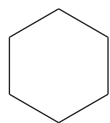




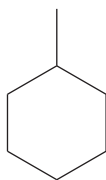


2 Crude oil is a source of many hydrocarbons.

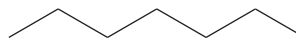
The skeletal formulae of some of these hydrocarbons are shown below.



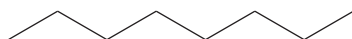
**A**



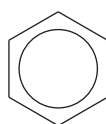
**B**



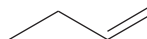
**C**



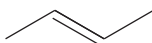
**D**



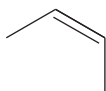
**E**



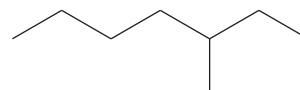
**F**



**G**



**H**



**I**

(a) Explain why compound **A** is both *saturated* and a *hydrocarbon*.

.....  
.....  
.....  
..... [2]

(b) What is the empirical formula for compound **A**?

..... [1]

(c) Give the letters, **A**, **B**, **C**, **D**, **E**, **F**, **G**, **H** or **I**, of two hydrocarbons that are structural isomers of each other.

..... and ..... [1]

(d) The petroleum industry processes straight chain alkanes into cyclic hydrocarbons such as **A**, **B** and **E**.

(i) Explain why the petroleum industry processes straight chain alkanes into cyclic hydrocarbons.

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

(ii) Hydrocarbon **C** can be processed into the cyclic hydrocarbon **B**.

Construct an equation for this reaction.

[1]

(e) Explain why hydrocarbon **D** has a higher boiling point than hydrocarbon **C**.

.....  
.....  
.....  
..... [2]

(f) Hydrocarbons **G** and **H** are stereoisomers of each other.

Explain what is meant by the term *stereoisomerism*.

.....  
.....  
.....  
..... [2]

(g) Construct the equation for the **complete** combustion of hydrocarbon **C**.

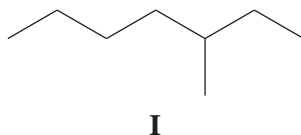
..... [2]

- (h) A hydrocarbon molecule,  $C_{16}H_{34}$ , is cracked to form an octane molecule and two molecules of but-2-ene.

Construct the equation for this reaction.

..... [1]

- (i) Compound **I** is 3-methylheptane. It does not contain a functional group.



- (i) What is meant by the term *functional group*?

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

- (ii) Compound **I** reacts with chlorine in the presence of ultraviolet radiation to give several structural isomers of  $C_8H_{17}Cl$ .

How many **structural** isomers could be formed in this reaction?

..... [1]

- (iii) The mechanism of the reaction involves radicals.

What is meant by the term *radical*?

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

[Total: 16]





(ii) The chemist isolates another product, the carboxylic acid, **K**.

**K** has the molecular formula  $C_4H_8O_2$ .

Suggest a possible structure and name for **K**.

structure

name ..... [2]

(c) Ethanoic acid is used in the manufacture of the ester, propyl ethanoate.

Describe how ethanoic acid is converted into propyl ethanoate.  
Include an equation in your answer.

.....  
.....  
.....  
.....  
.....  
.....  
..... [4]

