Q1.

Heptane, C_7H_{16}, is one of the compounds present in crude oil.

(a) When heptane is reformed, the products include 2,2,3-trimethylbutane and cycloheptane.

(i) Give a reason why petrol should **not** contain a high proportion of heptane.

(1)

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(ii) Draw the **skeletal** formula of 2,2,3-trimethylbutane.

(1)

(iii) Write the equation for reforming heptane into cycloheptane.

Use **molecular** formulae.

State symbols are not required.

(1)

(iv) When petrol is burned in a car engine, oxides of nitrogen are formed.

Explain how these compounds result in damage to trees.

(2)

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(b) Heptane reacts with chlorine in sunlight.

(i) Chlorine radicals are formed in the first step in the mechanism.

$$Cl_2 \rightarrow 2Cl\bullet$$

Name this step in the mechanism.

(1)

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(ii) Give the **two** propagation steps for the formation of chloroheptane.

Use molecular formulae. Curly arrows are **not** required.

(2)

(iii) Give the termination step which forms a hydrocarbon.

(1)

(iv) Explain how some dichloroheptane, $C_7H_{14}Cl_2$, also forms during this reaction.

You may include equation(s) in your answer.

(2)

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(Total for question = 11 marks)

Q2.

An electrophile

☒ **A** accepts a pair of electrons

☒ **B** always has a negative charge

☒ **C** always has a positive charge

☒ **D** donates a pair of electrons

(Total for question = 1 mark)

Q3.

Members of the homologous series of alkanes have the same

☒ **A** boiling temperature

☒ **B** density

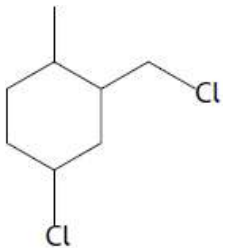
☒ **C** empirical formula

☒ **D** general formula

(Total for question = 1 mark)

Q4.

What is the empirical formula of the following molecule?



(1)

☒ **A** C_4H_4Cl

☒ **B** C_4H_7Cl

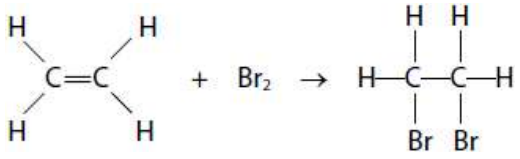
☒ **C** $C_8H_{11}Cl_2$

☒ **D** $C_8H_{14}Cl_2$

(Total for question = 1 mark)

Q5.

Ethene reacts with bromine to form 1,2-dibromoethane.



For the ethene molecule, what is the type of bond broken and the type of bond fission occurring in this reaction?

	Bond broken	Bond fission
☐ **A**	π	heterolytic
☐ **B**	π	homolytic
☐ **C**	σ	heterolytic
☐ **D**	σ	homolytic

(Total for question = 1 mark)

Q6.

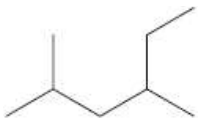
The alkanes are a homologous series of saturated hydrocarbons.

(a) Draw the displayed formulae of the three alkanes with molecular formula C_5H_{12}.

(3)

(b) Give the systematic name of compound **P**.

(1)



Compound **P**

Systematic name

.....

(c) The table shows the boiling temperatures of the first four straight-chain alkanes.

Molecular formula of alkane	Boiling temperature / °C
CH_4	−164
C_2H_6	−89
C_3H_8	−42
C_4H_{10}	−0.5

Predict the molecular formula and boiling temperature of the straight-chain alkane that has five carbon atoms in its molecules.

(2)

Molecular formula .....

Boiling temperature .....

(d) Alkanes undergo incomplete combustion when they burn in a limited supply of air.

(i) Write the equation for the incomplete combustion of propane, C_3H_8, to form carbon, carbon monoxide, carbon dioxide and water.

State symbols are not required.

(1)

(ii) Explain the toxicity of carbon monoxide.

(2)

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(e) Propane reacts with chlorine in the presence of ultraviolet radiation. The reaction starts when some chlorine molecules are split into free radicals. A mixture of products is formed.

(i) Write the two propagating steps to show how C_3H_7Cl is formed.

Curly arrows are not required.

(2)

(ii) Identify the different C_3H_7Cl molecules that are produced in this reaction.

(1)

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(iii) Give a reason why a mixture of C_3H_7Cl molecules is formed.

(1)

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(iv) Give a reason why some hexane is formed in this reaction.

(1)

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(v) A small amount of a product with molar mass 113 g mol^{-1} is formed.

Deduce the structure and name of a possible product with this molar mass.

(2)

Structure

.....

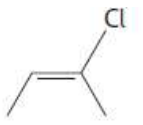
Name

.....

(Total for question = 16 marks)

Q7.

What is the systematic name of compound **X**?



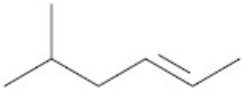
Compound **X**

- ☐ **A** *E*-2-chlorobut-2-ene
- ☐ **B** *Z*-2-chlorobut-2-ene
- ☐ **C** *E*-3-chlorobut-2-ene
- ☐ **D** *Z*-3-chlorobut-2-ene

(Total for question = 1 mark)

Q8.

What is the systematic name for this compound?



(1)

- ☒ **A** *E*-5-methylhex-2-ene
- ☒ **B** *Z*-5-methylhex-2-ene
- ☒ **C** *E*-2-methylpent-4-ene
- ☒ **D** *Z*-2-methylpent-4-ene

(Total for question = 1 mark)