

GCSE Chemistry (9 – 1)

Polymers

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/6
2	/11
3	/12
4	/13
5	/6
6	/14
Total	/62
%	
Grade	

Information

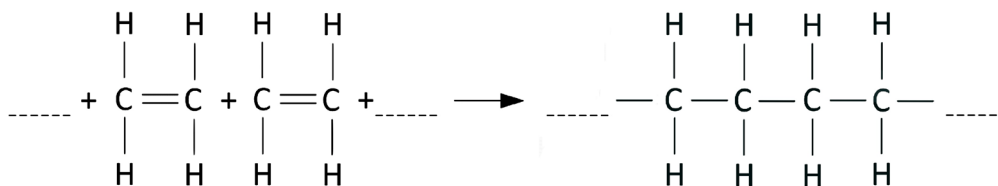
- The maximum mark for this paper is 62 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Polymers are very large molecules formed when many small, identical molecules, called monomers, join together to create long, repeating chains.

Circle the letter of the correct answer for each of the following questions.

- a. The diagram below illustrates the addition polymer formed from ethene.



Which terms describe this polymer?

- A** a saturated compound called poly(ethene).
B a saturated compound called poly(ethane).
C an unsaturated compound called poly(ethane).
D an unsaturated compound called poly(ethene).

(1 mark)

- b. A student is categorising polymers. The student looks at the following.

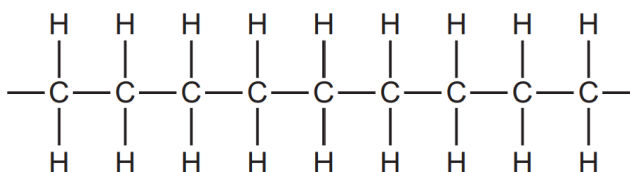
- i. Carbohydrates. ii. Nylon. iii. Proteins. iv. Poly(ethene).

Which row correctly identifies the origin of each polymer?

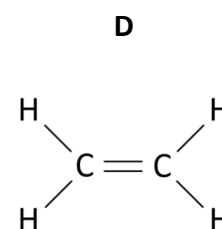
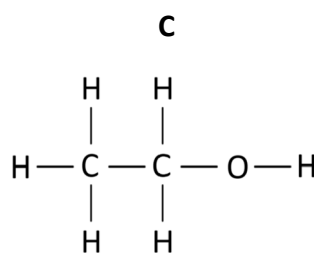
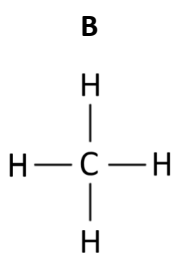
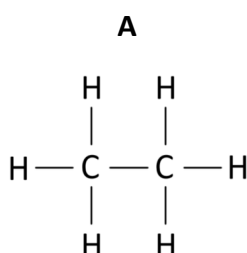
	Natural	Synthetic
A	Carbohydrates and Proteins	Nylon and Poly(ethene)
B	Nylon and Poly(ethene)	Carbohydrates and Proteins
C	Carbohydrates and Poly(ethene)	Nylon and Proteins
D	Nylon and Proteins	Carbohydrates and Poly(ethene)

(1 mark)

- c. The structure below represents a section of a polymer chain.

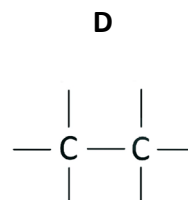
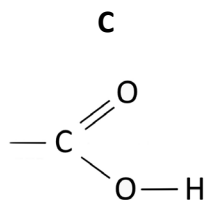
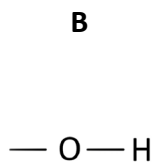
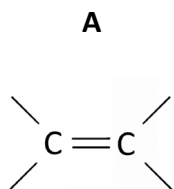


Which of the substances below undergoes polymerisation to produce this structure?



(1 mark)

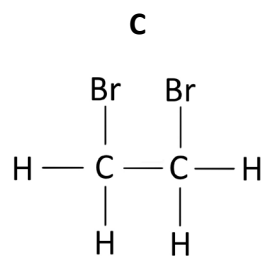
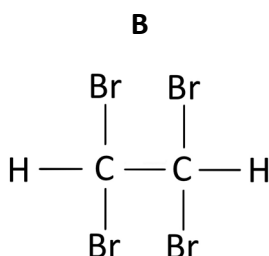
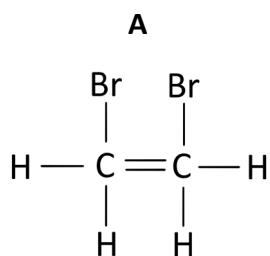
d. Which functional group does a monomer need to contain to form addition polymers?



