# Chapter 4 Review Problems

**INSTRUCTIONS:**

You ***do not*** need to write the **question**, ONLY WRITE THE PROBLEM NUMBER and ANSWERS/SOLUTIONS.

- For problems that involve calculations, you must ***show your work*** to get full credit.
- For multiple choice questions, you can simply write the letter (a, b, c, or d) of the correct response.
- Use the *navigation buttons* at the bottom of the pages to get hints, check your answers, move to the next problem, or go back to previous pages.

Chapter Review Problems are **due** at the ***end of class period*** on the dates shown in the CHEM 108 Schedule.

- Late submissions will not be accepted unless the student can prove to the instructor that something outside of their control prevented them from turning in the problem set on the due date (see the course syllabus for more details).

Go to first question

4.1) Draw the line bond structure of each of the following molecules:

a) $I_2$

b) $NBr_3$

c) $SO_3$

d) $CHCl_3$ (a small molecule - carbon is the central atom and *all of the other atoms* are bonded to the carbon)

Go back

Click here for a **hint**

Click here to **check your answer**

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**HINT:**
Use the *six-step method* for drawing line bond structures.
**Click HERE** to get the template for working on the *six-step method*.

**For more help:** See chapter 4 part 1 video and chapter 4 part 2 video or chapter 4 section 2 in the textbook.

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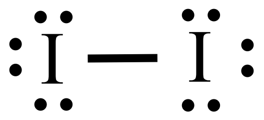
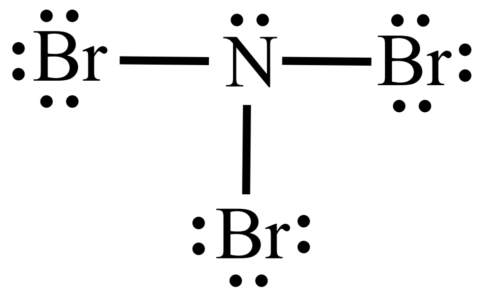
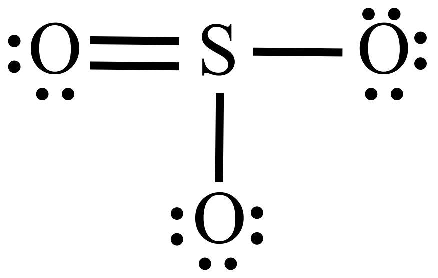
**a)**



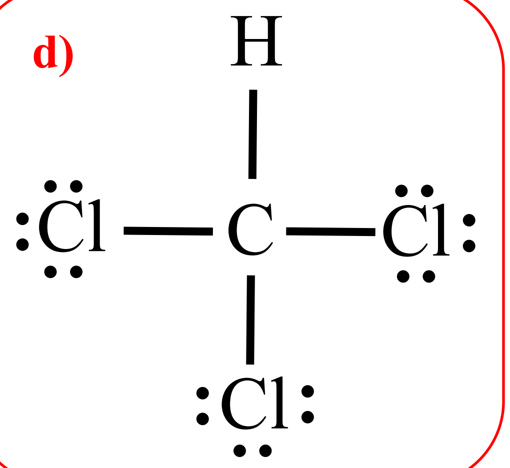
**b)**



**c)**



**d)**



**For more details:** See chapter 4 part 1 video and chapter 4 part 2 video or chapter 4 section 2 in the textbook.

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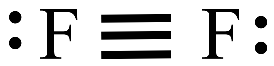
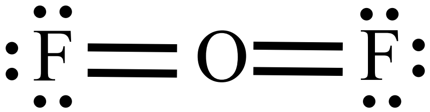
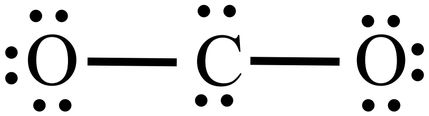
Go to next question

4.2) Each of the following line bond structures is INCORRECRT. For each structure, determine whether it is incorrect because of an **octet rule violation** or because there is an **incorrect number of electrons**.

a) 

b) 

c) 

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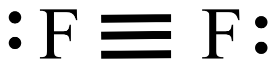
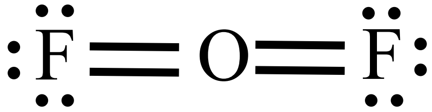
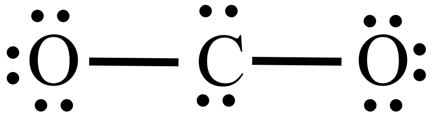
a) 

b) 

c) 

**HINT:**

Determine the ***correct number of electrons*** in a line bond structure by adding up the valence electrons from all of the atoms contained in the structure.

The ***octet rule*** is violated when an atom in a line bond structure is not surrounded by eight electrons. Hydrogen is an exception.

**For more help:** See chapter 4 part 1 video and chapter 4 part 2 video or chapter 4 section 2 in the textbook.

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Click here to **check your answer**

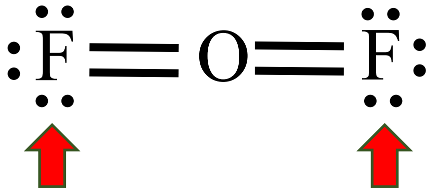
Go to next question

4.2) Each of the following line bond structures is INCORRECRT. For each structure, determine whether it is incorrect because of an **octet rule violation** or because there is an **incorrect number of electrons**.

a) 

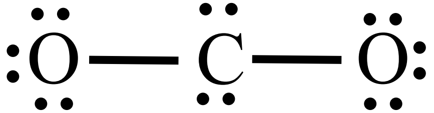
**incorrect number of electrons**

There are two fluorine atoms in the structure. Each fluorine atom has seven valence electrons; the correct structure would have 14 electrons. The structure shown here has only 10 electrons.

b) 

**octet rule violation**

The octet rule is violated at each fluorine atom; they are surrounded by 10 electrons. This structure has the correct number of electrons.

c) 

**incorrect number of electrons**

The carbon atom comes with four valence electrons and *each* of the two oxygen atoms comes with six valence electrons. The correct structure would have 16 electrons. The structure shown here has 20 electrons.

**For more details:** See chapter 4 part 1 video and chapter 4 part 2 video or chapter 4 section 2 in the textbook.

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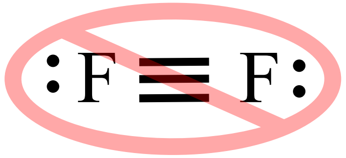
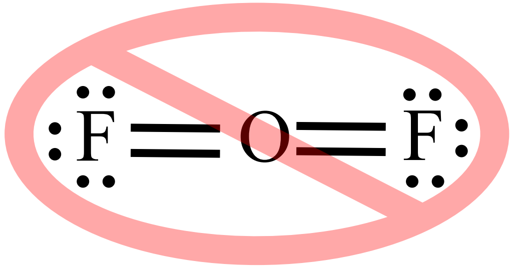
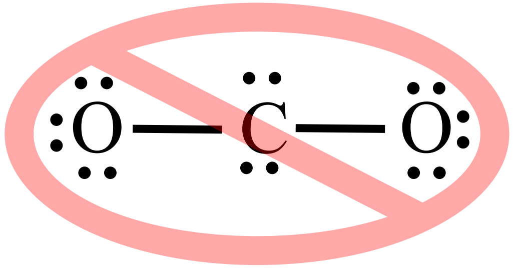
4.3) In the previous question (4.2), you were given the following INCORRECRT line bond structures, and then you determined whether there was an **octet rule violation** or an **incorrect number of electrons**. Draw the correct line bond structures for each of those molecules:

a)  **incorrect number of electrons**

b)  **octet rule violation**

c)  **incorrect number of electrons**

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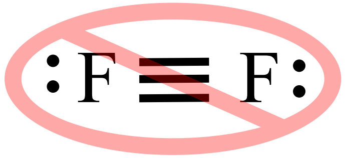
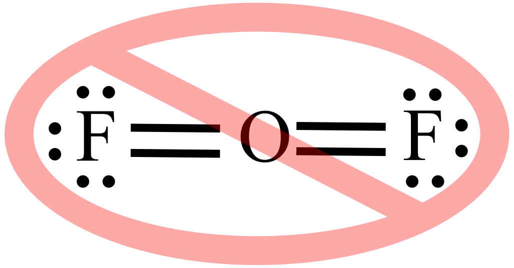
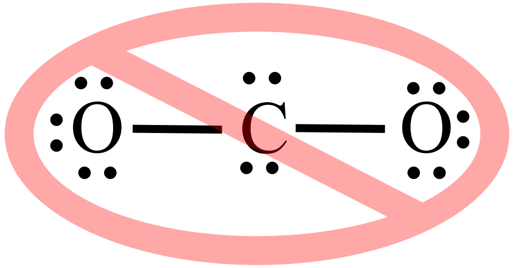
a)  **incorrect number of electrons**

b)  **octet rule violation**

c)  **incorrect number of electrons**

**HINT:**

Use the *six-step method* for drawing line bond structures.

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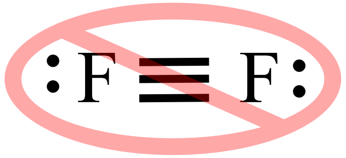
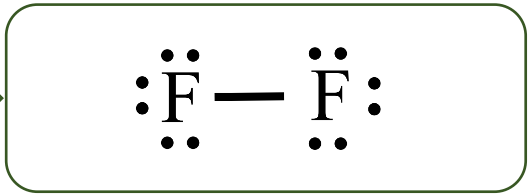
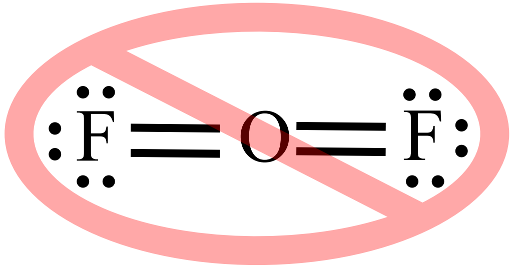
a) 

**incorrect number of electrons**

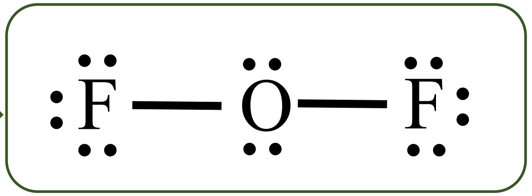
**correct structure**

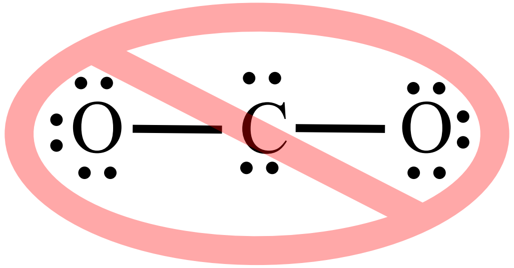


b) 

**octet rule violation**

**correct structure**



c) 

**incorrect number of electrons**

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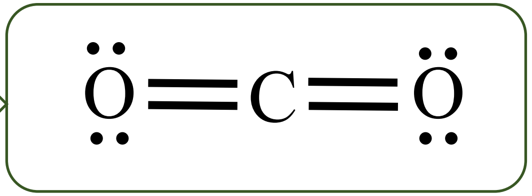

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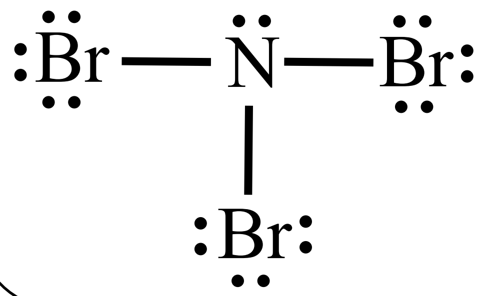
Go to next question

4.4) In which structure(s) does the **nitrogen** have a "**1+**" ***formal charge***?

a)



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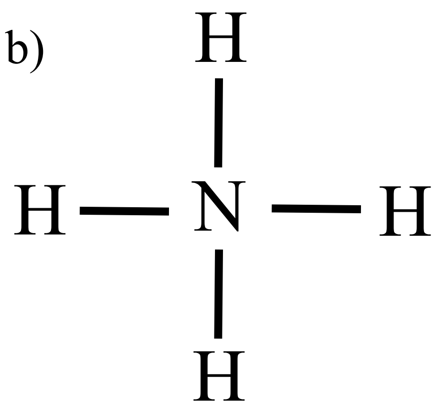
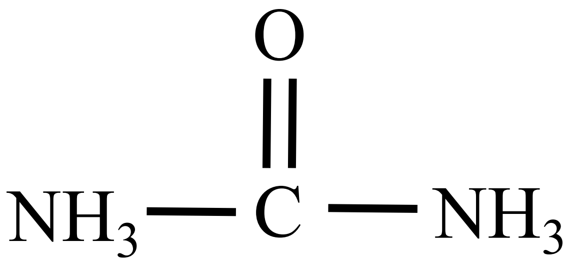


c)

d)



Go back

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Click here to **check your answer**

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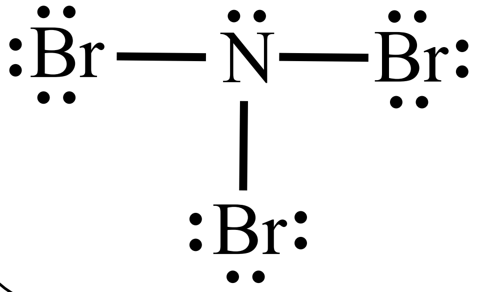

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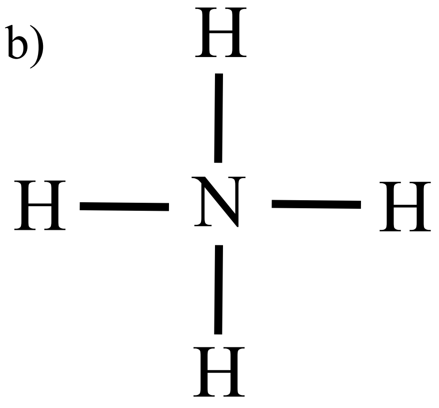
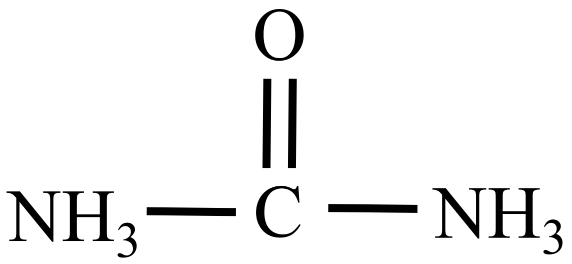
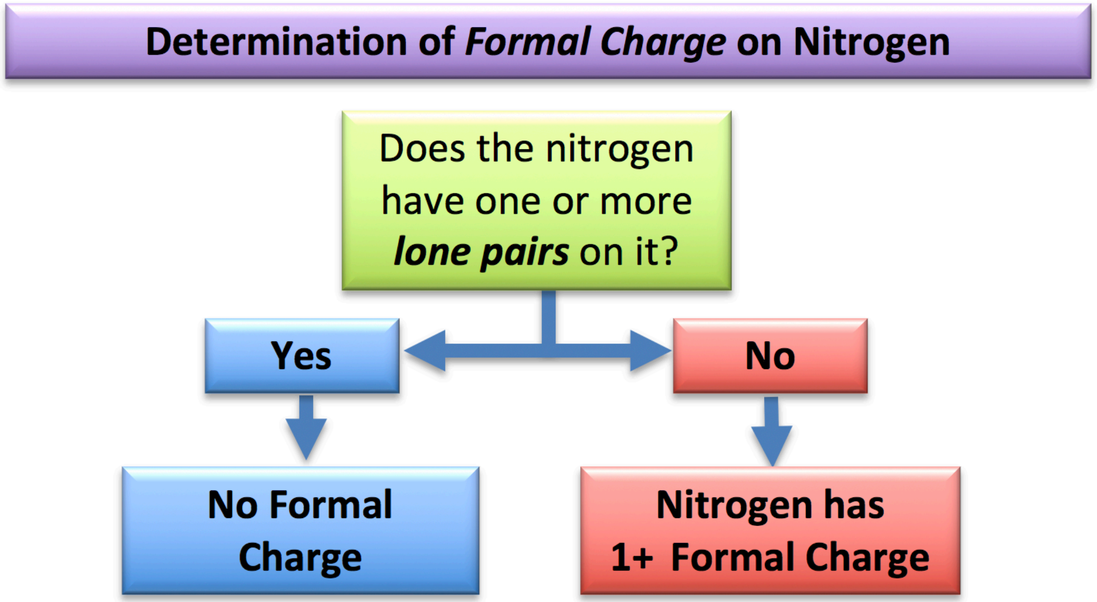


c)

d)



**HINT:**




**For more help:**
See chapter 4 part 9 video or chapter 4 section 5 in the textbook.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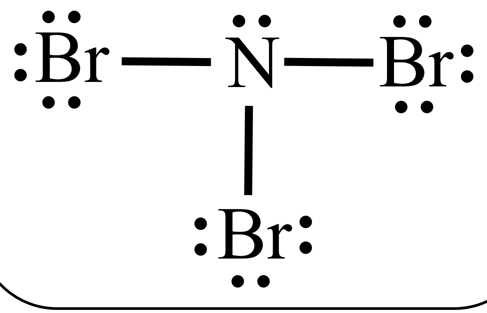
Click here to check your answer

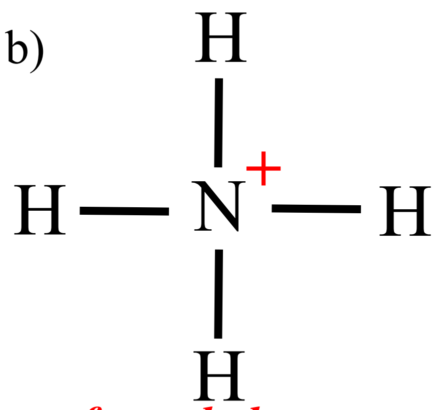
Go to next question

4.4) In which structure(s) does the **nitrogen** have a "**1+**" ***formal charge***?

a) ***NO formal charge***

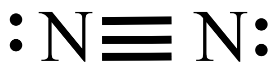



b)

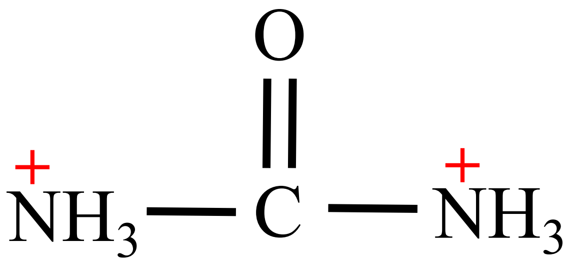



*formal charge*

c) ***NO formal charge***

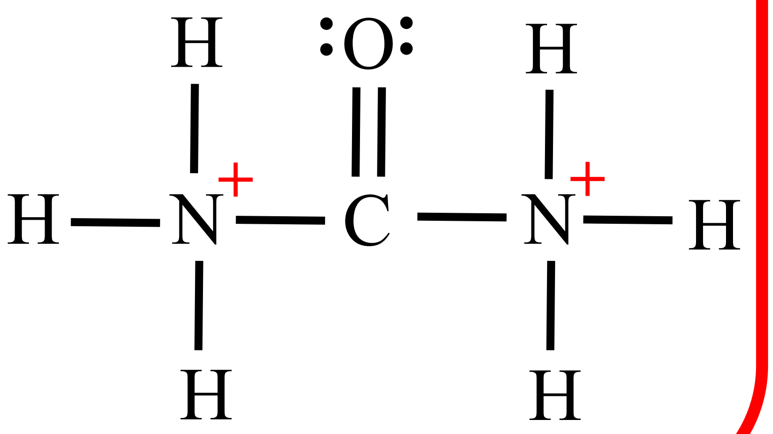



d)

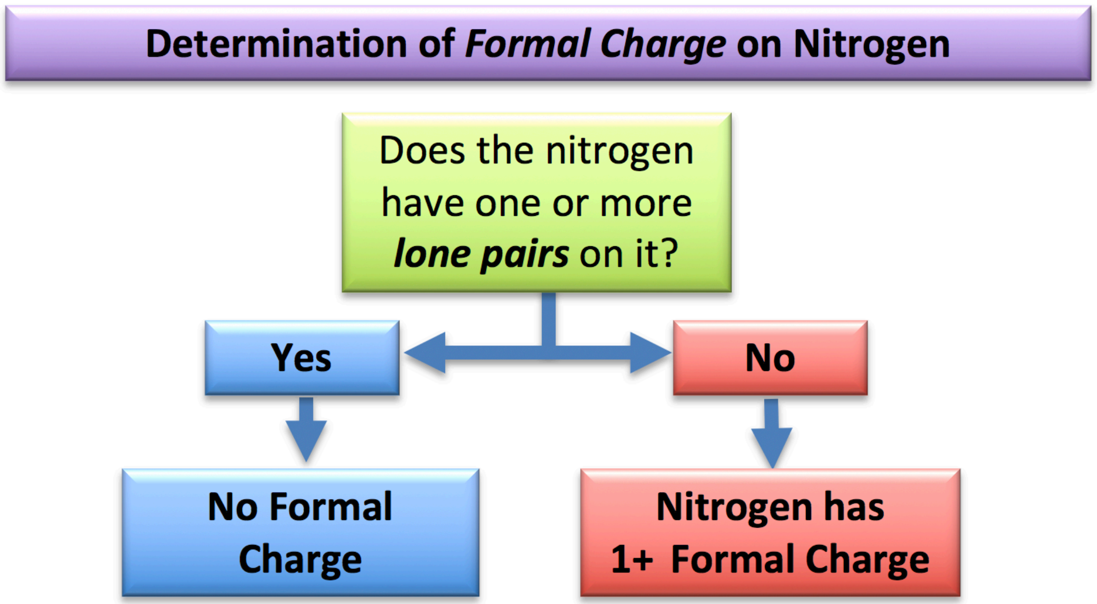



*formal charges*

line bond structure shown below:




**EXPLANATION:**

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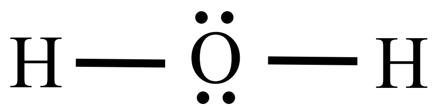
**For more details:** See chapter 4 part 9 video or chapter 4 section 5 in the textbook.

Go to next question

4.5) In which structure(s) does the **oxygen** have a “**1-**” ***formal charge***?

a)

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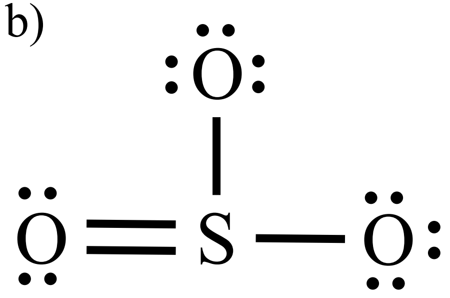
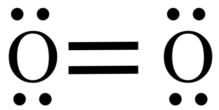
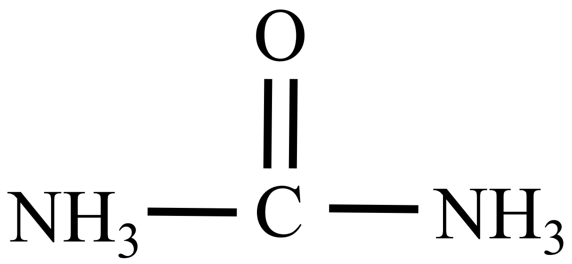



c)




d)




Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

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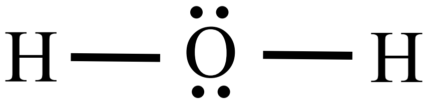
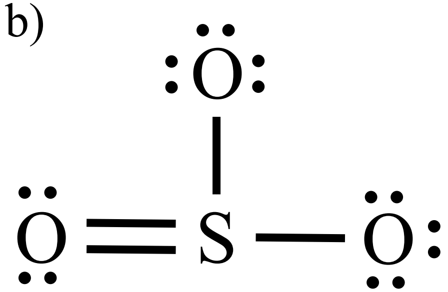
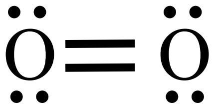
a)



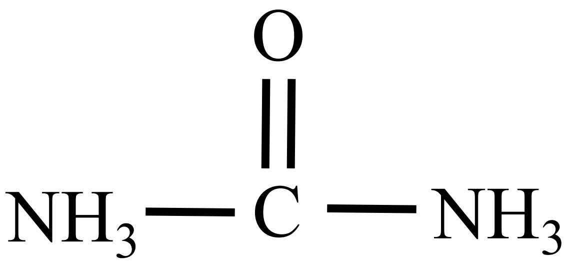
b)



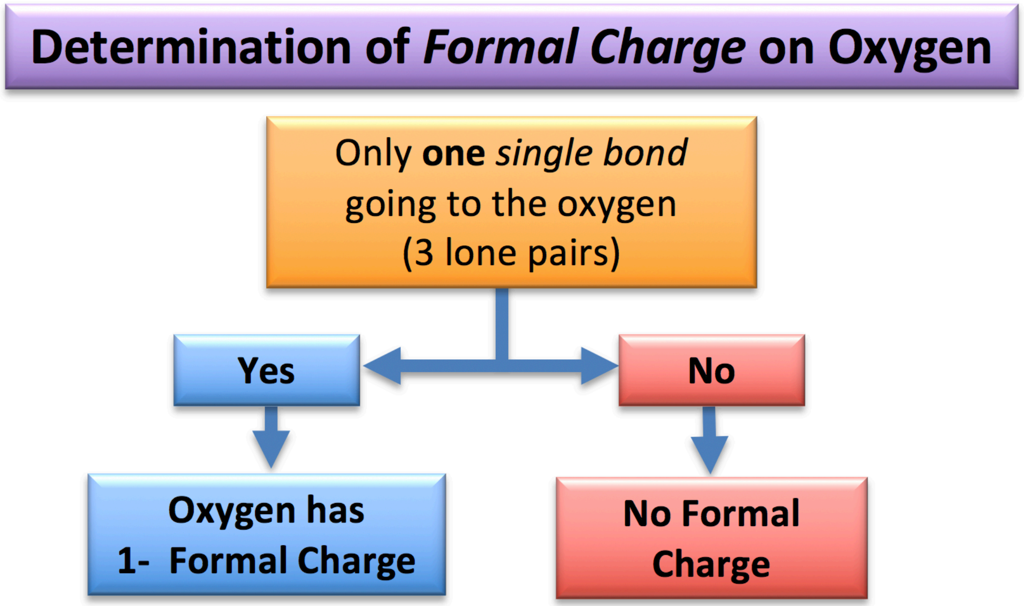
c)



d)



**HINT:**




**For more help:**
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Go back

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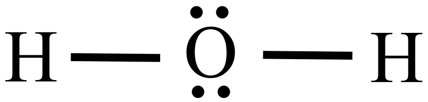
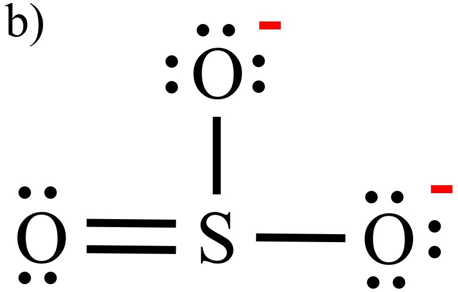
Go to next question

4.5) In which structure(s) does the **oxygen** have a "**1-**" ***formal charge***?

a) ***NO formal charge***

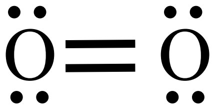


b)

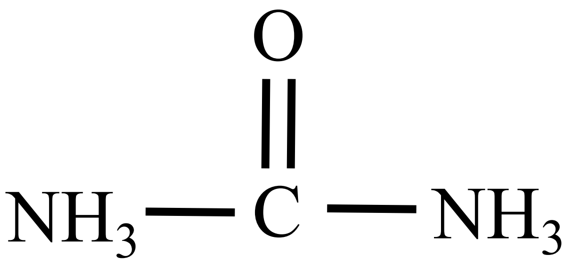


***formal charges***

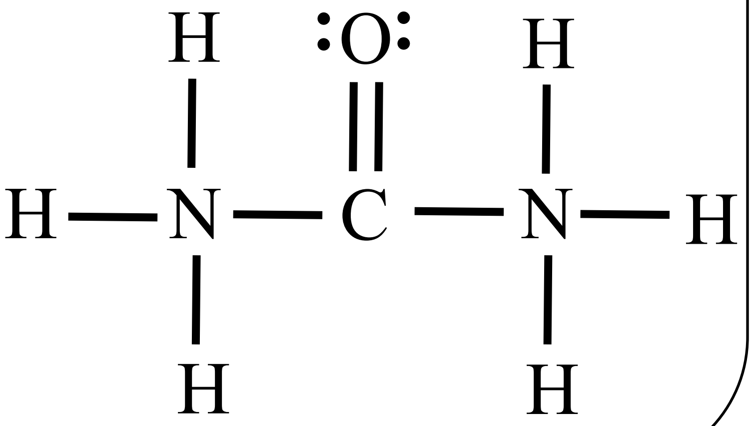
c) ***NO formal charge***



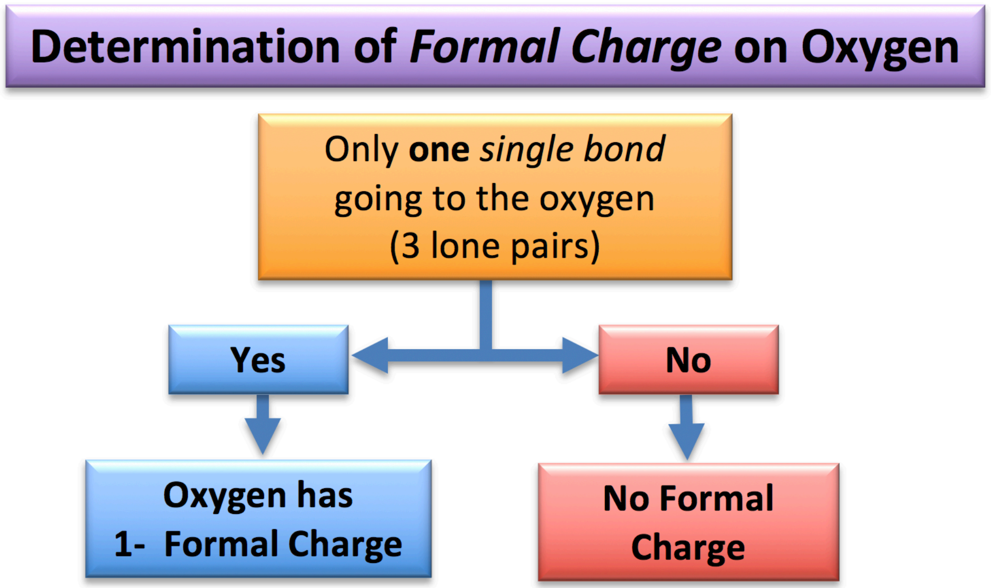
d) ***NO formal charge on oxygen***



line bond structure shown below:



**EXPLANATION:**

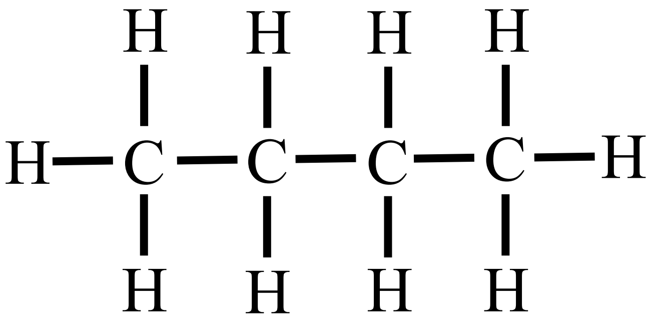



Go back

**For more details:** See chapter 4 part 9 video or chapter 4 section 5 in the textbook.

Go to next question

4.6) The line bond structure for butane is shown below. Draw the **condensed** and **skeletal structure** for butane.




**Line Bond Structure**

?

**Condensed Structure**

?

**Skeletal Structure**

Go back

Click here for a **hint**

Click here to **check your answer**

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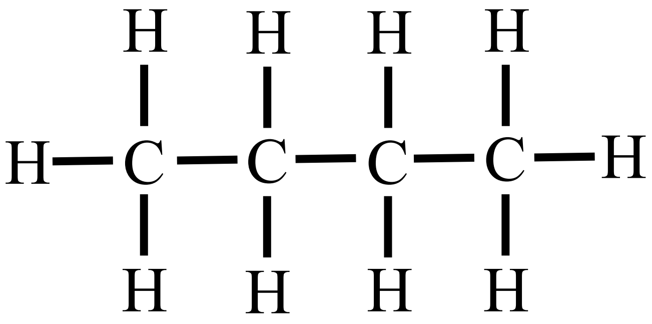

**Line Bond Structure**

?

**Condensed Structure**

?

**Skeletal Structure**

**HINT:** See the **method for drawing structural formulas** in the **chapter 4 part 3** video, or in **chapter 4 section 3** of the textbook.

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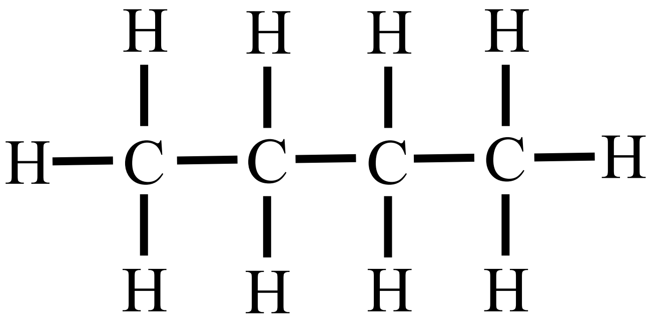
Click here to **check your answer**

Go to next question

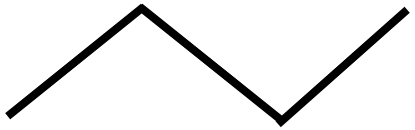
4.6) The line bond structure for butane is shown below. Draw the **condensed** and **skeletal structure** for butane.



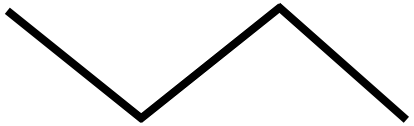
**Line Bond Structure**

$CH_3CH_2CH_2CH_3$

**Condensed Structure**



**or**



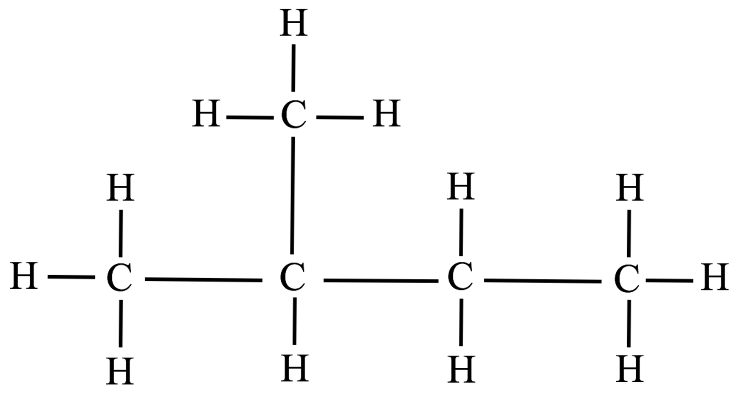
**Skeletal Structure**

**For more details:** See chapter 4 part 3 video or chapter 4 section 3 in the textbook.

Go back

Go to next question

4.7) The line bond structure for 2-methylbutane is shown below. Draw the **condensed** and **skeletal structure** of this molecule.



**Line Bond Structure**

?

**Condensed Structure**

?

**Skeletal Structure**

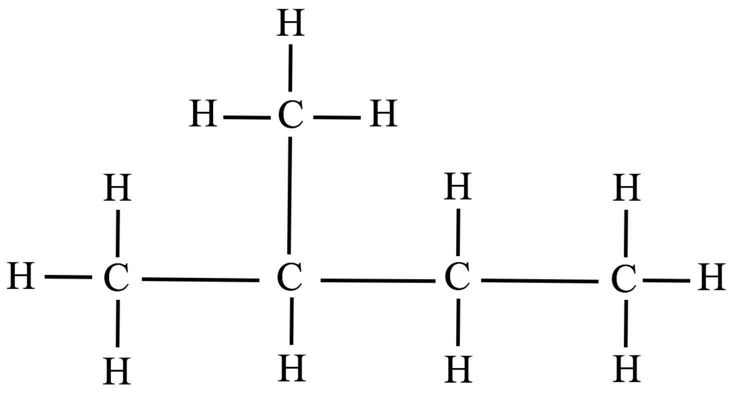
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.7) The line bond structure for 2-methylbutane is shown below. Draw the **condensed** and **skeletal structure** of this molecule.



**Line Bond Structure**

?

**Condensed Structure**

?

**Skeletal Structure**

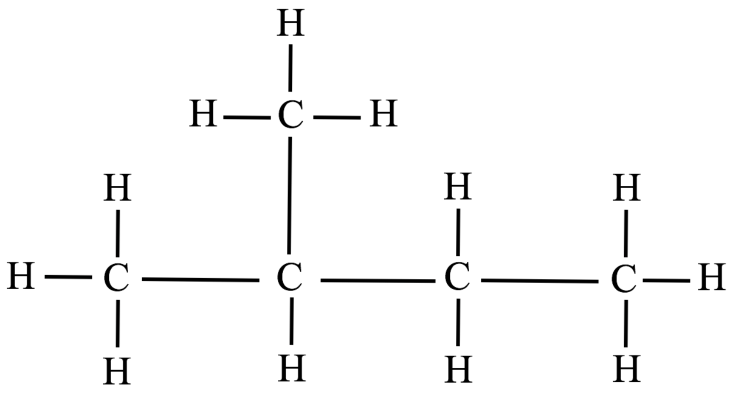
**HINT:** See the **method for drawing structural formulas** in the **chapter 4 part 3** video, or in **chapter 4 section 3** of the textbook.

