7 In this question, one mark is available for the quality of spelling, punctuation and grammar.

Cyclohexene reacts with bromine at room temperature. Benzene reacts with bromine only in the presence of a halogen carrier. Phenol rapidly decolourises bromine at room temperature.

Explain the different reactivities of bromine with cyclohexene, benzene and phenol.
In your answer, include balanced equations and state the reaction type in each case.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [10]

Quality of Written Communication [1]

[Total: 11]

END OF QUESTION PAPER

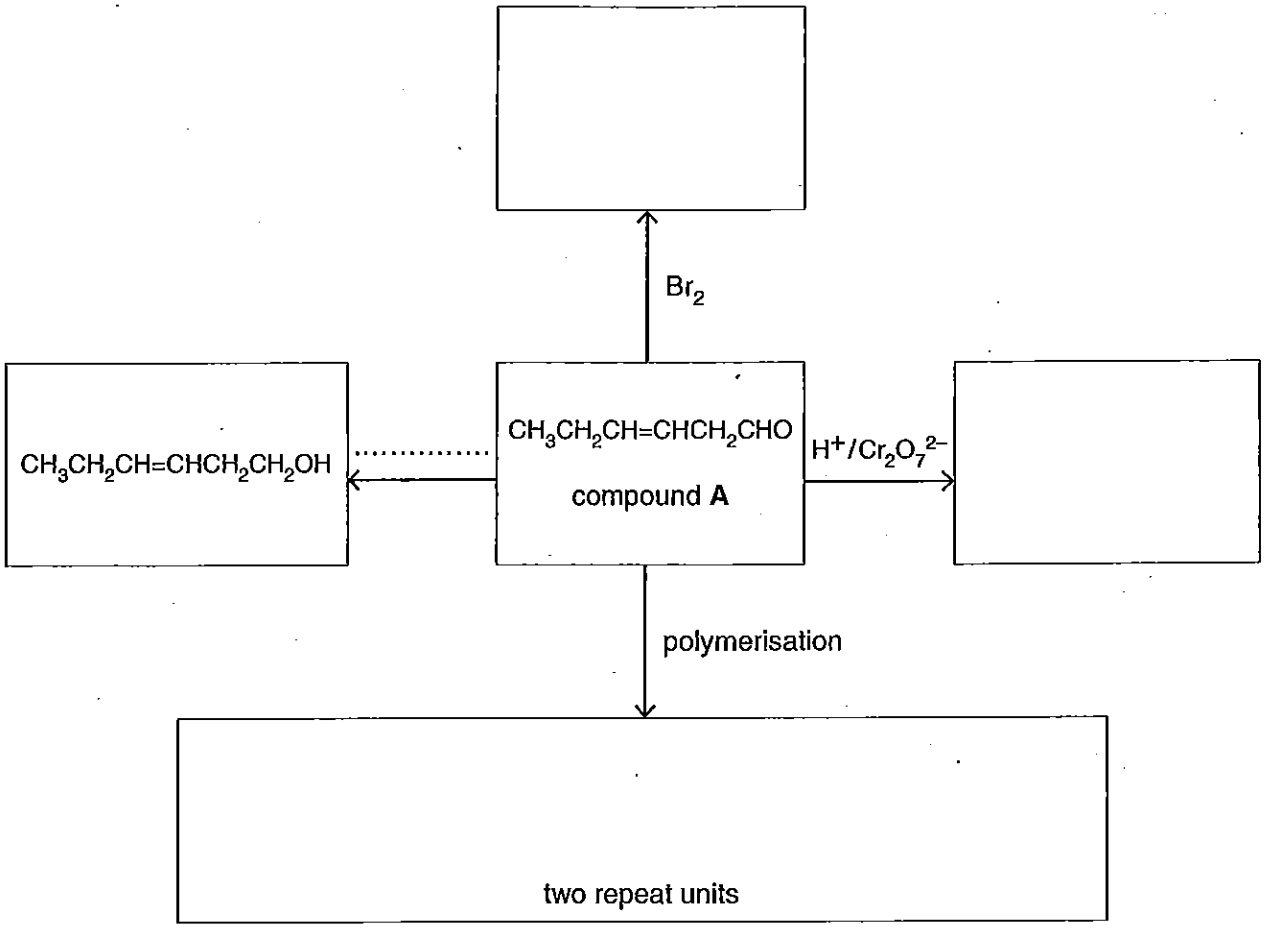
5 Compound **A**, $CH_3CH_2CH=CHCH_2CHO$, is produced in small amounts by most plants and insects.

(a) Name compound **A**.

..... [2]

(b) The flowchart shows some reactions of compound **A**.

Complete the flowchart below.



[5]

(c) There are two stereoisomers of $CH_3CH_2CH=CHCH_2CHO$.

Draw and label these stereoisomers.

[2]

[Total: 9]

6 This question is about identifying aldehydes and ketones.

(a) Describe two **chemical** tests:

- one to confirm that the compound was either an aldehyde or a ketone;
- one to distinguish between an aldehyde and a ketone.

.....

.....

.....