(1 mark)

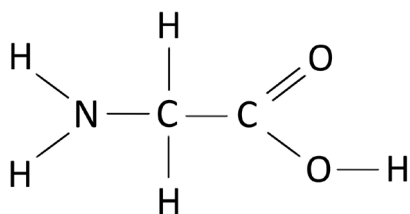
e. Bromine reacts with ethene to form a saturated compound.

Draw the full displayed formula of the product formed in this reaction.



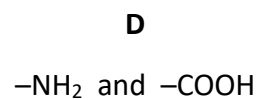
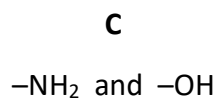
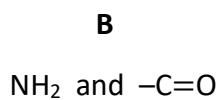
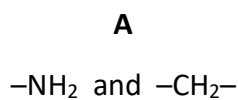
(1 mark)

f. Glycine is an amino acid used by the body to make proteins.



Glycine is a monomer that reacts to form proteins.

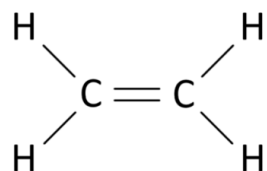
Identify the **two** functional groups found in a molecule of glycine from the table below.



(1 mark)

(Total for Question 1 is 6 marks)

2. The figure below shows the displayed formula of the monomer ethene.



a. What feature of ethene molecules allows them to act as monomers?

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(1 mark)

b. Ethene is an alkene.

What is the general formula for an alkene?

.....

(1 mark)

c. Ethene undergoes addition polymerisation to form poly(ethene).

Draw the **displayed formulae**, for poly(ethene).

(2 marks)

d. Polymers can be made from different monomers. What are the monomers in DNA called?

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(1 mark)

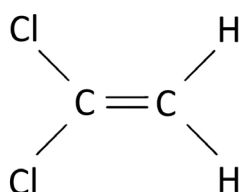
e. As mentioned DNA is made up of monomers.

What are the **three** main chemical parts of a DNA monomer?

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(2 marks)

The figure shows the structure of a molecule of **dichloroethene**.



- f. Describe how dichloroethene monomers can form a polymer.

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(2 marks)

- g. Calculate the relative formula mass of a poly(chloroethene) molecule made from 4150 chloroethene molecules, $\text{C}_2\text{H}_3\text{Cl}$.

Relative atomic masses: $\text{H} = 1.00$, $\text{C} = 12.0$, $\text{Cl} = 35.5$

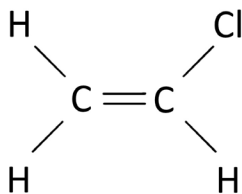
Give your answer to **three significant figures**. Show your working.

Relative formula mass = ...

(2 marks)

(Total for Question 2 is 11 marks)

3. Poly(chloroethene) is a polymer made from chloroethene.
A molecule of chloroethene is shown in the figure below.



- a. Draw a section of a poly(chloroethene) molecule containing **three** repeating units, showing all bonds.

(3 marks)

- b. What form of polymer is poly(chloroethene)?

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(1 mark)

- c. A molecule of poly(chloroethene) has a relative formula mass (M_r) of 187,500.
Calculate the number of chloroethene monomers ($\text{C}_2\text{H}_3\text{Cl}$) joined together to form this molecule.
(Relative atomic masses: $\text{H} = 1.00$, $\text{C} = 12.0$, $\text{Cl} = 35.5$)
Show your working.

(2 marks)

Poly(chloroethene), also known as PVC, is a polymer used extensively for window frames, water pipes, and electrical insulation.

Like poly(ethene), it is manufactured using raw materials obtained from crude oil.

