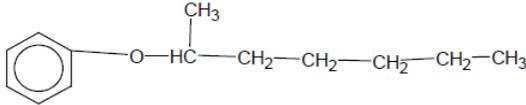
142. Draw the condensed structural formula for the following ether.  
2-phenoxyheptane

**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.

<b>Plan Your Strategy</b>	<b>Act on Your Strategy</b>
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.



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 \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.

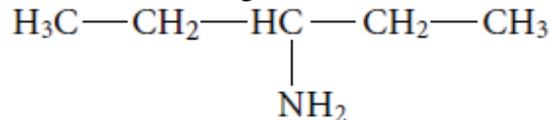
<b>Plan Your Strategy</b>	<b>Act on Your Strategy</b>
Identify the root.	The root is benzene, so the main chain is a six-membered aromatic-hydrocarbon ring.
Identify the prefix.	The prefix is 2-ethoxy, so an ethyl group is bonded to an oxygen atom, which is bonded to the main chain at carbon atom 2.
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.



148. Name the following amine.



**What Is Required?**

You must name the amine.

**What Is Given?**

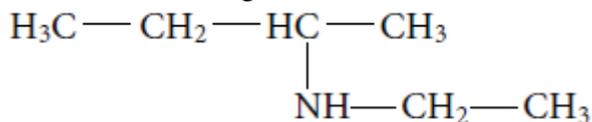
You are given the structure.

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.	Number the carbon atoms starting at the end of the main chain nearest the nitrogen atom. $\begin{array}{ccccccc} 1 & & 2 & & 3 & & 4 & & 5 \\ \text{H}_3\text{C} & \text{---} & \text{CH}_2 & \text{---} & \text{HC} & \text{---} & \text{CH}_2 & \text{---} & \text{CH}_3 \\ & & & &   & & & & \\ & & & & \text{NH}_2 & & & & \end{array}$ Carbon atom 3 is bonded to the nitrogen, so the suffix is -3-amine.
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?**

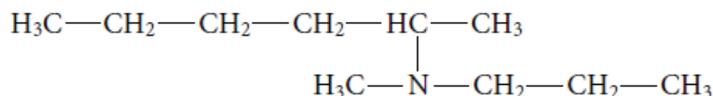
You are given the structure.

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.	Number the carbon atoms starting at the end of the main chain nearest the nitrogen atom. $\begin{array}{ccccccc} & & 4 & & 3 & & 2 & & 1 \\ & & \text{H}_3\text{C} & - & \text{CH}_2 & - & \text{HC} & - & \text{CH}_3 \\ & & & & & &   & & \\ & & & & & & \text{NH} & - & \text{CH}_2 - \text{CH}_3 \end{array}$ Carbon atom 2 is bonded to the nitrogen, so the suffix is -2-amine.
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.	Number the carbon atoms starting at the end of the main chain nearest the nitrogen atom. $\begin{array}{c} \text{H}_3\overset{6}{\text{C}}-\overset{5}{\text{CH}_2}-\overset{4}{\text{CH}_2}-\overset{3}{\text{CH}_2}-\overset{2}{\text{HC}}-\overset{1}{\text{CH}_3} \\   \\ \text{H}_3\text{C}-\text{N}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array}$ Carbon atom 2 is bonded to the nitrogen, so the suffix is -2-amine.
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.

<b>Plan Your Strategy</b>	<b>Act on Your Strategy</b>
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  C – 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.	<p>The suffix is -1-amine, which means that carbon atom 1 is bonded to the nitrogen atom.</p> $\begin{array}{cccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{N} \\ 4 & & 3 & & 2 & & 1 & & \end{array}$
Identify the prefix and draw the necessary structures.	<p>The prefix is N-propyl, so there is a propyl group on the nitrogen atom.</p> $\begin{array}{cccccccc} \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{N} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ 4 & & 3 & & 2 & & 1 & & & & & & & & \end{array}$
Add enough hydrogen atoms so that the nitrogen has a total of three bonds and each carbon has a total of four bonds.	$\text{H}_3\overset{4}{\text{C}} - \overset{3}{\text{CH}_2} - \overset{2}{\text{CH}_2} - \overset{1}{\text{CH}_2} - \text{NH} - \text{CH}_2 - \text{CH}_2 - \overset{3}{\text{CH}_3}$

**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{---} & \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{---} & \text{CH}_2 & \text{---} & \text{CH}_2 & \text{---} & \text{HC} & \text{---} & \text{CH}_2 & \text{---} & \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.	The suffix is -3-amine, which means that carbon atom 3 is bonded to a nitrogen atom.  $\begin{array}{ccccccc} 7 & & 6 & & 5 & & 4 & & 3 & & 2 & & 1 \\ \text{C} & - & \text{C} \\ & & & & & & & &   & & & & \\ & & & & & & & & \text{N} & & & & \end{array}$
Identify the prefix and draw the necessary structures.	The prefix is N-ethyl-N-methyl-, so there is an ethyl and a methyl group bonded to the nitrogen.  $\begin{array}{ccccccc} 7 & & 6 & & 5 & & 4 & & 3 & & 2 & & 1 \\ \text{C} & - & \text{C} \\ & & & & & & & &   & & & & \\ & & & & & & & & \text{H}_3\text{C} - \text{N} - \text{CH}_2 - \text{CH}_3 & & & & \end{array}$
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.

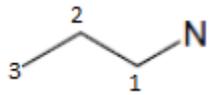
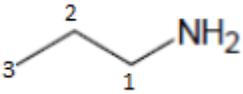
155. Draw the line structure for the following amine.  
propan-1-amine

**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.

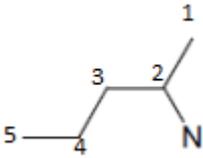
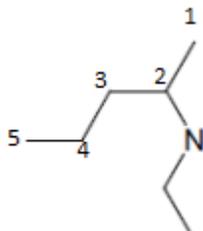
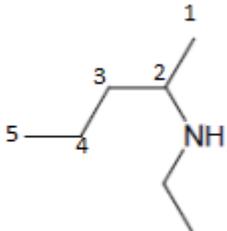
156. Draw the line structure for the following amine.  
N-ethyl-pentan-2-amine

**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.

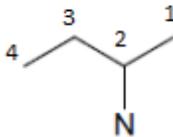
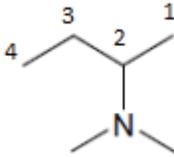
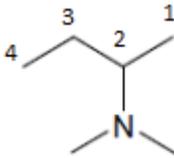
N,N-dimethylbutan-2-amine

### 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.