Year 12 Science: Naming and drawing organic compounds

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Name $CH_3CH_2CH_2CH_2OH$.

2. Name $CH_3CH(CH_3)CH_2CH_2CH_3$.

3. Name $CH_3CH_2CH{=}CHCH_3$.

4. Name $CH_3CH_2CH_2COOH$.

5. Is $CH_3CBr(CH_3)CH_3$ primary, secondary or tertiary, and what is its name?

Exam-style question: three bottles of $C_4H_{10}O$

A technician finds three unlabelled bottles, each holding a compound with the formula $C_4H_{10}O$: butan-1-ol, butan-2-ol and 2-methylpropan-2-ol.

6. Draw the structural formula of butan-2-ol and classify it as primary, secondary or tertiary.

7. Name a constitutional isomer of butan-1-ol, also an alcohol, that is not in the bottles.

8. The technician also has but-1-ene and but-2-ene. Explain which of the two forms geometric isomers.

9. Butan-1-ol dissolves only partly in water, but ethanol mixes completely. Discuss why, using the structure of each molecule.

Fix the mistake

10. Correct this statement: "$CH_3CH_2CH_2CH(CH_3)CH_3$ is 4-methylpentane."

11. Correct this statement: "$CH_3CH_2CH(CH_2CH_3)CH_3$ is 2-ethylbutane."

12. Correct this statement: "But-1-ene has cis and trans isomers because it has a C=C double bond."

13. Correct this statement: "Butan-1-ol boils higher than butane because its O–H bond takes more energy to break."

Answer key (for parents and tutors)

1. Name $CH_3CH_2CH_2CH_2OH$.
   Butan-1-ol: the OH is on C1 of a four-carbon chain.
2. Name $CH_3CH(CH_3)CH_2CH_2CH_3$.
   2-Methylpentane: number from the left so the branch is on C2, not C4.
3. Name $CH_3CH_2CH{=}CHCH_3$.
   Pent-2-ene: number from the right so the double bond starts at C2, not C3; it has cis and trans isomers.
4. Name $CH_3CH_2CH_2COOH$.
   Butanoic acid: four carbons, counting the COOH carbon.
5. Is $CH_3CBr(CH_3)CH_3$ primary, secondary or tertiary, and what is its name?
   Tertiary, because the carbon holding the Br is bonded to three other carbons; its name is 2-bromo-2-methylpropane.
6. Draw the structural formula of butan-2-ol and classify it as primary, secondary or tertiary.
   $CH_3CH(OH)CH_2CH_3$ drawn with every C–H bond shown; it is secondary, because the carbon holding the OH is bonded to two other carbons (Achieved).
7. Name a constitutional isomer of butan-1-ol, also an alcohol, that is not in the bottles.
   2-Methylpropan-1-ol, $(CH_3)_2CHCH_2OH$: the same formula with a branched chain (Achieved).
8. The technician also has but-1-ene and but-2-ene. Explain which of the two forms geometric isomers.
   But-2-ene: the C=C cannot rotate, and each of its carbons holds two different groups (H and CH_3), so the CH_3 groups can sit on the same side (cis) or opposite sides (trans). But-1-ene has two H atoms on C1, so it has no geometric isomers (Merit for one requirement explained, Excellence for both requirements applied to both molecules).
9. Butan-1-ol dissolves only partly in water, but ethanol mixes completely. Discuss why, using the structure of each molecule.
   Both have a polar OH group that hydrogen bonds with water. Ethanol's non-polar part is only two carbons, so it mixes in any amount; in butan-1-ol the four-carbon non-polar chain is a bigger part of the molecule and is not attracted to water, so only some dissolves and the rest forms a layer (Achieved names chain length, Merit links it to the polar OH, Excellence compares both molecules).
10. Correct this statement: "$CH_3CH_2CH_2CH(CH_3)CH_3$ is 4-methylpentane."
    Number from the end nearer the branch: it is 2-methylpentane. Always check the other direction.
11. Correct this statement: "$CH_3CH_2CH(CH_2CH_3)CH_3$ is 2-ethylbutane."
    The longest chain runs through the ethyl group, giving five carbons: it is 3-methylpentane.
12. Correct this statement: "But-1-ene has cis and trans isomers because it has a C=C double bond."
    A double bond is not enough: each of its carbons needs two different groups, and C1 of but-1-ene has two H atoms.
13. Correct this statement: "Butan-1-ol boils higher than butane because its O–H bond takes more energy to break."
    Boiling never breaks covalent bonds; butan-1-ol boils higher because its molecules attract each other more strongly, through hydrogen bonds.