Go back

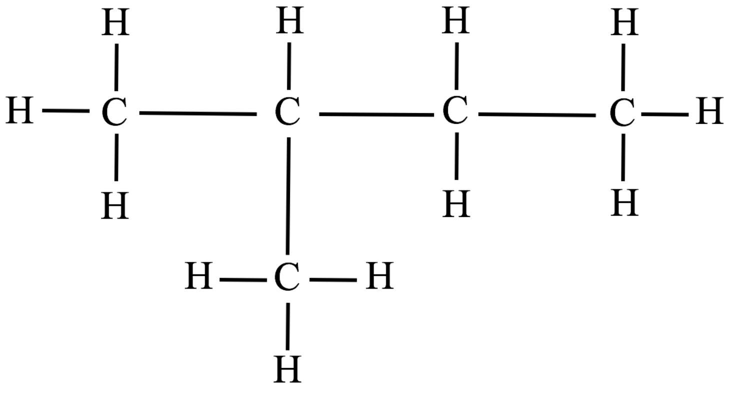
Click here to **check your answer**

Go to next question

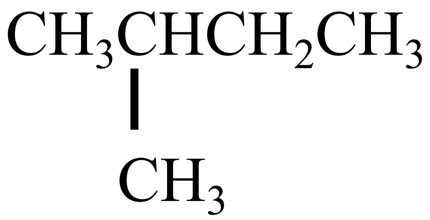
4.7) The line bond structure for 2-methylbutane is shown below. Draw the **condensed** and **skeletal structure** of this molecule.



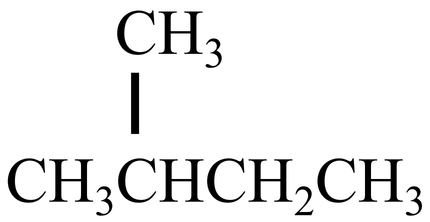
**or**



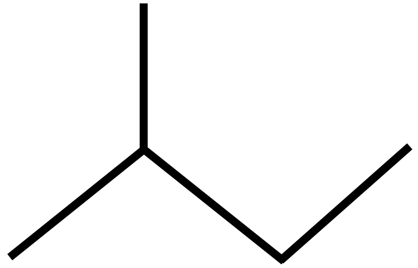
**Line Bond Structure**



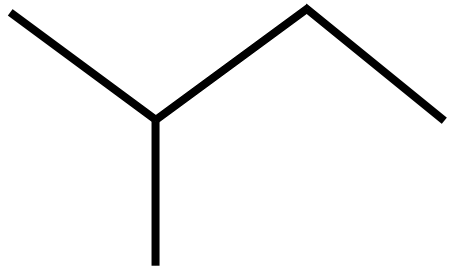

**or**




**Condensed Structure**



**or**



**Skeletal Structure**

**For more details:** See [chapter 4 part 3 video] or chapter 4 section 3 in the textbook.

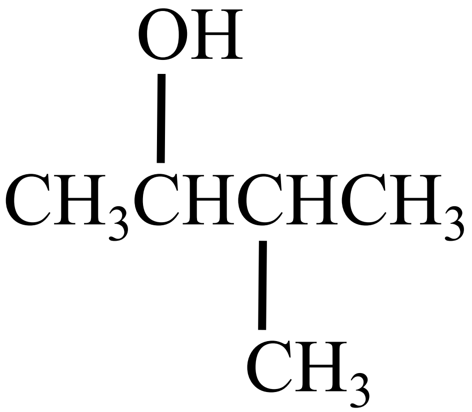
Go back

Go to next question

4.8) The condensed structure of sec-isoamyl alcohol is shown below. Draw the **line bond** and **skeletal structure** of this molecule.

?

**Line Bond Structure**




**Condensed Structure**

?

**Skeletal Structure**

**REMINDER: Lone pairs** are optional in condensed and skeletal structures, ***however they must be shown in line bond structures***.

Go back

Click here for a **hint**

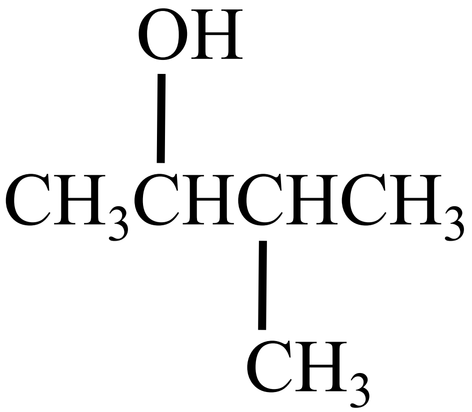
Click here to **check your answer**

Go to next question

4.8) The condensed structure of sec-isoamyl alcohol is shown below. Draw the **line bond** and **skeletal structure** of this molecule.

?

**Line Bond Structure**




**Condensed Structure**

?

**Skeletal Structure**

**REMINDER: Lone pairs** are optional in condensed and skeletal structures, ***however they must be shown in line bond structures***.

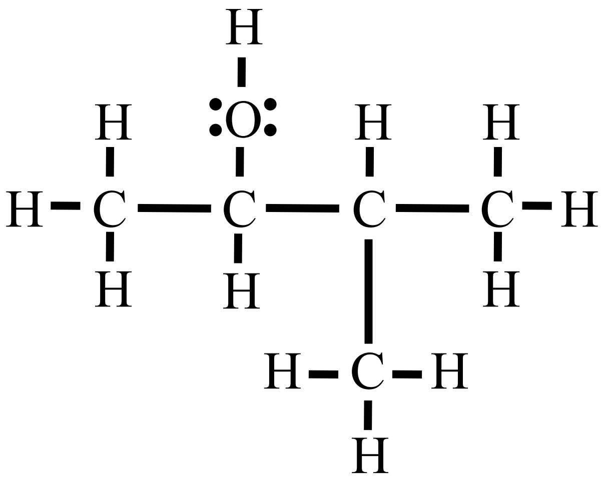
**HINT:** See the **method for drawing structural formulas** in the **chapter 4 part 3** video, or in **chapter 4 section 3** of the textbook.

Go back

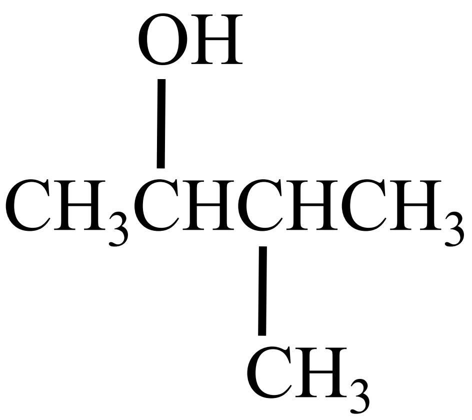
Click here to **check your answer**

Go to next question

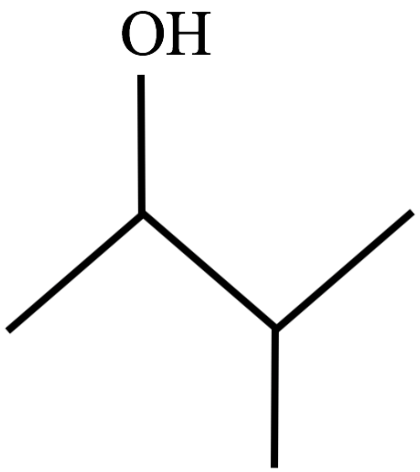
4.8) The condensed structure of sec-isoamyl alcohol is shown below. Draw the **line bond** and **skeletal structure** of this molecule.




**Line Bond Structure**




**Condensed Structure**




**Skeletal Structure**

**REMINDER: Lone pairs** are optional in condensed and skeletal structures, ***however they must be shown in line bond structures***.

NOTE: If your answer has the **same atomic connectivity** but a different configuration, then it is correct.

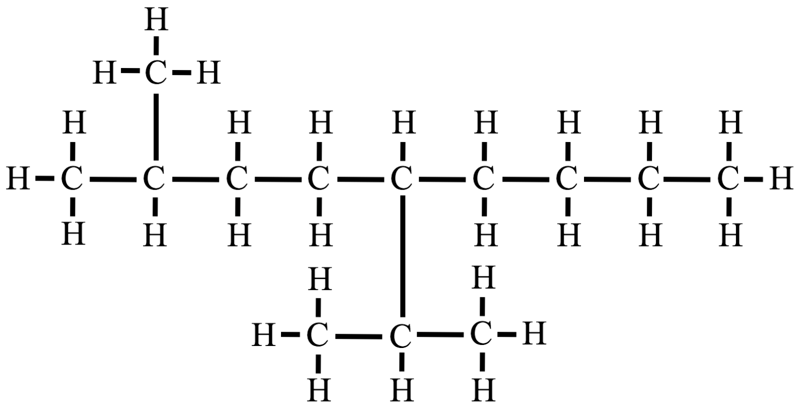
**For more details:** See chapter 4 part 3 video or chapter 4 section 3 in the textbook.

Go back

Go to next question

4.9) The line bond structure of 5-isopropyl-2-methylnonane is shown below. Draw its **condensed** and **skeletal structure.**

**Line Bond Structure**



**Condensed Structure**

?

**Skeletal Structure**

?

Go back

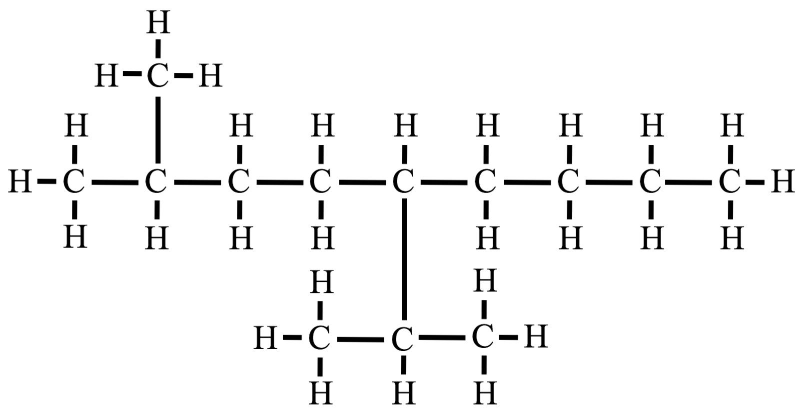
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.9) The line bond structure of 5-isopropyl-2-methylnonane is shown below. Draw its **condensed** and **skeletal structure.**

**Line Bond Structure**



**Condensed Structure**

**Skeletal Structure**

**HINT:** See the **method for drawing structural formulas** in the **chapter 4 part 3** video, or in **chapter 4 section 3** of the textbook.

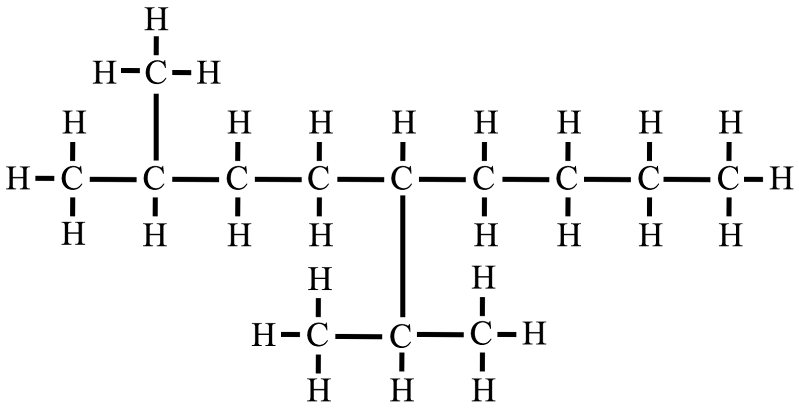
Go back

Click here to **check your answer**

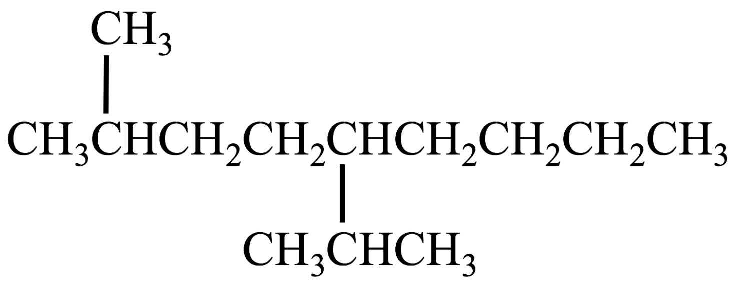
Go to next question

4.9) The line bond structure of 5-isopropyl-2-methylnonane is shown below. Draw its **condensed** and **skeletal structure.**

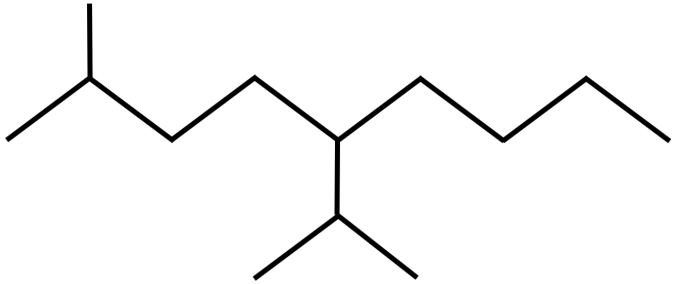
**Line Bond Structure**



**Condensed Structure**




**Skeletal Structure**



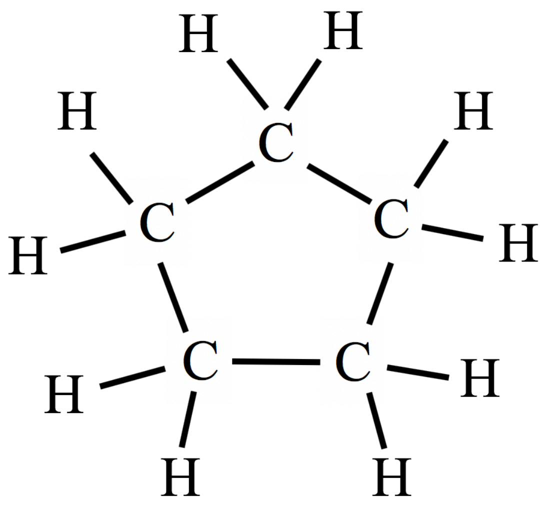
**NOTE:** If your answer has the **same atomic connectivity** but a different configuration, then it is correct.

**For more details:** See chapter 4 part 3 video or chapter 4 section 3 in the textbook.

Go back

Go to next question

4.10) The line bond structure of *cyclopentane* is shown below. Draw the **line bond** and **skeletal structure** of this molecule.




Line Bond Structure

?

Condensed Structure

?

Skeletal Structure

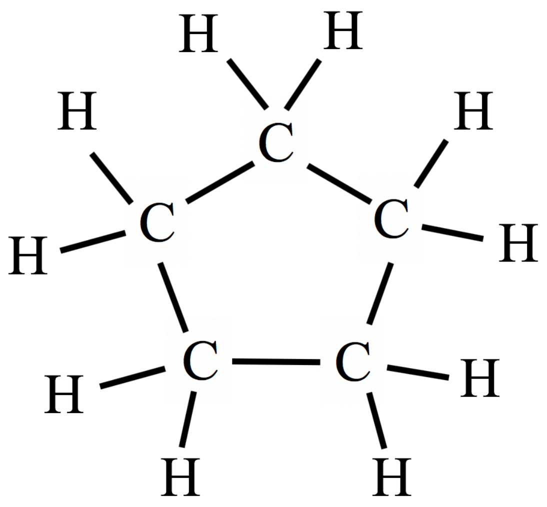
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.10) The line bond structure of *cyclopentane* is shown below. Draw the **line bond** and **skeletal structure** of this molecule.



**Line Bond Structure**

?

**Condensed Structure**

?

**Skeletal Structure**

**HINT:** See the **method for drawing structural formulas** in the **chapter 4 part 3** video, or in **chapter 4 section 3** of the textbook.

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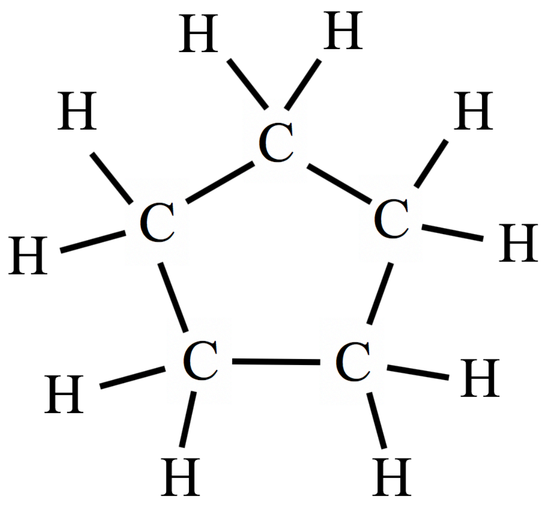
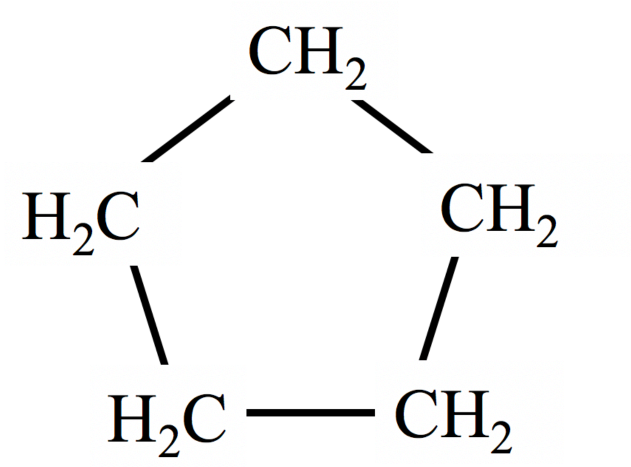
Click here to **check your answer**

Go to next question

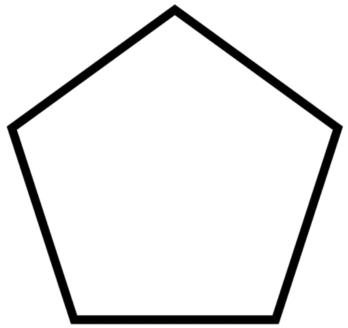
4.10) The line bond structure of *cyclopentane* is shown below. Draw the **line bond** and **skeletal structure** of this molecule.



**Line Bond Structure**



**Condensed Structure**



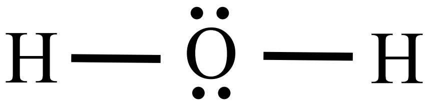
**Skeletal Structure**

**For more details:** See chapter 4 part 3 video or chapter 4 section 3 in the textbook.

Go back

Go to next question

4.11) Determine the *“ABE” classification*, *bond angles*, and *molecular shape* for $H_2O$.




**“ABE” classification =** ?

**bond angles =** ?____________

**molecular shape name =** ?____________

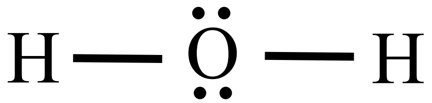
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.11) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $H_2O$.



**"ABE" classification =** ___?___

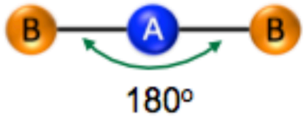
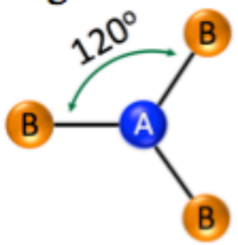
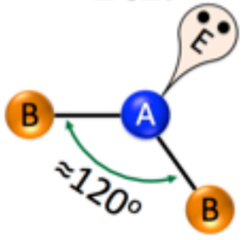
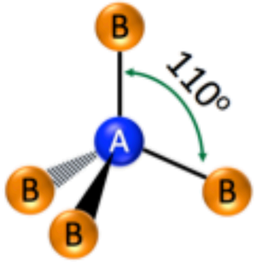
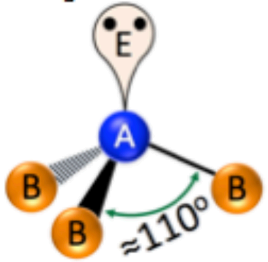
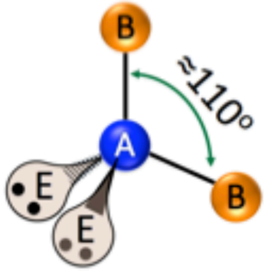
**bond angles =** ___?___

**molecular shape name =** ___?___

**HINT:** "**A**" represents the central atom.
"**B**" and "**E**" represent **electron groups** *around the central atom*.

- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom*.

Use the **molecular shape table** (on right) to determine the bond angles and the molecular shape name based on the ABE classification.

| | | |
|---|---|---|
| $AB_2$ Linear   | | |
| $AB_3$ Trigonal Planar   | $AB_2E$ Bent   | |
| $AB_4$ Tetrahedral   | $AB_3E$ Pyramidal   | $AB_2E_2$ Bent   |

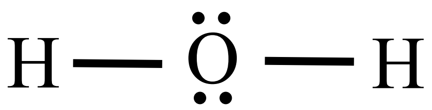
**For more help:**
See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.

Go back

Click here to check your answer

Go to next question

4.11) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $H_2O$.




**"ABE" classification =** $AB_2E_2$

- We write "$B_2$" because there are two atoms bonded to the central atom.
- We write "$E_2$" because there are two lone pairs *on the central atom*.

**bond angles =** 110° (or ≈110°)

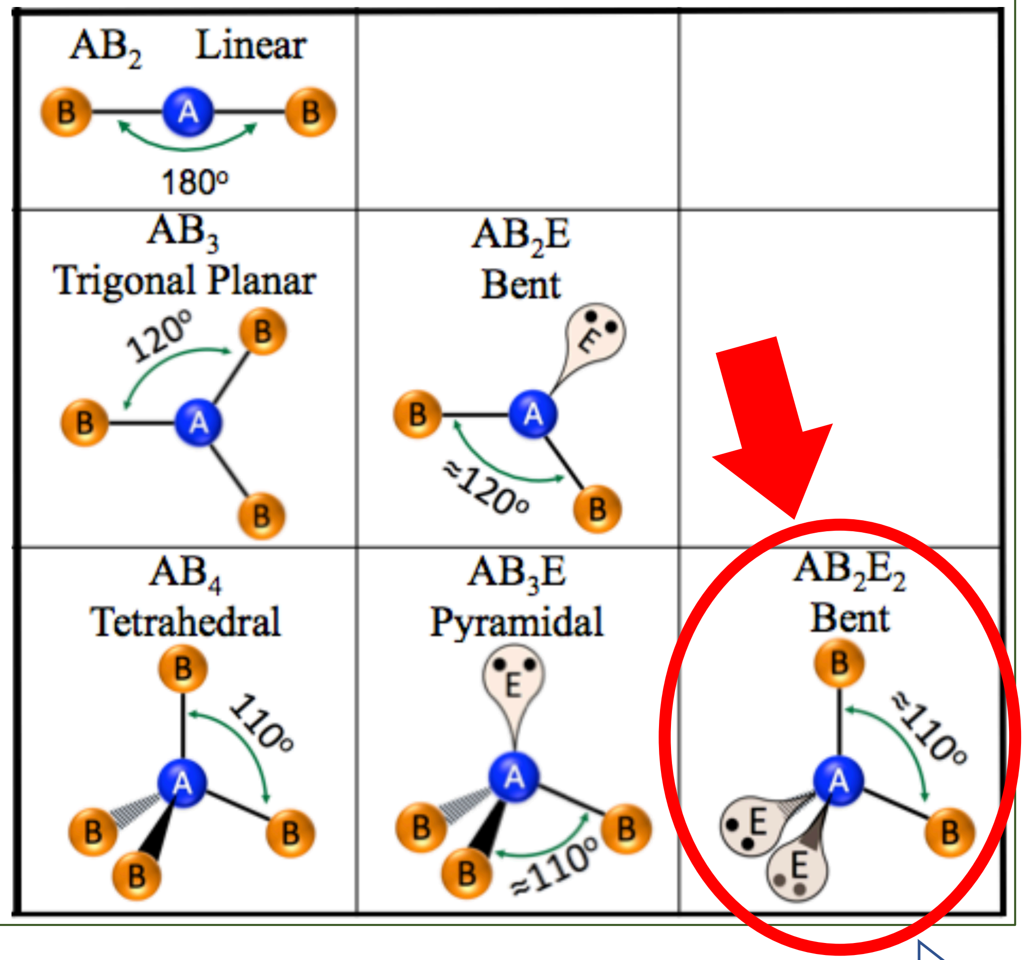
**molecular shape name =** bent

**EXPLANATION:** "**A**" represents the central atom.

"**B**" and "**E**" represent **electron groups** *around the central atom*.

- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom*.

The **molecular shape table** can be used to determine the bond angles and the molecular shape name based on the ABE classification.




**For more details:**

See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.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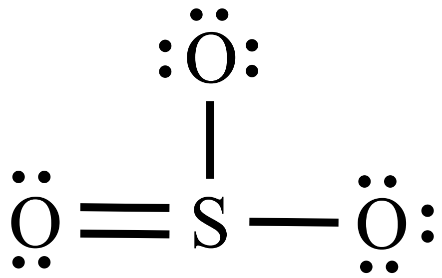
Go to next question

4.12) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $SO_3$.



**"ABE" classification =** ______?______

**bond angles =** ______?______

**molecular shape name =** ______?______

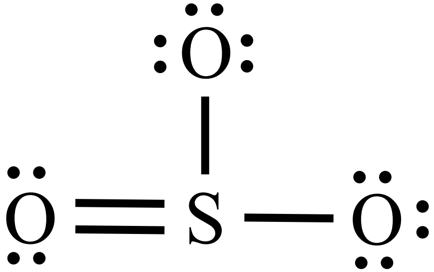
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.12) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $SO_3$.



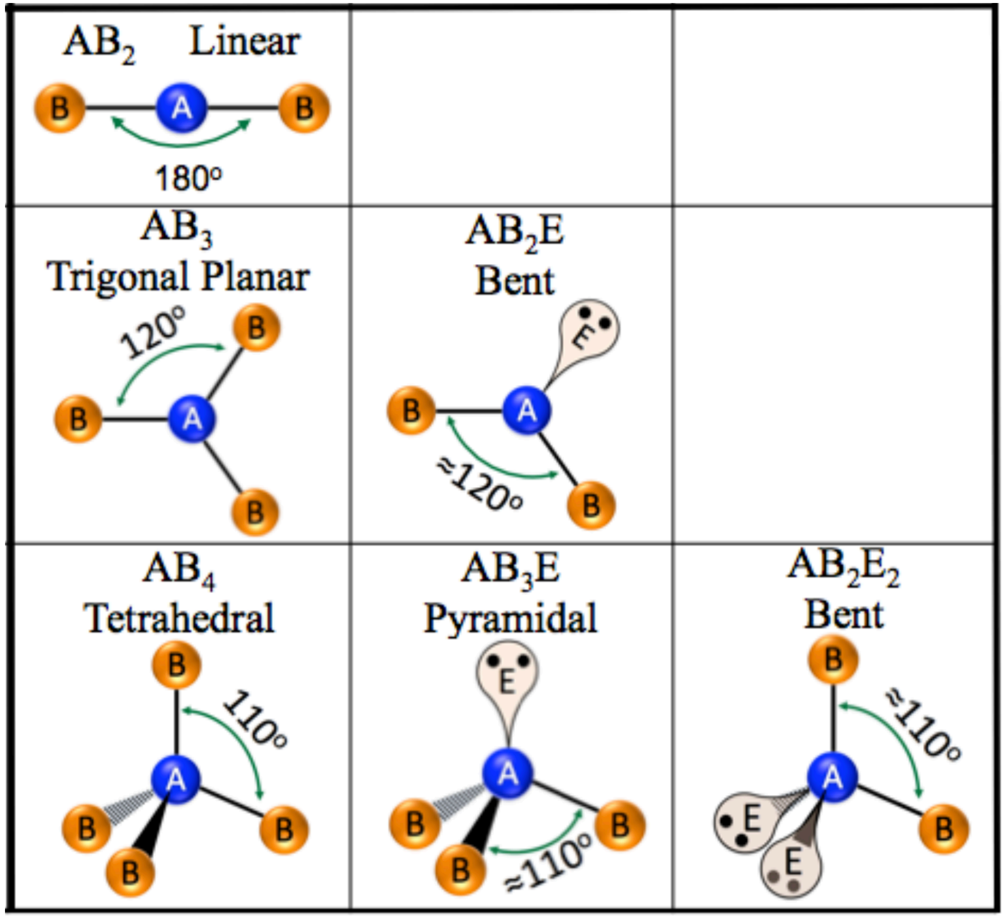

**"ABE" classification =** ______?______

**bond angles =** ______?______

**molecular shape name =** ______?______

**HINT:** "**A**" represents the central atom.
"**B**" and "**E**" represent **electron groups** *around the central atom*.
- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom*.

Use the **molecular shape table** (on right) to determine the bond angles and the molecular shape name based on the ABE classification.



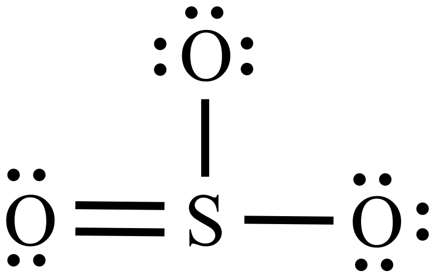

**For more help:**
See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.

Go back

Click here to check your answer

Go to next question

4.12) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $SO_3$.



**"ABE" classification =** **$AB_3$**

- We write "**$B_3$**" because there are three atoms bonded to the central atom.
- We **do not** write "**E**" because there are **NO** lone pairs *on the central atom*.

**bond angles =** **120°**

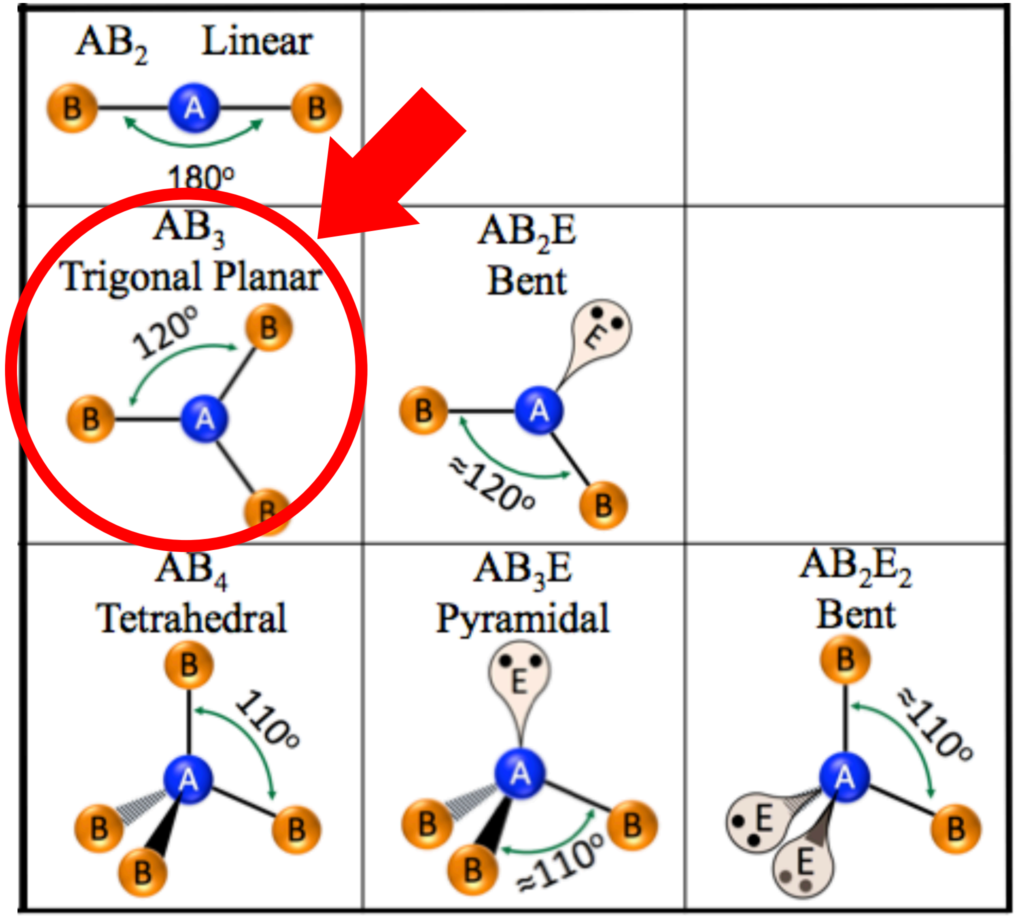
**molecular shape name =** **trigonal planar**

**EXPLANATION:** "**A**" represents the central atom.

"**B**" and "**E**" represent **electron groups** *around the central atom*.

- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom*.

The **molecular shape table** can be used to determine the bond angles and the molecular shape name based on the ABE classification.




**For more details:**

See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.

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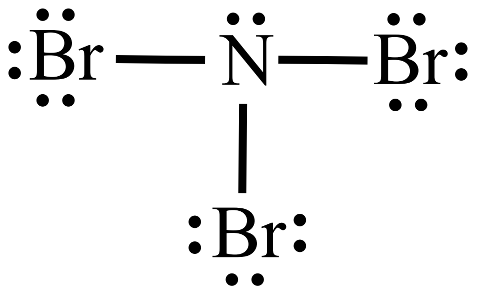
Go to next question

4.13) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $NBr_3$.



**"ABE" classification =** ____?____

**bond angles =** ____?____

**molecular shape name =** ____?____

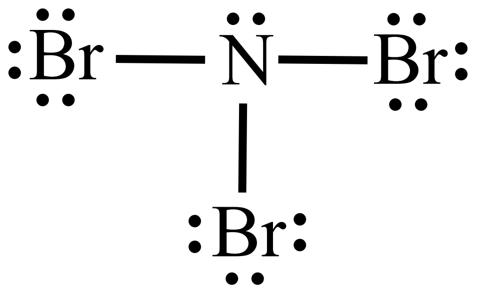
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.13) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $NBr_3$.



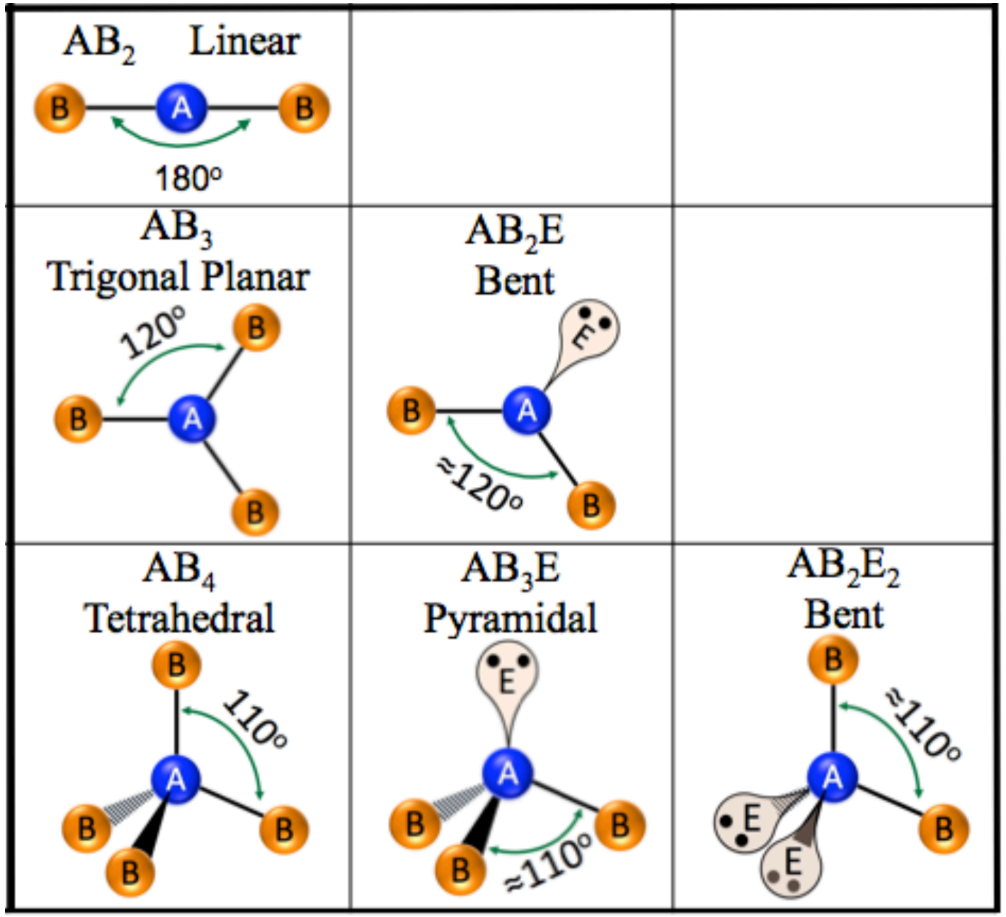
**"ABE" classification =** ______?______

**bond angles =** ______?______

**molecular shape name =** ______?______

**HINT:** "**A**" represents the central atom.
"**B**" and "**E**" represent **electron groups** *around the central atom*.
- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom*.

Use the **molecular shape table** (on right) to determine the bond angles and the molecular shape name based on the ABE classification.