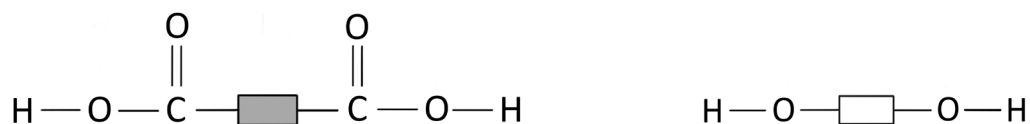
- d. Explain the environmental and safety problems associated with the manufacture and disposal of poly(chloroethene).

[illegible]

(6 marks)

(Total for Question 3 is 12 marks)

4. Esters can be made from the two different molecules shown in the figure below.



- a. Complete the diagram to show a section of the ester made from these two molecules. Include all of the atoms and all of the bonds in the ester molecule.

(2 marks)

- b. Identify the type of polymerisation that takes place when this polymer forms.

(2 marks)

- c. Synthetic polymers are disposed of in landfill sites and by burning.

- i. Describe **two** problems caused by the disposal of synthetic polymers in landfill sites.

(2 marks)

- ii. Describe one problem caused by burning synthetic polymers.

(1 mark)

The structural formulae of two synthetic polymers are given below.

Polymer X	$\begin{array}{cccccccc} \text{---CH}_2 & \text{---CH}_2 & \text{---CH}_2 & \text{---CH}_2 & \text{---CH}_2 & \text{---CH}_2 & \text{---CH}_2 & \text{---CH}_2 & \text{---} \\ & & & & & & & & \\ & \text{CH}_3 & & \text{CH}_3 & & \text{CH}_3 & & \text{CH}_3 & \end{array}$
Polymer Y	$\text{---O---}\overset{\text{O}}{\parallel}\text{C---}\boxed{}\text{---}\overset{\text{O}}{\parallel}\text{C---O---}\boxed{}\text{---O---}\overset{\text{O}}{\parallel}\text{C---}\boxed{}\text{---}\overset{\text{O}}{\parallel}\text{C---O---}\boxed{}\text{---O---}$

d. Draw the structural formula of the **monomer** of polymer X.

(2 marks)

e. Deduce the **two** types of organic compound which have reacted to form polymer Y.

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(2 marks)

f. Explain the difference between addition and condensation polymers.

In your explanation you should identify which type of polymer, addition or condensation X and Y are.

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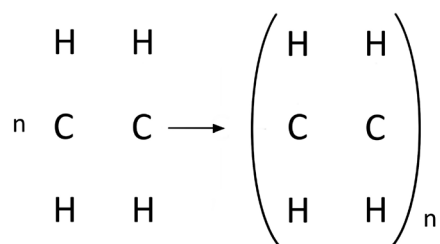
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(3 marks)

(Total for Question 4 is 13 marks)

5. Ethene is used to produce poly(ethene).

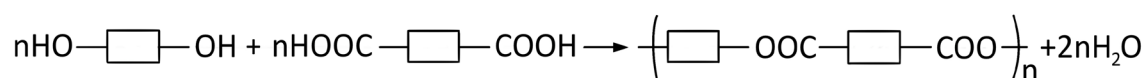
a. Draw the bonds to complete the displayed formulae of ethene and poly(ethene) in the equation.



(2 marks)

A different type of polymerisation reaction is required to manufacture polyesters.

This process is represented by the following general equation:



Poly(ethene) is an addition polymer, whereas polyester is a condensation polymer.

b. Explain the differences between these two methods of polymerisation

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(4 marks)

(Total for Question 5 is 6 marks)

6. Propene is an alkene. The formula of its molecule is C_3H_6 .
- a. Draw the structure of a **propene molecule**, showing **all** of the bonds.

(2 marks)

- b. Propane is a saturated hydrocarbon, whereas propene is unsaturated.

Describe a chemical test to distinguish between a sample of propane and a sample of propene.
Include the expected colour change for the propene.

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(3 marks)

- c. Calculate the percentage by mass of carbon in a propene molecule (C_3H_6).
(Relative atomic masses: $H = 1.00$, $C = 12.0$). Give your answer to **three** significant figures.

percentage by mass = ...

(3 marks)

- d. Poly(propene) is a widely used plastic manufactured from the monomer propene.

Describe the chemical reaction that turns propene into poly(propene).

In your answer, give examples of how the specific properties of poly(propene) make it suitable for its common uses.

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(6 marks)

(Total for Question 6 is 14 marks)