

- 1 Ethane reacts with chlorine by radical substitution to form chloroethane.

Which radical(s) is/are present in the mechanism?

- 1 $\text{H}\cdot$
 - 2 $\text{Cl}\cdot$
 - 3 $\text{C}_2\text{H}_5\cdot$
- A** 1, 2 and 3
- B** Only 1 and 2
- C** Only 2 and 3
- D** Only 1

Your answer

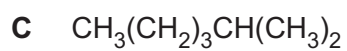
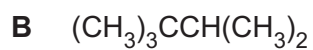
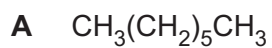
[1]

2(a)

Write an equation for the incomplete combustion of heptane.

..... **[1]**

3 Which alkane has the highest boiling point?

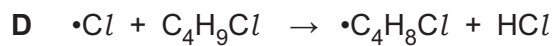
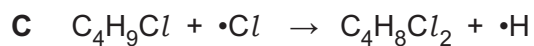
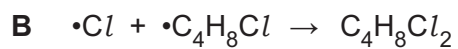
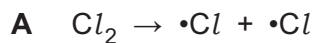


Your answer

[1]

- 4 Butane reacts with chlorine in the presence of ultraviolet radiation to form a mixture of organic products.

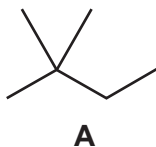
Which equation shows a propagation step in the mechanism for this reaction?



Your answer

[1]

- 5 The structure of hydrocarbon **A** is shown below.



- (a) Complete the table to show the mechanism for the reaction of hydrocarbon **A** with Br₂ to form (CH₃)₃CCHBrCH₃.

Use skeletal formulae for all organic compounds.

Use 'dots' (•) to show the position of unpaired electrons.

Initiation

.....

Propagation



+ → + ...

..... + ... → + ...

[3]

- (b) State **two** limitations of using radical substitution in organic synthesis.

1

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2

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[2]

- 6 2-Methylbutane is reacted with chlorine by radical substitution.

What is the number of structural isomers with the molecular formula $\text{C}_5\text{H}_{11}\text{Cl}$ that could be formed?

A 2

B 3

C 4

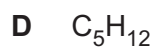
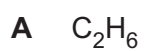
D 5

Your answer

[1]

- 7 Complete combustion of 0.050 mol of an alkane produces 5.40 g of H_2O .

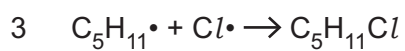
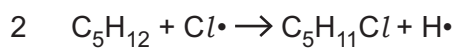
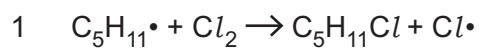
What is the molecular formula of the alkane?



Your answer

[1]

8 Which equation(s) could be part of the propagation step in the radical substitution of C_5H_{12} to form $C_5H_{11}Cl$?



A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer

[1]

- 9 For complete combustion, 0.100 mol of an alkane requires 22.8 dm³ of O₂, measured at RTP.

Which alkane has undergone complete combustion?

- A** pentane
- B** hexane
- C** heptane
- D** octane

Your answer

[1]

10 This question is about hydrocarbons.

(a) The boiling points of some hydrocarbons containing 6 carbon atoms are shown below.

Hydrocarbon	Boiling point/°C
2,2-dimethylbutane	50
2-methylpentane	60
hexane	69

State and explain the trend in boiling points shown by these hydrocarbons.

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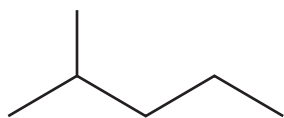
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..... [4]

- (b) 2-methylpentane reacts with bromine by radical substitution.



2-methylpentane

A mixture of organic products is formed, including 3-bromo-2-methylpentane, and compounds **A** and **B**.

- (i) Complete the table below to show the mechanism for the formation of 3-bromo-2-methylpentane and **three** possible equations for termination.

In your equations, use **structural** or **skeletal formulae** and 'dots' (•) for the position of radicals.

Initiation	Equation: Conditions:
Propagation	→ →
Termination	→ → →

[6]

- (ii) Organic compound **A** is formed by the substitution of **all** 14 H atoms in 2-methylpentane by Br atoms.

Write the equation, using **molecular formulae**, for the formation of compound **A** from 2-methylpentane.

..... [2]

- (iii) Organic compound **B** is formed by the substitution of **some** of the 14 H atoms in 2-methylpentane by Br atoms.

0.8649 g of compound **B** is heated until it is vaporised.

Under the conditions used:

- compound **B** has a volume of 72.0 cm^3
- the molar gas volume is $40.0 \text{ dm}^3 \text{ mol}^{-1}$.

Determine a possible molecular formula of compound **B**.

molecular formula = ... [3]

- 11(a) Haloalkanes can be synthesised by reacting alkanes with halogens in the presence of ultraviolet radiation.

An alkane reacts with bromine to form 2-bromo-2-methylpropane.

- (i) Write the equation for this reaction, showing the structures of the organic compounds.

Name the reaction mechanism and the type of bond fission that occurs.

Equation

Name of reaction mechanism

Type of bond fission

[3]

- (ii) Describe **two** limitations of the synthesis of 2-bromo-2-methylpropane from an alkane and bromine.

1

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2

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[2]

12(a) Hexane, C_6H_{14} , is used as a fuel.

1.0 mol of hexane is mixed with 6.0 mol of oxygen and combusted.

Construct an equation for the **incomplete** combustion of 1.0 mol of hexane with 6.0 mol of oxygen.

..... [1]