Same Atoms, Different Shapes

Compare hydrocarbon models by counting atoms and tracing bonds.

CHE.4.5 "Use models of simple hydrocarbons to exemplify structural isomerism."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle the models with molecular formula C_5H_{12}, then write the same number beside models with the same carbon connections. This will help you tell different structures from a chain written in reverse.

What Changes When a Chain Branches?

1. A hydrocarbon contains only carbon and hydrogen. In a structural model, each carbon forms four bonds, and each hydrogen forms one. A condensed formula uses a hyphen to show a bond between neighboring carbons. Parentheses show a group attached to the carbon just before them. Two molecules are structural isomers when they have the same molecular formula but different connections between their atoms. Rotating a model or reading a chain from its other end does not make a new isomer.

2. A fuel lab records three possible models using condensed formulas. Model A is CH_3-CH_2-CH_2-CH_2-CH_3. Model B is CH_3-$CH(CH_3)$-CH_2-CH_3. Model C is CH_3-CH_2-$CH(CH_3)$-CH_3. In each model, CH_3 has three hydrogens, CH_2 has two, and CH has one. Count every carbon, including any inside parentheses. Then trace which carbons bond to each other, not just the order of the printed symbols. This matters when a chain is written from opposite ends.

3. The lab also records three smaller models. Model D is CH_3-CH_2-CH_2-CH_3. Model E is CH_3-$CH(CH_3)$-CH_3. Model F is CH_3-CH_2-CH_3. For each pair, the lab must check both the atom count and the carbon connections. Matching atom counts alone do not prove that two written models show different molecules. Different atom counts rule out structural isomerism, even if the models look similar at first glance. A careful comparison uses both checks.

2 ANSWER WITH EVIDENCE

Use the passage

1. Are Models A and B structural isomers? Use their atom counts and carbon connections to explain.

2. Do Models B and C show structural isomers or the same structure? Explain by tracing the branch.

3. Are Models D and E structural isomers? Support your answer with both required checks.

4. Could Models D and F be structural isomers? Show how their atom counts settle the question.

3 YOUR TURN

Your own words

Write two different condensed structural formulas for C_6H_{14}. In one sentence, explain why your models are structural isomers.

Same Atoms, Different Shapes

PART 1 · READ AND MARK

Circle the models with molecular formula C_5H_{12}, then write the same number beside models with the same carbon connections. This will help you tell different structures from a chain written in reverse. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Are Models A and B structural isomers? Use their atom counts and carbon connections to explain.	**Yes. Both are C_5H_{12}, but A has an unbranched carbon chain and B has a branch.**
2	Do Models B and C show structural isomers or the same structure? Explain by tracing the branch.	**They show the same structure. Reading B's main chain from the other end gives C; the branch is attached to the same carbon.**
3	Are Models D and E structural isomers? Support your answer with both required checks.	**Yes. Both are C_4H_{10}, but D is unbranched and E is branched.**
4	Could Models D and F be structural isomers? Show how their atom counts settle the question.	**No. D is C_4H_{10} and F is C_3H_8, so they do not have the same molecular formula.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

CH_3-CH_2-CH_2-CH_2-CH_2-CH_3
CH_3-$CH(CH_3)$-CH_2-CH_2-CH_3
Both models are C_6H_{14}, but the second has a carbon branch that the first does not.

For the marking job, A, B, and C should be circled; B and C must have the same number, while A has a different number. For Your Turn, accept any two valid C_6H_{14} structures with different atom connections.