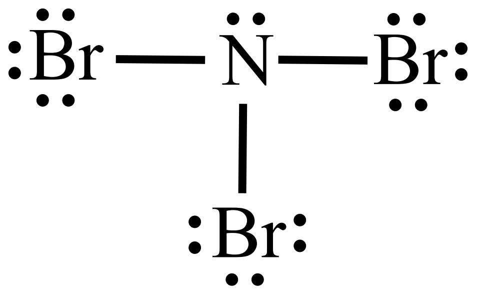

**For more help:**
See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.

Go back

Click here to check your answer

Go to next question

4.13) Determine the *"ABE" classification*, *bond angles*, and *molecular shape* for $NBr_3$.




**"ABE" classification =** $AB_3E$

- We write "$B_3$" because there are three atoms bonded to the central atom.
- We write "E" because there is one lone pair *on the central atom*.

**bond angles =** 110º (or ≈110º)

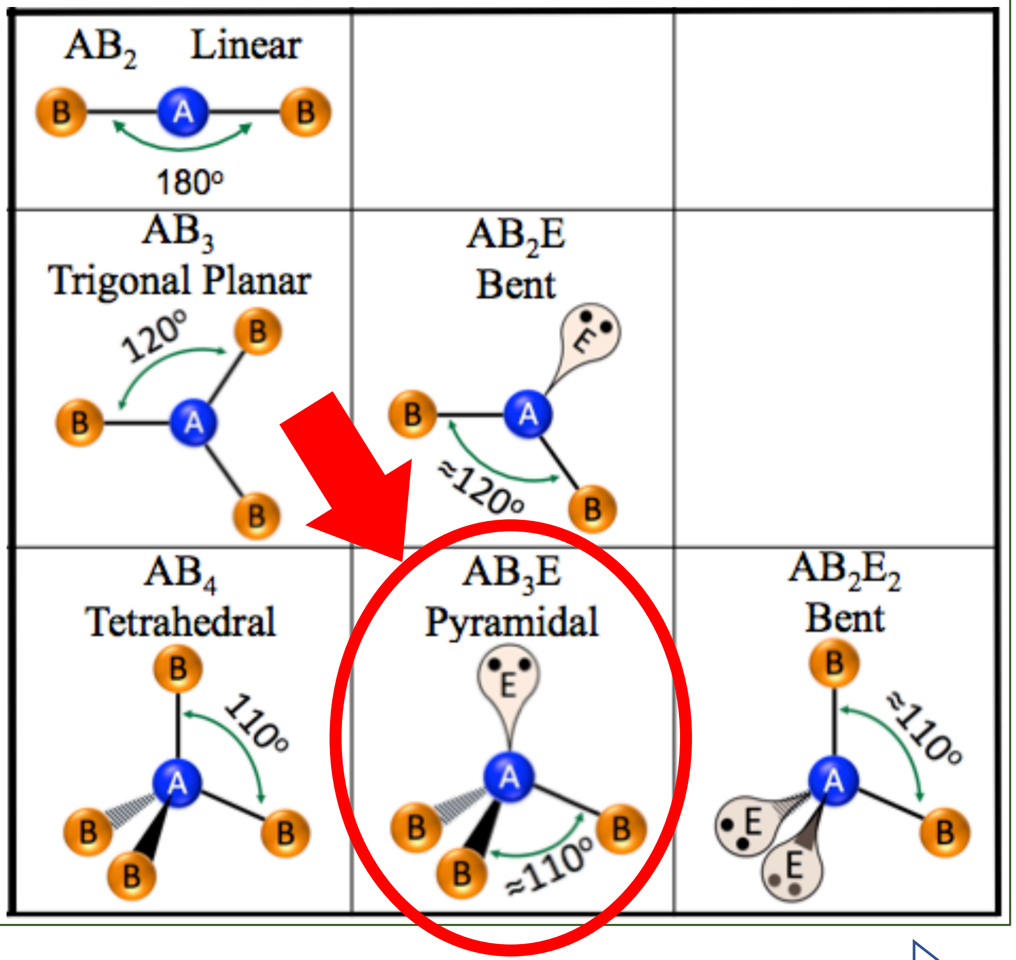
**molecular shape name =** pyramidal

**EXPLANATION:** "**A**" represents the central atom.

"**B**" and "**E**" represent **electron groups** *around the central atom*.

- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom*.

The **molecular shape table** can be used to determine the bond angles and the molecular shape name based on the ABE classification.




**For more details:**

See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.

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Go to next question

4.14) Draw the *line bond structure* for $CH_4$, and then determine its *"ABE" classification*, *bond angles*, and *molecular shape*.

**"ABE" classification =** ___?___

**bond angles =** ___?___

**molecular shape name =** ___?___

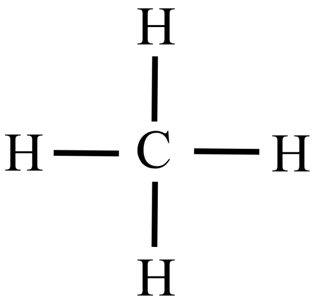
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.14) Draw the *line bond structure* for $CH_4$, and then determine its *"ABE" classification*, *bond angles*, and *molecular shape*.




**"ABE" classification =** ________?________

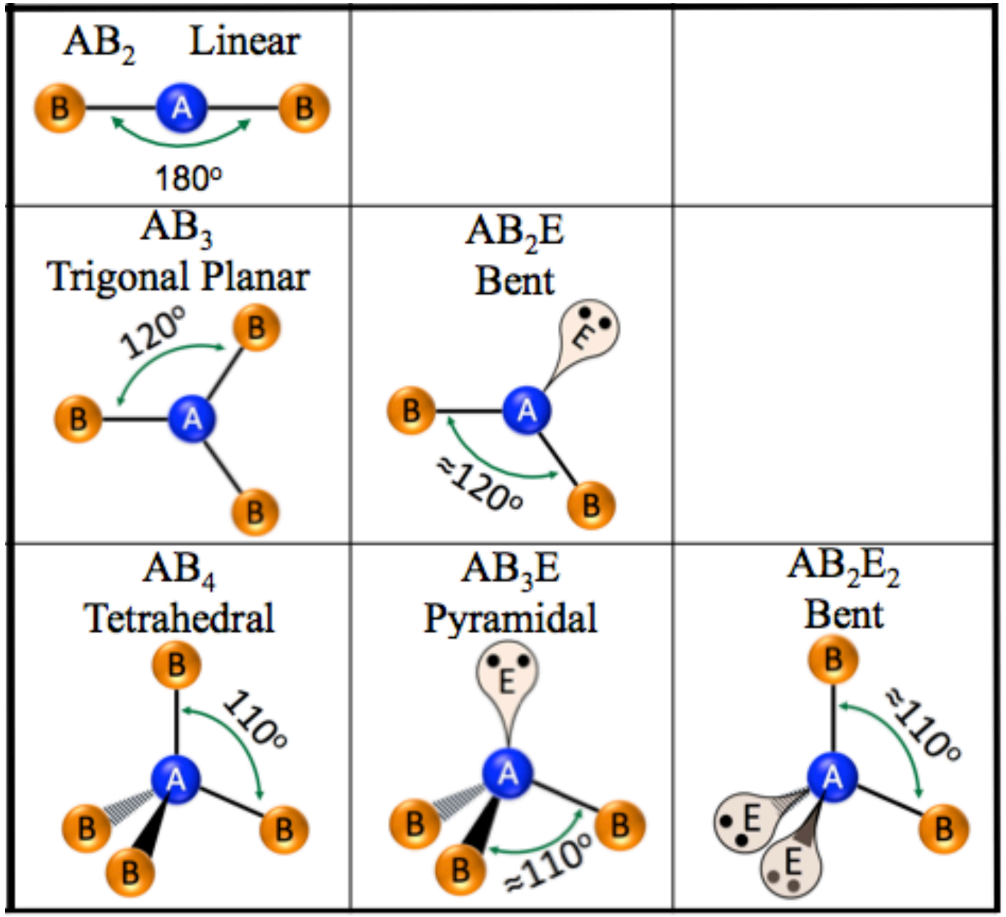
**bond angles =** ________?________

**molecular shape name =** ________?________

**HINT:** "**A**" represents the central atom.
"**B**" and "**E**" represent **electron groups** *around the central atom.*

- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom.*

Use the **molecular shape table** (on right) to determine the bond angles and the molecular shape name based on the ABE classification.



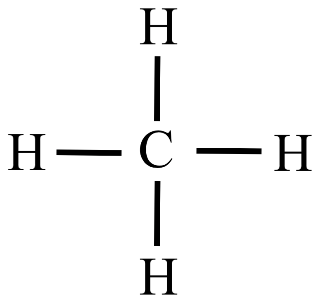

**For more help:**
See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.

Go back

Click here to check your answer

Go to next question

4.14) Draw the *line bond structure* for $CH_4$, and then determine its *"ABE" classification*, *bond angles*, and *molecular shape*.




**"ABE" classification =** $AB_4$

- We write "$B_4$" because there are four atoms bonded to the central atom.
- We **do not** write "**E**" because there are **NO** lone pairs *on the central atom*.

**bond angles =** 110°

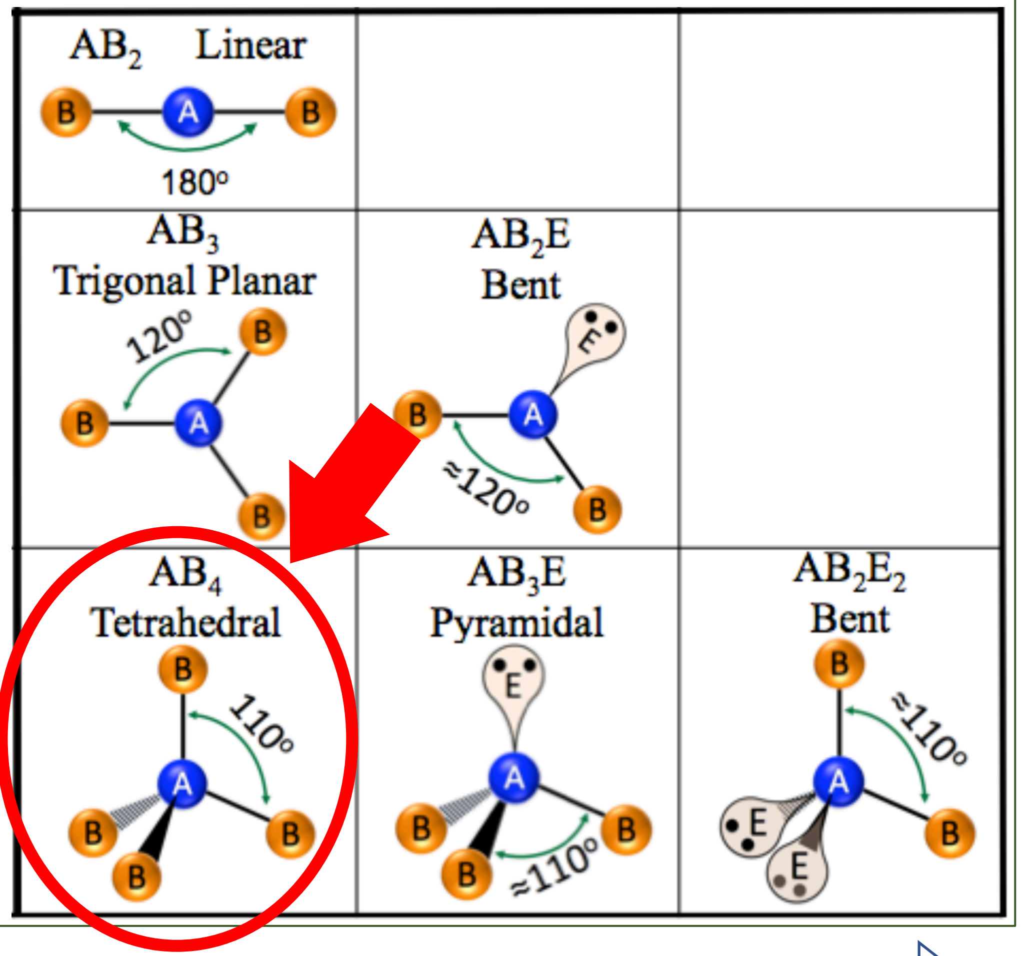
**molecular shape name =** **tetrahedral**

**EXPLANATION:** "**A**" represents the central atom.

"**B**" and "**E**" represent **electron groups** *around the central atom*.

- "**B**" represents atoms that are bonded to the central atom.
- "**E**" represents lone pair(s) *on the central atom*.

The **molecular shape table** can be used to determine the bond angles and the molecular shape name based on the ABE classification.




**For more details:**

See chapter 4 part 4 and part 5 videos or chapter 4 section 4 in the textbook.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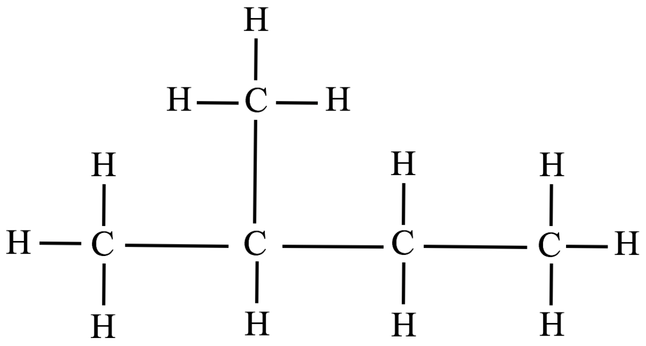
Go to next question

4.15) The **bond angles** around *all of the carbons* in 2-methylbutane are the same because all of the carbons in this molecule have the same "ABE" classification.



2-methylbutane

a) What is the "ABE" classification of the carbons in this molecule? ____________

b) What is the value of the bond angles around the carbons in this molecule? ___________

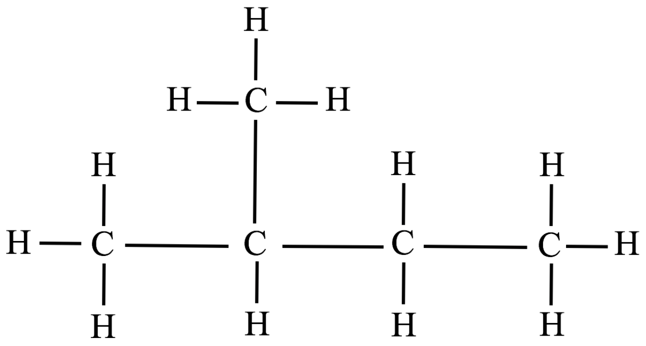
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.15) The **bond angles** around *all of the carbons* in 2-methylbutane are the same because all of the carbons in this molecule have the same "ABE" classification.




2-methylbutane

a) What is the "ABE" classification of the carbons in this molecule? ___________

b) What is the value of the bond angles around the carbons in this molecule? __________

**The Geometry of Large Molecules: ABE Method**

| ABE Class | Bond Angles |
|---|---|
| $AB_2$ | 180° |
| $AB_3$ | 120° |
| $AB_2E$ | ≈ 120° |
| $AB_4$ | 110° |
| $AB_3E$ | ≈ 110° |
| $AB_2E_2$ | ≈ 110° |

**HINT:** The bond angles around any atom of interest in a large molecule can be predicted in the same manner that we used for small molecules. Simply use the **ABE** method, but in this case let "**A**" represent the atom of interest in the large molecule instead of the central atom of a small molecule. "**B**" and "**E**" represent the electron groups; "**B**" for atoms bonded to the atom of interest, and "**E**" for lone pairs on the atom of interest. The bond angles for the various **ABE** classes are the same angles that we used for small molecules and are listed in the table above.

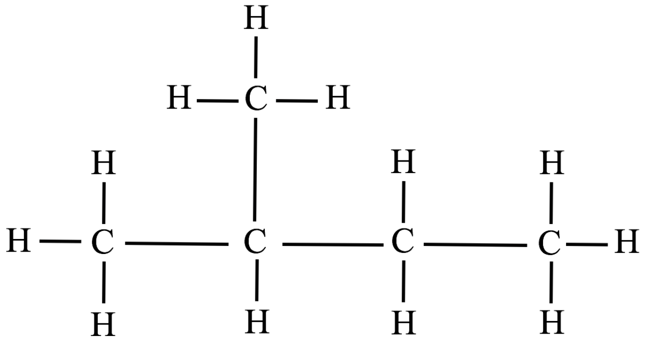
**For more help:** See chapter 4 part 6 video or chapter 4 section 4 in the textbook.

Go back

Click here to check your answer

Go to next question

4.15) The **bond angles** around all of the carbons in 2-methylbutane are the same because all of the carbons in this molecule have the same "ABE" classification.



2-methylbutane

**The Geometry of Large Molecules: ABE Method**

| ABE Class | Bond Angles |
|---|---|
| $AB_2$ | 180° |
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| $AB_2E$ | ≈ 120° |
| $AB_4$ | 110° |
| $AB_3E$ | ≈ 110° |
| $AB_2E_2$ | ≈ 110° |

a) What is the "ABE" classification of the carbons in this molecule? **$AB_4$**

b) What is the value of the bond angles around the carbons in this molecule? **110°**

**EXPLANATION**: The bond angles around any atom of interest in a large molecule can be predicted in the same manner that we used for small molecules. Simply use the **ABE** method, but in this case let "**A**" represent the atom of interest in the large molecule instead of the central atom of a small molecule. "**B**" and "**E**" represent the electron groups; "**B**" for atoms bonded to the atom of interest, and "**E**" for lone pairs on the atom of interest. The bond angles for the various **ABE** classes are the same angles that we used for small molecules and are listed in the table above.

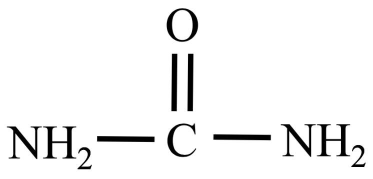
- There are **4** atoms bonded to each carbon in 2-methylbutane; therefore, the ABE classification of the carbons is **$AB_4$**.
- The bond angles around **$AB_4$** atoms are **110°**.

Go back

**For more details:** See chapter 4 part 6 video or chapter 4 section 4 in the textbook.

Go to next question

4.16) The condensed structure of a urea molecule is shown below.



condensed structure of urea

**?**

line bond structure of urea

a) Draw the line bond structure for urea (be sure to include lone pairs).

b) What is the "ABE" classification of the **nitrogens** in this molecule? ___________

c) What is the value of the bond angles around the **nitrogens** in this molecule? __________

d) What is the "ABE" classification of the **carbon** in this molecule? ___________

e) What is the value of the bond angles around the **carbon** in this molecule? __________

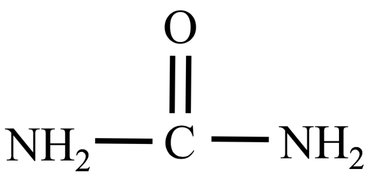
Go back

Click here for a **hint**

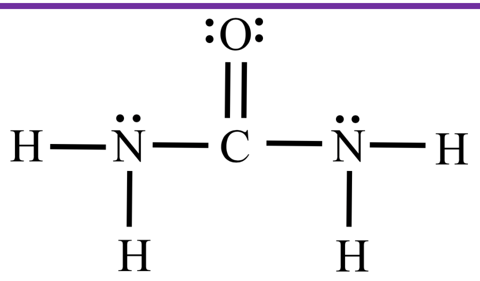
Click here to **check your answer**

Go to next question

4.16) The condensed structure of a urea molecule is shown below.



condensed structure of urea



line bond structure of urea

**HINT**: The bond angles around any atom of interest in a large molecule can be predicted using the **ABE** method. The bond angles for the various **ABE** classes are listed in the table on the right.

**The Geometry of Large Molecules: ABE Method**

| ABE Class | Bond Angles |
|---|---|
| $AB_2$ | 180° |
| $AB_3$ | 120° |
| $AB_2E$ | ≈ 120° |
| $AB_4$ | 110° |
| $AB_3E$ | ≈ 110° |
| $AB_2E_2$ | ≈ 110° |

a) Draw the line bond structure for urea (be sure to include lone pairs).

b) What is the "ABE" classification of the **nitrogens** in this molecule? ___________

c) What is the value of the bond angles around the **nitrogens** in this molecule? __________

d) What is the "ABE" classification of the **carbon** in this molecule? ___________

e) What is the value of the bond angles around the **carbon** in this molecule? __________

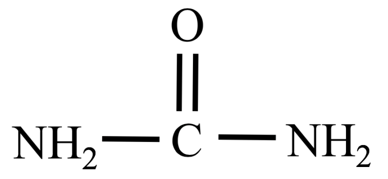
**For more help:**
See chapter 4 part 6 video or chapter 4 section 4 in the textbook.

Go back

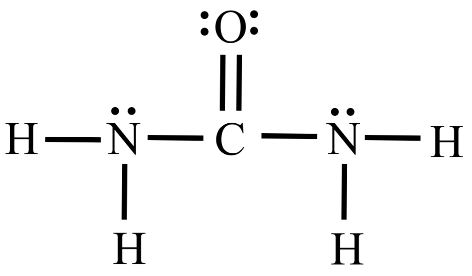
Click here to check your answer

Go to next question

4.16) The condensed structure of a urea molecule is shown below.



condensed structure of urea



line bond structure of urea

**EXPLANATION:** The bond angles around any atom of interest in a large molecule can be predicted using the **ABE** method. The bond angles for the various **ABE** classes are listed in the table on the right.

**The Geometry of Large Molecules: ABE Method**

| ABE Class | Bond Angles |
|---|---|
| $AB_2$ | 180° |
| $AB_3$ | 120° |
| $AB_2E$ | ≈ 120° |
| $AB_4$ | 110° |
| $AB_3E$ | ≈ 110° |
| $AB_2E_2$ | ≈ 110° |

a) Draw the line bond structure for urea (be sure to include lone pairs).

b) What is the "ABE" classification of the **nitrogens** in this molecule? **$AB_3E$**

- There are **3** atoms bonded to each nitrogen and there is **1** lone pair on each nitrogen in urea; therefore, the ABE classification of the nitrogens is **$AB_3E$**.

c) What is the value of the bond angles around the **nitrogens** in this molecule? **110°** (or ≈**110°**)

- The bond angles around **$AB_3E$** atoms are **≈110°**.

d) What is the "ABE" classification of the **carbon** in this molecule? **$AB_3$**

- There are **3** atoms bonded to the carbon and there are **NO** lone pairs on the carbon in urea; therefore, the ABE classification of the carbon is **$AB_3$**.

e) What is the value of the bond angles around the **carbon** in this molecule? **120°**

- The bond angles around **$AB_3$** atoms are **120°**.

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**For more details:** See chapter 4 part 6 video or chapter 4 section 4 in the textbook.

Go to next question

4.17) Classify the following **bonds** as either **polar bonds** or **nonpolar bonds**.

a) H−H

b) H−F

c) N≡N

d) O−H

e) O=O

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.17) Classify the following **bonds** as either **polar bonds** or **nonpolar bonds**.

a) H−H

b) H−F

c) N≡N

d) O−H

e) O=O

**HINT:** We classify covalent bonds as being either **polar** or **nonpolar**.

- **Polar bonds** occur because of unequal sharing of electrons in covalent bonds when two **unlike-atoms** (such as H-Br or H-Cl) are bonded together.
- **Nonpolar bonds** occur when the electrons are shared evenly between two **like-atoms** (such as H-H or F-F).

**For more help:** See chapter 4 part 7 video or chapter 4 section 5 in the textbook.

4.17) Classify the following **bonds** as either **polar bonds** or **nonpolar bonds**.

a) H−H **nonpolar bond**

b) H−F **polar bond**

c) N≡N **nonpolar bond**

d) O−H **polar bond**

e) O=O **nonpolar bond**

**EXPLANATION:** We classify covalent bonds as being either **polar** or **nonpolar**.

- **Polar bonds** occur because of unequal sharing of electrons in covalent bonds when two **unlike-atoms** (such as H-Br or H-Cl) are bonded together.
- **Nonpolar bonds** occur when the electrons are shared evenly between two **like-atoms** (such as H-H or F-F).

**For more details:** See chapter 4 part 7 video or chapter 4 section 5 in the textbook.

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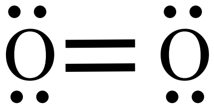
Go to next question

4.18) Is $O_2$ a **polar** or **nonpolar** molecule?

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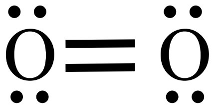
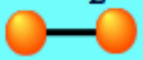
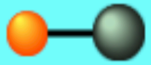
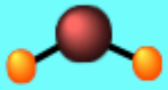
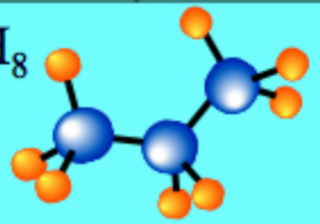
Click here to **check your answer**

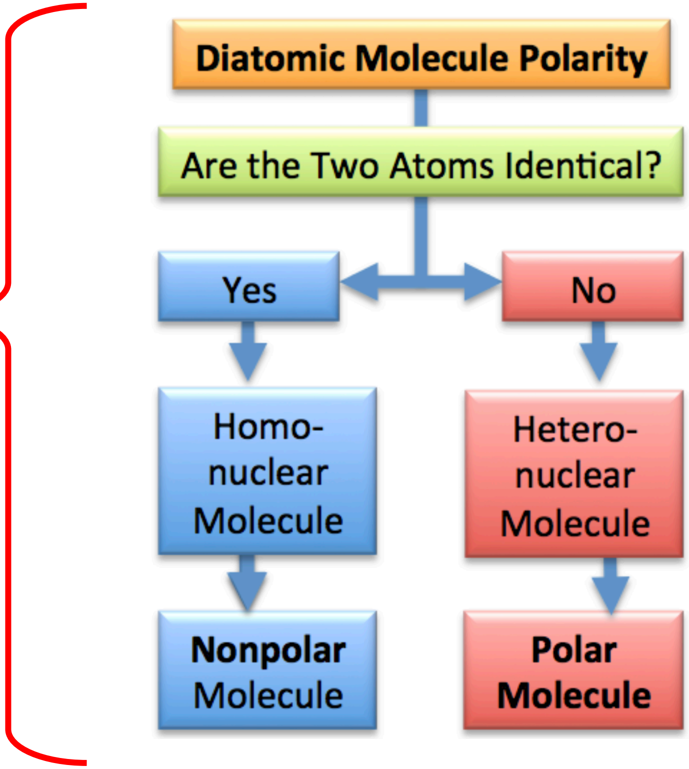
Go to next question

4.18) Is $O_2$ a **polar** or **nonpolar** molecule?



**HINT:** $O_2$ is a **diatomic** (two-atom) molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has <u>**one central atom**</u> with ***all other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is <u>not</u> just one single, central atom** with **<u>all</u>** the other atoms bonded to it | $C_3H_8$  | |



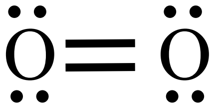

**For more help:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.


Go back

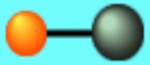
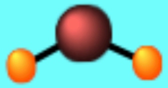
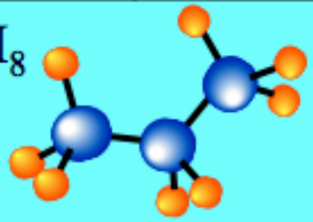
Click here to check your answer

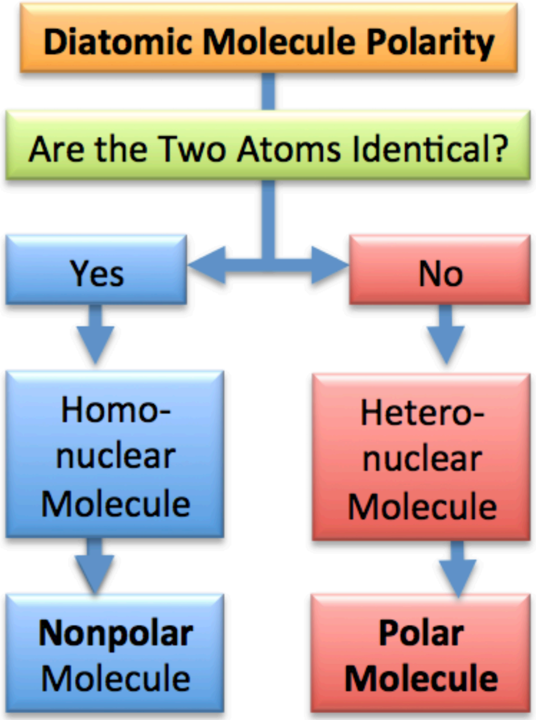
Go to next question

4.18) Is $O_2$ a **polar** or **nonpolar** molecule? **Answer: nonpolar**



**EXPLANATION:** $O_2$ is a **diatomic** (two-atom) molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **__one__ central atom** with ***__all__ other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is __not__ just one single, central atom** with **__all__** the other atoms bonded to it | $C_3H_8$  | |




When the atoms in a diatomic molecule are identical, the electrons are shared evenly so the molecule is **nonpolar**.

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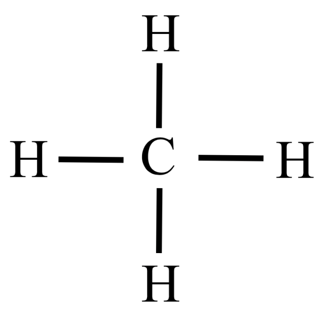
**For more details:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

Go to next question

4.19) Is $CH_4$ a **polar** or **nonpolar** molecule?



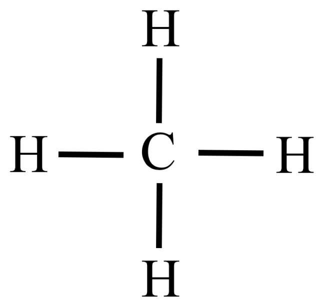

Go back

Click here for a **hint**

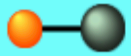
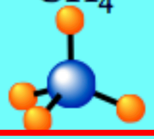
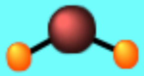
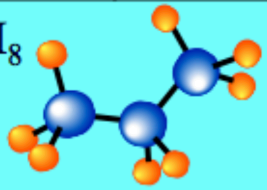
Click here to **check your answer**

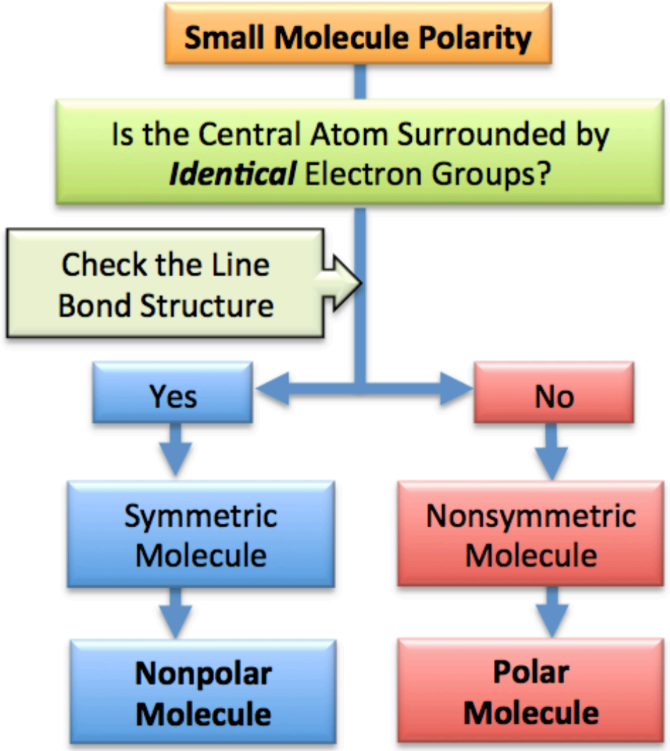
Go to next question

4.19) Is $CH_4$ a **polar** or **nonpolar** molecule?




**HINT:** $CH_4$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$  | |




A small molecule is symmetric if the central atom is surrounded by **identical** *electron groups*. Recall that *electron groups* (EG) are **bonded atoms** and **lone pairs**. When looking at a molecule's line bond structure, if there are no lone pairs on the central atom and all of the atoms bonded to the central atom are identical to each other, then the molecule is **symmetric** and **nonpolar**. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

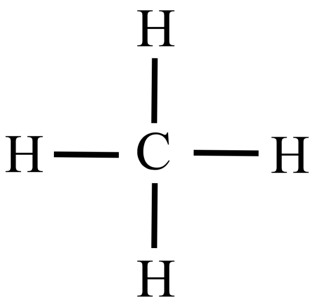
**For more help:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.


Go back

Click here to **check your answer**

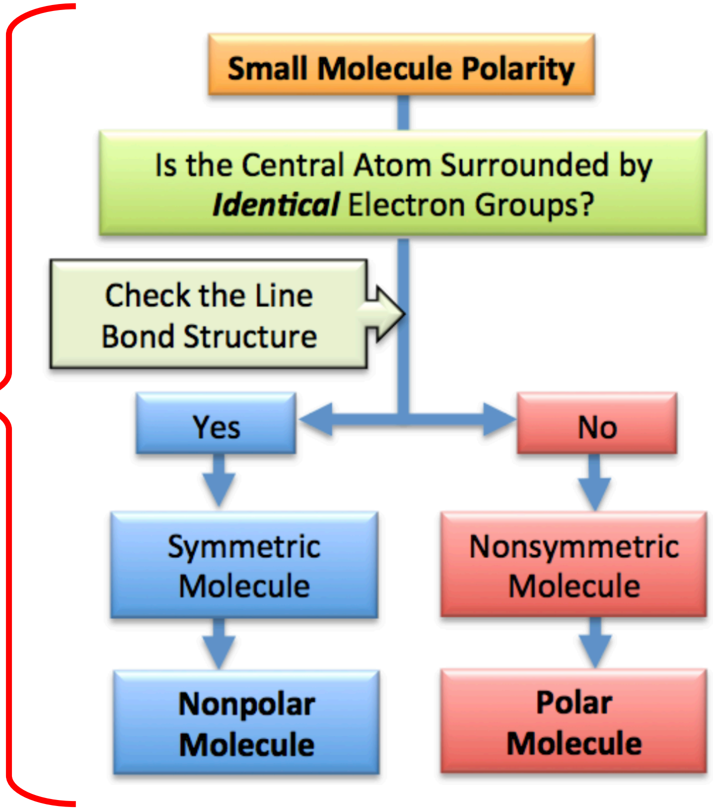
Go to next question

4.19) Is $CH_4$ a **polar** or **nonpolar** molecule? **Answer: nonpolar**



**EXPLANATION:** $CH_4$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$ | $HCl$ |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$ | $H_2O$ |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$ | |




A small molecule is symmetric if the central atom is surrounded by **identical** *electron groups*. Recall that *electron groups* (EG) are **bonded atoms** and **lone pairs**. When looking at a molecule's line bond structure, if there are no lone pairs on the central atom and all of the atoms bonded to the central atom are identical to each other, then the molecule is **symmetric** and **nonpolar**. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

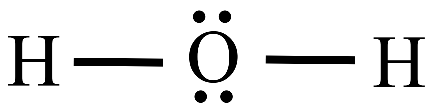
- The central atom in $CH_4$ (carbon) is surrounded by *identical electron groups* (bonded hydrogen atoms) so $CH_4$ is **nonpolar**.

Go back

**For more details:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

Go to next question

4.20) Is $H_2O$ a **polar** or **nonpolar** molecule?




Go back

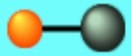
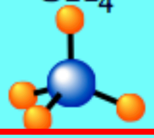
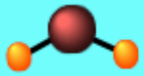
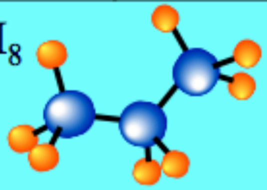
Click here for a **hint**

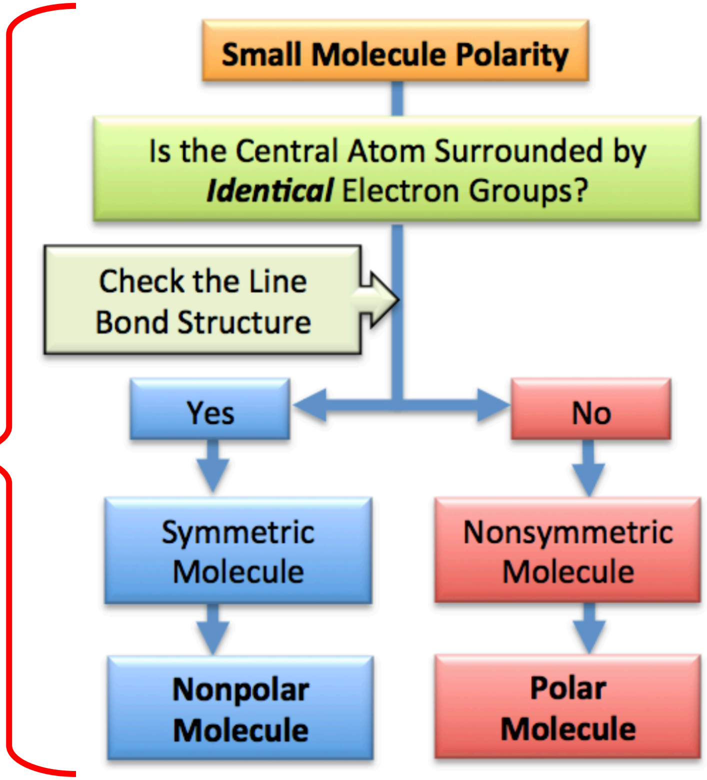
Click here to **check your answer**

Go to next question

4.20) Is $H_2O$ a **polar** or **nonpolar** molecule?

