

1 There are two types of polymerisation, addition and condensation.

(a) Explain the difference between these two types of polymerisation.

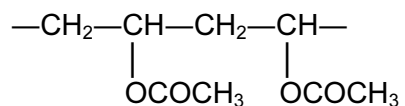
.....
.....
..... [2]

(b) Some plastics, formed by polymerisation, are non-biodegradable.

Describe **two** pollution problems that are caused by non-biodegradable plastics.

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

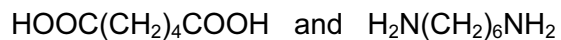
- (c) The polymer known as PVA is used in paints and adhesives. Its structural formula is shown below.



Deduce the structural formula of its monomer.

[1]

- (d) A condensation polymer can be made from the following monomers.



Draw the structural formula of this polymer.

[3]

[Total: 8]

2 (a) 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]

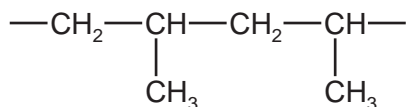
(ii) Describe **one** problem caused by burning synthetic polymers.

..... [1]

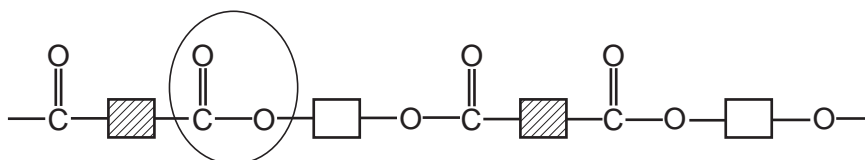
(b) State **two** uses of synthetic polymers.

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

(c) The structural formulae of two synthetic polymers are given below.



polymer A



polymer B

(i) Draw the structural formula of the monomer of polymer A.

[2]

(ii) Identify the functional group circled in polymer B.

..... [1]

(iii) Deduce the **two** types of organic compound which have reacted to form polymer B.

..... [2]

(d) Explain the difference between addition and condensation polymers. Classify **A** and **B** as either addition or condensation polymers.

.....

.....

.....

..... [3]

[Total: 12]

3 (a) Glucose, sucrose and starch are all carbohydrates. Their formulae are:

glucose, $C_6H_{12}O_6$,
sucrose, $C_{12}H_{22}O_{11}$,
starch, $(C_6H_{10}O_5)_n$.

(i) Identify **two** common features in the formulae of these carbohydrates.

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

(ii) Draw the structure of a complex carbohydrate, such as starch. The formula of glucose, can be represented by



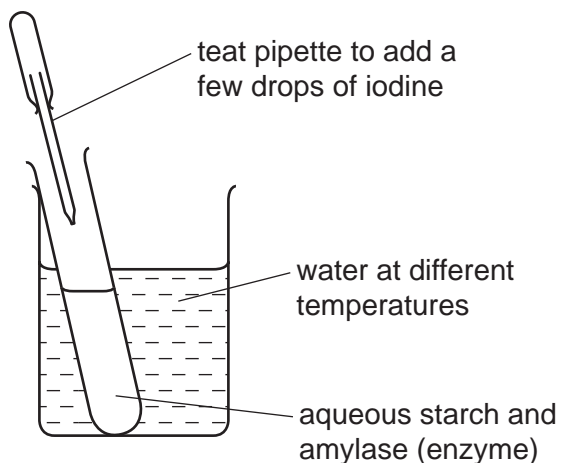
Include **three** glucose units in the structure.

[2]

(b) Starch hydrolyses to glucose in the presence of the enzyme, amylase.
What is meant by the term *enzyme*?

..... [2]

- (c) The effect of temperature on this reaction can be studied by the experiment shown below. Starch and iodine form a blue-black colour. Glucose and iodine do not form a blue-black colour.



The experiment is set up as in the diagram and the time measured for the mixture to change from blue-black to colourless. The experiment is repeated at different temperatures. Typical results of this experiment are given in the table below.

experiment	temperature /°C	time for blue-black colour to disappear /min
A	20	30
B	40	15
C	70	remained blue-black

- (i) Put the experiments in order of reaction rate – slowest first and fastest last.

..... [2]

- (ii) Explain why the reaction rates in experiments A and B are different.

.....

 [3]

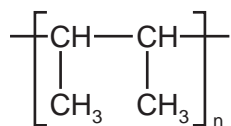
- (iii) Suggest why the colour remains blue-black in experiment C.

..... [1]

[Total: 12]

4 Polymers are made by the polymerisation of simple molecules called monomers.

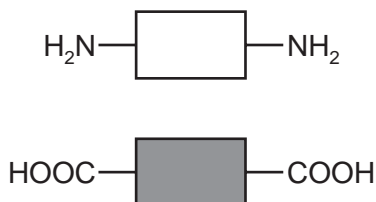
(a) The structural formula of a polymer is given below.