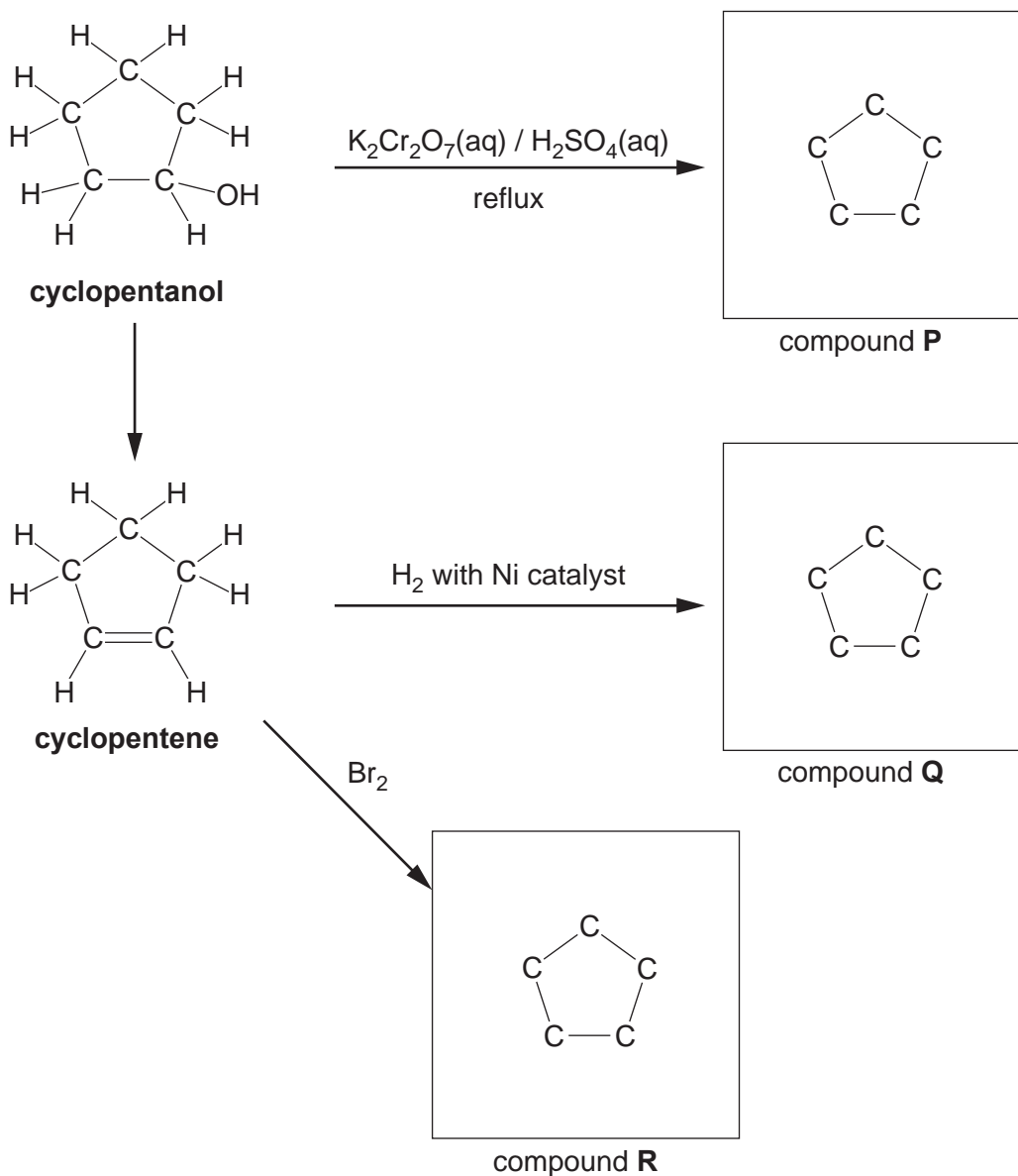
[Total: 14]



4 Cyclopentene is a cyclic alkene.

(a) The flowchart shows some reactions involving cyclopentene and cyclopentanol.

Complete the partial structures in the boxes to show compounds **P**, **Q** and **R**, the main organic products of the reactions.



[3]

(b) What would be the colour change in the reaction between cyclopentene and bromine?

..... to .....

[1]

(c) Cyclopentene can be polymerised to give poly(cyclopentene).

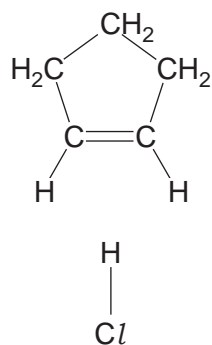
Draw a section of poly(cyclopentene) to show **two** repeat units.

[1]

(d) Cyclopentene reacts with HCl by electrophilic addition.

Use the curly arrow model to complete the mechanism for this reaction.

In your answer include any relevant dipoles, the intermediate and the product.



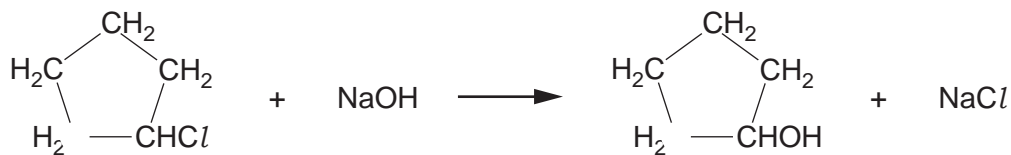
intermediate



product

[5]

(e) Chlorocyclopentane can be hydrolysed by heating with aqueous sodium hydroxide.

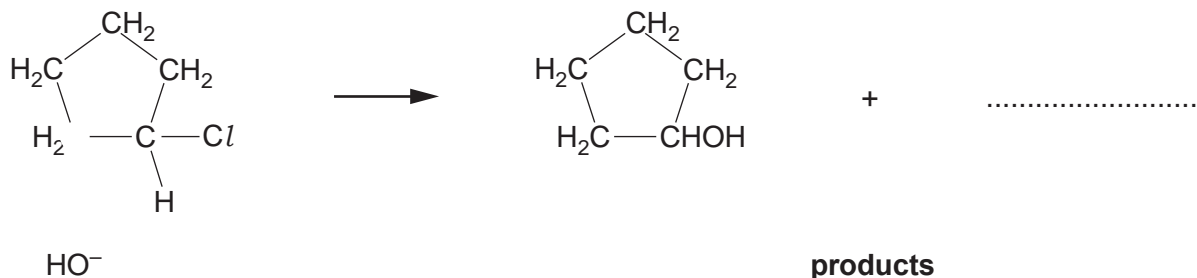


Use the curly arrow model to complete the mechanism for this hydrolysis reaction.

Include in your answer, relevant dipoles, the name of the mechanism and the type of bond fission.



*In your answer you should use the correct technical terms, spelled correctly.*



name of mechanism .....

type of bond fission ..... **[5]**

**[Total: 15]**