**HINT:** $H_2O$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$  | |




A small molecule is symmetric if the central atom is surrounded by **identical** *electron groups*. Recall that *electron groups* (EG) are **bonded atoms** and **lone pairs**. When looking at a molecule's line bond structure, if there are no lone pairs on the central atom and all of the atoms bonded to the central atom are identical to each other, then the molecule is **symmetric** and **nonpolar**. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

**For more help:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.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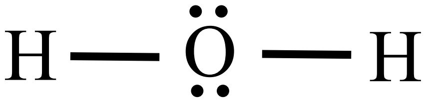
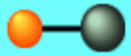
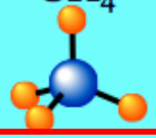
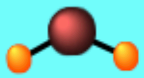
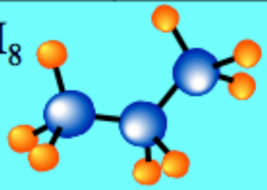
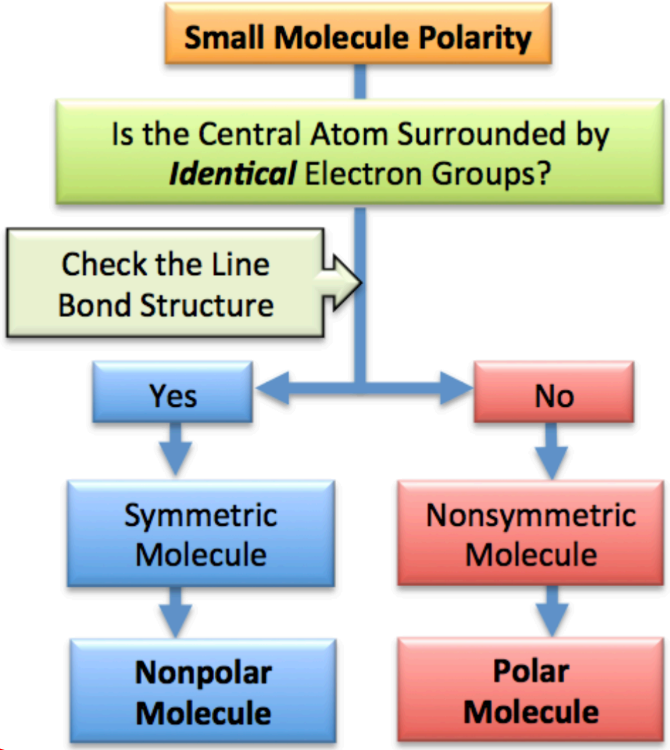
4.20) Is $H_2O$ a **polar** or **nonpolar** molecule? **Answer: polar**



**EXPLANATION:** $H_2O$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$  | |




A small molecule is **symmetric**, and therefore **nonpolar**, if the central atom is surrounded by **identical** *electron groups*. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

- The central atom in $H_2O$ (oxygen) is NOT surrounded by *identical electron groups*; two electron groups are lone pairs and two electron groups are bonded hydrogen atoms, so $H_2O$ is **polar**.

**For more details:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

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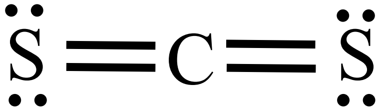
4.21) Is $CS_2$ a **polar** or **nonpolar** molecule?



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Click here to **check your answer**

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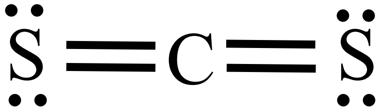
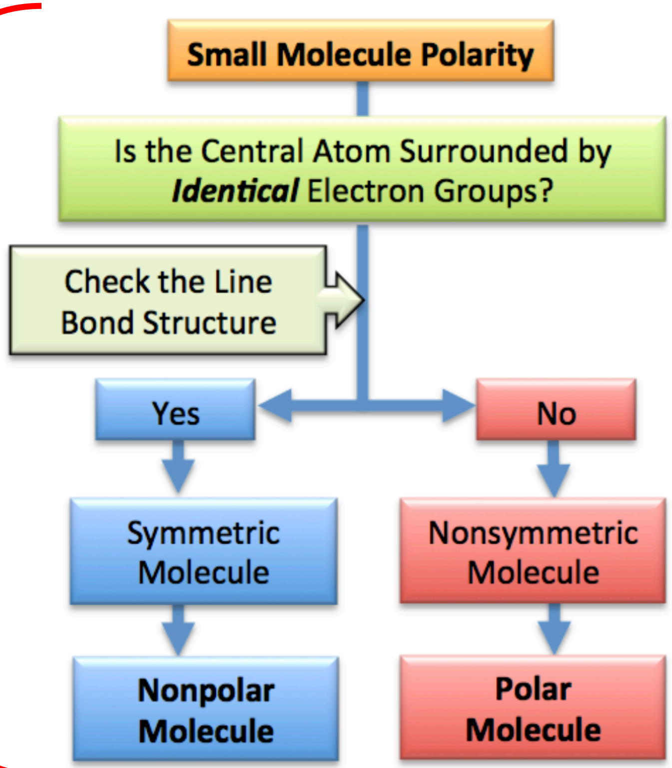
4.21) Is $CS_2$ a **polar** or **nonpolar** molecule?



**HINT:** $CS_2$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$ | HCl |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$ | $H_2O$ |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$ | |




A small molecule is symmetric if the central atom is surrounded by **identical** *electron groups*. Recall that *electron groups* (EG) are **bonded atoms** and **lone pairs**. When looking at a molecule's line bond structure, if there are no lone pairs on the central atom and all of the atoms bonded to the central atom are identical to each other, then the molecule is **symmetric** and **nonpolar**. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

**For more help:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.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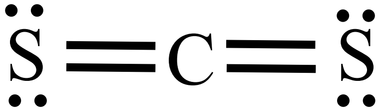
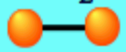
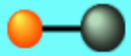
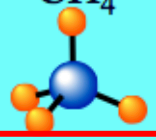
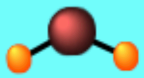
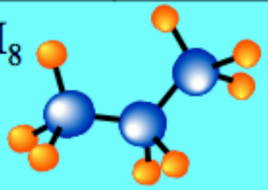
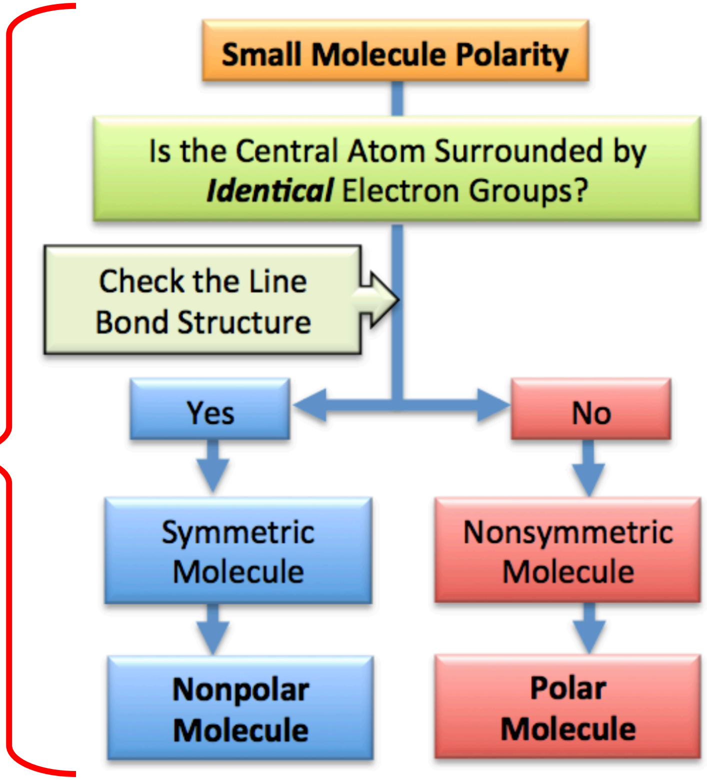
4.21) Is $CS_2$ a **polar** or **nonpolar** molecule? **Answer: nonpolar**



**EXPLANATION:** $CS_2$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **<u>one</u> central atom** with ***<u>all</u> other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is <u>not</u> just one single, central atom** with **<u>all</u>** the other atoms bonded to it | $C_3H_8$  | |




A small molecule is **symmetric**, and therefore **nonpolar**, if the central atom is surrounded by **identical** *electron groups*. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

- The central atom in $CS_2$ (carbon) is surrounded by *identical electron groups*; two bonded sulfur atoms, so $CS_2$ is **nonpolar**.

**For more details:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

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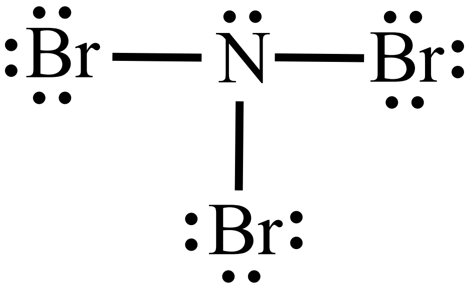
4.22) Is $NBr_3$ a **polar** or **nonpolar** molecule?



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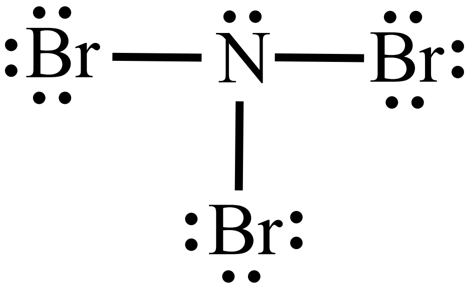
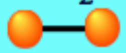
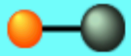
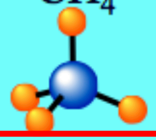
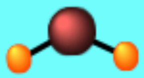
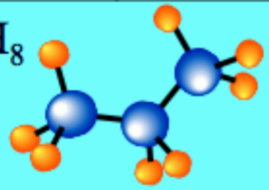
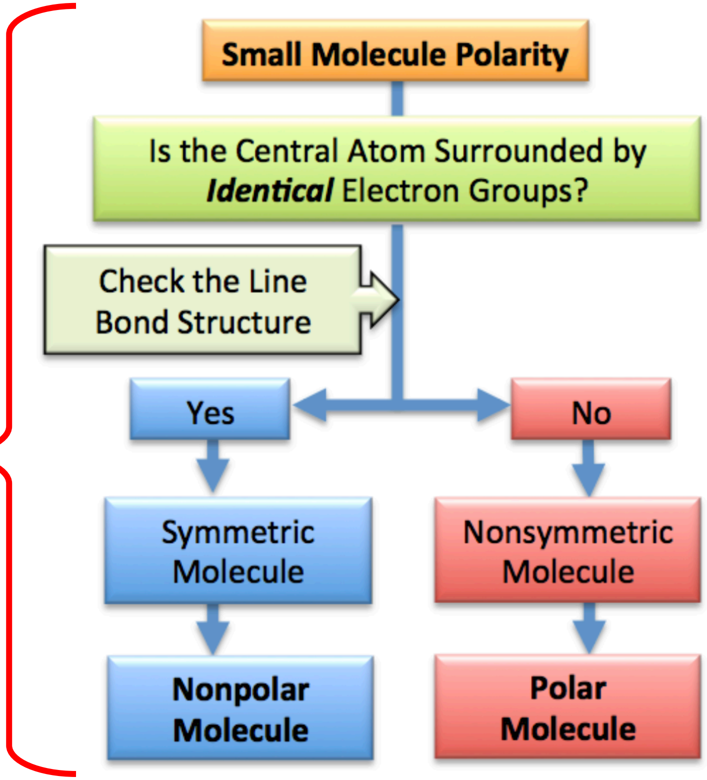
4.22) Is $NBr_3$ a **polar** or **nonpolar** molecule?



**HINT:** $NBr_3$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **<u>one</u> central atom** with ***<u>all</u> other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is <u>not</u> just one single, central atom** with **<u>all</u>** the other atoms bonded to it | $C_3H_8$  | |




A small molecule is symmetric if the central atom is surrounded by **identical** *electron groups*. Recall that *electron groups* (EG) are **bonded atoms** and **lone pairs**. When looking at a molecule's line bond structure, if there are no lone pairs on the central atom and all of the atoms bonded to the central atom are identical to each other, then the molecule is **symmetric** and **nonpolar**. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

**For more help:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.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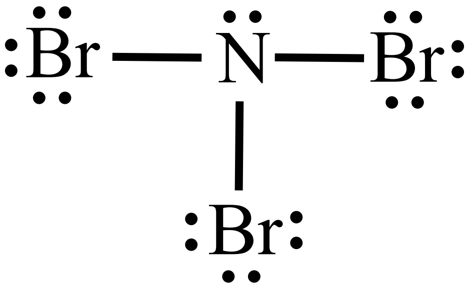
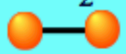
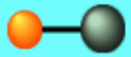
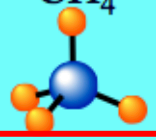
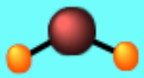
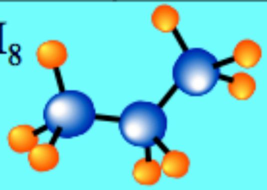
Click here to **check** your answer

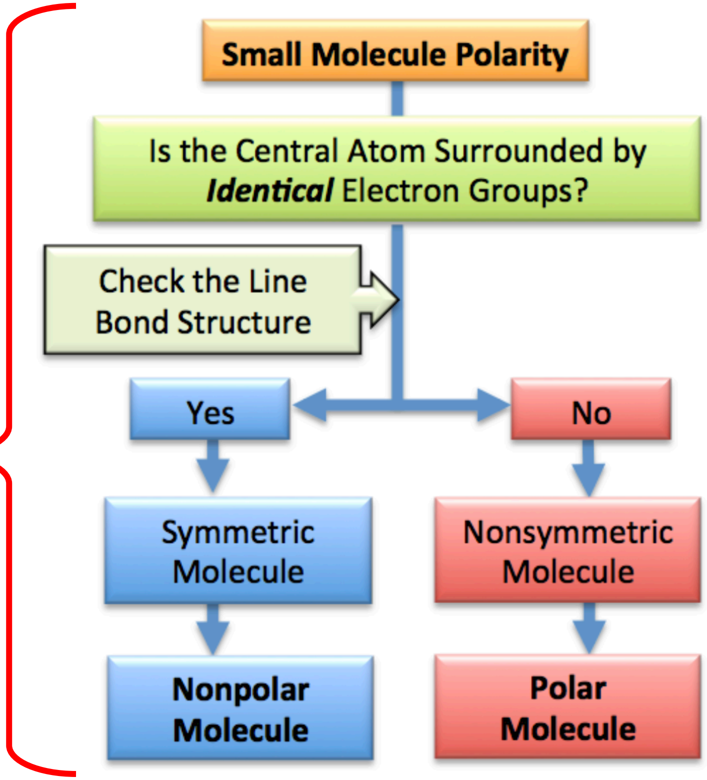
Go to next question

4.22) Is $NBr_3$ a **polar** or **nonpolar** molecule? **Answer: polar**



**EXPLANATION:** $NBr_3$ is a **small** molecule.

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$  | |




A small molecule is **symmetric**, and therefore **nonpolar**, if the central atom is surrounded by **identical** *electron groups*. If this is not the case, then the molecule is **nonsymmetric** and therefore **polar**.

- The central atom in $NBr_3$ (nitrogen) is NOT surrounded by *identical electron groups*; one electron group is a lone pair and three electron groups are bonded bromine atoms, so $NBr_3$ is **polar**.

**For more details:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.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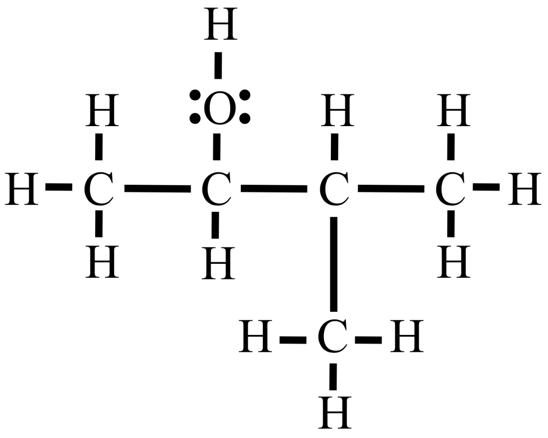
Go to next question

4.23) The line bond structure for sec-isoamyl alcohol is shown below. Is this molecule **polar** or **nonpolar**?



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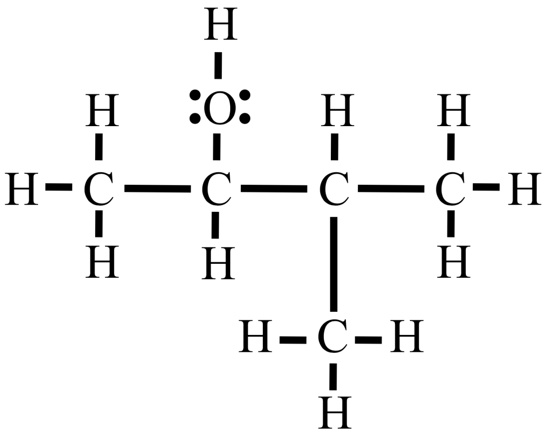
Click here for a **hint**

Click here to **check your answer**

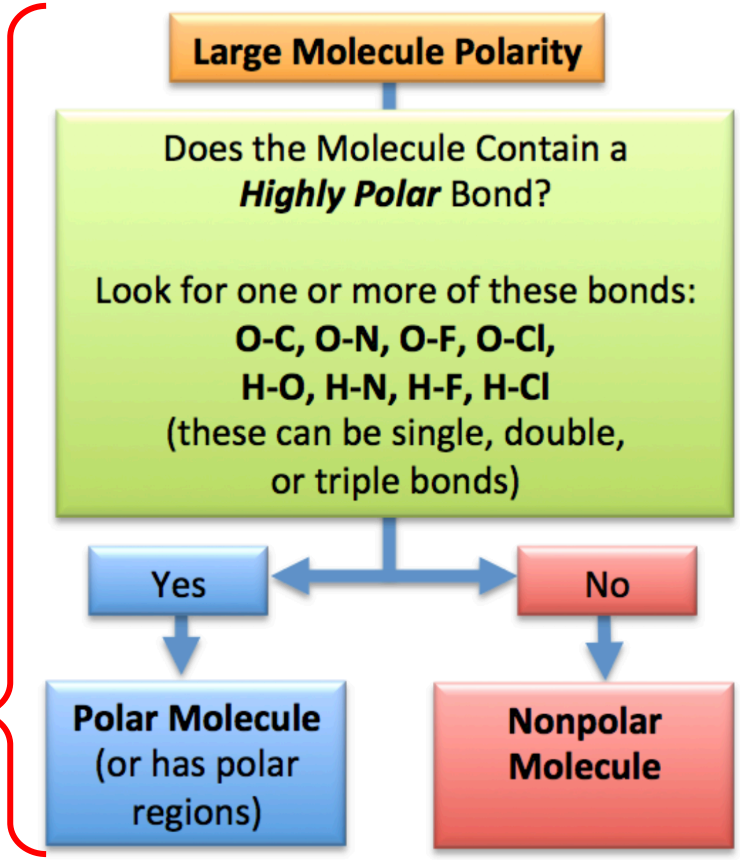
Go to next question

4.23) The line bond structure for sec-isoamyl alcohol is shown below. Is this molecule **polar** or **nonpolar**?



**HINT:** sec-isoamyl alcohol is a **large** molecule. A large molecule is **polar** if it contains one or more "**highly polar**" bonds. The *highly polar bonds* are listed in the figure (below/right).

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$ | HCl |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$ | $H_2O$ |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$ | |




**For more help:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

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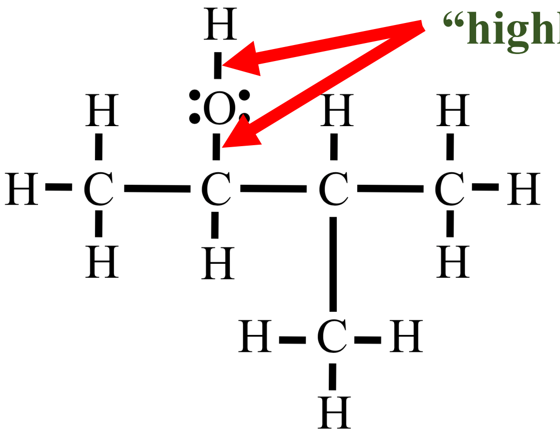
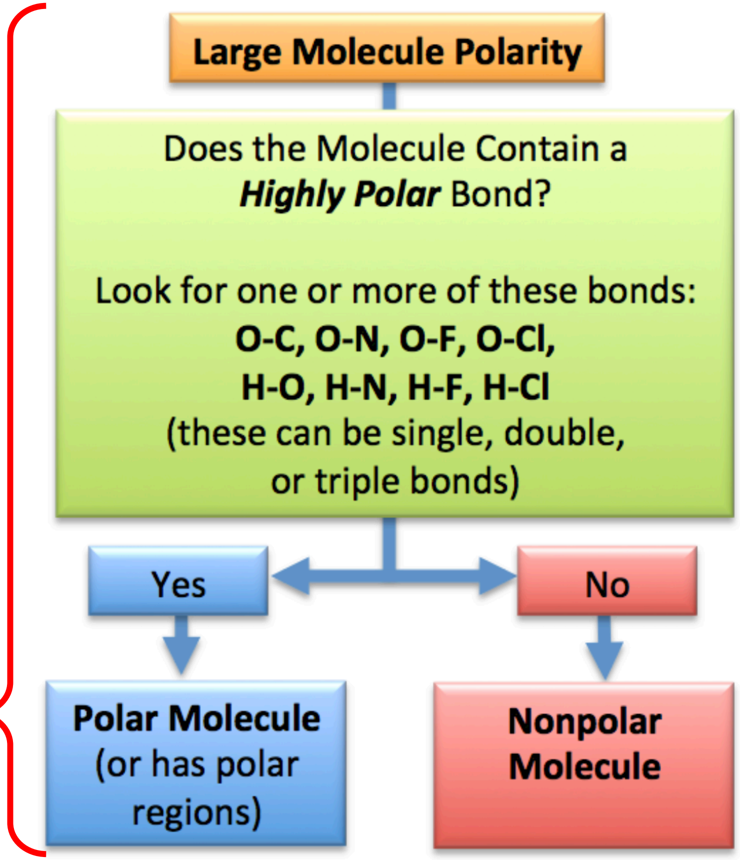
Click here to check your answer

Go to next question

4.23) The line bond structure for sec-isoamyl alcohol is shown below. Is this molecule **polar** or **nonpolar**? **Answer: polar**




| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$ | HCl |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$ | $H_2O$ |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$ | |




**EXPLANATION:** Sec-isoamyl alcohol is a **large** molecule. A large molecule is **polar** if it contains one or more "**highly polar**" bonds. The *highly polar bonds* are listed in the figure (above/right). Sec-isoamyl alcohol is **polar** because it contains one or more *highly polar bonds*. It contains an **O-C** bond and an **H-O** bond.

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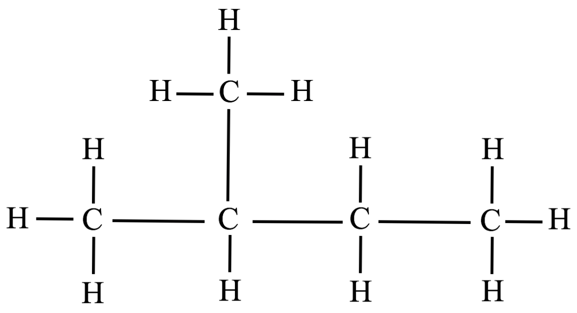
**For more details:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

Go to next question

4.24) The line bond structure for 2-methylbutane is shown below. Is this molecule **polar** or **nonpolar**?

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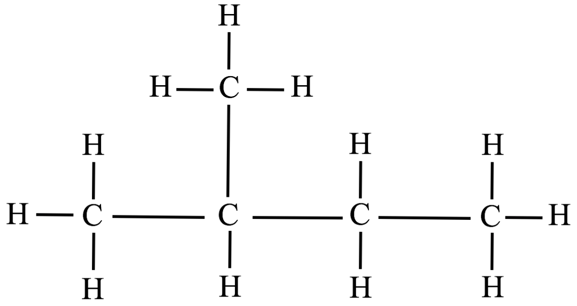
Click here for a **hint**

Click here to **check your answer**

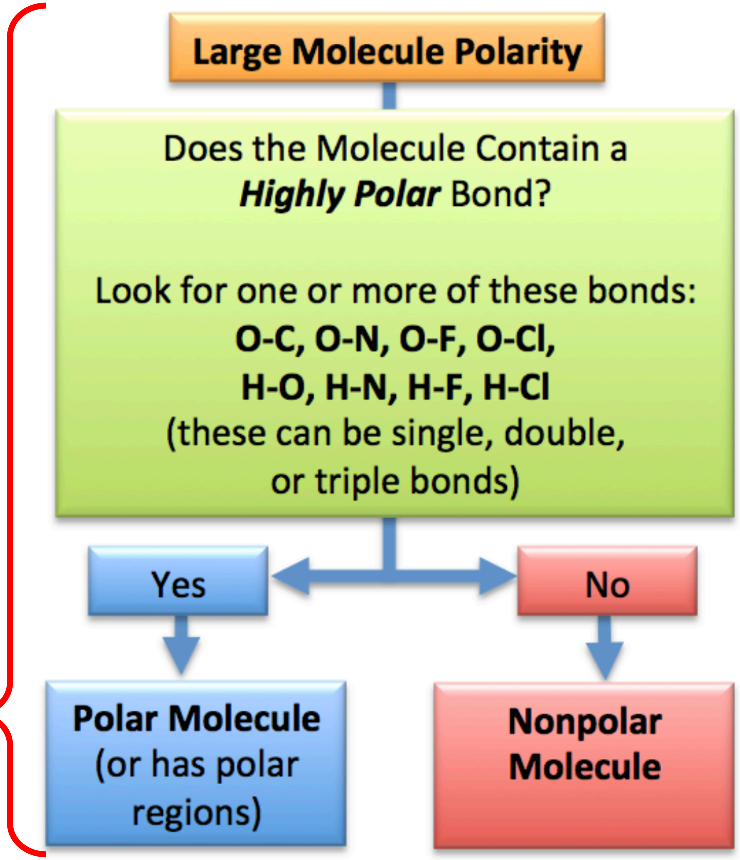
Go to next question

4.24) The line bond structure for 2-methylbutane is shown below. Is this molecule **polar** or **nonpolar**?



**HINT:** 2-methylbutane is a **large** molecule. A large molecule is **polar** if it contains one or more "**highly polar**" bonds. The *highly polar bonds* are listed in the figure (below/right).

| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$ | HCl |
| Small Molecule | Molecule has **<u>one</u> central atom** with ***<u>all</u> other*** atoms bonded to the central atom | $CH_4$ | $H_2O$ |
| Large Molecule | Larger than *Small Molecule*; there **is <u>not</u> just one single, central atom** with **<u>all</u>** the other atoms bonded to it | $C_3H_8$ | |




**For more help:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

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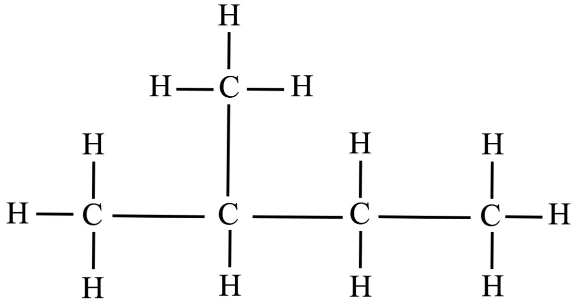
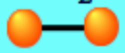
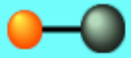
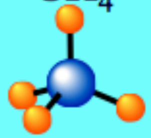
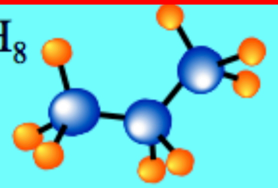
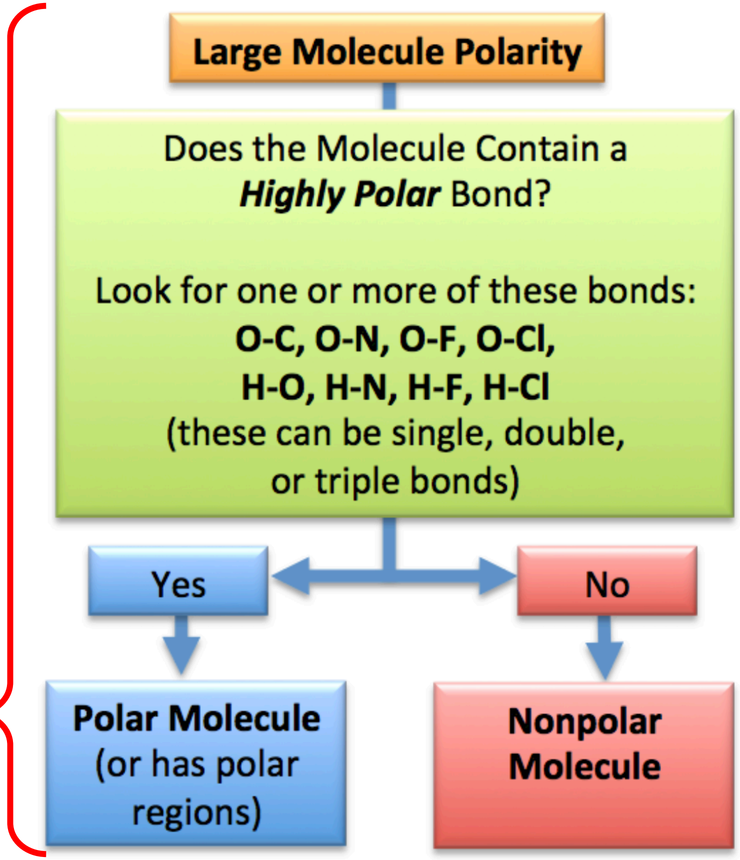
Click here to **check your answer**

Go to next question

4.24) The line bond structure for 2-methylbutane is shown below. Is this molecule **polar** or **nonpolar**? **Answer: nonpolar**



| Molecular Size Category | Description | Example(s) | |
|---|---|---|---|
| Diatomic Molecule | Molecule contains **only two atoms** | $H_2$  | HCl  |
| Small Molecule | Molecule has **one central atom** with ***all other*** atoms bonded to the central atom | $CH_4$  | $H_2O$  |
| Large Molecule | Larger than *Small Molecule*; there **is not just one single, central atom** with **all** the other atoms bonded to it | $C_3H_8$  | |




**EXPLANATION:** 2-methylbutane is a **large** molecule. A large molecule is **polar** if it contains one or more "**highly polar**" bonds. The *highly polar bonds* are listed in the figure (above/right). 2-methylbutane is **nonpolar** because it **does not** contain any of these *highly polar bonds*.

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**For more details:** See chapter 4 part 8 video or chapter 4 section 5 in the textbook.

Go to next question

4.25) One of the five *noncovalent interactions* is referred to as “**hydrogen bonding**.” Define “**hydrogen bonding**.”

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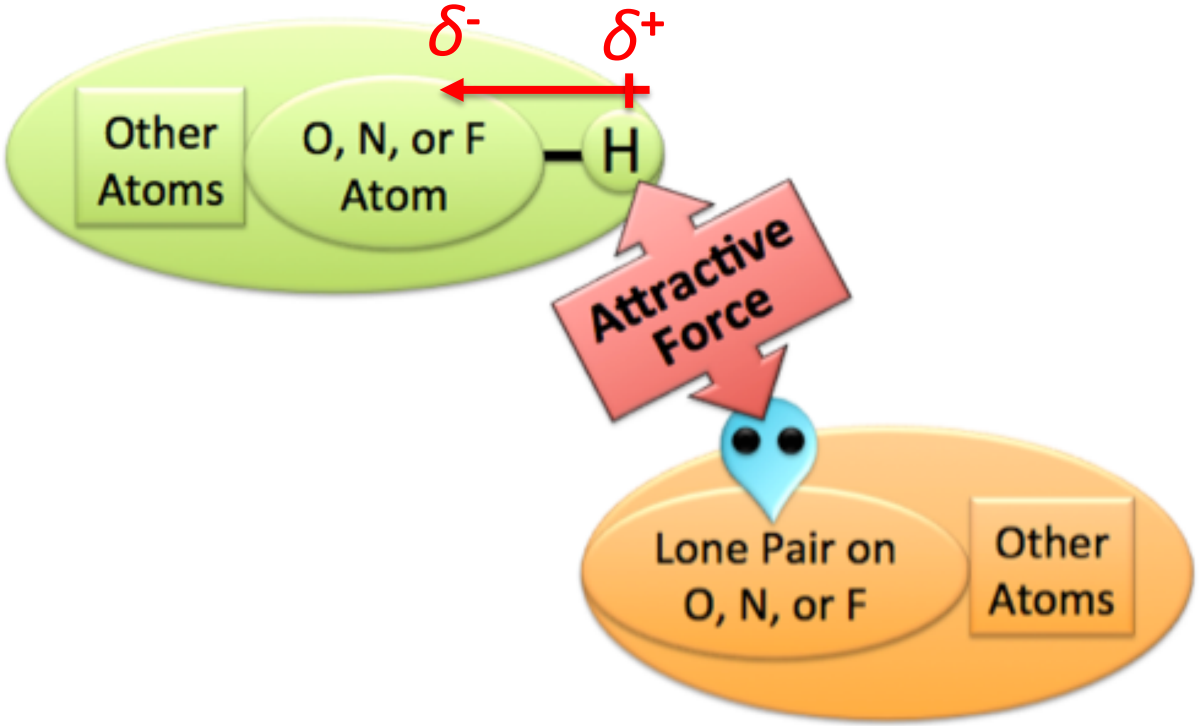
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.25) One of the five *noncovalent interactions* is referred to as “**hydrogen bonding**.” Define “**hydrogen bonding**.”

**HINT:** Try using the image below as a guide in WRITING your definition.




**For more help:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.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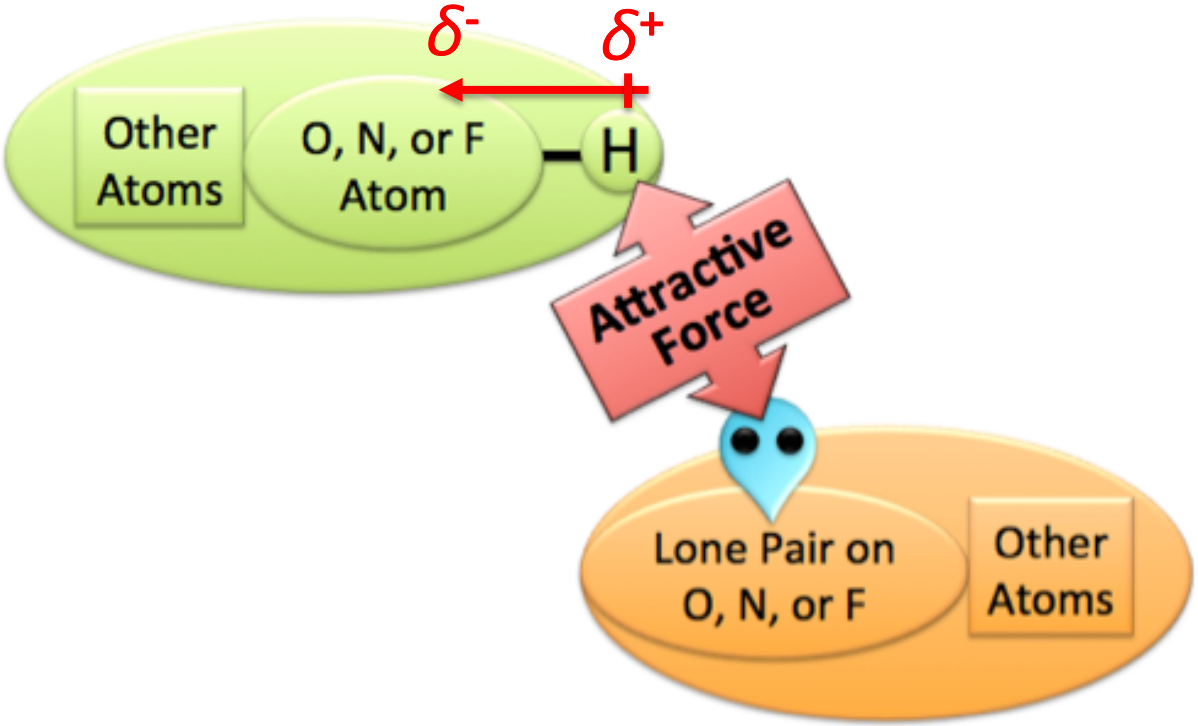
4.25) One of the five *noncovalent interactions* is referred to as "**hydrogen bonding**." Define "**hydrogen bonding**."

**ANSWER:** Hydrogen bonding is the electrostatic attraction between the partially positive charged hydrogen end of an O-H, N-H, or F-H bond and the negative charge of a lone pair on an O, F, or N.

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

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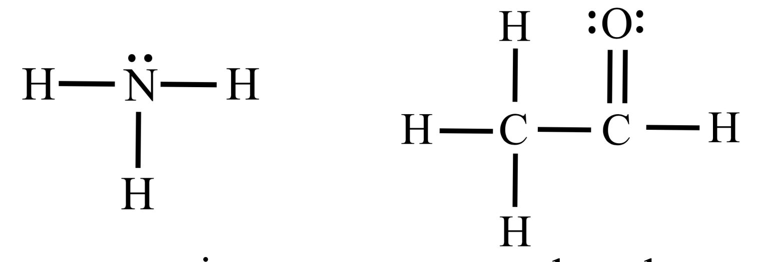
Go to next question

4.26) The line bond structures of ammonia and ethanal are shown here.




a) Can hydrogen bonding occur between two ammonia molecules?

b) Can hydrogen bonding occur between two ethanal molecules?

c) Can hydrogen bonding occur between an ammonia molecule and an ethanal molecule?