This polymer is made by addition polymerisation. Draw the structural formula of its monomer.

[1]

(ii) The two monomers shown below form a nylon which is a condensation polymer.



Draw its structural formula showing one repeat unit of the polymer.

[3]

(iii) Name the natural macromolecule which contains the same linkage as nylon.

..... [1]

(iv) Explain the difference between addition polymerisation and condensation polymerisation.

.....
.....

[2]

(b) Many polymers are non-biodegradable.

(i) Explain the term *non-biodegradable*.

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

(ii) State **three** problems caused by the disposal of non-biodegradable polymers.

.....
.....
..... [3]

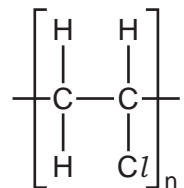
(c) Storage tanks for cold water are now made from polymers because they are cheaper than metal tanks. Suggest **two** other advantages of making cold water tanks from polymers.

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

[Total: 14]

5 Many monomer molecules react together to form one molecule of a polymer. This reaction is called polymerisation.

(a) The structural formula of the polymer, poly(chloroethene), is given below. This polymer is also known as PVC.



(i) A major use of PVC is insulation of electric cables. PVC is a poor conductor of electricity.

Suggest another property which makes it suitable for this use.

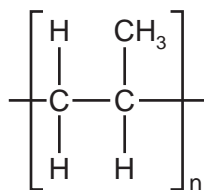
..... [1]

(ii) One way of disposing of waste PVC is by burning it. This method has the disadvantage that poisonous gases are formed.

Suggest **two** poisonous gases which could be formed by the combustion of PVC.

..... [2]

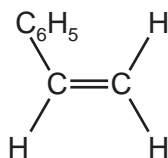
(b) (i) Deduce the structural formula of the monomer from that of the polymer.



structural formula of monomer

[1]

(ii) Deduce the structural formula of the polymer, poly(phenylethene), from the formula of its monomer, phenylethene.

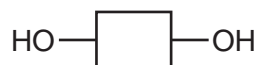


structural formula of polymer

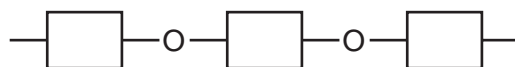
[2]

(c) The carbohydrate, glucose, polymerises to form the more complex carbohydrate starch.

If glucose is represented by



then the structural formula of starch is as drawn below.



How does the polymerisation of glucose differ from that of an alkene such as phenylethene?

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

[Total: 8]

6 Domestic rubbish is disposed of in landfill sites. Rubbish could include the following

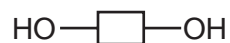
item of rubbish	approximate time for item to break down
newspaper	one month
cotton rag	six months
woollen glove	one year
aluminium container	up to 500 years
styrofoam cup	1000 years

(a) Explain why aluminium, a reactive metal, takes so long to corrode.

..... [1]

(b) Both paper and cotton are complex carbohydrates. They can be hydrolysed to simple sugars such as glucose.

The formula of glucose can be represented as:



Draw the structural formula of a complex carbohydrate, such as cotton. Include at least **two** glucose units.

[2]

(c) Wool is a protein. It can be hydrolysed to a mixture of monomers by enzymes.

(i) What are enzymes?

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

(ii) Name another substance which can hydrolyse proteins.

..... [1]

(iii) What type of compound are the monomers formed by the hydrolysis of proteins?

..... [1]

(iv) Which technique could be used to identify the individual monomers in the mixture?

..... [1]

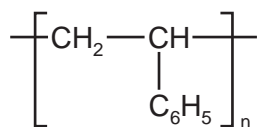
(v) Proteins contain the amide linkage. Name a synthetic macromolecule which contains the same linkage.

..... [1]

(d) What is the scientific term used to describe polymers which do not break down in landfill sites?

..... [1]

(ii) Styrofoam is poly(phenylethene). It is an addition polymer. Its structural formula is given below. Deduce the structural formula of the monomer, phenylethene.



[1]

[Total: 11]

7 Plastics are polymers. They are formed from their monomers by polymerisation.

(a) Two methods for the disposal of waste plastics are

- burning
- recycling.

Describe one advantage **and** one disadvantage of each method.

burning

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.....

recycling

.....

..... [4]

(b) There are two types of polymerisation reaction. Give their names and explain the differences between them.

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..... [4]

(ii) Give the structural formula of a polymer which is formed from two different monomers.

[2]

[Total: 10]