2023 Ch H2 Q9

Section: Nature’s Chemistry

Topic: Haloalkanes

Question Summary

(a) Boiling points of haloalkanes: identify two trends and intermolecular forces in bromoethane.
(b) Classification of 2-bromobutane and drawing tertiary isomer.
(c) Free radical substitution steps: initiation, propagation, termination.
(d) Reaction of haloalkanes to form alcohols and further oxidation; deduce structure of compound P.
(e) Apply IUPAC naming rules to complex haloalkane.

Worked Solution

According to the SQA Marking Instructions for 2023 H2 Q9:

(a)(i) Trend 1: For a given chain length, boiling point increases as halogen atom

increases in size (Cl < Br < I). This is due to stronger London dispersion forces with larger halogen atoms.
Trend 2: For a given halogen, boiling point increases with carbon chain length due to stronger London dispersion forces.

(a)(ii) The strongest intermolecular forces broken when bromoethane boils are London dispersion forces.

(b)(i) In 2-bromobutane, the carbon bonded to Br is attached to two other carbons, so it is a secondary haloalkane.

(b)(ii) A tertiary isomer is 2-bromo-2-methylpropane (structural formula: $C(CH_3)_3Br$).

(c)(i) Initiation requires UV light to split Br_2 into free radicals.

(c)(ii) Possible termination step: $\bullet CH_3 + \bullet CH_3 \rightarrow C_2H_6$.

(d) Compound R does not react with Tollens'/Fehling's → it is a ketone. Thus compound Q is a secondary alcohol, and P

must be a secondary haloalkane. Correct structure: 2-bromobutane.

(e) Following naming rules, the molecule shown is 2-bromo-1-chloro-1,1,2-trifluoropropane.

Final Answer

(a)(i) Boiling point ↑ with larger halogen; ↑ with longer chain.

(a)(ii) London dispersion forces.

(b)(i) Secondary haloalkane.

(b)(ii) 2-bromo-2-methylpropane.

(c)(i) UV light.

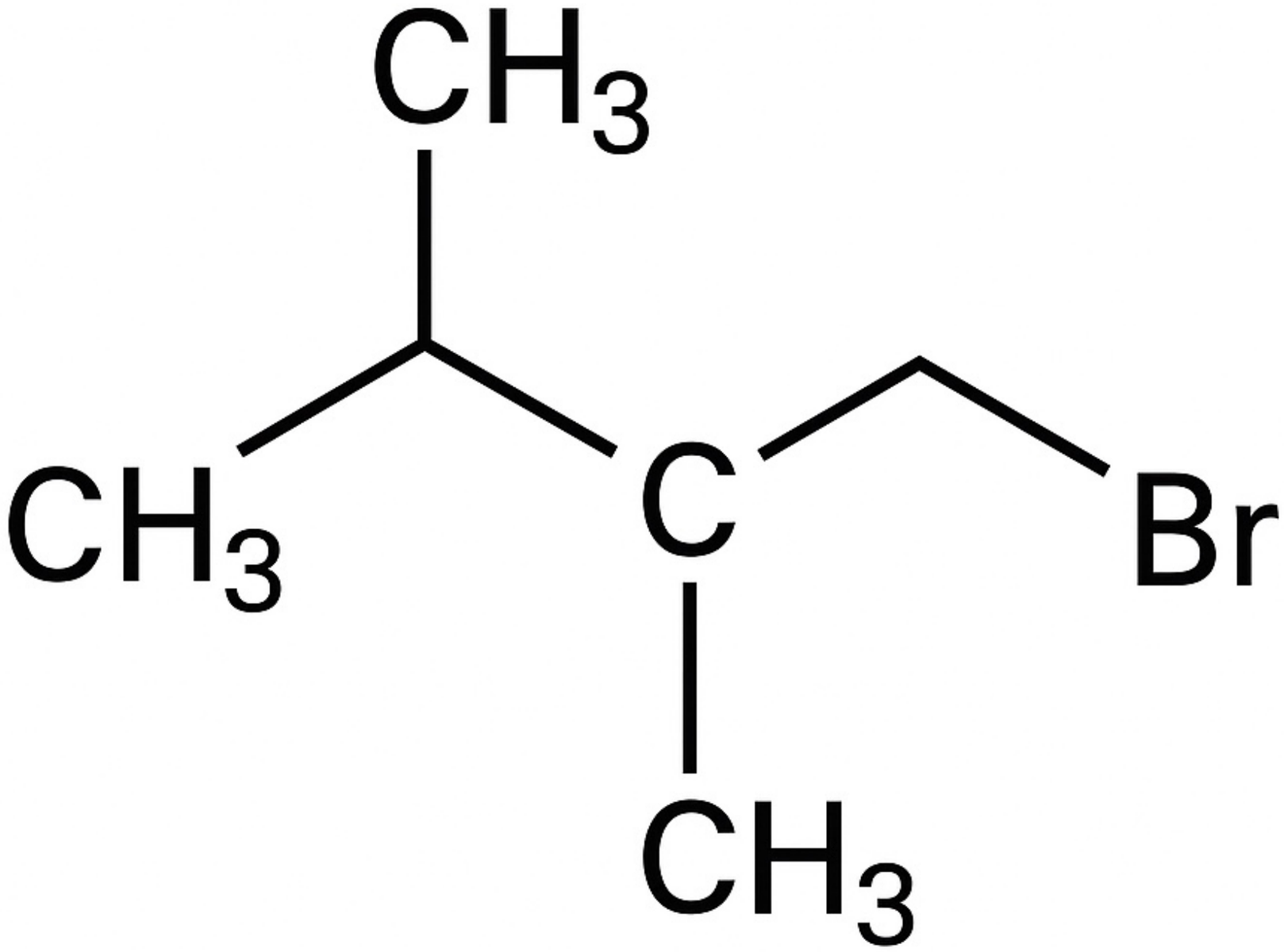
(c)(ii) $\bullet CH_3 + \bullet CH_3 \rightarrow C_2H_6$.