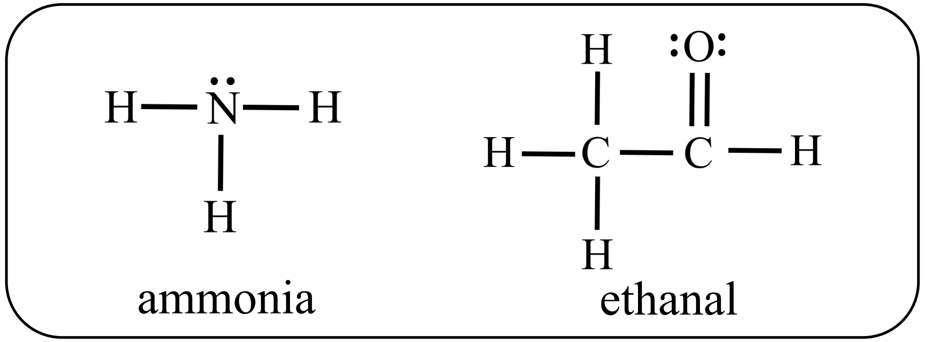
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.26) The line bond structures of ammonia and ethanal are shown here.

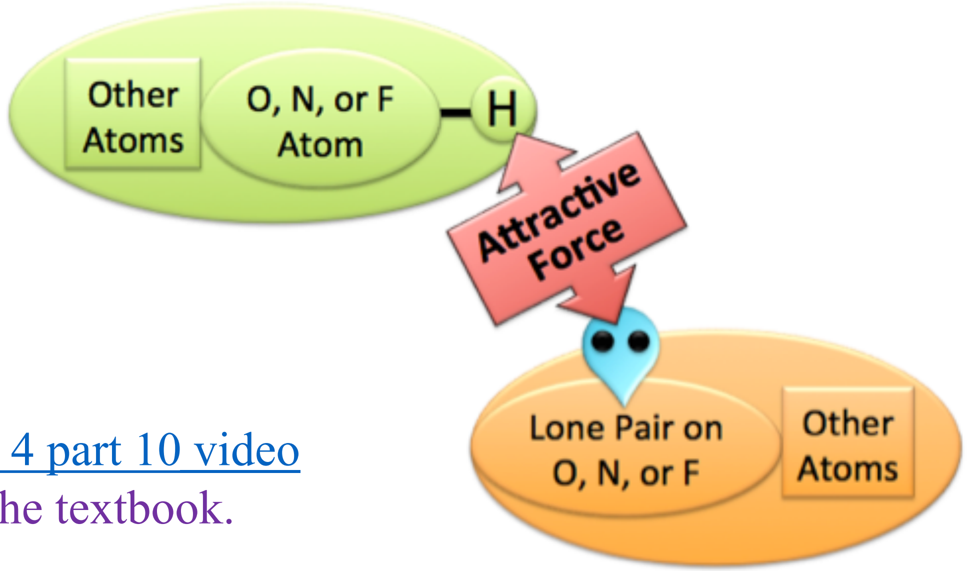



a) Can hydrogen bonding occur between two ammonia molecules?

b) Can hydrogen bonding occur between two ethanal molecules?

c) Can hydrogen bonding occur between an ammonia molecule and an ethanal molecule?

**HINT:** Hydrogen bonding is the electrostatic attraction between the partially positive charged hydrogen end of an O-H, N-H, or F-H bond and the negative charge of a lone pair on an O, F, or N.




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

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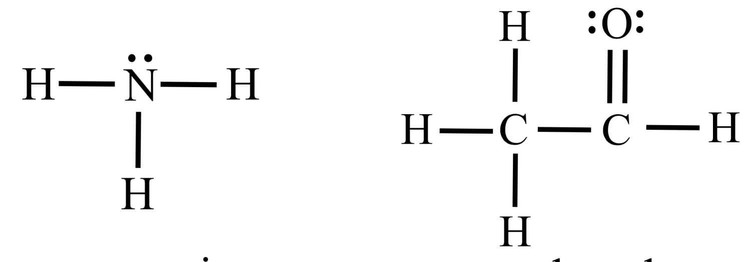
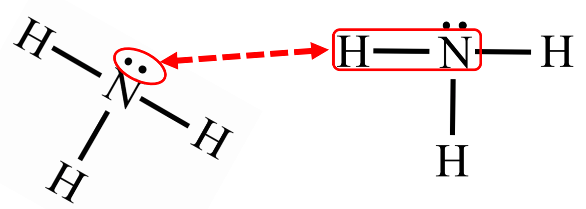
Click here to check your answer

Go to next question

4.26) The line bond structures of ammonia and ethanal are shown here.




a) Can hydrogen bonding occur between two ammonia molecules? **yes**



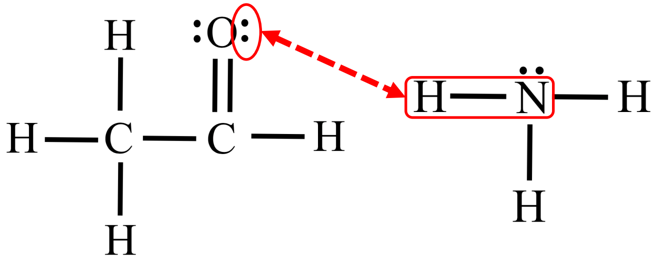
Hydrogen bonding can occur between the partially positive charged hydrogen end of an O-H, N-H, or F-H bond and the negative charge of a lone pair on an O, F, or N.

- Hydrogen bonding *can occur* between two ammonia molecules because ammonia molecules have an **N-H** bond **AND** a lone pair on an **N**.
- The hydrogen bonding attractive force is indicated by the red-dashed double arrow.

b) Can hydrogen bonding occur between two ethanal molecules? **no**

Ethanal molecules do have a lone pair on an oxygen, however **they lack** the **O-H**, **N-H**, or **F-H** bond that is also required for hydrogen bonding.

c) Can hydrogen bonding occur between an ammonia molecule and an ethanal molecule? **yes**



Hydrogen bonding *can occur* between ammonia and ethanal because ethanal has a lone pair on an **O** and ammonia has an **N-H** bond.

Go back

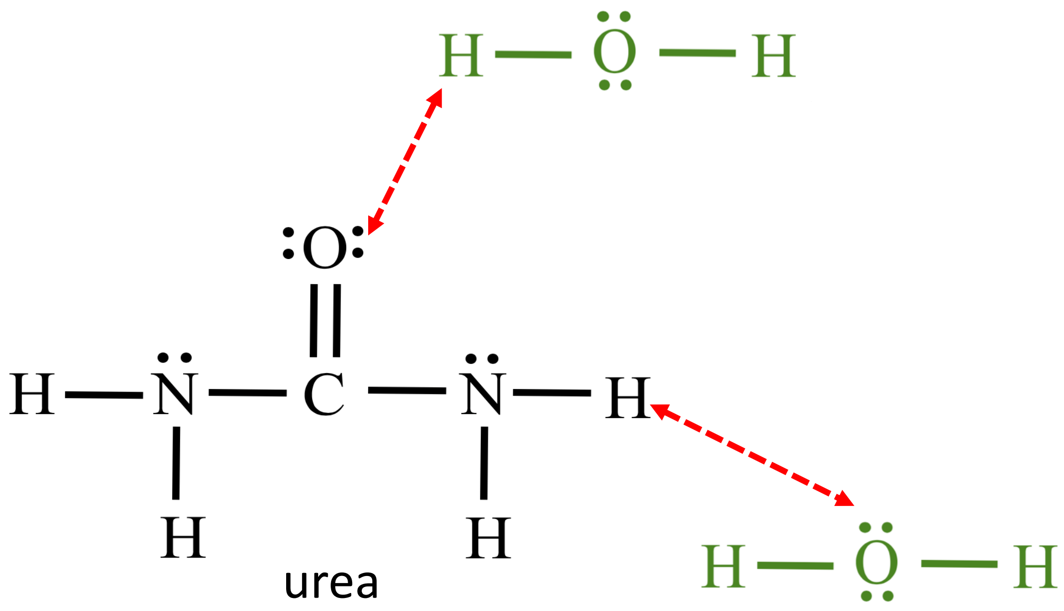
**For more details:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.

Go to next question

4.27) It is possible for ***several*** $H_2O$ molecules to hydrogen bond with urea. In the drawing below, I have illustrated ***two*** of the $H_2O$-urea hydrogen bonds that can occur.

a) Redraw the illustration below and add as many $H_2O$-urea hydrogen bonds as possible.

b) What is the maximum number of $H_2O$-urea hydrogen bonds that can occur? ________





Go back

Click here for a **hint**

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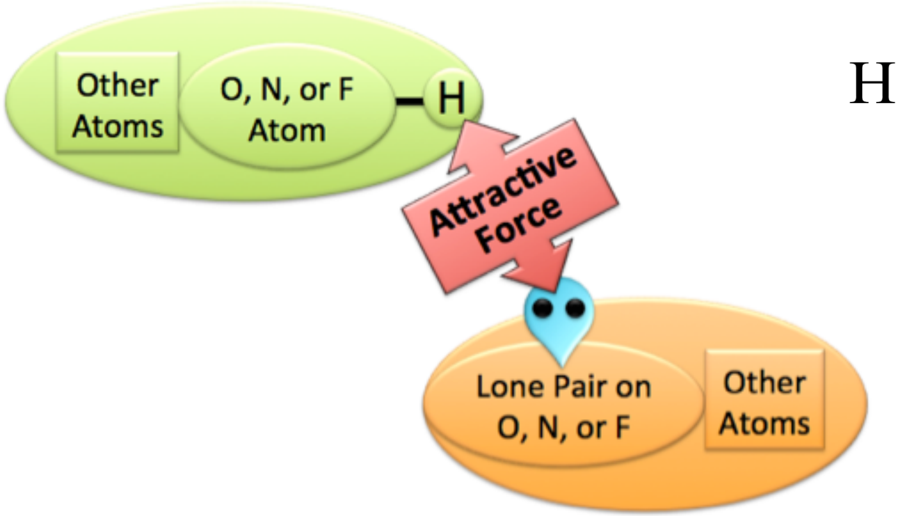
Go to next question

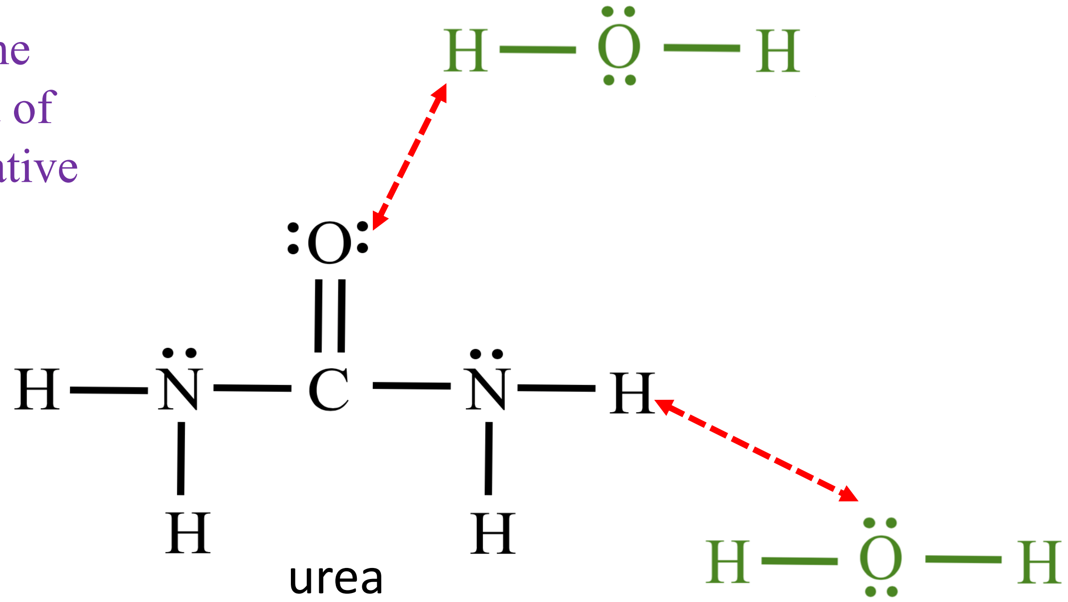
4.27) It is possible for ***several*** $H_2O$ molecules to hydrogen bond with urea. In the drawing below, I have illustrated ***two*** of the $H_2O$-urea hydrogen bonds that can occur.

a) Redraw the illustration below and add as many $H_2O$-urea hydrogen bonds as possible.

b) What is the maximum number of $H_2O$-urea hydrogen bonds that can occur? _________

**HINT:** Hydrogen bonding can occur between the partially positive charged hydrogen end of an O-H, N-H, or F-H bond and the negative charge of a lone pair on an O.




**For more help:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.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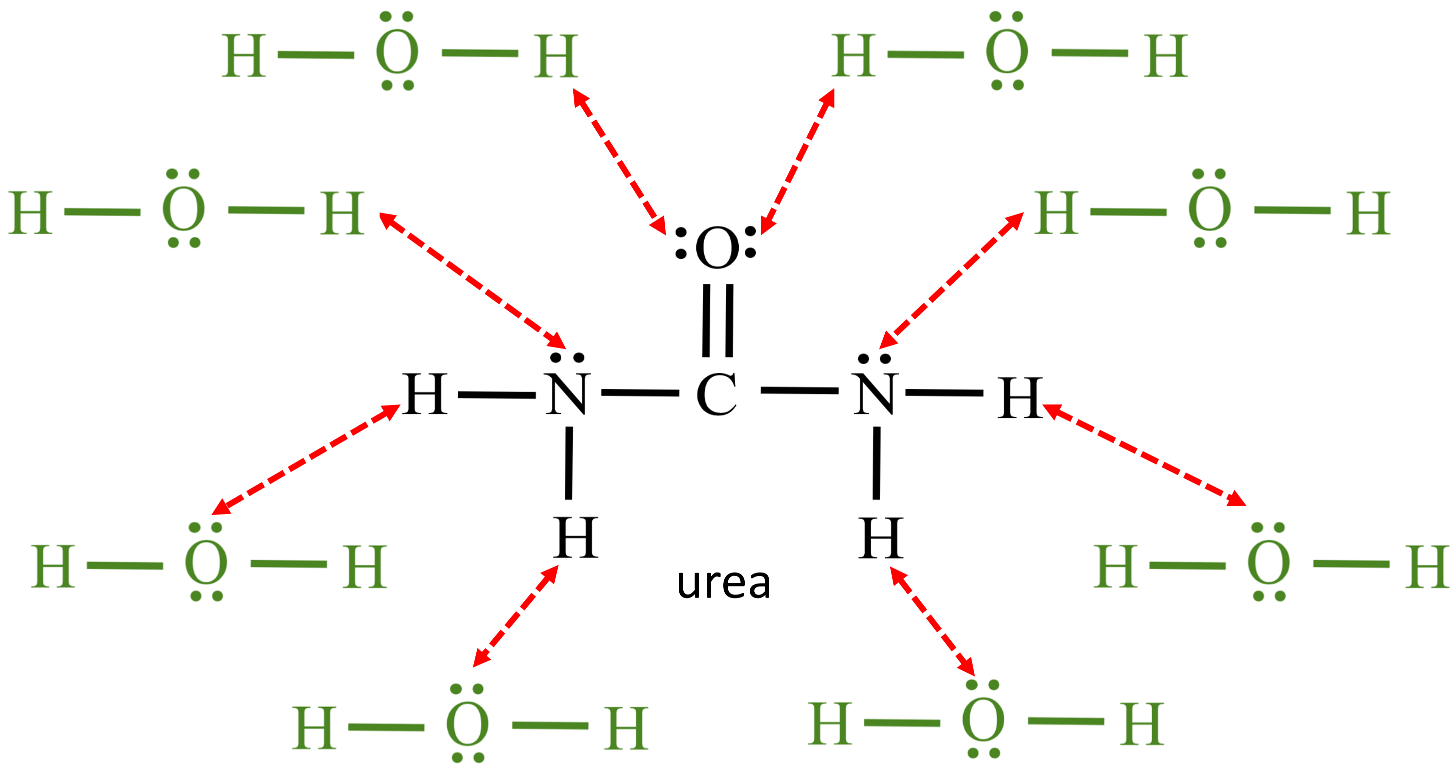
Click here to check your answer

Go to next question

4.27) It is possible for ***several*** $H_2O$ molecules to hydrogen bond with urea. In the drawing below, I have illustrated ***two*** of the $H_2O$-urea hydrogen bonds that can occur.

a) Redraw the illustration below and add as many $H_2O$-urea hydrogen bonds as possible.

b) What is the maximum number of $H_2O$-urea hydrogen bonds that can occur? **8**




Hydrogen bonding can occur between the partially positive charged hydrogen end of an O-H, N-H, or F-H bond and the negative charge of a lone pair on an O, F, or N.

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

Go to next question

4.28) One of the five *noncovalent interactions* is referred to as "**dipole-dipole forces**." Describe "**dipole-dipole forces**."

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Click here for a **hint**

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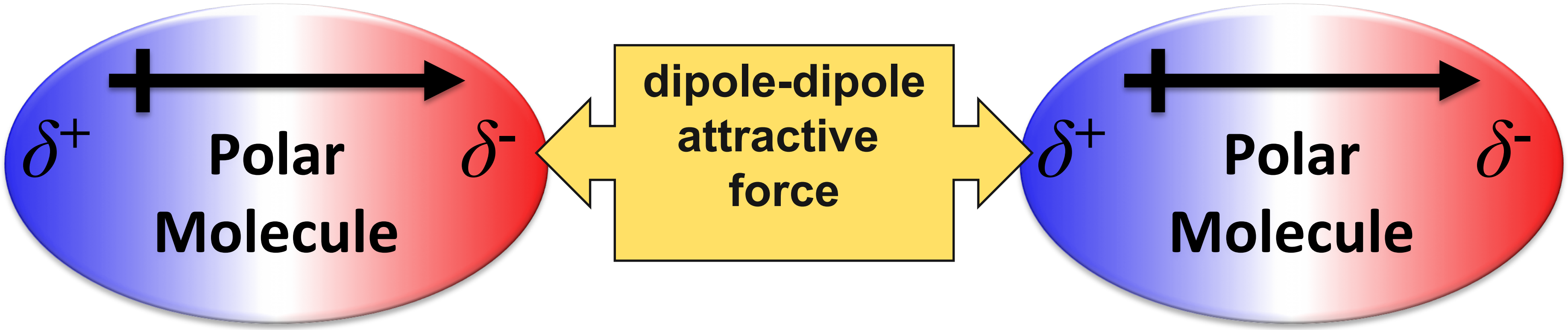
Go to next question

4.28) One of the five *noncovalent interactions* is referred to as "**dipole-dipole forces**." Describe "**dipole-dipole forces**."

**HINT:** Try using the image below as a guide in WRITING your description.




**For more help:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.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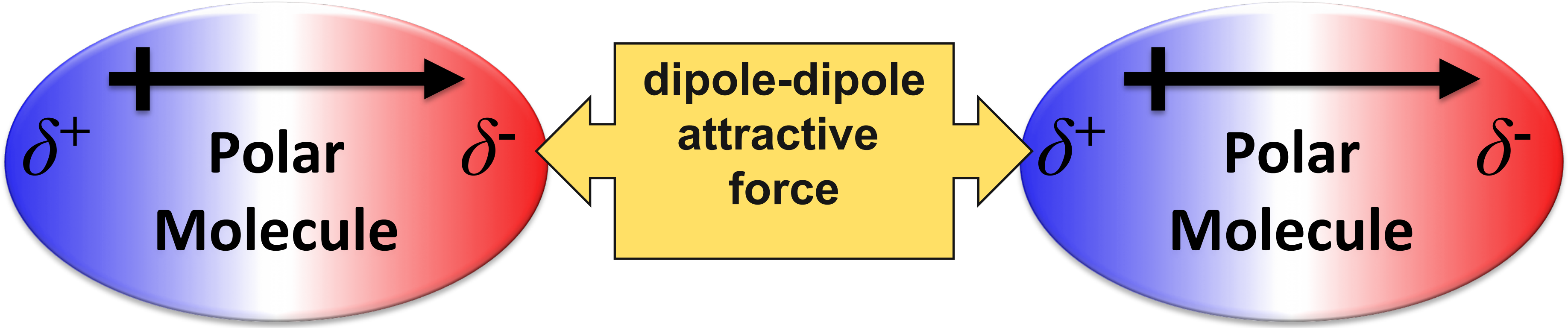
4.28) One of the five *noncovalent interactions* is referred to as "**dipole-dipole forces**." Describe "**dipole-dipole forces**."

**ANSWER:** Polar molecules are attracted to other polar molecules by a type of noncovalent interaction called the dipole-dipole force. The partially positive (δ+) end of one molecule's dipole is attracted to the partially negative (δ-) end of another molecule's dipole (and vice versa) by electrostatic attraction.

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

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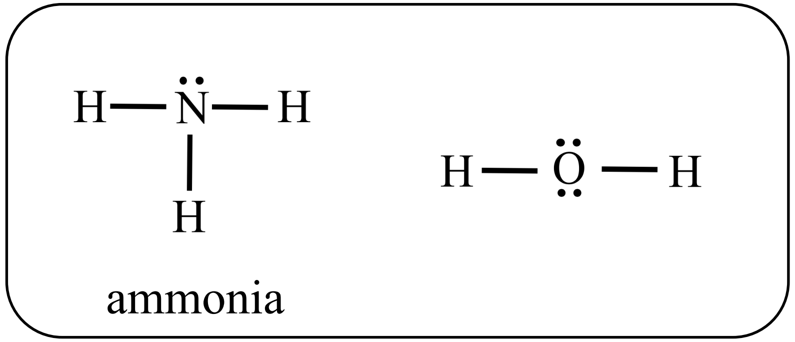
Go to next question

4.29) The line bond structures of ammonia and $H_2O$ are shown here.

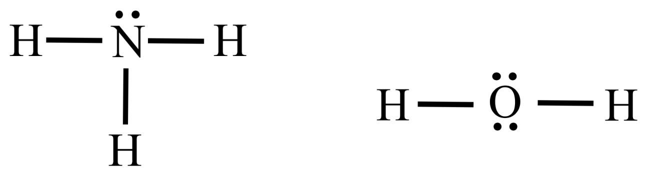



a) Would two ammonia molecules be attracted to each other through ***dipole-dipole forces***?

b) Can ***dipole-dipole forces*** occur between two $H_2O$ molecules?

c) Can ***dipole-dipole forces*** occur between an ammonia molecule and an $H_2O$ molecule?

4.29) The line bond structures of ammonia and $H_2O$ are shown here.



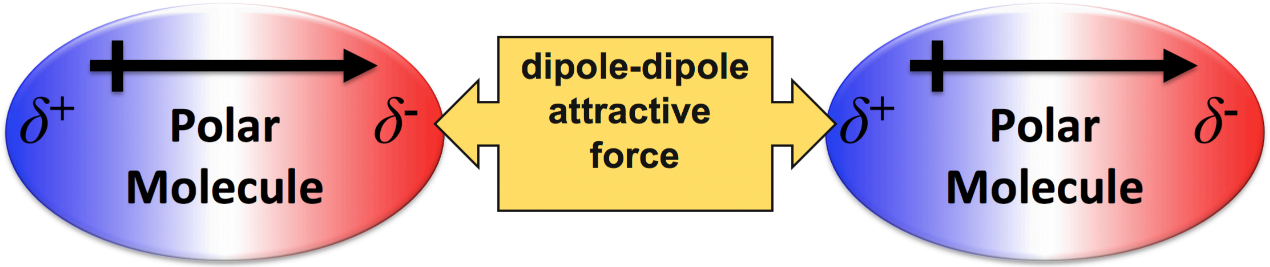
ammonia

a) Would two ammonia molecules be attracted to each other through ***dipole-dipole forces***?

b) Can ***dipole-dipole forces*** occur between two $H_2O$ molecules?

c) Can ***dipole-dipole forces*** occur between an ammonia molecule and an $H_2O$ molecule?

**HINT:** Polar molecules are attracted to other polar molecules by dipole-dipole forces.




Are ammonia and $H_2O$ molecules polar?

**For more help:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.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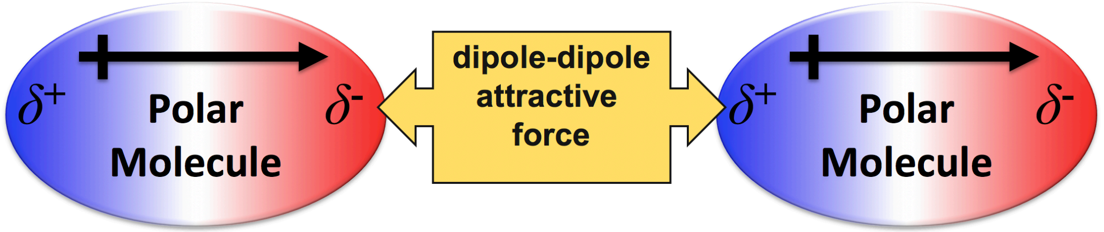
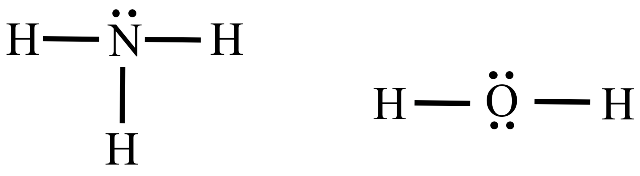
Click here to check your answer

Go to next question

4.29) The line bond structures of ammonia and $H_2O$ are shown here.

**EXPLANATION:** Polar molecules are attracted to other polar molecules by dipole-dipole forces.



ammonia

a) Would two ammonia molecules be attracted to each other through ***dipole-dipole forces***? **yes**

Ammonia is a polar molecule; therefore ammonia molecules are attracted to each other through dipole-dipole forces.

b) Can ***dipole-dipole forces*** occur between two $H_2O$ molecules? **yes**

$H_2O$ is a polar molecule; therefore $H_2O$ molecules are attracted to each other through dipole-dipole forces.

c) Can ***dipole-dipole forces*** occur between an ammonia molecule and an $H_2O$ molecule? **yes**

Both ammonia and $H_2O$ are polar molecules; therefore, ammonia and $H_2O$ molecules are attracted to each other through dipole-dipole forces.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**For more details:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.

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4.30) Would two carbon dioxide molecules be attracted to each other through ***dipole-dipole forces***?

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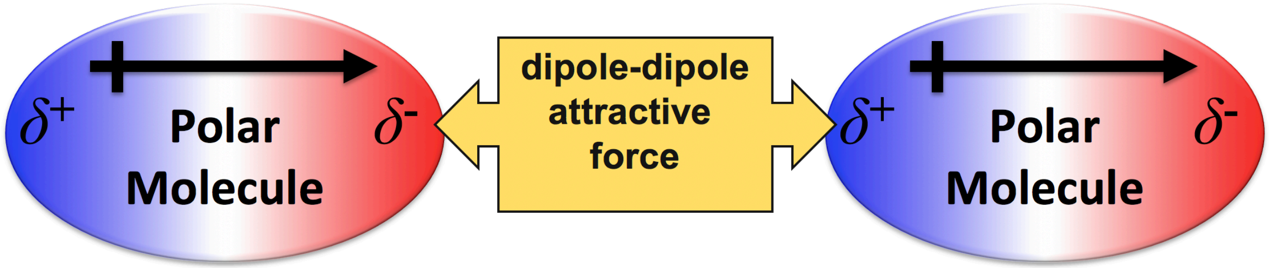
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.30) Would two carbon dioxide molecules be attracted to each other through ***dipole-dipole forces***?

**HINT:** Polar molecules are attracted to other polar molecules by dipole-dipole forces.

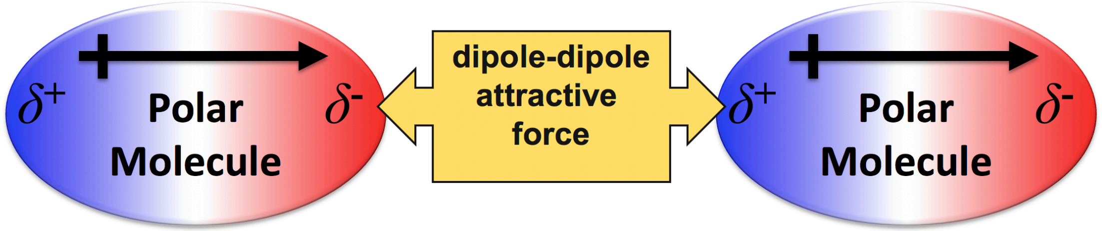



Draw the line bond structure of carbon dioxide.
Are carbon dioxide molecules polar?

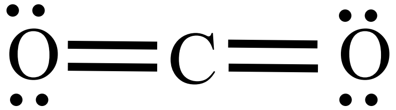
**For more help:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.

4.30) Would two carbon dioxide molecules be attracted to each other through ***dipole-dipole forces***? **ANSWER: No**

**EXPLANATION:** Polar molecules are attracted to other polar molecules by dipole-dipole forces.




The line bond structure of carbon dioxide is shown below.




Carbon dioxide is a **nonpolar** molecule; therefore, ***dipole-dipole forces*** **cannot** occur between carbon dioxide molecules.

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

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4.31) One of the five *noncovalent interactions* is referred to as "**London dispersion forces**." Describe "**London dispersion forces**."

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Click here to **check your answer**

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4.31) One of the five *noncovalent interactions* is referred to as "**London dispersion forces**."
Describe "**London dispersion forces**."

**HINT:** Recall how both *polar* AND *nonpolar* molecules can be attracted to each other.

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

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4.31) One of the five *noncovalent interactions* is referred to as "**London dispersion forces**."
Describe "**London dispersion forces**."

**ANSWER:** London dispersion forces are attractive forces caused by an "instantaneous" dipole in one molecule ***inducing*** the formation of a "temporary" dipole in another molecule.

- The ***larger*** a molecule is, the easier (lower in energy) it is to polarize its electrons, and therefore, **the stronger is its London dispersion force interactions**.

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

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4.32) Would two carbon dioxide molecules be attracted to each other through ***London dispersion forces***?

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Click here for a **hint**

Click here to **check your answer**

Go to next question

4.32) Would two carbon dioxide molecules be attracted to each other through ***London dispersion forces***?

**BIG HINT :** **All molecules** are attracted to each other through ***London dispersion forces***.

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

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Click here to **check your answer**

Go to next question

4.32) Would two carbon dioxide molecules be attracted to each other through ***London dispersion forces***? **ANSWER: Yes**

**EXPLANATION:** **All molecules** are attracted to each other through ***London dispersion forces***.

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

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Go to next question

4.33) Would you expect **stronger London dispersion forces** between two *propane molecules* or between two *octane molecules*?

*propane*: $CH_3CH_2CH_3$

*octane*: $CH_3CH_2CH_2CH_3CH_2CH_2CH_2CH_3$



Click here for a **hint**

Click here to **check your answer**

4.33) Would you expect **stronger London dispersion forces** between two *propane molecules* or between two *octane molecules*?

*propane*: $CH_3CH_2CH_3$

*octane*: $CH_3CH_2CH_2CH_3CH_2CH_2CH_2CH_3$

**HINT:** The larger a molecule is, the easier (lower in energy) it is to polarize its electrons. Therefore, the larger a molecule, the stronger is its London dispersion force interactions.

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

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Click here to **check your answer**

Go to next question

4.33) Would you expect **stronger** **London dispersion forces** between two *propane molecules* or between two *octane molecules*?

*propane*: $CH_3CH_2CH_3$

*octane*: $CH_3CH_2CH_2CH_3CH_2CH_2CH_2CH_3$

**EXPLANATION:** The larger a molecule is, the easier (lower in energy) it is to polarize its electrons. Therefore, the larger a molecule, the stronger is its London dispersion force interactions.

Because *octane* is **larger** than *propane*, the **London dispersion forces** between **two *octane molecules*** are stronger.

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

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Go to next question

4.34) One of the five *noncovalent interactions* is referred to as "**ion-dipole forces**." Describe "**ion-dipole forces**."

Go back

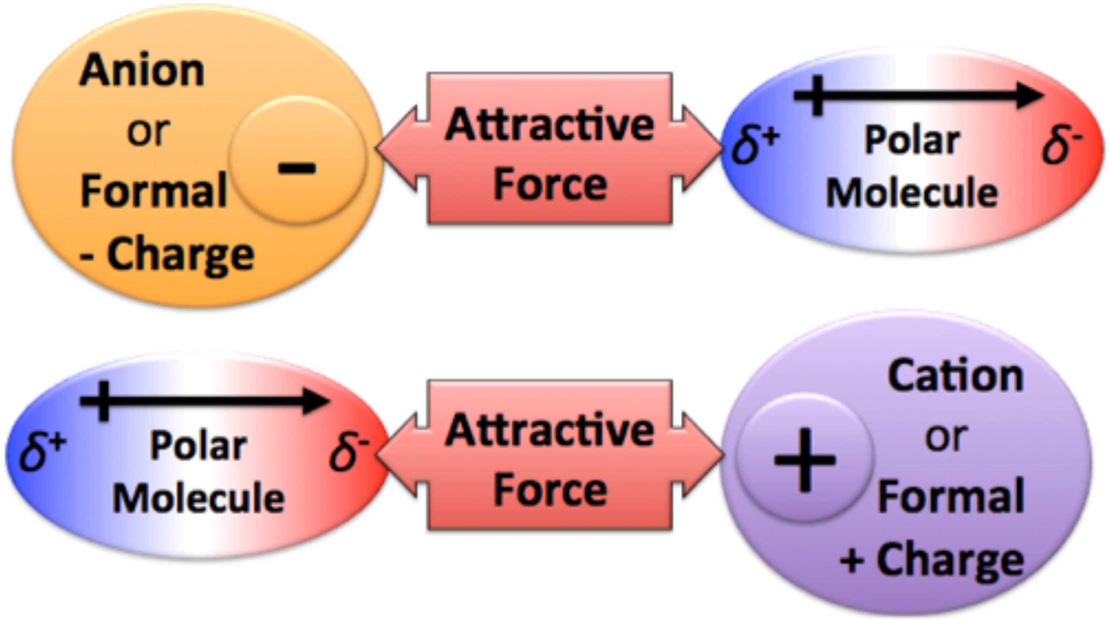
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.34) One of the five *noncovalent interactions* is referred to as "**ion-dipole forces**." Describe "**ion-dipole forces**."

**HINT:** Try using the image below as a guide in WRITING your description.




**For more help:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.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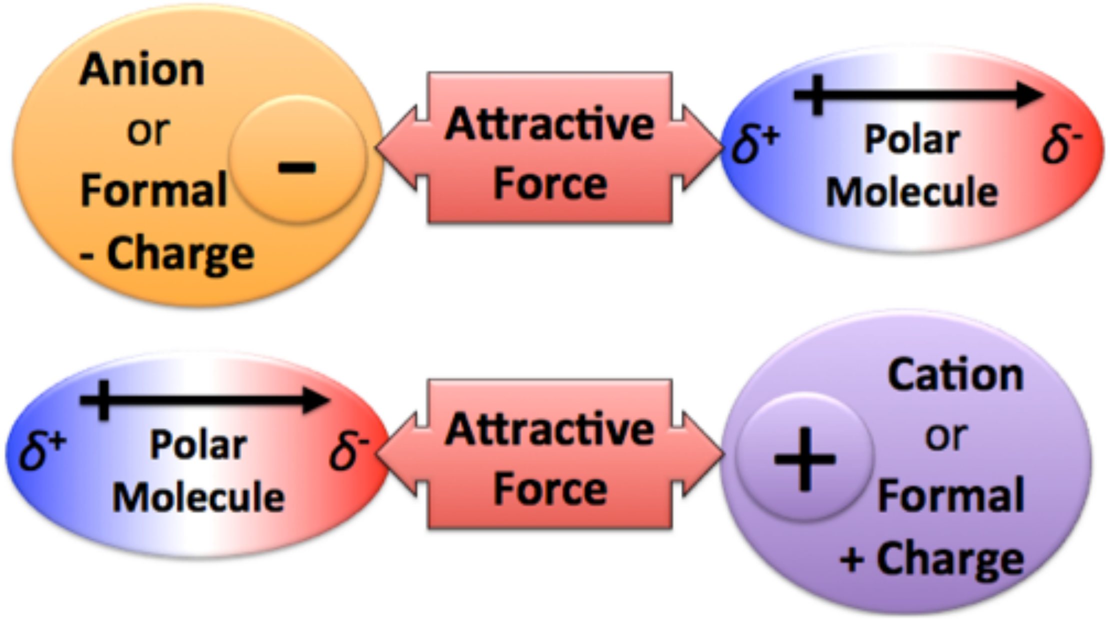
Click here to **check your answer**

Go to next question

4.34) One of the five *noncovalent interactions* is referred to as "**ion-dipole interactions**." Describe "**ion-dipole interactions**."

**ANSWER:** An **ion-dipole interaction**, as the name implies, is the electrostatic attractive interaction ***between*** an ***ion*** (or formal charge) ***and*** the ***dipole*** of a polar molecule.

- The attraction could be ***between*** an **anion** (or negative formal charge) ***and*** the partially positive end **($\delta^+$)** of a dipole, or vice versa, ***between*** a **cation** (or positive formal charge) ***and*** the partially negative end **($\delta^-$)** of a dipole.




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

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Go to next question

4.35) In which of the following pairs of species can an ***ion-dipole interaction*** occur?

a) $H_2O$ and $H_2O$

b) $H_2O$ and $CO_2$

c) $Mg^{2+}$ and $H_2O$

d) $Mg^{2+}$ and $CO_2$

4.35) In which of the following pairs of species can an ***ion-dipole interaction*** occur?

