Decode the Molecule

Read how hydrocarbon names reveal bonds and branches.

CHE.12.2 "Enrichment: Obtain information to communicate the system used for naming the basic linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline rules that turn a carbon pattern into a name, circle name endings and benzene, and number the steps for locating a branch or multiple bond.

What a Chemical Name Reveals

1. At a fuel-testing lab, a label must tell chemists which carbon atoms connect, not just how many atoms a sample contains. Hydrocarbons contain only carbon and hydrogen. An alkane has only single carbon-to-carbon bonds. For an unbranched alkane, the carbon count sets the stem: meth- means one, eth- two, prop- three, but- four, pent- five, hex- six, and hept- seven. Add -ane for an alkane. A branch changes the name: choose the longest continuous carbon chain, number it from the end nearest a branch, and name a one-carbon branch methyl. Thus a seven-carbon molecule can be 3-methylhexane rather than heptane.

2. Single bonds are not the whole story. A carbon-to-carbon double bond makes a hydrocarbon an alkene; a triple bond makes it an alkyne. Use -ene for a double bond and -yne for a triple bond. Choose the longest chain containing the multiple bond, then number from the end that gives that bond the lowest possible position. The number tells where the bond starts, as in hept-2-ene, whose double bond joins carbons 2 and 3. Hex-1-yne has a triple bond joining carbons 1 and 2. Each name communicates both chain length and bond placement, even when two samples share a molecular formula.

3. Some samples contain a benzene ring, a six-carbon ring with a special pattern of bonding. Benzene is not named as an ordinary six-carbon alkene: its bonding is shared around the ring. When one group replaces a hydrogen on benzene, name the group before benzene, as in ethylbenzene, which has a two-carbon ethyl group. If two identical groups attach, number the ring to give their positions the lowest possible numbers; 1,3-dimethylbenzene has methyl groups on ring carbons 1 and 3. A precise label lets another chemist distinguish it from a different arrangement of the same atoms.

2 ANSWER WITH EVIDENCE

Use the passage

1. Name both single-bond molecules, $CH_3CH_2CH_2CH_2CH_3$ and $CH_3CH(CH_3)CH_2CH_3$. What difference in their carbon connections explains the names?

2. Name $CH_3CH{=}CHCH_2CH_3$. How did you choose the number in its name?

3. Name $HC{\equiv}CCH_2CH_2CH_3$. Which part of its name shows the triple bond's position?

4. A benzene ring has methyl groups attached at ring positions 1 and 4. What name communicates both groups and their positions?

3 YOUR TURN

Your own words

Invent four molecules not used above: a branched alkane, an alkene, an alkyne, and a molecule with a benzene ring. For each, write a condensed structure or describe the ring group, give its name, and explain one clue that supports the name.

Decode the Molecule

PART 1 · READ AND MARK

Underline rules that turn a carbon pattern into a name, circle name endings and benzene, and number the steps for locating a branch or multiple bond. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Name both single-bond molecules, $CH_3CH_2CH_2CH_2CH_3$ and $CH_3CH(CH_3)CH_2CH_3$. What difference in their carbon connections explains the names?	**The first is pentane, an unbranched five-carbon chain. The second is 2-methylbutane, a four-carbon main chain with a methyl branch on carbon 2.**
2	Name $CH_3CH{=}CHCH_2CH_3$. How did you choose the number in its name?	**Pent-2-ene. Numbering from the nearer end places the double bond between carbons 2 and 3.**
3	Name $HC{\equiv}CCH_2CH_2CH_3$. Which part of its name shows the triple bond's position?	**Pent-1-yne. The 1 shows that the triple bond begins at carbon 1.**
4	A benzene ring has methyl groups attached at ring positions 1 and 4. What name communicates both groups and their positions?	**1,4-dimethylbenzene.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

$CH_3CH_2CH(CH_3)CH_2CH_3$ is 3-methylpentane; its five-carbon main chain has a methyl branch on carbon 3. $CH_2{=}CHCH_2CH_3$ is but-1-ene; its double bond begins at carbon 1. $CH_3CH_2C{\equiv}CCH_2CH_3$ is hex-3-yne; its triple bond begins at carbon 3. A benzene ring with one $CH_2CH_2CH_3$ group is propylbenzene; propyl names the three-carbon group attached to the ring.

Accept equivalent condensed structures and valid systematic names. For Your Turn, each structure or ring description must match its name and supporting clue.