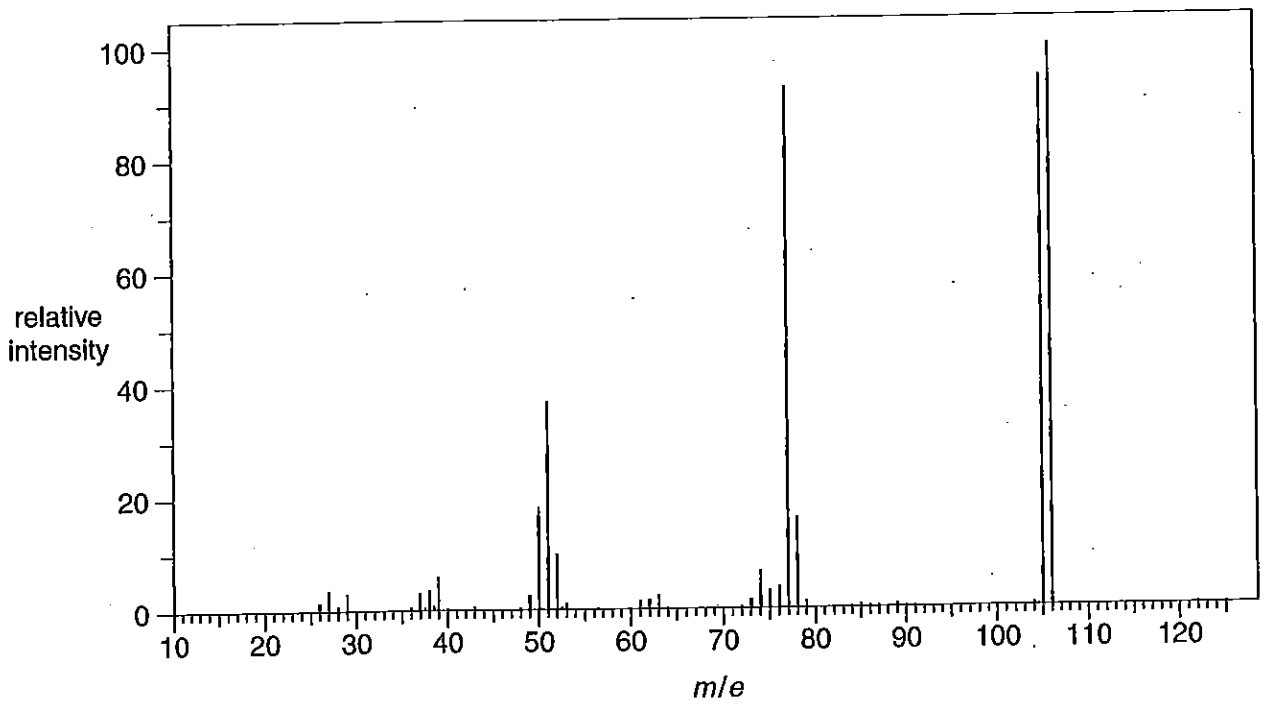
.....

.....

..... [5]

(b) An unknown compound **B** is thought to be either an aldehyde or a ketone with the molecular formula C_xH_yO.

The molecular formula of the unknown compound **B** was deduced with the help of the mass spectrum shown below.



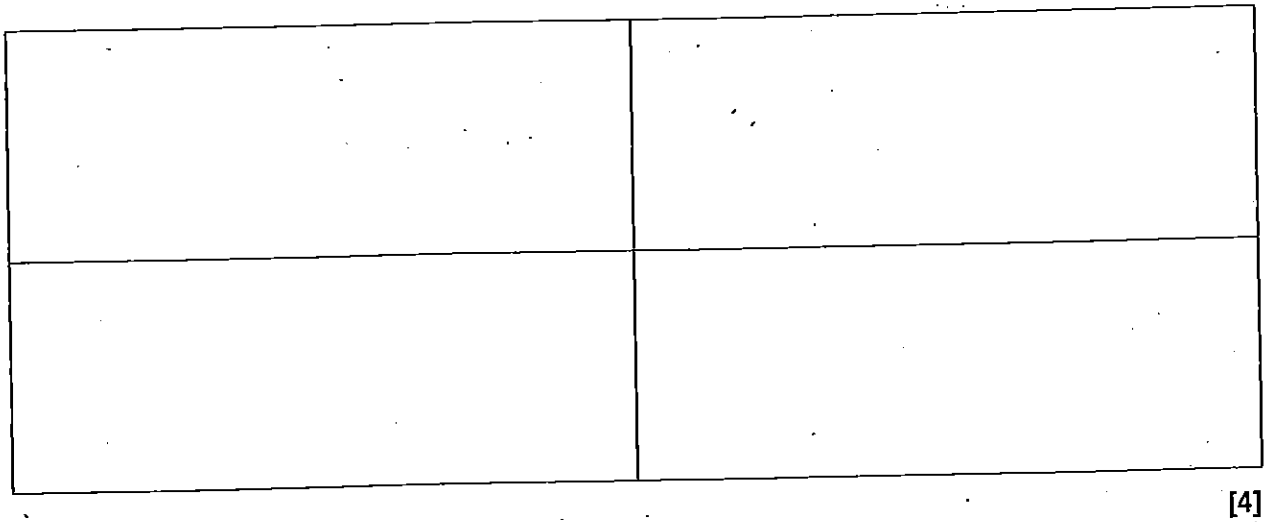
(i) On the mass spectrum, write the letter **M** next to the peak that can be used to identify the molecular ion. [1]

(ii) Deduce the molecular formula of compound **B**.

molecular formula = ... [2]

(c) Another unknown compound **C** is an aldehyde with the molecular formula $C_5H_{10}O$.