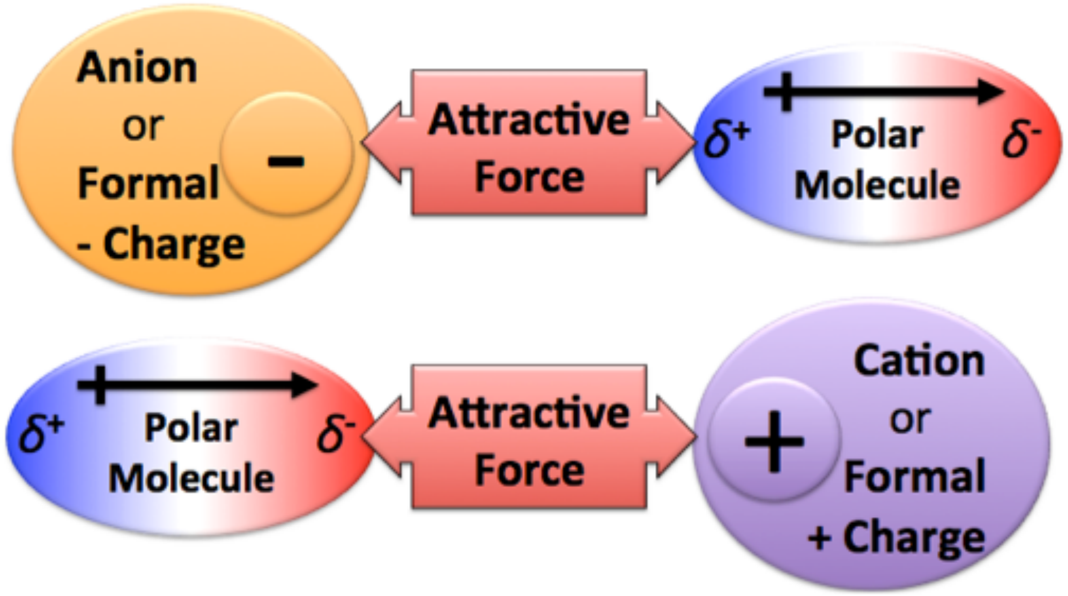
a) $H_2O$ and $H_2O$

b) $H_2O$ and $CO_2$

c) $Mg^{2+}$ and $H_2O$

d) $Mg^{2+}$ and $CO_2$

**HINT:** An **ion-dipole interaction**, as the name implies, is the electrostatic attractive interaction ***between*** an ***ion*** (or formal charge) ***and*** the ***dipole*** of a polar molecule.




**For more help:** See chapter 4 part 10 video or chapter 4 section 5 in the textbook.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Click here to **check your answer**

Go to next question

4.35) In which of the following pairs of species can an ***ion-dipole interaction*** occur?

a) $H_2O$ and $H_2O$

There is not an **ion** in this pair.

b) $H_2O$ and $CO_2$

There is not an **ion** in this pair.

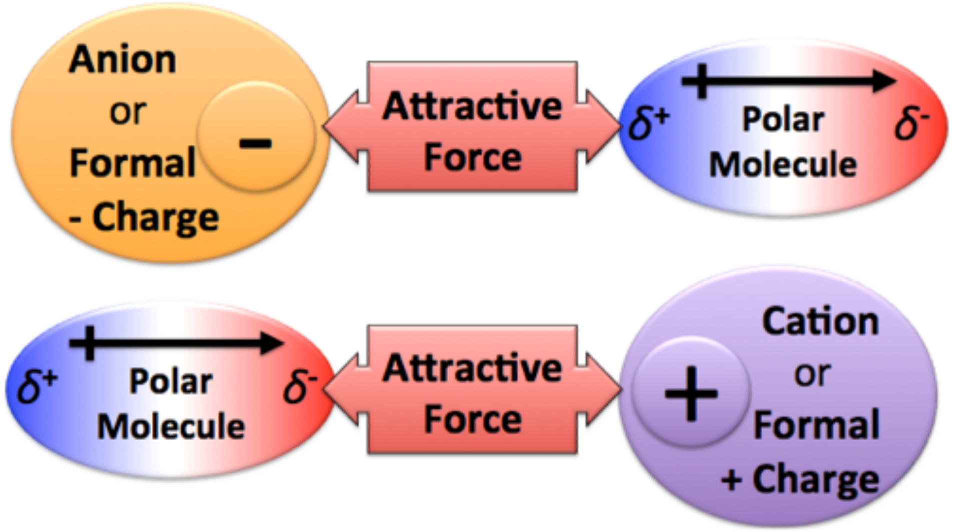
c) $Mg^{2+}$ and $H_2O$

There is **both** an **ion** and a **polar molecule** in this pair; therefore **an ion-dipole interaction can occur**.

d) $Mg^{2+}$ and $CO_2$

Although there is an **ion** present , there is **not** a **polar molecule** in this pair.

**EXPLANATION:** An **ion-dipole interaction**, as the name implies, is the electrostatic attractive interaction ***between*** an ***ion*** (or formal charge) ***and*** the ***dipole*** of a polar molecule.

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

Go to next question

4.36) One of the five *noncovalent interactions* is referred to as "**salt bridge interactions**." Describe "**salt bridge interactions**."

Go back

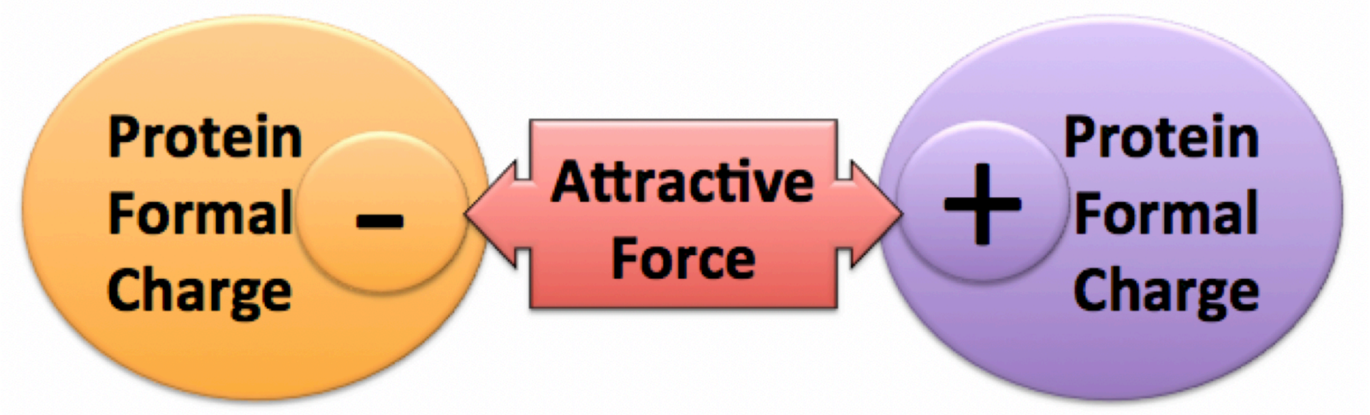
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.36) One of the five *noncovalent interactions* is referred to as "**salt bridge interactions**." Describe "**salt bridge interactions**."

**HINT:** Try using the image below as a guide in WRITING your description.




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

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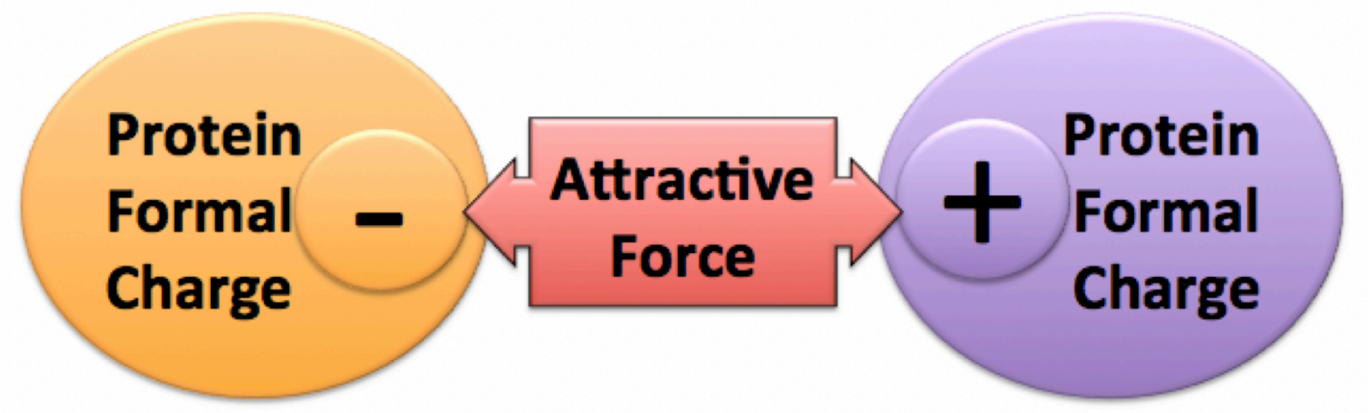
Click here to **check your answer**

Go to next question

4.36) One of the five *noncovalent interactions* is referred to as "**salt bridge interactions**." Describe "**salt bridge interactions**."

**ANSWER:** A **salt bridge** is the electrostatic attractive interaction ***between*** a negative formal charge ***and*** a positive formal charge in protein.

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

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4.37) The strongest noncovalent interaction that can occur between **hydrocarbons** is ________________.

a) dipole-dipole forces

b) London dispersion forces

c) ion-dipole interactions

d) hydrogen bonding

4.37) The strongest noncovalent interaction that can occur between **hydrocarbons** is ________________.

a) dipole-dipole forces

b) London dispersion forces

c) ion-dipole interactions

d) hydrogen bonding

**HINTS:**

**Hydrocarbons** contain *carbon* and *hydrogen* **only**.

Are **hydrocarbons** capable of hydrogen bonding?

Are **hydrocarbons** *polar* or *nonpolar*?

**Which** of the noncovalent interactions can occur between **hydrocarbons?**

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

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Click here to **check your answer**

Go to next question

4.37) The strongest noncovalent interaction that can occur between **hydrocarbons** is _________________.

a) dipole-dipole forces

b) London dispersion forces

c) ion-dipole interactions

d) hydrogen bonding

**EXPLANATION:**

**Hydrocarbons** contain *carbon* and *hydrogen* **only** so they are **not capable** of hydrogen bonding.

**Hydrocarbons** are **nonpolar**; therefore, the are **not capable** of interacting through ***dipole-dipole forces*** or ***ion-dipole interactions***.

The **only, and therefore strongest**, noncovalent interaction that can occur between **hydrocarbons** is **London dispersion forces**.

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

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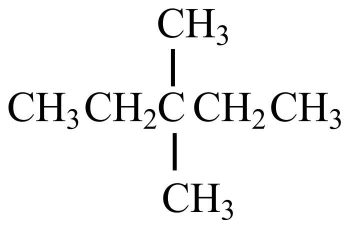
4.38) What is the IUPAC system name for the alkane shown below?



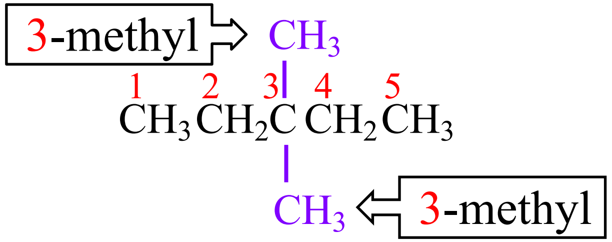

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.38) What is the IUPAC system name for the alkane shown below?




**Method for Naming Normal and Branched Alkanes**

**Step 1.** Name the *parent chain*.
**Step 2.** Name any *alkyl group substituents*.
**Step 3.** Determine the *point of attachment* of alkyl group(s) to the parent chain.
**Step 4.** Construct the name of the alkane by placing the alkyl groups in *alphabetical order* and specifying their position numbers, followed by the name of the parent chain.

- Add the Greek prefix labels di, tri, or tetra in front of the alkyl group name **if** two, three, or four (respectively) identical substituents are present.
  - Do not consider these prefixes when alphabetizing.
- Place a *comma* between *position numbers*.
- Place a *dash* between *position numbers* and *letters*.

**Alkyl Groups**

| Number of Carbon Atoms | Alkyl Group Name | Condensed Structure |
|---|---|---|
| 1 | methyl | $-CH_3$ |
| 2 | ethyl | $-CH_2CH_3$ |
| 3 | propyl | $-CH_2CH_2CH_3$ |
| 3 | isopropyl | $-CHCH_3$ with $CH_3$ on the CH |
| 4 | butyl | $-CH_2CH_2CH_2CH_3$ |
| 4 | isobutyl | $-CH_2CHCH_3$ with $CH_3$ on the CH |
| 4 | *sec*-butyl | $-CHCH_2CH_3$ with $CH_3$ on the CH |
| 4 | *tert*-butyl (or *t*-butyl) | $-C-CH_3$ with CH above and $CH_3$ below the C |

For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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Click here to check your answer

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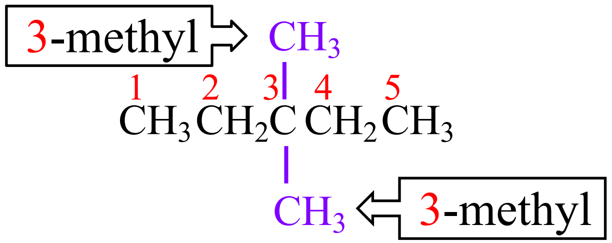
4.38) What is the IUPAC system name for the alkane shown below? **ANSWER: 3,3-dimethylpentane**




**Method for Naming Normal and Branched Alkanes**

**Step 1.** Name the *parent chain*.
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- Add the Greek prefix labels di, tri, or tetra in front of the alkyl group name **if** two, three, or four (respectively) identical substituents are present.
  - Do not consider these prefixes when alphabetizing.
- Place a *comma* between *position numbers*; note that we used "**3,3-**" in the name of this molecule.
- Place a *dash* between *position numbers* and *letters*.

**Alkyl Groups**

| Number of Carbon Atoms | Alkyl Group Name | Condensed Structure |
|---|---|---|
| 1 | methyl | $-CH_3$ |
| 2 | ethyl | $-CH_2CH_3$ |
| 3 | propyl | $-CH_2CH_2CH_3$ |
| 3 | isopropyl | $-CHCH_3$ with $CH_3$ on the CH |
| 4 | butyl | $-CH_2CH_2CH_2CH_3$ |
| 4 | isobutyl | $-CH_2CHCH_3$ with $CH_3$ on the CH |
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For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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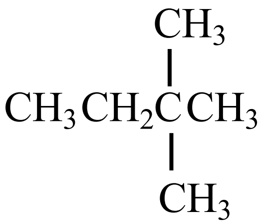
4.39) What is the IUPAC system name for the alkane shown below?

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Click here for a **hint**

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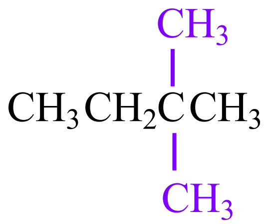
Go to next question

4.39) What is the IUPAC system name for the alkane shown below?




**HINT:** Be sure to begin numbering from the **end** of the parent chain that is ***nearest*** *to a substituent*.

### Method for Naming Normal and Branched Alkanes

**Step 1.** Name the *parent chain*.
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| 2 | ethyl | $-CH_2CH_3$ |
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| 3 | isopropyl | $-CHCH_3$ (with $CH_3$ below CH) |
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For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.


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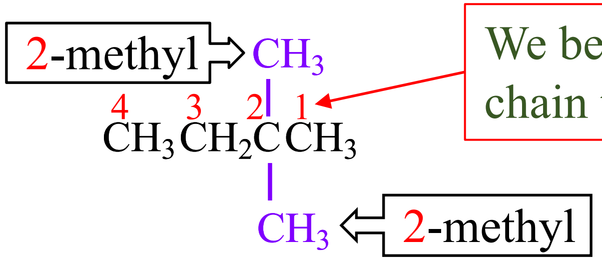
Click here to **check your answer**

Go to next question

4.39) What is the IUPAC system name for the alkane shown below? **ANSWER: 2,2-dimethylbutane**




We begin numbering from the **end** of the parent chain that is ***nearest*** *to a substituent*.

**Alkyl Groups**

| Number of Carbon Atoms | Alkyl Group Name | Condensed Structure |
|---|---|---|
| 1 | methyl | $-CH_3$ |
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## Method for Naming Normal and Branched Alkanes

**Step 1.** Name the *parent chain*.
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- Place a *comma* between *position numbers*; note that we used "**2,2-**" in the name of this molecule.
- Place a *dash* between *position numbers* and *letters*.

For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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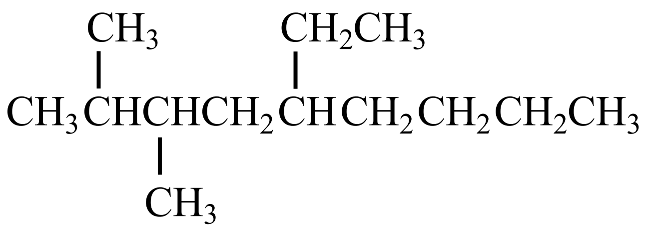
4.40) What is the IUPAC system name for the alkane shown below?

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Click here for a **hint**

Click here to **check your answer**

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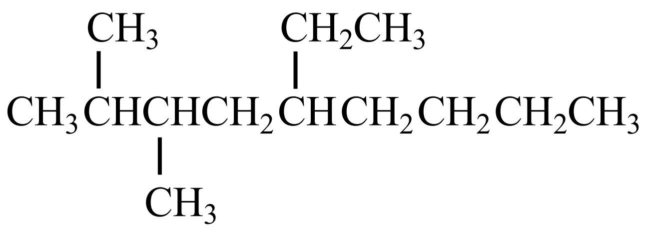
4.40) What is the IUPAC system name for the alkane shown below?




## Method for Naming Normal and Branched Alkanes

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For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.


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Click here to check your answer

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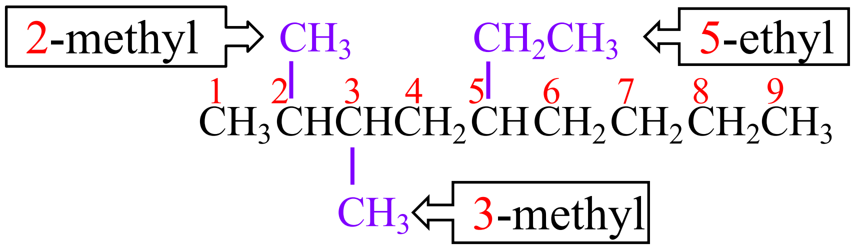
4.40) What is the IUPAC system name for the alkane shown below? **ANSWER: 5-ethyl-2,3-dimethylnonane**




## Method for Naming Normal and Branched Alkanes

**Step 1.** Name the *parent chain*.
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For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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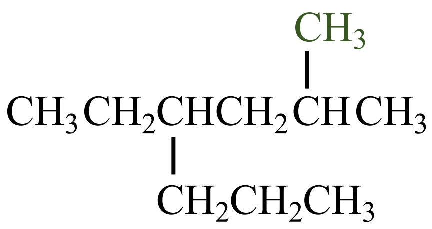
4.41) What is the IUPAC system name for the alkane shown below?

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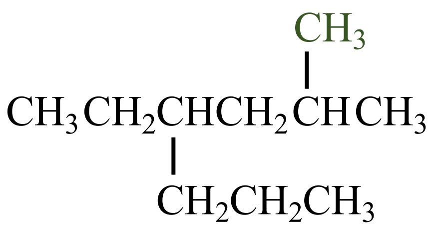
4.41) What is the IUPAC system name for the alkane shown below?




## Method for Naming Normal and Branched Alkanes

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| 3 | isopropyl | $—CHCH_3$ (with $CH_3$ below CH) |
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For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.


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Click here to check your answer

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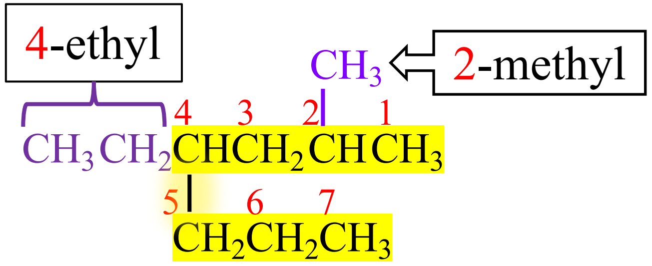
4.41) What is the IUPAC system name for the alkane shown below? **ANSWER: 4-ethyl-2-methylheptane**




**EXPLANATION:** It would be fair to say that this was a "*trick question.*" I used it in order to make the point that *for normal and branched alkanes, the* ***parent chain is the longest, continuous chain of carbons atoms****.* The longest continuous chain of carbons is highlighted yellow and numbered in structure shown above.

**Alkyl Groups**

| Number of Carbon Atoms | Alkyl Group Name | Condensed Structure |
|---|---|---|
| 1 | methyl | $—CH_3$ |
| 2 | ethyl | $—CH_2CH_3$ |
| 3 | propyl | $—CH_2CH_2CH_3$ |
| 3 | isopropyl | $—CHCH_3$ (with $CH_3$ branch) |
| 4 | butyl | $—CH_2CH_2CH_2CH_3$ |
| 4 | isobutyl | $—CH_2CHCH_3$ (with $CH_3$ branch) |
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| 4 | *tert*-butyl (or *t*-butyl) | $—C—CH_3$ (with CH above and $CH_3$ below) |

For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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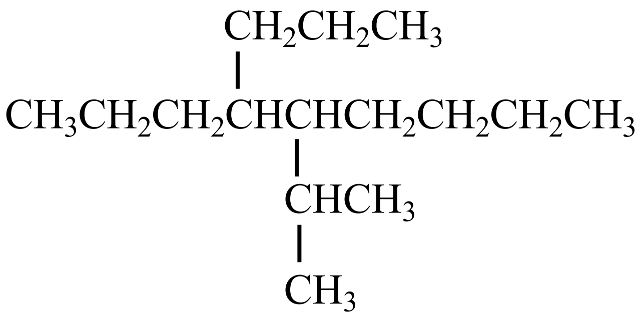
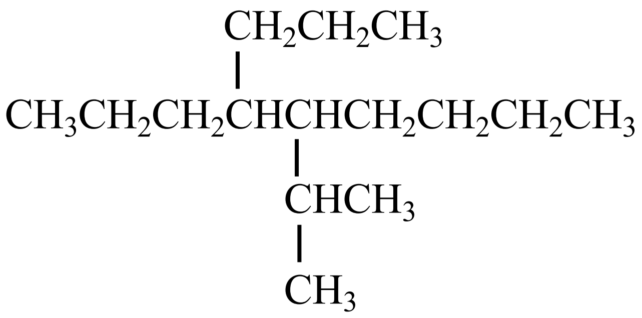
4.42) What is the IUPAC system name for the alkane shown below?



4.42) What is the IUPAC system name for the alkane shown below?




**HINT:** Consider the difference between ***propyl*** and ***isopropyl*** alkyl groups.

For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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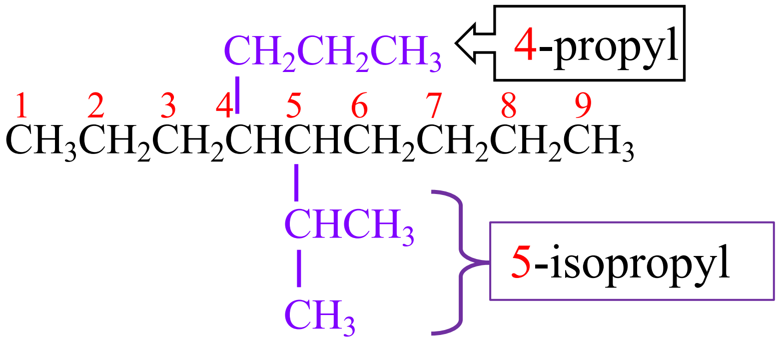
Click here to **check your answer**

Go to next question

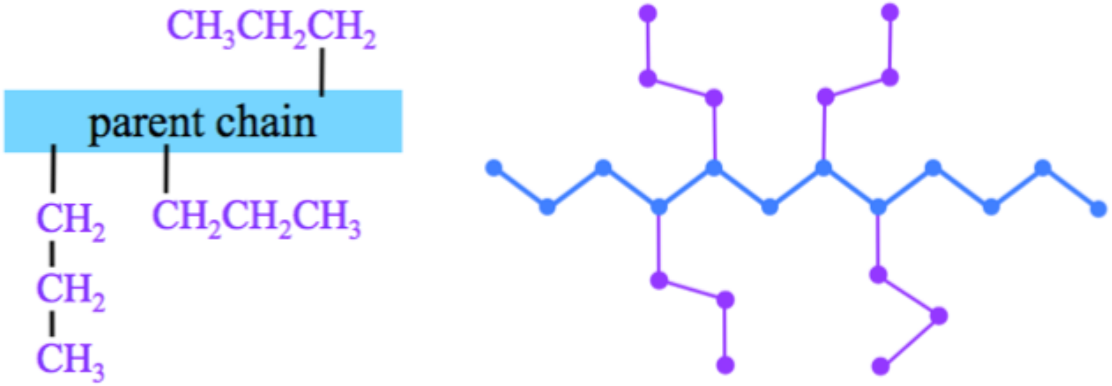
4.42) What is the IUPAC system name for the alkane shown below? **ANSWER: 5-isopropyl-4-propylnonane**



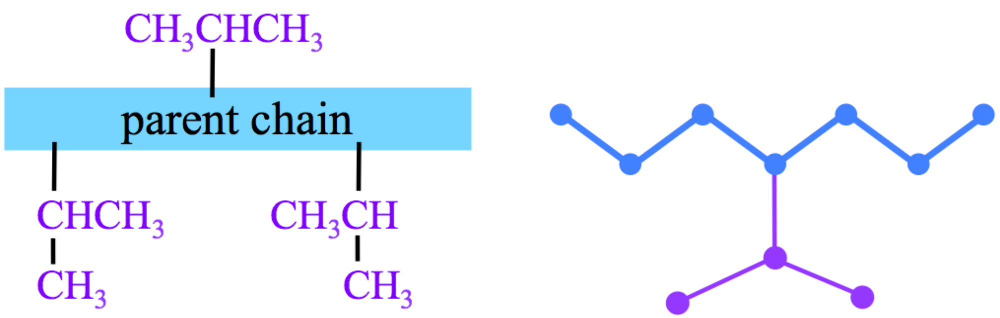

**EXPLANATION:** Compare ***propyl*** and ***isopropyl*** alkyl groups. Both contain three carbon atoms; however, their connection to the parent chain is not the same.

- In a ***propyl*** *group*, the carbon on the ***end of the substituent*** is bonded to the parent chain.
- In an ***isopropyl*** *group*, the carbon ***in the center of the substituent*** is bonded to the parent chain.

- There are multiple, ***correct*** ways to draw **propyl and isopropyl** groups in structural formulas:




***correct*** ways to draw **propyl** groups




***correct*** ways to draw **isopropyl** groups

For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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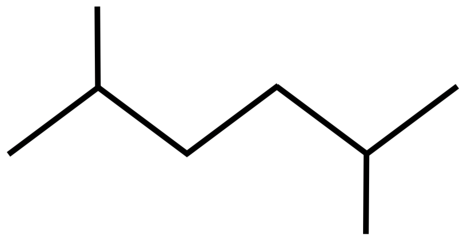
4.43) What is the IUPAC system name for the alkane shown below?

NOTE: If this problem seems difficult to you, it is likely because you were given the skeletal structure. You may wish to draw the line bond or condensed structure before naming.



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Click here for a **hint**

Click here to **check your answer**

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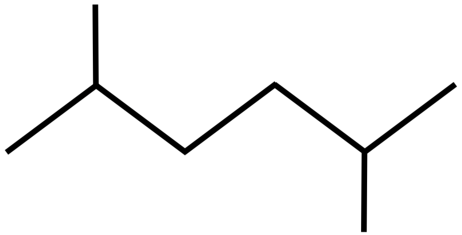
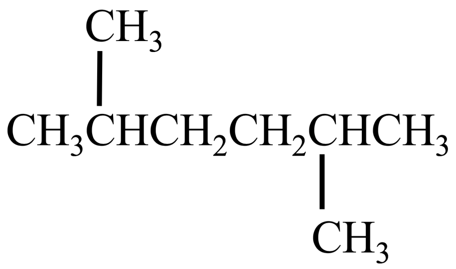
4.43) What is the IUPAC system name for the alkane shown below?



HINT:

The condensed structure of this molecule is:




For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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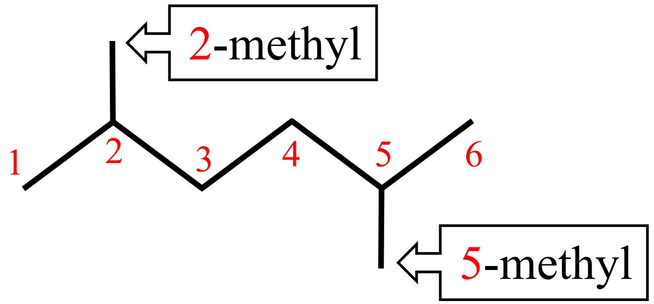
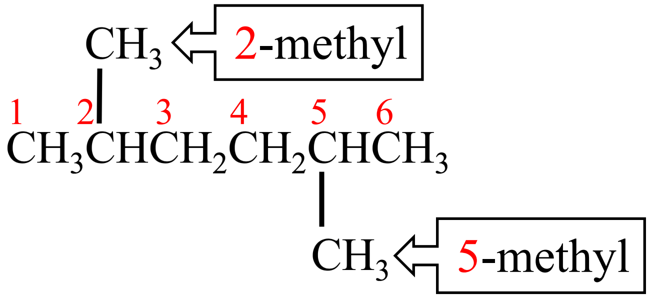
Click here to check your answer

Go to next question

4.43) What is the IUPAC system name for the alkane shown below? **ANSWER: 2,5-dimethylhexane**




For more help with naming alkanes, see the chapter 4 part 12 video, or chapter 4 section 8 in the textbook.

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4.44) Draw the **line bond**, **condensed**, and **skeletal structure** for 6-ethyl-2,3-dimethyl-decane.

Go back

Click here for a **hint**

Click here to **check your answer**

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4.44) Draw the **line bond**, **condensed**, and **skeletal structure** for 6-ethyl-2,3-dimethyl-decane.

**Line Bond Structure**

?

**Condensed Structure**

?

**Skeletal Structure**

?

**HINT:** See the **method for drawing structural formulas** in the **chapter 4 part 3** video, or in **chapter 4 section 3** of the textbook.

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Click here to **check your answer**

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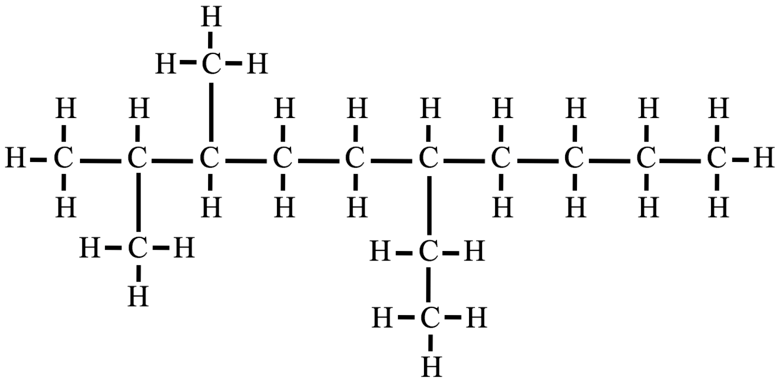
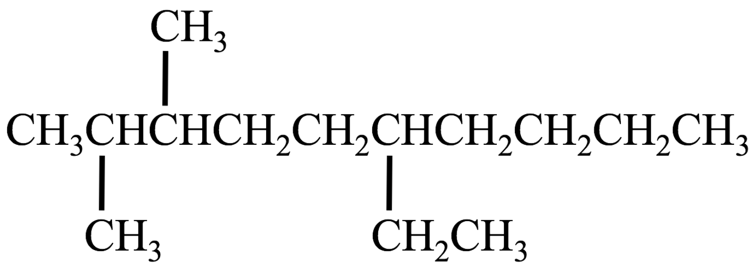
4.44) Draw the **line bond**, **condensed**, and **skeletal structure** for 6-ethyl-2,3-dimethyl-decane.

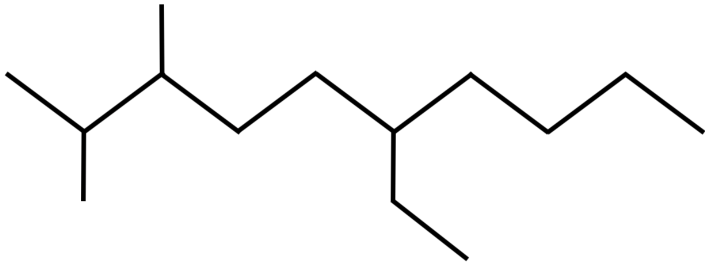
**Line Bond Structure**



**Condensed Structure**



**Skeletal Structure**



NOTE: If your answer has the **same atomic connectivity** but a different configuration, then it is correct.

**For more details:** see the **method for drawing structural formulas** in the **chapter 4 part 3** video, or in chapter 4 section 3 of the textbook.

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4.45) Molecules that have the ***same*** *molecular formula*, but ***different*** *atomic connections* are called **constitutional isomers**. **Draw** and **name** the ***five*** constitutional isomers of $\mathbf{C_6H_{14}}$.

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Click here for a **hint**

Click here to **check your answer**

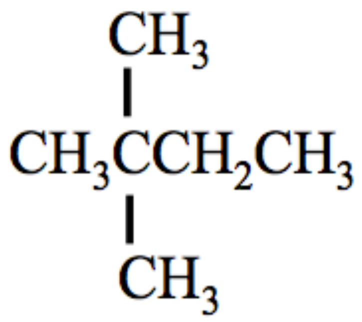
Go to next question

4.45) Molecules that have the ***same*** *molecular formula*, but ***different*** *atomic connections* are called **constitutional isomers**. **Draw** and **name** the ***five*** constitutional isomers of $\mathbf{C_6H_{14}}$.

**HINT:** Here are ***two*** of the ***five*** isomers:

$CH_3CH_2CH_2CH_2CH_2CH_3$

hexane




2,2-dimethylbutane

For more information on *constitutional isomers* and a detailed discussion of the solution to this problem see the **chapter 4 part 14** video.

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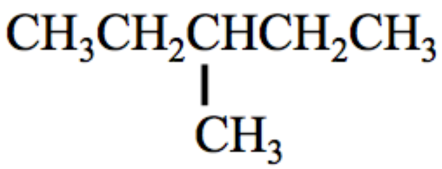
Click here to **check your answer**

Go to next question

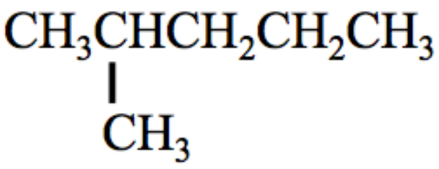
4.45) Molecules that have the ***same*** *molecular formula*, but ***different*** *atomic connections* are called **constitutional isomers**. **Draw** <u>and</u> **name** the ***five*** constitutional isomers of $\mathbf{C_6H_{14}}$.

$CH_3CH_2CH_2CH_2CH_2CH_3$

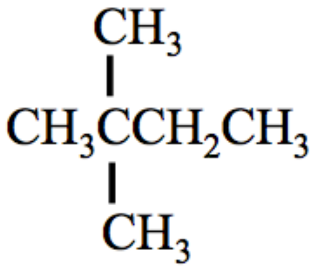
hexane



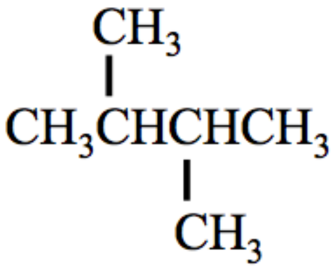
3-methylpentane



2-methylpentane



2,2-dimethylbutane



2,3-dimethylbutane

For more information on *constitutional isomers* and a detailed discussion of the solution to this problem see the **chapter 4 part 14** video.

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Go to next question

4.46) Draw the line bond, condensed, **and** skeletal structures for the following ***cycloalkanes***.

a) cyclopropane

b) cyclobutane

c) cyclopentane

d) cyclohexane

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Click here for a **hint**

Click here to **check your answer**

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4.46) Draw the line bond, condensed, **and** skeletal structures for the following ***cycloalkanes***.

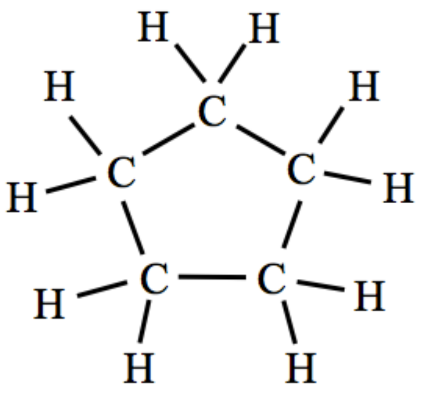
a) cyclopropane

b) cyclobutane

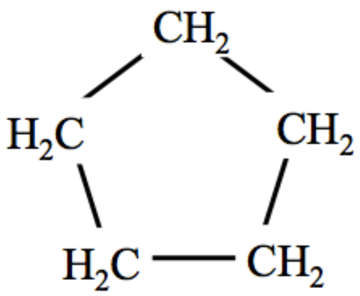
c) cyclopentane

d) cyclohexane

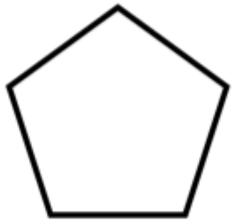
HINT: The line bond, condensed, and skeletal structure for cyclopentane are shown here:



**line bond structure**



**condensed structure**



**skeletal structure**

For more help with naming **cycloalkanes**, see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.

