

**Q1.(a)** The hydrocarbon but-1-ene ( $C_4H_8$ ) is a member of the homologous series of alkenes. But-1-ene has structural isomers.

(i) State the meaning of the term *structural isomers*.

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(2)

(ii) Give the IUPAC name of the **position** isomer of but-1-ene.

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(1)

(iii) Give the IUPAC name of the **chain** isomer of but-1-ene.

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(1)

(iv) Draw the displayed formula of a **functional group** isomer of but-1-ene.

(1)

(b) But-1-ene burns in a limited supply of air to produce a solid and water only.

(i) Write an equation for this reaction.

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(1)

(ii) State **one** hazard associated with the solid product in part (b)(i).

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(1)

(c) One mole of compound **Y** is cracked to produce two moles of ethene, one mole of but-1-ene and one mole of octane ( $C_8H_{18}$ ) only.

(i) Deduce the molecular formula of **Y**.

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(1)

(ii) Other than cracking, give **one** common use of **Y**.

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(1)

(d) In cars fitted with catalytic converters, unburned octane reacts with nitrogen monoxide to form carbon dioxide, water and nitrogen only.

(i) Write an equation for this reaction.

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(1)

(ii) Identify a catalyst used in a catalytic converter.

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(1)

(Total 11 marks)

**Q2.** Pent-1-ene is a member of the alkene homologous series.

(a) Pent-1-ene can be separated from other alkenes.

State the physical property of alkenes that allows them to be separated from a mixture by fractional distillation.

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(1)

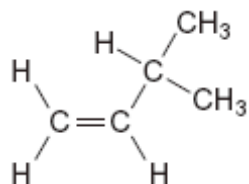
(b) (i) State the meaning of the term *structural isomerism*.

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(2)

(ii) Name the branched chain isomer of pent-1-ene shown below.



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(1)

(iii) Draw the structure of a functional group isomer of pent-1-ene.

(1)

(c) The cracking of one molecule of compound **X** produces pent-1-ene, ethene and butane in a 1:2:1 mol ratio.  
Deduce the molecular formula of **X** and state a use for the ethene formed.

Molecular formula of **X** .....

.....

Use of ethene .....

(2)

(Total 7 marks)

**Q3.** Hexane ( $C_6H_{14}$ ) is a member of the homologous series of alkanes.

- (a) (i) Name the raw material from which hexane is obtained.

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(1)

- (ii) Name the process used to obtain hexane from this raw material.

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(1)

- (b)  $C_6H_{14}$  has structural isomers.

- (i) Deduce the number of structural isomers with molecular formula  $C_6H_{14}$ .

Write the number in this box.

*(Space for working)*

(1)

- (ii) State **one** type of structural isomerism shown by the isomers of  $C_6H_{14}$ .

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(1)

- (c) One molecule of an alkane **X** can be cracked to form one molecule of hexane and two molecules of propene.

- (i) Deduce the molecular formula of **X**.

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(1)

- (ii) State the type of cracking that produces a high percentage of alkenes. State the conditions needed for this type of cracking.

Type of cracking .....

Conditions .....

.....

(2)

- (iii) Explain the main economic reason why alkanes are cracked.

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(1)

- (d) Hexane can react with chlorine under certain conditions as shown in the following equation.



- (i) Both the products are hazardous. The organic product would be labelled 'flammable'. Suggest the most suitable hazard warning for the other product.

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(1)

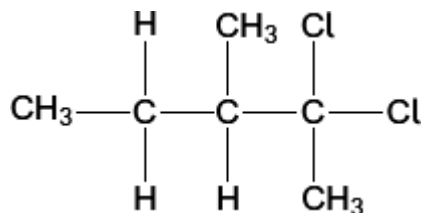
- (ii) Calculate the percentage atom economy for the formation of  $\text{C}_6\text{H}_{13}\text{Cl}$  ( $M_r = 120.5$ ) in this reaction.

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(1)

- (e) A different chlorinated compound is shown below. Name this compound and state its empirical formula.



Name .....

Empirical formula .....

(2)  
(Total 12 marks)

**Q4.** Pentane is a member of the alkane homologous series.

(a) Give the general formula for the homologous series of alkanes.

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(1)

(b) One of the structural isomers of pentane is 2,2-dimethylpropane.

Draw the displayed formula of 2,2-dimethylpropane.

State the type of structural isomerism shown.

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(2)

(c) A molecule of hydrocarbon **Y** can be thermally cracked to form one molecule of pentane and two molecules of ethene only.

Deduce the molecular formula of **Y**.

State why high temperatures are necessary for cracking reactions to occur.  
Give **one** reason why thermal cracking reactions are carried out in industry.

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(Extra space) .....

(3)

(d) Write an equation for the incomplete combustion of pentane to form a solid pollutant.

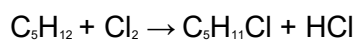
Suggest why this solid pollutant is an environmental problem.

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(Extra space) .....

(2)

(e) Pentane can react with chlorine as shown in the following equation.



Calculate the percentage atom economy for the formation of  $C_5H_{11}Cl$

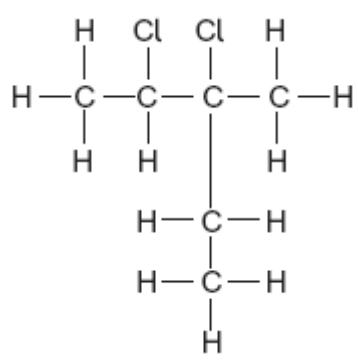
Deduce how many straight-chain isomers of  $C_5H_{11}Cl$  could be formed.

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 (Extra space).....  
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(3)

(f) Consider the following compound.



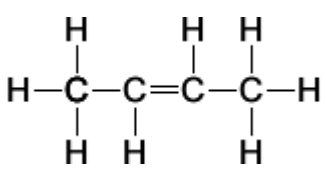
Name this compound.

Deduce the empirical formula of this compound.

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(2)  
 (Total 13 marks)

Q5. Compound X is shown below. It is a member of a homologous series of hydrocarbons.







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(2)

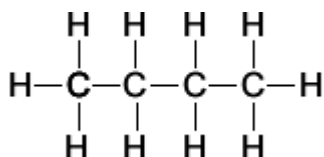
(iii) State why high temperatures are needed for this process.

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(1)

(d) Compound **X** can be converted into compound **Y**.  
Compound **Y** is shown below.



(i) Suggest the formula of a reagent that could be added to **X** in order to convert it into **Y**.

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(1)

(ii) Give **one** use of **Y**.

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(1)

(iii) Write an equation to show the reaction of **Y** in a limited supply of air to produce a solid and water only.

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(1)

(iv) When a sample of **Y**, contaminated with  $\text{CH}_3\text{SH}$ , is burned completely in air, a toxic gas is formed.

Identify this toxic gas and suggest a compound that could be used to remove the toxic gas from the products of combustion.

Toxic gas .....

Compound used to remove toxic gas .....

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(2)

(v) Suggest the name of the process that occurs when the toxic gas in part (d)(iv) is removed.

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(1)

(e) Explain why the boiling points of **X** and **Y** are similar.

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(2)  
(Total 16 marks)