Show the four structural isomers of $C_5H_{10}O$ that are aldehydes.



[4]

6

(c) Lactic acid, $CH_3CH(OH)COOH$, polymerises to form poly(lactic acid), PLA.

(i) Draw a section of PLA to show **two** repeat units.

[2]

(ii) PLA is a biodegradable plastic derived from renewable sources.

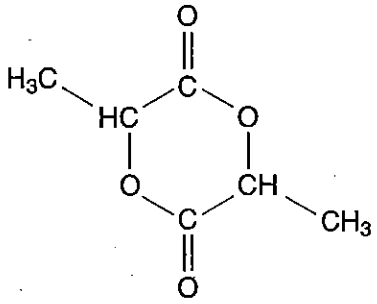
Suggest why PLA is better for the environment than oil-based hydrocarbon polymers.

.....

.....

..... [2]

(d) Lactic acid can be dimerised to produce the compound below.



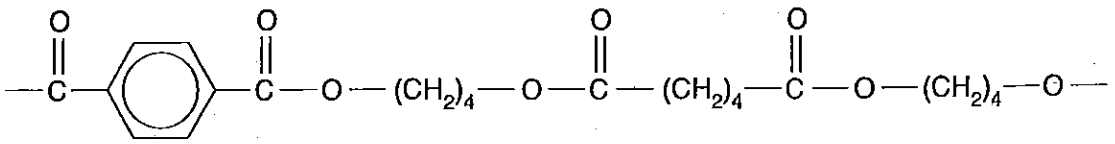
Write a balanced equation for the dimerisation of lactic acid.

[2]

[Total: 16]

3 Ecoflex® is a biodegradeable plastic made by combining three different monomers.

A short section of the Ecoflex® polymer is shown below.



(a) Draw a circle around an ester link in the section of Ecoflex® shown above. [1]

(b) One of the monomers used to make Ecoflex® is $HOOC(CH_2)_4COOH$.

(i) Give the systematic name of $HOOC(CH_2)_4COOH$.

..... [1]

(ii) Draw the structures of the other two monomers used to make Ecoflex®.

[2]

(c) The monomer $HOOC(CH_2)_4COOH$ can be made in the laboratory by oxidising compound **X**, $C_6H_{10}O_2$.

(i) Draw the displayed formula **and** the skeletal formula of compound **X**.

[2]

(ii) Write a balanced equation for the oxidation of compound **X** to form $HOOC(CH_2)_4COOH$.

Use [O] to represent the oxidising agent.

..... [1]

(iii) Explain how infra-red spectra of compound **X** and $HOOC(CH_2)_4COOH$ could be used to confirm that the oxidation had taken place.

.....

.....

..... [1]

(d) Poly(but-1-ene) can be made from the monomer but-1-ene, $CH_3CH_2CH=CH_2$.

Draw a section of poly(but-1-ene) to show **two** repeat units.

[1]

(e) Ecoflex® and poly(but-1-ene) are both polymers but the type of polymerisation reaction used to make each one is different.

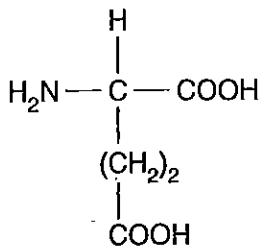
State the type of polymerisation reaction used to make each polymer.

ecoflex®.....

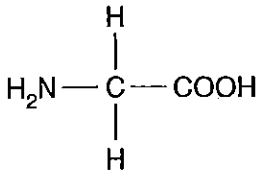
poly(but-1-ene) ..... [1]

2 Glutamic acid and glycine are both α-amino acids that occur widely in living organisms.

The structures of the amino acids are shown below.



glutamic acid



glycine

(a) State the general formula of an α-amino acid.

..... [1]

(b) Glutamic acid has optical isomers but glycine does not.

Explain why.

Include suitable 3-D diagrams in your answer.

.....

.....

.....

.....

[4]

(c) Amino acids form different ions at different pH values.

(i) Draw the structure of the ion formed by glycine at pH 2.

[1]

(ii) Draw the structure of the ion formed by glutamic acid at pH 14.

[2]

(d) Glutamic acid and glycine can react to form a mixture of dipeptides.

Draw two dipeptides formed when one molecule of glutamic acid reacts with one molecule of glycine.

[3]

(e) In the presence of a suitable catalyst, glutamic acid is esterified by an excess of ethanol to form a compound with molecular formula $C_9H_{17}NO_4$.

(i) Identify a suitable catalyst for this reaction.

..... [1]

(ii) Draw the structure of the compound with molecular formula $C_9H_{17}NO_4$.

[2]

[Total: 14]