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Click here to **check your answer**

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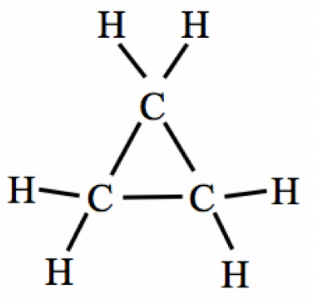
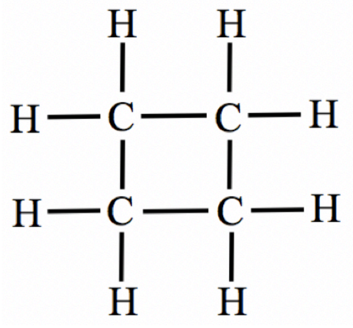
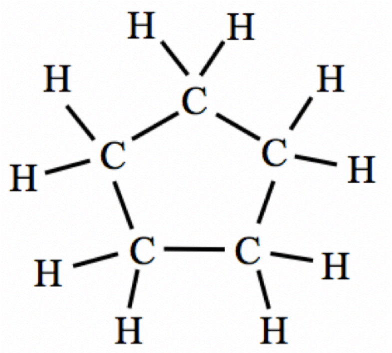
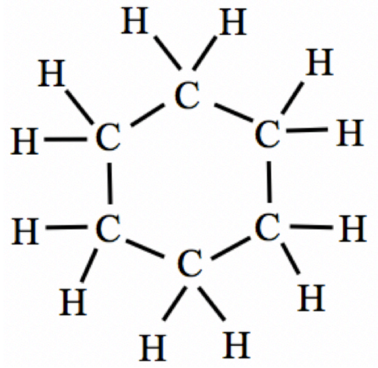
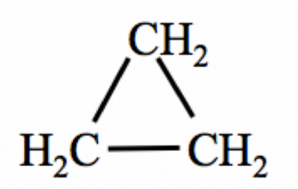
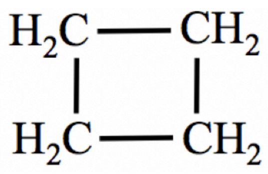
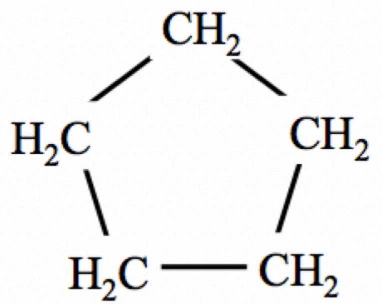
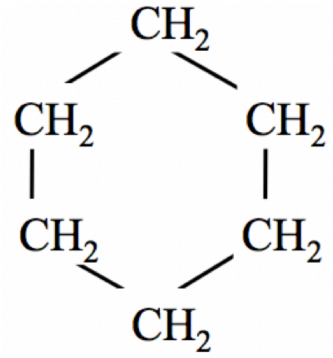
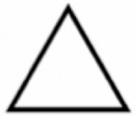
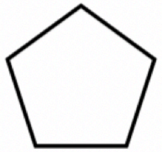
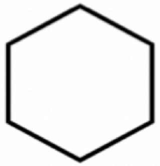
4.46) Draw the line bond, condensed, **and** skeletal structures for the following ***cycloalkanes***.

a) cyclopropane

b) cyclobutane

c) cyclopentane

d) cyclohexane

| | **Cyclopropane** | **Cyclobutane** | **Cyclopentane** | **Cyclohexane** |
|---|---|---|---|---|
| Line Bond Structure |  |  |  |  |
| Condensed Structure |  |  |  |  |
| Skeletal Structure |  |  |  |  |

For more help with naming **cycloalkanes**, see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.

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4.47) In order to communicate *three-dimensional structure information*, cycloalkanes are often represented using "side-views." Draw the "**side-view**" structures for ***cyclopentane*** and ***cyclohexane***.

Go back

Click here for a **hint**

Click here to **check your answer**

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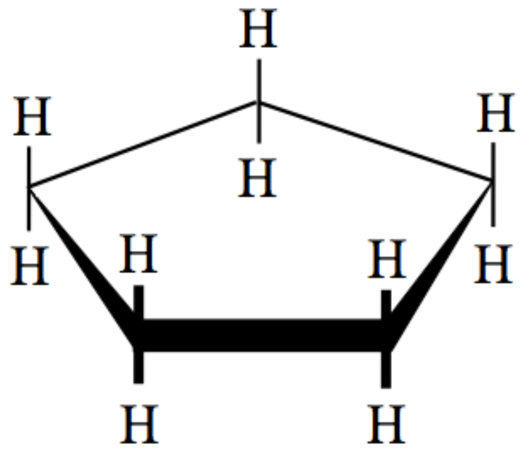
4.47) In order to communicate *three-dimensional structure information*, cycloalkanes are often represented using "side-views." Draw the "**side-view**" structures for ***cyclopentane*** and ***cyclohexane***.

**HINT:** The **side-view** structure for ***cyclopentane*** is:




**For more help**: see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.

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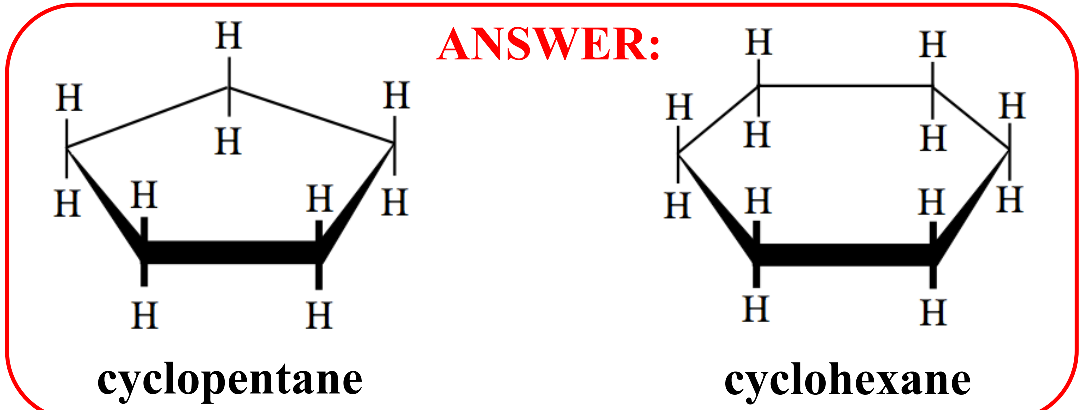
4.47) In order to communicate *three-dimensional structure information*, cycloalkanes are often represented using "side-views." Draw the "**side-view**" structures for ***cyclopentane*** and ***cyclohexane***.

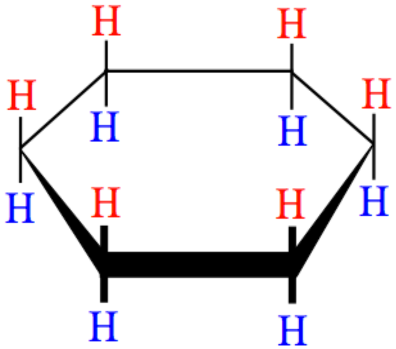
**ANSWER:**




**EXPLANATION:** A ball-and-stick model and a side-view structure for cyclohexane are shown below. Note that in the ball-and-stick model (**left**), the ring of carbons (carbon atoms shaded black) is oriented horizontally. Each carbon is bonded to ***two hydrogen atoms***. From each ring-carbon, one of these two bonds is oriented in a direction *pointing* ***above*** the ring structure (bonds to the red-shaded hydrogens), and the other bond is oriented in a direction *pointing* ***below*** the ring structure (bonds to the blue-shaded hydrogens).

It is convenient to express this three-dimensional information in the **side-view structural formula**. The actual bond angles are shown in the *ball-and-stick models* and are ***implied*** in the *side-view* representation.

In ***side-view*** structures, bold lines are used to indicate the perspective when viewing the ring. The ring is depicted as being oriented horizontally with the **bold edges** toward the viewer. The two bonds that are oriented upwards or downwards from the ring-carbons are drawn vertically. The hydrogen atoms in red font correspond to the hydrogens shown as red spheres in the ball and stick model; likewise the hydrogen atoms in the blue font correspond to the hydrogens shown as blue spheres in the ball-and-stick model.

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**For more details**: see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.

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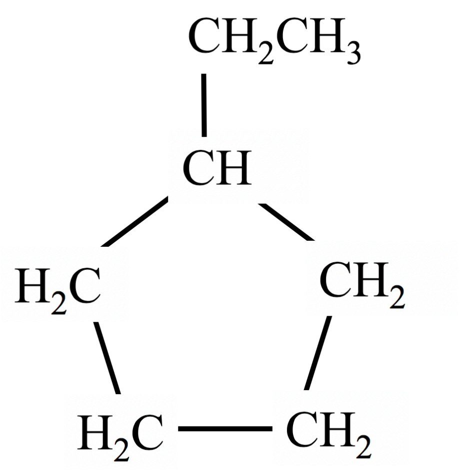
4.48) Name this molecule.

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Click here for a **hint**

Click here to **check your answer**

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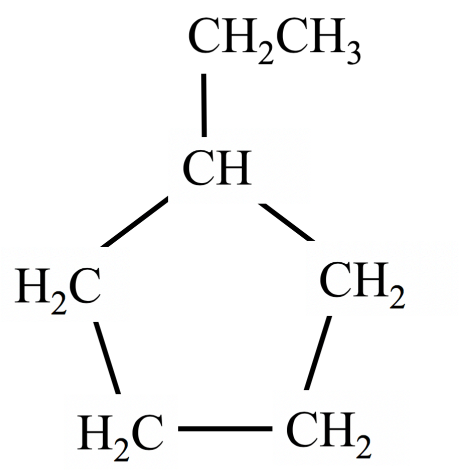
4.48) Name this molecule.



**HINT: Naming Cycloalkanes**

**Step 1.** Name the *parent chain*.

- For cycloalkanes, the ***parent chain*** *is the* ***ring*** *of carbon atoms*.

**Step 2.** Name any *alkyl groups* substituents.

**Step 3.** Determine the *point of attachment* of alkyl group(s) to the parent chain.

- If there is *only* ***one*** *substituent*, a position number **is not used**.

**Step 4.** Construct the name of the alkane by placing the alkyl groups in alphabetical order and specifying their position numbers, followed by the name of the parent chain.

For more help with naming **cycloalkanes**, see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.

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Click here to **check your answer**

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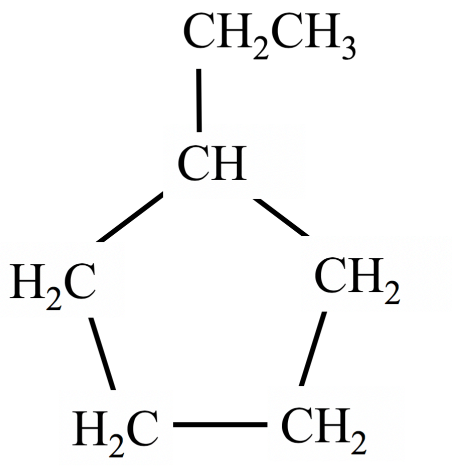
4.48) Name this molecule. **ANSWER: ethylcyclopentane**




**EXPLANATION: Naming Cycloalkanes**

**Step 1.** Name the *parent chain.*

- For cycloalkanes, the ***parent chain*** *is the* ***ring*** *of carbon atoms*. **cyclopentane**

**Step 2.** Name any *alkyl groups* substituents. **ethyl**

**Step 3.** Determine the *point of attachment* of alkyl group(s) to the parent chain.

- If there is *only* ***one*** *substituent*, a position number **is not used**.

**Step 4.** Construct the name of the alkane by placing the alkyl groups in alphabetical order and specifying their position numbers, followed by the name of the parent chain.

**ethylcyclopentane**

For more help with naming **cycloalkanes**, see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.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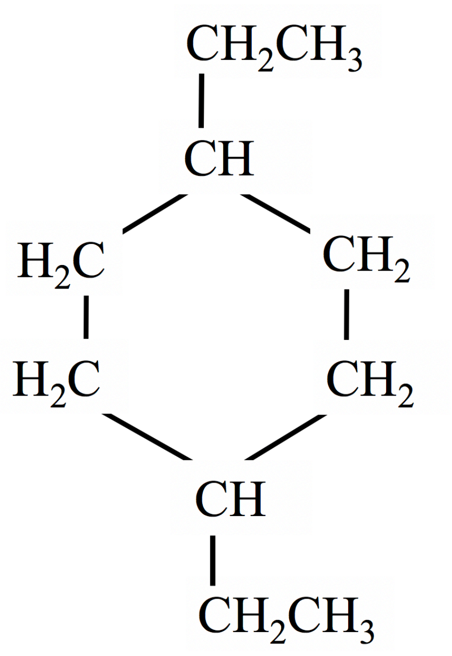
4.49) Name this molecule.



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Click here for a **hint**

Click here to **check your answer**

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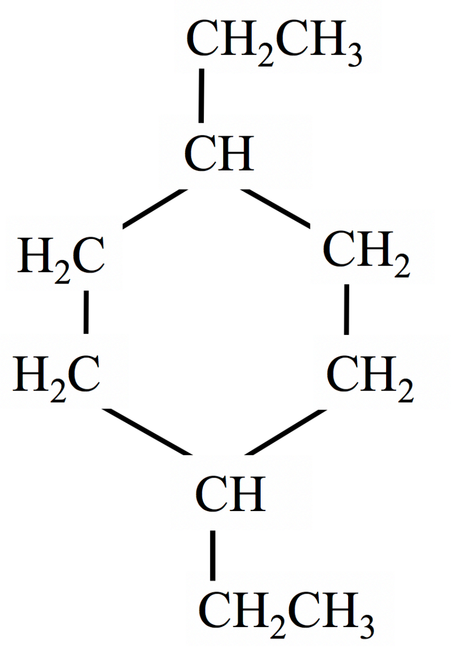
4.49) Name this molecule.




**HINT: Naming Cycloalkanes**

**Step 1.** Name the *parent chain*.

- For cycloalkanes, the ***parent chain*** *is the* ***ring*** *of carbon atoms*.

**Step 2.** Name any *alkyl groups* substituents.

**Step 3.** Determine the *point of attachment* of alkyl group(s) to the parent chain.

- If there is ***more than one*** *substituent*, assign position numbers to the alkyl groups.
  - For ***identical substituents***, arbitrarily assign one of them to position number one. Then, beginning with carbon number **1**, number the other carbons in the direction (clockwise or counterclockwise) that gives the least sum of position numbers.

**Step 4.** Construct the name of the alkane by placing the alkyl groups in alphabetical order and specifying their position numbers, followed by the name of the parent chain.

For more help with naming **cycloalkanes**, see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.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Click here to **check your answer**

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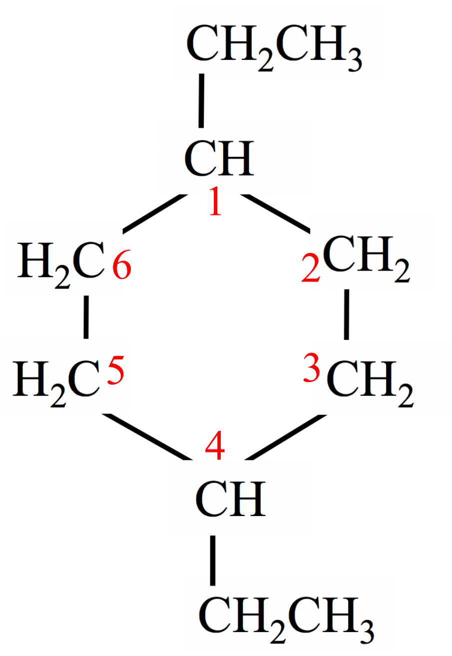
4.49) Name this molecule. **ANSWER: 1,4-diethylcyclohexane**




**EXPLANATION: Naming Cycloalkanes**

**Step 1.** Name the *parent chain.*

- For cycloalkanes, the ***parent chain*** *is the* ***ring*** *of carbon atoms.* **cyclohexane**

**Step 2.** Name any *alkyl groups* substituents. **diethyl**

**Step 3.** Determine the *point of attachment* of alkyl group(s) to the parent chain.

- If there is ***more than one*** *substituent*, assign position numbers to the alkyl groups.
  - For ***identical substituents***, arbitrarily assign one of them to position number one. Then, beginning with carbon number **1**, number the other carbons in the direction (clockwise or counterclockwise) that gives the least sum of position numbers.

**1,4-diethyl**

**Step 4.** Construct the name of the alkane by placing the alkyl groups in alphabetical order and specifying their position numbers, followed by the name of the parent chain.

**1,4-diethylcyclohexane**

For more help with naming **cycloalkanes**, see the chapter 4 part 13 video, or chapter 4 section 8 in the textbook.

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4.50) Draw the **line bond**, **condensed**, and **skeletal structure** for 2-methyl-1-butene. **Note:** This is an **alk<u>ene</u>**.

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Click here for a **hint**

Click here to **check your answer**

Go to next question

4.50) Draw the **line bond**, **condensed**, and **skeletal structure** for 2-methyl-1-butene. **Note:** This is an **alkene**.

## HINTS:

For alkenes, the *parent chain is the longest, continuous chain of carbon atoms that contains **the double bond***.

Alkene *parent chain* names have an "**-ene**" suffix.

When numbering the parent chain of an **alkene**, ***position number* 1** is assigned to the *carbon at the end of the parent chain* that is **closest to the double bond.**

For alkenes with ***more than three carbons***, the position of the double bond must be indicated by adding a ***position number*** to the parent chain name.

- If the double bond is between carbons number **1** and **2**, the number "**1**" is used as a prefix to the parent chain name.
- If the double bond is between carbons number **2** and **3**, the number "**2**" is used as a prefix to the parent chain name.
- If the double bond is between carbons number **3** and **4**, the number "**3**" is used as a prefix to the parent chain name...etc

For more help with drawing alkenes, see the chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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Click here to **check your answer**

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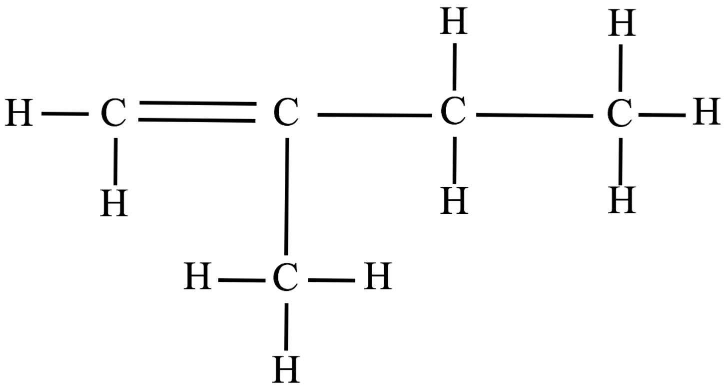
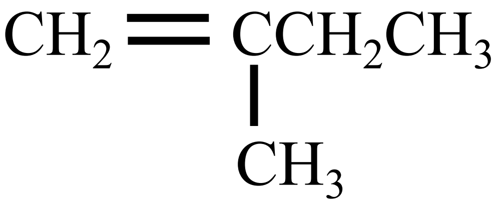
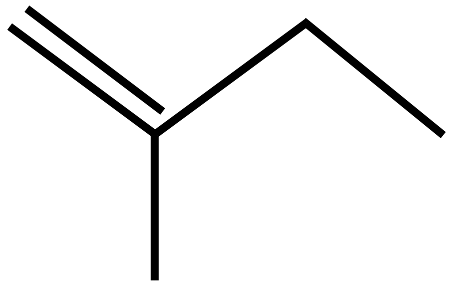
4.50) Draw the **line bond**, **condensed**, and **skeletal structure** for 2-methyl-1-butene. **Note:** This is an **alkene**.




**Line Bond Structure**




**Condensed Structure**



**Skeletal Structure**

NOTE: There is often more than one correct way to draw structural formulas. If your answer has the **same atomic connectivity** but a different configuration, then it is correct.

For more help with drawing alkenes, see the chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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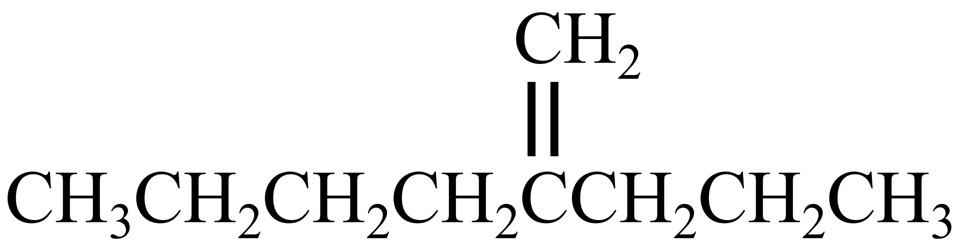
4.51) What is the systematic name for the molecule shown below?

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Click here for a **hint**

Click here to **check your answer**

Go to next question

4.51) What is the systematic name for the molecule shown below?

$$\begin{array}{c} \phantom{CH_3CH_2CH_2CH_2}CH_2\phantom{CH_2CH_2CH_3} \\ \phantom{CH_3CH_2CH_2CH_2}\| \phantom{CH_2CH_2CH_3}\\ CH_3CH_2CH_2CH_2CCH_2CH_2CH_3 \end{array}$$

**HINTS:**

For alk<u>enes</u>, the *parent chain is the longest, continuous chain of carbon atoms* ***that contains the double bond***.

- **Note that this is different from the method we used for finding the parent chain of *alkanes***; for alkanes, the *parent chain is simply the longest, continuous chain of carbon atoms*.

When numbering the parent chain of an **alkene**, *position number* 1 is assigned to the *carbon at the end of the parent chain* that is **closest to the double bond.**

For alkenes with ***more than three carbons***, the position of the double bond must be indicated by adding a ***position number*** to the parent chain name.

- If the double bond is between carbons number **1** and **2**, the number "**1**" is used as a *prefix* to the parent chain name.
- If the double bond is between carbons number **2** and **3**, the number "**2**" is used as a *prefix* to the parent chain name.
- If the double bond is between carbons number **3** and **4**, the number "**3**" is used as a *prefix* to the parent chain name...etc.

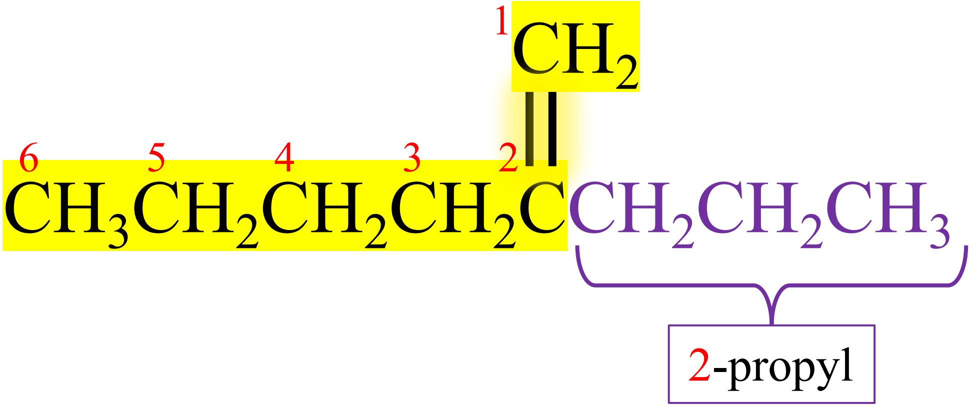
For more help with naming alkenes, see the chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

Go back

Click here to **check your answer**

Go to next question

4.51) What is the systematic name for the molecule shown below? **ANSWER: 2-propyl-1-hexene**




**EXPLANATION:**

For alk<u>enes</u>, the *parent chain is the longest, continuous chain of carbon atoms* ***that contains the double bond***.

- **Note that this is different from the method we used for finding the parent chain of *alk<u>anes</u>***; for alkanes, the *parent chain is simply the longest, continuous chain of carbon atoms*.

The parent chain is highlighted in yellow and numbered in the structure shown here.

For alkenes with ***more than three carbons***, the position of the double bond must be indicated by adding a ***position number*** to the parent chain name.

- In this problem, because the double bond is between carbons number **1** and **2**, the number "**2**" is used as a prefix to the parent chain name.

For more help with naming alkenes, see the chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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4.52) Which of the following classes of molecules can exist as geometric (cis/trans) isomers?
*Choose more than one answer if appropriate.*

a) alkanes

b) alkenes

c) alkynes

d) cycloalkanes

4.52) Which of the following classes of molecules can exist as geometric (cis/trans) isomers?
*Choose more than one answer if appropriate.*

a) alkanes

b) alkenes

c) alkynes

d) cycloalkanes

**HINT:**
When *stereoisomers* exist because of ***restricted bond rotation***, the stereoisomers are called ***geometric isomers***.

For more help with ***geometric isomers***, see chapter 4 part 14 video and the last part of chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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Click here to check **your answer**

Go to next question

4.52) Which of the following classes of molecules can exist as geometric (cis/trans) isomers?
*Choose more than one answer if appropriate.*

**EXPLANATION:**
When *stereoisomers* exist because of ***restricted bond rotation***, the stereoisomers are called ***geometric isomers***.

a) alkanes

b) **alkenes**

Because of the *lack of rotation around double bonded carbons*, some alkenes exist as geometric (cis/trans) isomers.

c) alkynes

d) **cycloalkanes**

Some cycloalkanes exist as geometric (cis/trans) isomers because hydrogens and/or substituents bonded to *ring-carbons* are *too large to rotate through the center of the ring structure*.

- When cycloalkanes have **two *substituents***, ***each on a different ring-carbon***, then there are two geometric isomers.

For more help with ***cycloalkane*** geometric isomers, see chapter 4 part 14 video, or chapter 4 section 9 in the textbook.
For more help with ***alkane*** geometric isomers, see the last part of chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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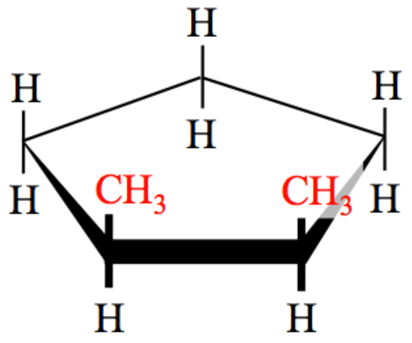
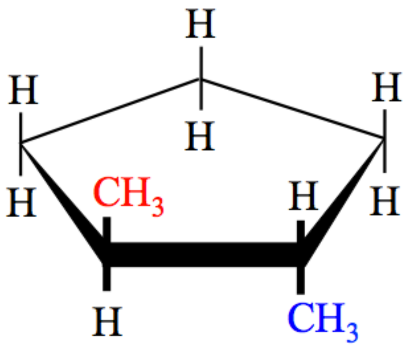
4.53) Label each of the following molecules as **either** a ***cis*** isomer or a ***trans*** isomers.

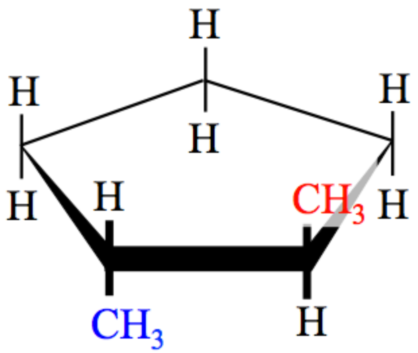
a)



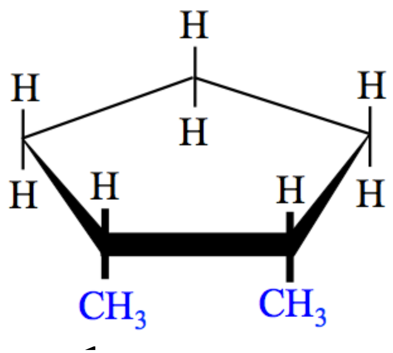

b)




c)




d)



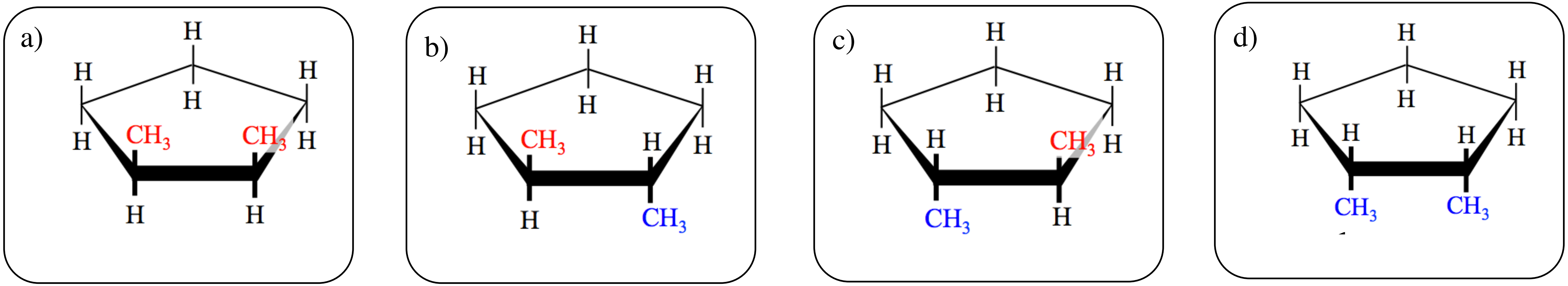

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.53) Label each of the following molecules as **either** a ***cis*** isomer or a ***trans*** isomers.




**EXPLANATION:**

When cycloalkanes have **two *substituents***, ***each on a different ring-carbon***, then there are geometric (cis/trans) isomers.

- For *cycloalkanes*, a ***cis*** geometric isomer has ***both substituents*** oriented in the **same** direction (either **both** *pointing **above*** the ring structure or **both** *pointing **below*** the ring structure).
- Conversely, a ***trans*** geometric isomer has the two ***substituents*** oriented in **opposite** directions (**one** *pointing **above*** the ring structure and the **other** *pointing **below*** the ring structure).

For more help with ***cycloalkane*** geometric isomers, see chapter 4 part 14 video, or chapter 4 section 9 in the textbook.

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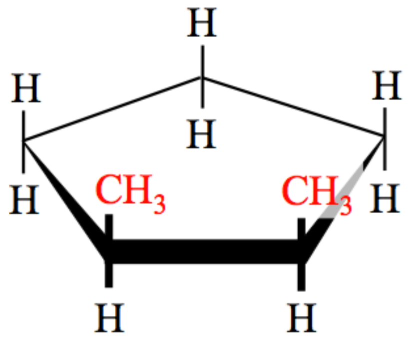
Click here to **check your answer**

Go to next question

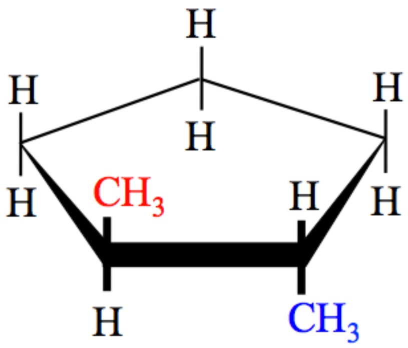
4.53) Label each of the following molecules as **either** a ***cis*** isomer or a ***trans*** isomers.

a)



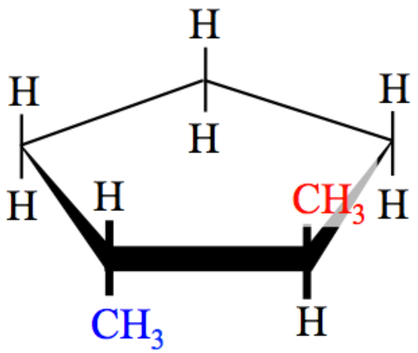

***cis***

b)



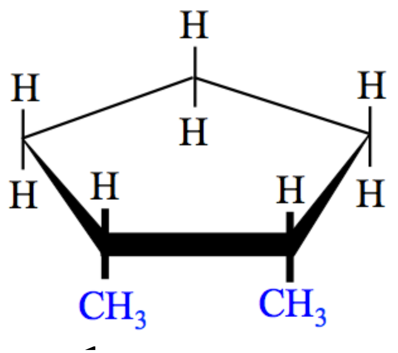

***trans***

c)




***trans***

d)




***cis***

**EXPLANATION:**

When cycloalkanes have **two *substituents***, ***each on a different ring-carbon***, then there are geometric (cis/trans) isomers.

- For *cycloalkanes*, a ***cis*** geometric isomer has ***both substituents*** oriented in the same direction (either **both** *pointing* ***above*** the ring structure or **both** *pointing* ***below*** the ring structure).
- Conversely, a ***trans*** geometric isomer has the two ***substituents*** oriented in opposite directions (**one** *pointing* ***above*** the ring structure and the **other** *pointing* ***below*** the ring structure).

For more help with ***cycloalkane*** geometric isomers, see chapter 4 part 14 video, or chapter 4 section 9 in the textbook.

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Go to next question

4.54) Which molecule(s) can exist as cis and trans isomers?
*Choose more than one answer if appropriate.*

a) 1,1-dimethylcyclopentane

b) methylcyclopentane

c) cyclopentane

d) 1,2-dimethylcyclopentane

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Click here for a **hint**

Click here to **check your answer**

Go to next question

4.54) Which molecule(s) can exist as cis and trans isomers?
*Choose more than one answer if appropriate.*

a) 1,1-dimethylcyclopentane

b) methylcyclopentane

c) cyclopentane

d) 1,2-dimethylcyclopentane

**HINT:**

When cycloalkanes have **two** ***substituents***, ***each on a different ring-carbon***, then there are geometric (cis/trans) isomers.

You may find it helpful to *draw the structures* of these molecules.

For more help with ***cycloalkane*** geometric isomers, see chapter 4 part 14 video, or chapter 4 section 9 in the textbook.

Go back

Click here to **check your answer**

Go to next question

4.54) Which molecule(s) can exist as cis and trans isomers?
*Choose more than one answer if appropriate.*

**EXPLANATION:**
When cycloalkanes have **two *substituents***, ***each on a different ring-carbon***, then there are geometric (cis/trans) isomers.

a) 1,1-dimethylcyclopentane

Although this cycloalkane has ***two substituents***, it **does not** exist as cis and trans isomers because ***its substituents are attached to the same carbon***.

b) methylcyclopentane

This cycloalkane cannot exist as cis and trans isomers because it has ***only one substituent***.

c) cyclopentane

This cycloalkane cannot exist as cis and trans isomers because it has **NO *substituents***.

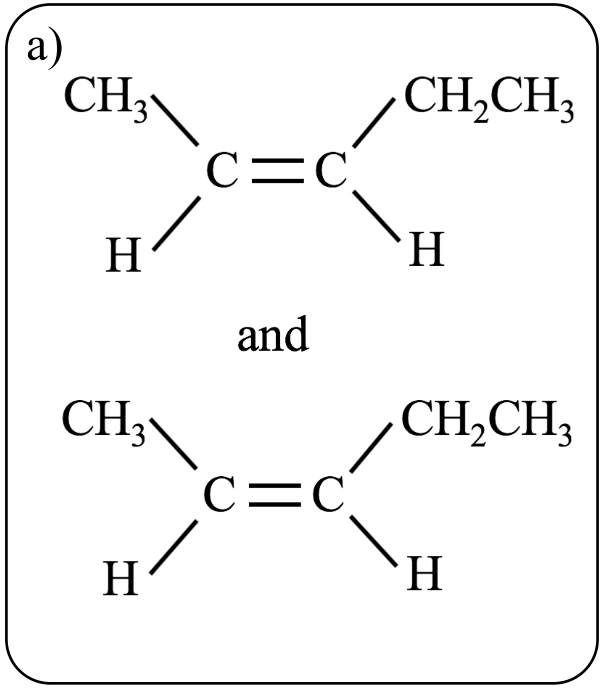
d) 1,2-dimethylcyclopentane

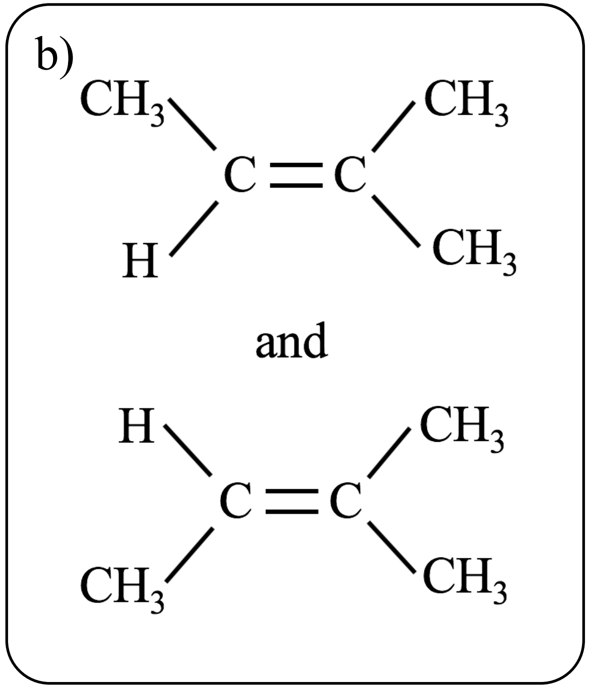
This cycloalkane can exist as cis and trans isomers because it has **two *substituents***, ***each on a different ring-carbon***.

