Unit 9 · Organic Compounds

HARDER PRACTICE QUESTIONS

Full marks 41

Write your answers on separate paper. Show your working. Use C = 12, H = 1, O = 16. Every structure here can be named by the rules in the unit.

1 Spot the error [4]

Amisha named four compounds. Each name is wrong. Say what went wrong and give the correct name.

a. $CH_3–CH(CH_3)–CH_2–CH_2–CH_3$, "4-methylpentane"

b. $CH_3–CH(CH_2CH_3)–CH_2–CH_3$, "2-ethylbutane"

c. $CH_3–CH_2–CHO$, "propan-3-al"

d. $CH_3–CH_2–CH_2–CHO$, "butan-1-one"

2 Hunt them all [4]

Lochan says $C_4H_{10}O$ can only be butanol. Write the condensed formula and IUPAC name of every compound with this formula that has an –OH group or an ether oxygen. How many are there? (Check your count by making sure no two have the same structure.)

3 Check the claim [4]

These are the boiling points of the first five alkanes:

Alkane	methane	ethane	propane	butane	pentane
Boiling point (°C)	−162	−89	−42	−0.5	36

Zeenat says: "**Every step adds the same CH_2, so every step must add the same to the boiling point. Methane to ethane is 73 °C, so hexane boils at 36 + 73 = 109 °C.**"

a. Work out the rise at each step. What do they show about her claim?

b. Make a better estimate for hexane, and say how you got it.

4 Which explanation fits the evidence? [3]

Two students explain why ethanol boils so much higher than propane.

Prashant: "Boiling point depends on the mass of the molecule, and on nothing else."

Srijana: "Ethanol's –OH groups hold its molecules together."

Compound	Molecular mass	Boiling point
propane	44	−42 °C
ethanol	46	78 °C
methoxymethane	46	−25 °C
methanol	32	65 °C
butane	58	−0.5 °C

Which explanation does the table support? Use two comparisons from it.

5 Work backwards [4]

Three bottles have lost their labels. Each compound has a molecular mass of 74.

X turns blue litmus red. Y has an unbranched chain and reacts with sodium to give hydrogen; its functional group is on carbon 2. Z has an oxygen atom between two identical alkyl groups, and boils at 35 °C.

Name X, Y and Z, and show how the mass gives each formula.

6 What if? [4]

The bond energies, in kJ/mol, are C–C 347, C=C 614 and C≡C 839.

a. How much does the second bond add? How much does the third add?
b. What would C=C's energy be if the second bond were as strong as the first?
c. What if that were true: would alkenes be as ready to react as they are? Give a reason.

7 Estimate [4]

A polythene chain runs to tens of thousands of carbon atoms. Take one with 20,000, and a C–C bond of 154 pm. (1 pm is a millionth of a millionth of a meter.)

a. Using C_2H_4 as the repeating unit, about what is its molecular mass?
b. Pretend the chain is pulled out in a straight line. About how long is it, in meters?
c. About how many such chains, end to end, would stretch across 1 mm?

8 Design a fair test [4]

Ishwori thinks that a liquid with a lower boiling point evaporates faster. She has propanone (boils at 56 °C), ethanol (78 °C) and water (100 °C). Plan a fair test. Say what you would change, what you would measure, what you would keep the same, and what result would support her idea. Add one safety rule.

9 Correct the misconceptions [3]

Each statement is wrong. Correct it, with a reason or an example.

a. "The plastic of a bucket can't be organic, because it was made in a factory."
b. "Ethanol has an –OH, so its solution must be alkaline like sodium hydroxide's."
c. "Methanol and ethanol are in the same family, so a small sip of methanol is as harmless as one of ethanol."

10 Predict, then explain [3]

Write your prediction first, then your reason.

a. A small piece of sodium is dropped into ethanol, and another into dry ethoxyethane. Which gives off hydrogen?
b. Baking soda is put into ethanoic acid, and more into propanal. Which fizzes?
c. A compound with the formula C_6H_{12} has no double bond at all. Is that possible?

11 Prove the formula [4]

Use only the fact that every carbon makes four bonds and every hydrogen one.

a. An alkane has n carbons in a chain, with or without branches. How many C–C bonds does it have? How many of the carbons' bonds do they use up?
b. Show that the number of hydrogens is $2n + 2$.
c. Show in the same way why an alkene has $2n$ hydrogens.