(d) Compound P = 2-bromobutane.

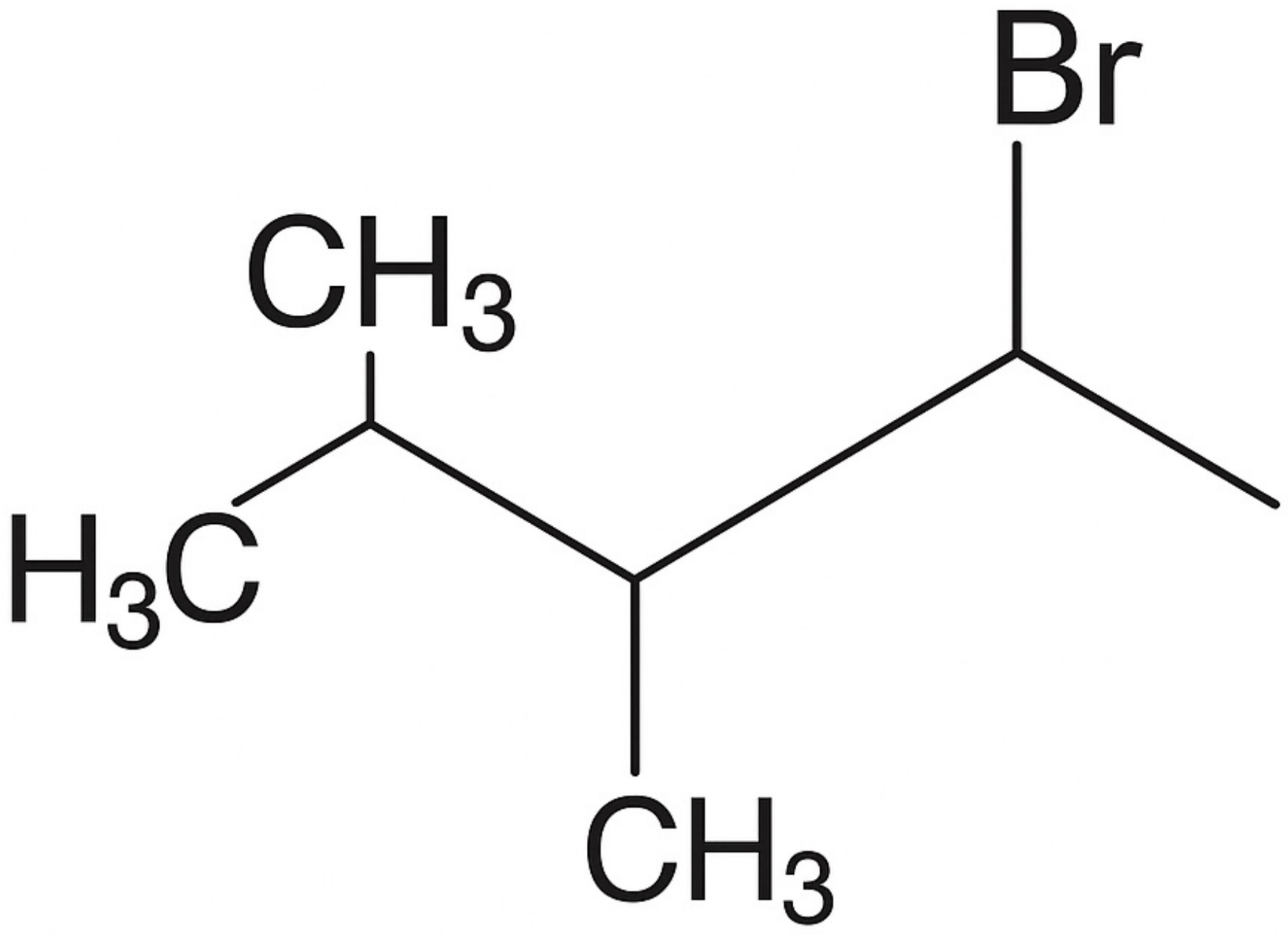
(e) 2-bromo-1-chloro-1,1,2-trifluoropropane.

Revision Tips

• Boiling point ↑ with molar mass and chain length (stronger LDF).
• Primary, secondary, tertiary halogenoalkanes differ by number of C atoms bonded to the C–X carbon.
• Free radical substitution: initiation (UV), propagation, termination.
• Aldehydes react with Tollens’/Fehling’s; ketones do not.
• Use IUPAC rules: longest chain, halogen prefixes in alphabetical order, lowest numbers.



tertiary haloalkane



compound P
(2-bromobutane)