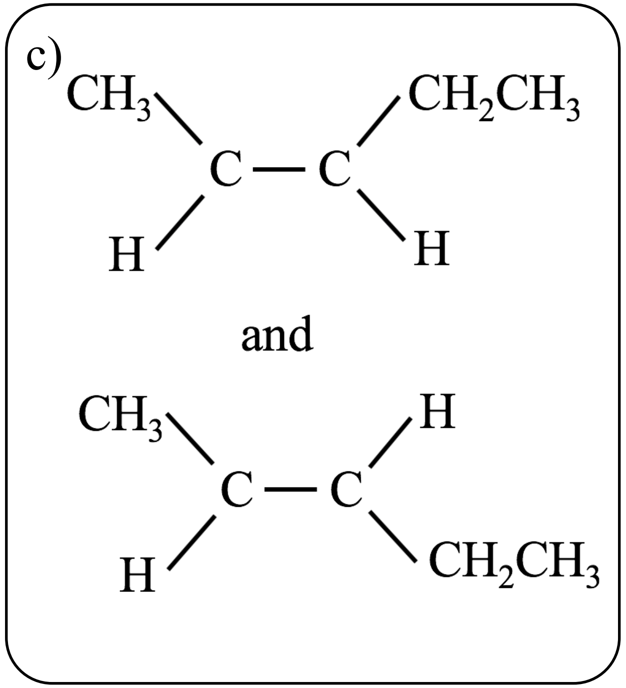
For more help with ***cycloalkane*** geometric isomers, see chapter 4 part 14 video, or chapter 4 section 9 in the textbook.

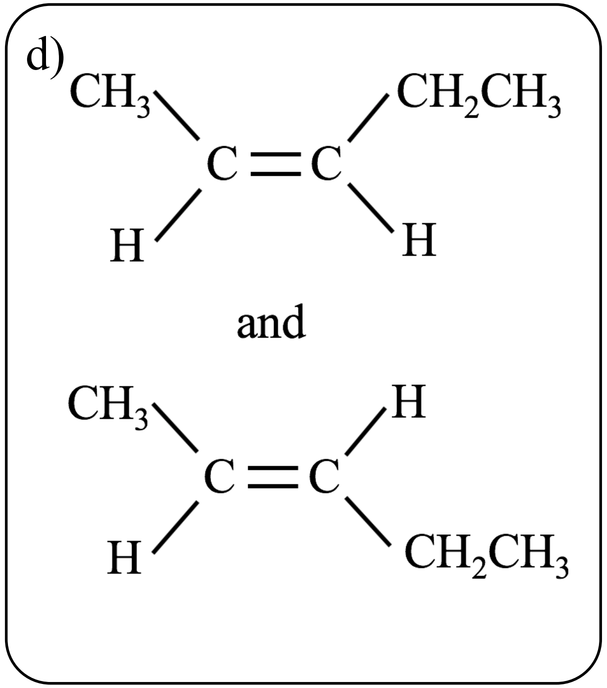
4.55) Which of the following choices are a ***cis*** and ***trans*** geometric isomer pair?

*Choose more than one answer if appropriate.*

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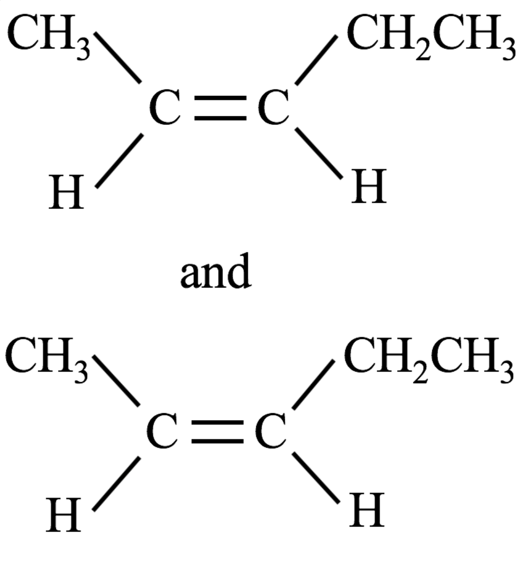
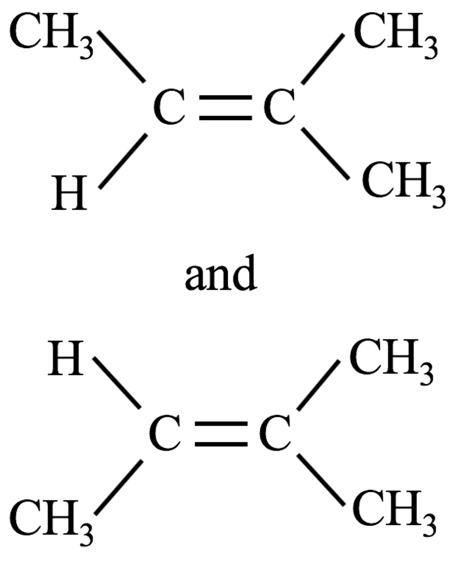
Click here for a **hint**

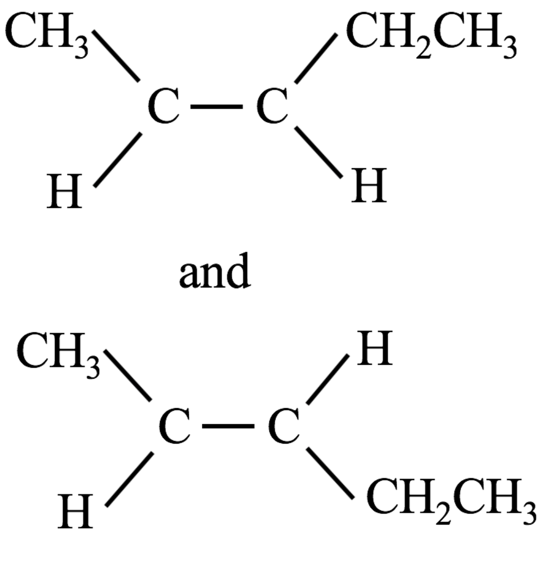
Click here to **check your answer**

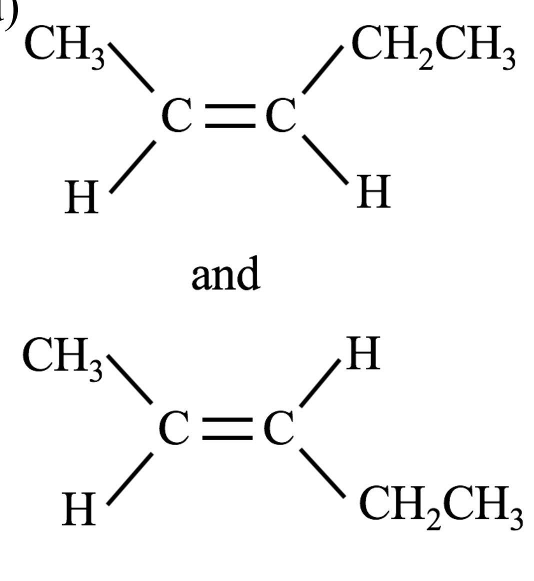
Go to next question

4.55) Which of the following choices are a ***cis*** and ***trans*** geometric isomer pair?
*Choose more than one answer if appropriate.*

a)


b)


c)


d)


We identify the ***cis*** and ***trans*** isomers by noting the positions of alkyl groups on each of the double-bonded carbons relative to an ***imaginary line*** *passing along the double bond*.

- When the alkyl groups are on ***different sides*** of the imaginary line, we have the ***trans*** geometric isomer.
- When ***both*** of the alkyl groups are on the ***same side*** of the imaginary line, we have the ***cis*** geometric isomer.

For more help with ***alkene geometric isomers***, see the last part of chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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Click here to **check your answer**

Go to next question

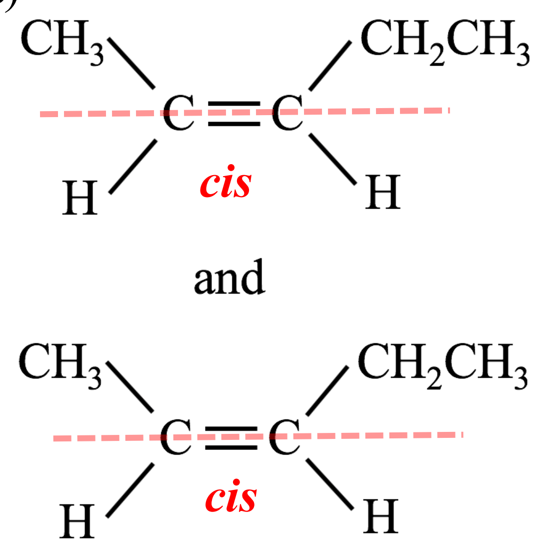
4.55) Which of the following choices are a ***cis*** and ***trans*** geometric isomer pair? **ANSWER: choice "d" only**

**EXPLANATION:**

When the alkyl groups are on ***different sides*** of the imaginary line (shown as dashed red line in the structures below), we have the ***trans*** geometric isomer.

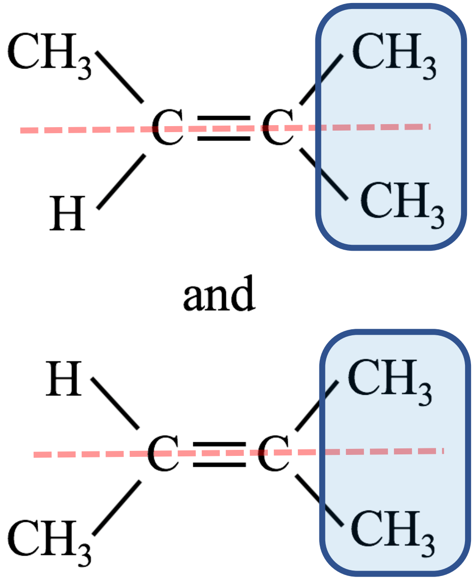
When ***both*** of the alkyl groups are on the ***same side*** of the imaginary line, we have the ***cis*** geometric isomer.

a)



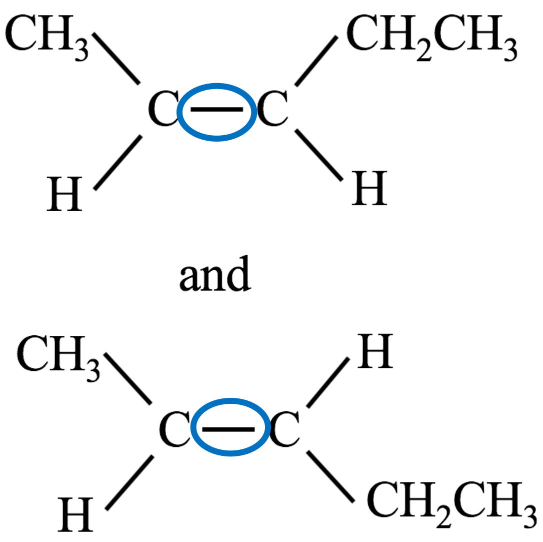

*These are identical molecules; **both** are **cis** isomers.*

b)



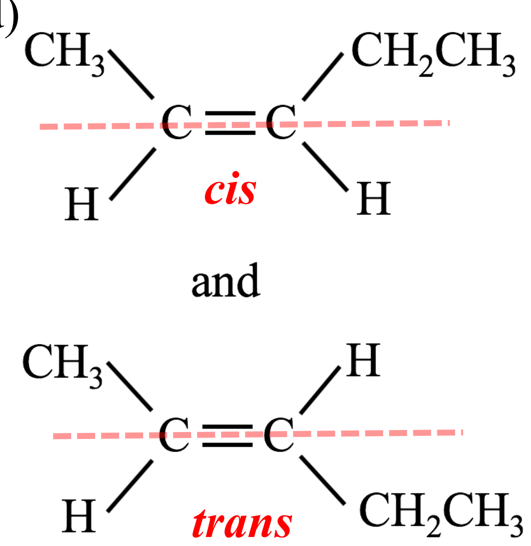

*These are identical; **switching** the methyl substituents on the right yields the same structure.*

c)




*Not geometric isomers, **rotation** around the **single bond** yields conformations, **not cis/trans isomers**.*

d)




*These are* a ***cis*** and ***trans*** geometric isomer pair.

For more help with ***alkene geometric isomers***, see the last part of chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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Go to next question

4.56) Draw the condensed and skeletal structures of the geometric (cis/trans) isomers of 3-heptene.

a) *trans*-3-heptene

**Condensed Structure**

**Skeletal Structure**

b) *cis*-3-heptene

**Condensed Structure**

**Skeletal Structure**

Go back

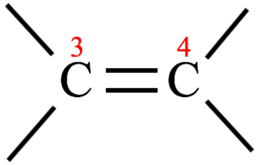
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.56) Draw the condensed and skeletal structures of the geometric (cis/trans) isomers of 3-heptene.

a) *trans*-3-heptene




**HINT:** Begin by drawing the bonds around the double bonded carbons, as shown on the left. Because this is **3**-heptene, the ***double bond*** is between carbon number **3** and **4**. The carbon position numbers are shown in red font here.

**Condensed Structure**

**Skeletal Structure**

b) *cis*-3-heptene

**Condensed Structure**

**Skeletal Structure**

For more help with ***alkene geometric isomers***, see the last part of [chapter 4 part 15 video](), or chapter 4 section 4.9 in the textbook.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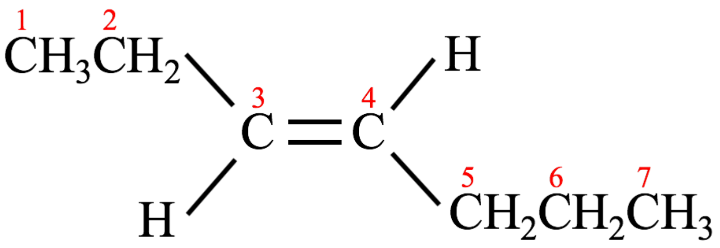
Click here to **check your answer**

Go to next question

4.56) Draw the condensed and skeletal structures of the geometric (cis/trans) isomers of 3-heptene.

a) *trans*-3-heptene

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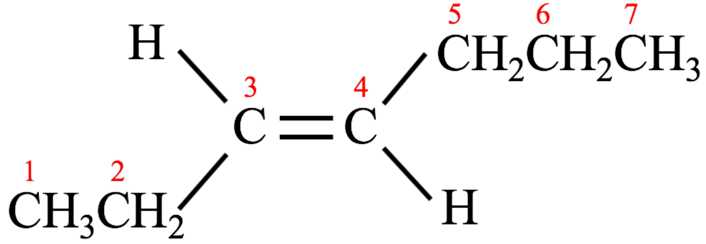
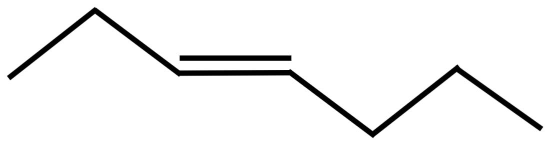



*You **do not** need to number the carbons. I did so here for clarification.*

**Condensed Structure**



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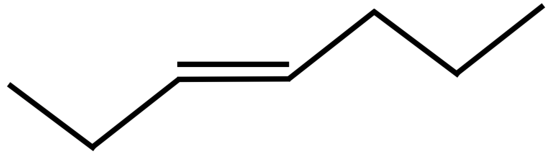
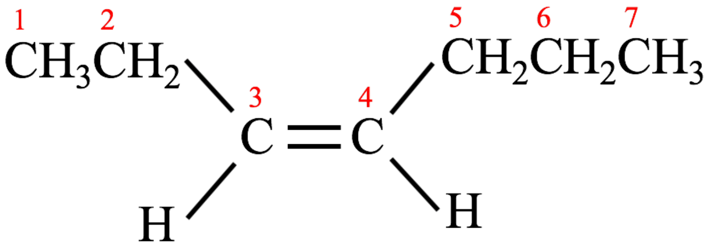


**Skeletal Structure**

b) *cis*-3-heptene

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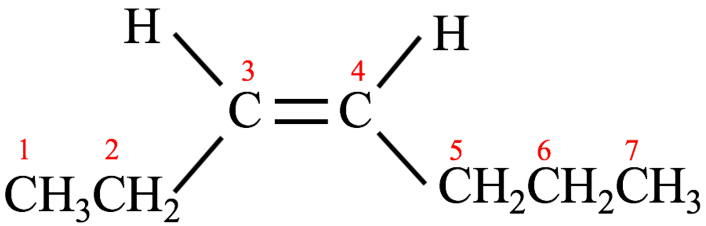
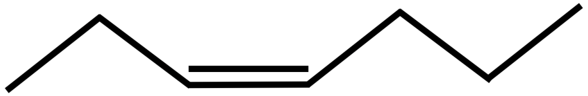



**Condensed Structure**



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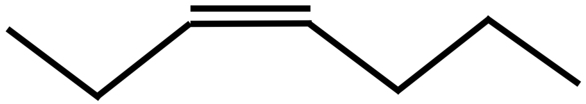

**Skeletal Structure**

For more help with ***alkene geometric isomers***, see the last part of chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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Go to next question

4.57) Draw the condensed and skeletal structures of the geometric (cis/trans) isomers of 2-octene.

a) *trans*-2-octene

**Condensed Structure**

**Skeletal Structure**

b) *cis*-2-octene

**Condensed Structure**

**Skeletal Structure**

Go back

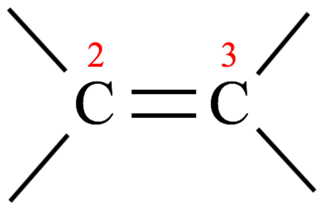
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.57) Draw the condensed and skeletal structures of the geometric (cis/trans) isomers of 2-octene.

a) *trans*-2-octene




**HINT:** Begin by drawing the bonds around the double bonded carbons, as shown on the left. Because this is **2**-octene, the ***double bond*** is between carbon number **2** and **3**. The carbon position numbers are shown in red font here.

**Condensed Structure**

**Skeletal Structure**

b) *cis*-2-octene

**Condensed Structure**

**Skeletal Structure**

For more help with ***alkene geometric isomers***, see the last part of chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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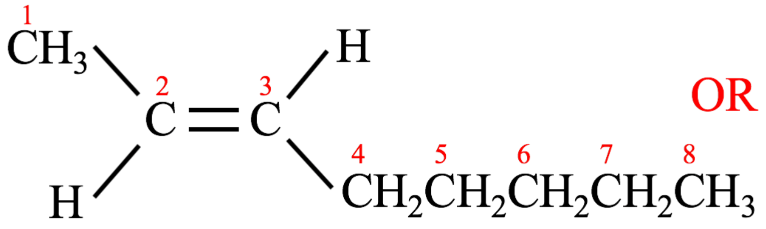
Click here to **check your answer**

Go to next question

4.57) Draw the condensed and skeletal structures of the geometric (cis/trans) isomers of 2-octene.

a) *trans*-2-octene

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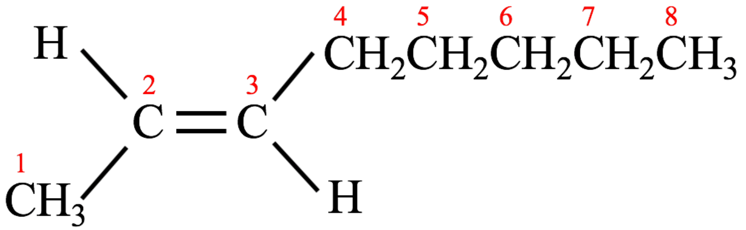
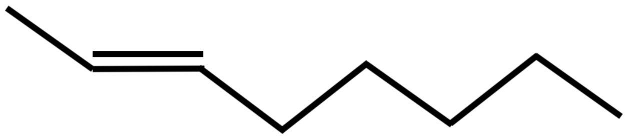



*You **do not** need to number the carbons. I did so here for clarification.*

**Condensed Structure**



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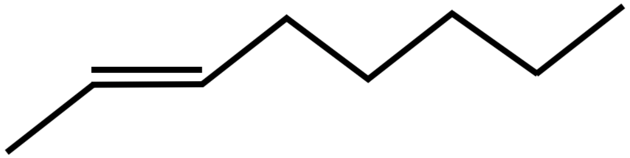
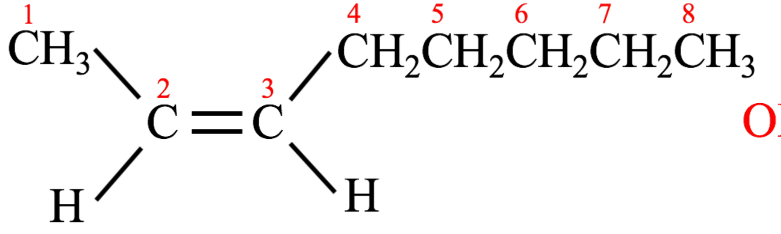
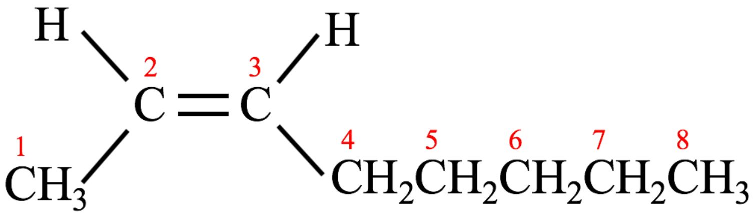


**Skeletal Structure**

b) *cis*-2-octene




OR




**Condensed Structure**

OR

**Skeletal Structure**

For more help with ***alkene geometric isomers***, see the last part of chapter 4 part 15 video, or chapter 4 section 9 in the textbook.

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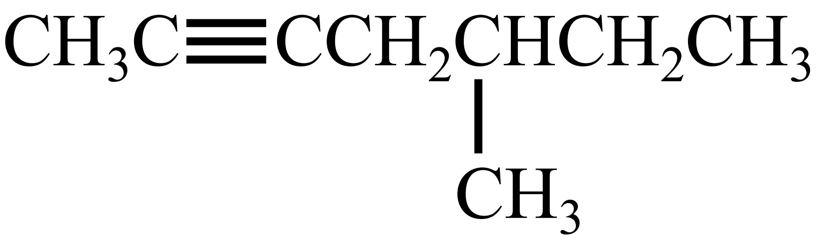
Go to next question

4.58) What is the IUPAC system name for the molecule shown below?




Go back

Click here for a **hint**

Click here to **check your answer**

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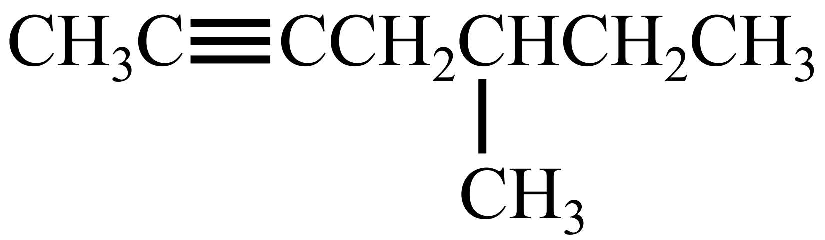
4.58) What is the IUPAC system name for the molecule shown below?




**HINTS:**

This molecule is an **alkyne**. For **alkynes**, the *parent chain is the longest, continuous chain of carbon atoms* ***that contains the triple bond***.

When numbering the parent chain of an **alkyne**, ***position number* 1** is assigned to the *carbon at the end of the parent chain* that is **closest to the triple bond.**

For alkynes with ***more than three carbons***, the position of the triple bond is indicated by adding a ***position number*** to the parent chain name.

- If the triple bond is between carbons number **1** and **2**, the number "**1**" is used as a *prefix* to the parent chain name.
- If the triple bond is between carbons number **2** and **3**, the number "**2**" is used as a *prefix* to the parent chain name.
- If the triple bond is between carbons number **3** and **4**, the number "**3**" is used as a *prefix* to the parent chain name...etc.

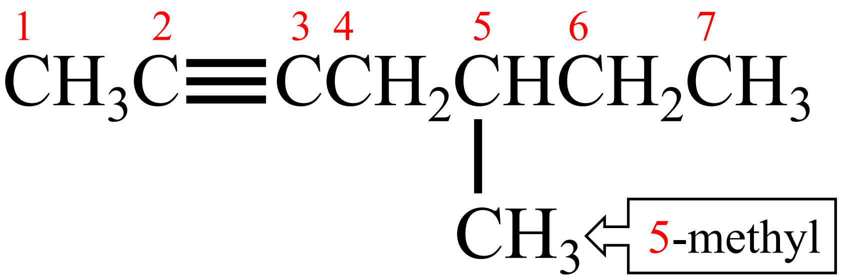
For more help with alkynes, see the chapter 4 part 16 video, or chapter 4 section 9 in the textbook.

Go back

Click here to **check your answer**

Go to next question

4.58) What is the IUPAC system name for the molecule shown below? **ANSWER: 5-methyl-2-heptyne**




**EXPLANATION:**

This molecule is an **alkyne**. **Alkynes** are hydrocarbon molecules that contain ***at least one carbon-carbon*** **triple bond**.

For **alkynes**, the *parent chain is the longest, continuous chain of carbon atoms* ***that contains the triple bond***.

Alkynes are named in the same way as you did for alkenes; the only difference is that we use the "**yne**" suffix instead of the "**ene**" suffix.

For alkynes with ***more than three carbons***, the position of the triple bond must be indicated by adding a ***position number*** to the parent chain name.

- In this problem, because the triple bond is between carbons number **2** and **3**, the number "**2**" is used as a prefix to the parent chain name.

For more help with alkynes, see the chapter 4 part 16 video, or chapter 4 section 9 in the textbook.

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Go to next question

4.59) Draw the **line bond**, **condensed**, and **skeletal structure** for 3-methyl-1-butyne.

?

Line Bond Structure

?

Condensed Structure

?

Skeletal Structure

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

4.59) Draw the **line bond**, **condensed**, and **skeletal structure** for 3-methyl-1-butyne.

?

**Line Bond Structure**

?

**Condensed Structure**

?

**Skeletal Structure**

**HINTS:**

This molecule is an **alkyne**. When numbering the parent chain of an **alkyne**, *position number* 1 is assigned to the *carbon at the end of the parent chain* that is **closest to the triple bond.**

For alkynes with ***more than three carbons***, the position of the triple bond is indicated by adding a ***position number*** to the parent chain name.

- If the triple bond is between carbons number **1** and **2**, the number "**1**" is used as a *prefix* to the parent chain name.
- If the triple bond is between carbons number **2** and **3**, the number "**2**" is used as a *prefix* to the parent chain name.
- If the triple bond is between carbons number **3** and **4**, the number "**3**" is used as a *prefix* to the parent chain name...etc.

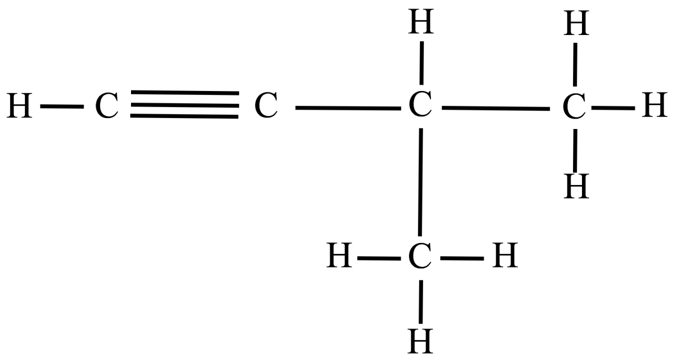
For more help with alkynes, see the chapter 4 part 16 video, or chapter 4 section 9 in the textbook.

Go back

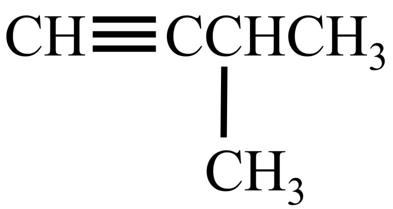
Click here to **check your answer**

Go to next question

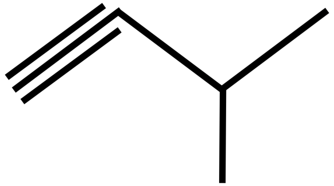
4.59) Draw the **line bond**, **condensed**, and **skeletal structure** for 3-methyl-1-butyne.



Line Bond Structure



Condensed Structure



Skeletal Structure

NOTE: If your answer has the **same atomic connectivity** but a different configuration, then it is correct.

**EXPLANATION:**

This molecule is an **alkyne**. **Alkynes** are hydrocarbon molecules that contain ***at least one carbon-carbon* triple *bond***.

For alkynes with ***more than three carbons***, the position of the triple bond must be indicated by adding a ***position number*** to the parent chain name.

- In this problem, because the triple bond is between carbons number **1** and **2**, the number "**1**" is used as a prefix to the parent chain name.

For more help with alkynes, see the chapter 4 part 16 video, or chapter 4 section 9 in the textbook.

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Go to next question

4.60) **Aromatic hydrocarbons** have alternating single and double bonds between ring-carbons. The smallest and simplest aromatic hydrocarbon that occurs is called *benzene*. Benzene is compose of a six-carbon ring. Draw the **line bond**, **condensed**, and **skeletal structure** for benzene.

| Line Bond Structure | Condensed Structure | Skeletal Structure |
|---|---|---|
| | | |

Go back

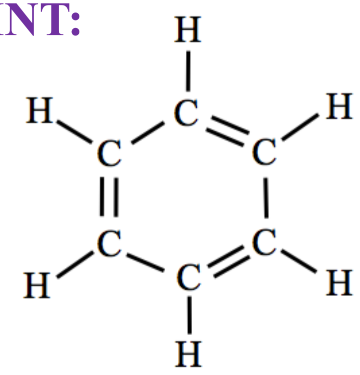
Click here for a **hint**

Click here to **check your answer**

Go to next question

4.60) **Aromatic hydrocarbons** have alternating single and double bonds between ring-carbons. The smallest and simplest aromatic hydrocarbon that occurs is called *benzene*. Benzene is compose of a six-carbon ring. Draw the **line bond**, **condensed**, and **skeletal structure** for benzene.

**HINT:**



Line Bond Structure

Condensed Structure

Skeletal Structure

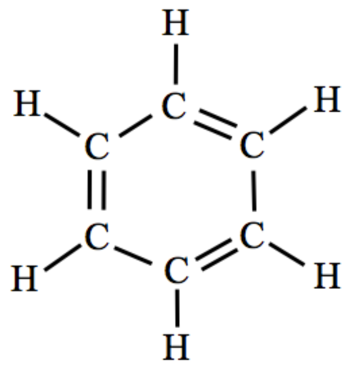
For more details about *aromatic hydrocarbons*, see the second half of the chapter 4 part 16 video, or chapter 4 section 9 in the textbook.

Go back

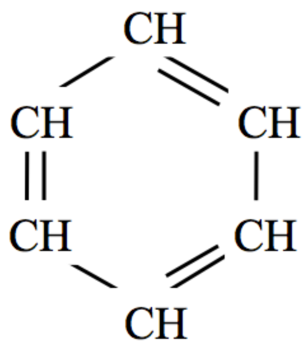
Click here to check **your answer**

Go to next question

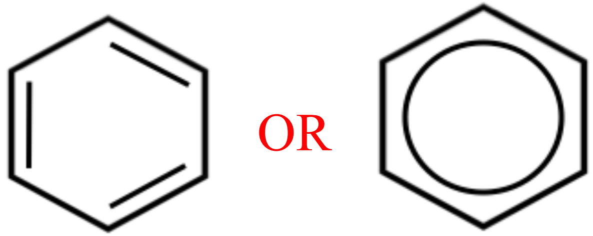
4.60) **Aromatic hydrocarbons** have alternating single and double bonds between ring-carbons. The smallest and simplest aromatic hydrocarbon that occurs is called *benzene*. Benzene is compose of a six-carbon ring. Draw the **line bond**, **condensed**, and **skeletal structure** for benzene.




Line Bond Structure




Condensed Structure




Skeletal Structure

For more details about *aromatic hydrocarbons*, see the second half of the chapter 4 part 16 video, or chapter 4 section 9 in the textbook.

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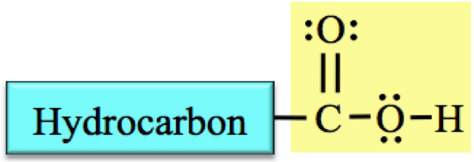
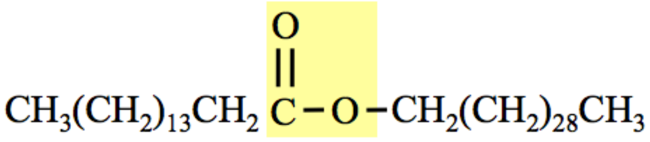
Go to next question

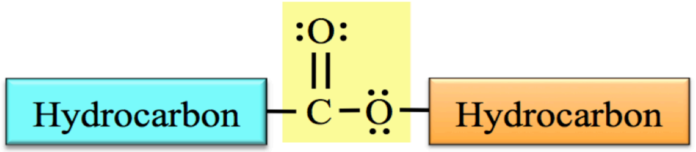
4.61) Classify each of the following structures as either an **alcohol**, **carboxylic acid**, or **ester**.

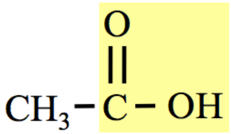
a) 


b) 


c) 


d) $CH_3CH_2-OH$

e) 


f) 

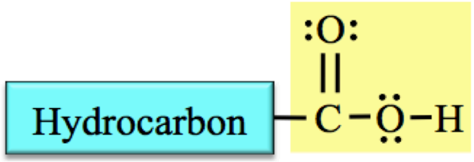

Go back

Click here for a **hint**

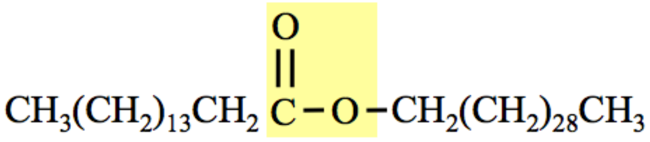
Click here to **check your answer**

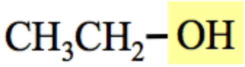
**This is the last problem.**

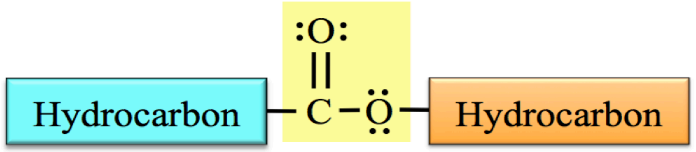
4.61) Classify each of the following structures as either an **alcohol**, **carboxylic acid**, or **ester**.

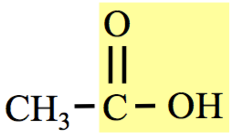
a) 


b) 

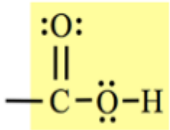
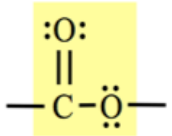

c) 


d) 


e) 


f) 


**HINT:** Organic molecules are categorized into ***organic families of compounds*** based on their **functional groups**.

| Organic Family | Functional Group | Description |
|---|---|---|
| Alcohol | -OH<br>hydroxyl group | One or more hydroxyl groups bonded to a hydrocarbon |
| Carboxylic Acid | <br>carboxyl group | Carboxyl group bonded to a hydrocarbon |
| Ester | <br>carboxylate group | Carboxylate group bonded ***between*** two hydrocarbons |

For more details about *organic families of compounds*, see the chapter 4 part 17 video, or chapter 4 section 10 in the textbook.

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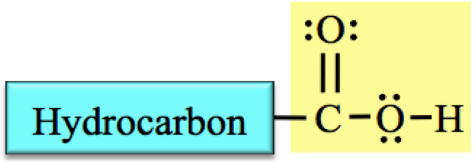
Click here to check your answer

**This is the last problem.**

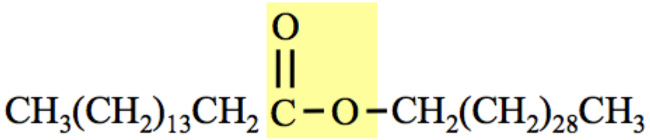
4.61) Classify each of the following structures as either an **alcohol**, **carboxylic acid**, or **ester**.

a) 


**carboxylic acid**, note the presence of a *carboxyl* functional group

b) 

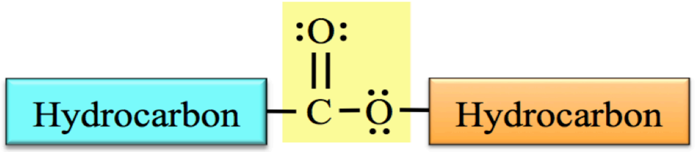

**alcohol**, note the presence of a *hydroxyl* (OH) functional group

c) 

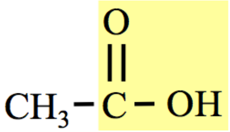

**ester**, note the presence of a *carboxylate* functional group

d) $CH_3CH_2-OH$

**alcohol**, note the presence of a *hydroxyl* (OH) functional group

e) 


**ester**, note the presence of a *carboxylate* functional group

f) 


**carboxylic acid**, note the presence of a *carboxyl* functional group

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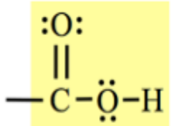
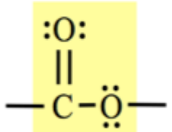
| Carboxylic Acid |  carboxyl group | Carboxyl group bonded to a hydrocarbon |
| Ester |  carboxylate group | Carboxylate group bonded ***between*** two hydrocarbons |

For more details about *organic families of compounds*, see the chapter 4 part 17 video, or chapter 4 section 10 in the textbook.

Go back

**This is the last chapter 4 review problem.**