

Chem!stry

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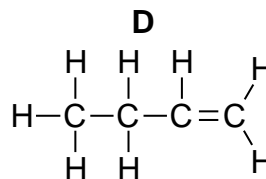
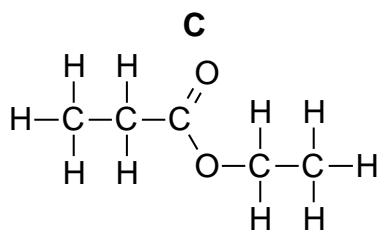
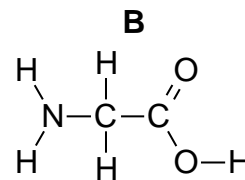
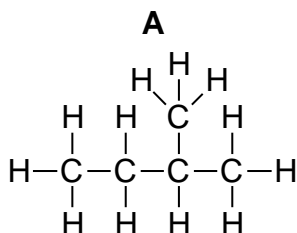
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Assignment on Polymer Chemistry – Answers

Multiple Choice Questions

1. Which one of the following formulae represents a compound likely to undergo addition polymerisation?



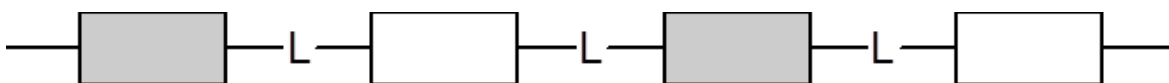
2. Part of a polymer molecule has the following structure:



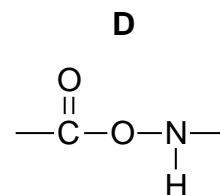
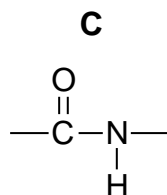
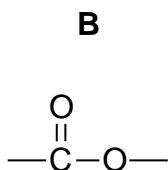
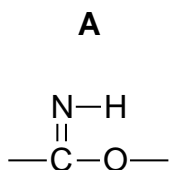
From which substance is this polymer made?

- | | | | |
|----------|------------------------|----------|------------------------|
| A | CH_4 | B | C_2H_4 |
| C | C_2H_6 | D | C_3H_6 |
3. The macromolecules of proteins, fats and carbohydrates can all be broken down into their simple units by a similar process. What is the process called?
- | | | | |
|----------|-----------------|----------|-------------|
| A | Dehydration. | B | Hydrolysis. |
| C | Esterification. | D | Oxidation. |

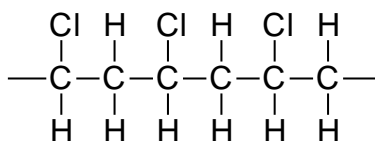
4. The diagram below represents the structure of a polyamide (such as nylon):



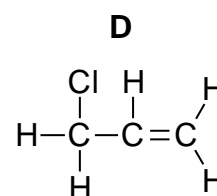
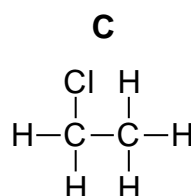
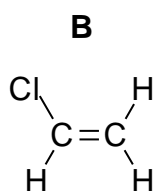
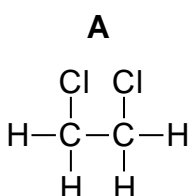
Which one of the following “linkages” does **L** represent?



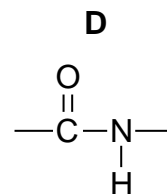
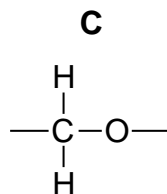
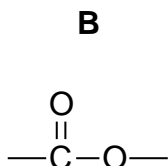
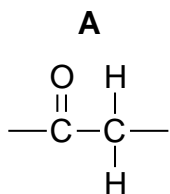
5. A polymer formed by addition polymerisation has the following structure:



What is the structure of the monomer?



6. Which one of the following structures correctly represents the linkage between the monomer units in *Terylene*?



7. Which one of the following substances is **not** a polymer?

A Nylon.

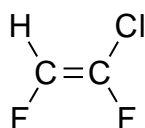
B Poly(ethene).

C Propene.

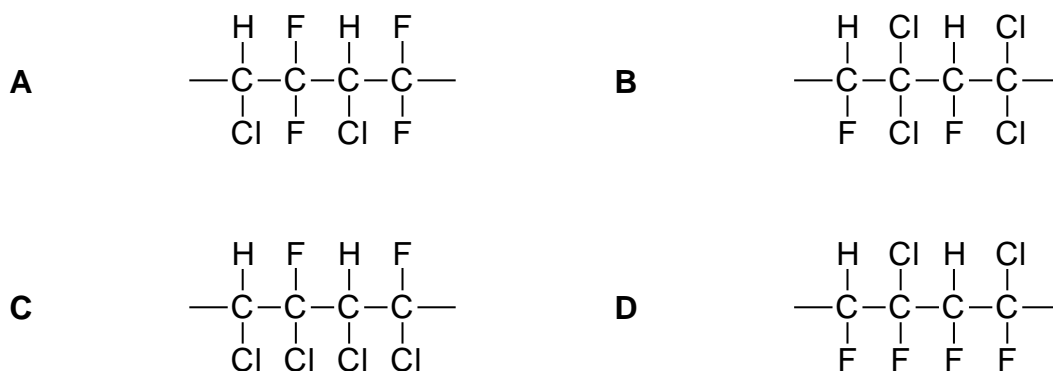
D Starch.

8. Some synthetic products are said to be non-biodegradable. What does this term mean?
- A Cannot act as catalysts for biological processes.
 - B Cannot be obtained from plant or animal matter.
 - C Not harmful to living organisms.
 - D Not broken down by bacteria.

9. The structure of a monomer is shown below:



Which formula shows two repeating units of the polymer made from this monomer?



10. Which of the following is an example of an addition polymer?
- A Nylon.
 - B Poly(ethene).
 - C *Terylene*.
 - D Starch.

Write your answers to the multiple choice questions in the table below:

1. D	2. B	3. B	4. C	5. B
6. B	7. C	8. D	9. D	10. B

Short Answer Questions

Question 1.

Terylene is a synthetic polymer which is mainly used for the manufacture of clothing. It is a polyester and hence the clothing should not be washed in a strongly alkaline detergent.

a) What is meant by the term “polymer”?

A polymer is a macromolecule that is made up of a very large number of small repeating units (monomers) joined together.

b) Name one other synthetic polymer which is also used for the manufacture of clothing.

Nylon.

c) Give the name and the full structural formula of an ester which contains a total of four carbon atoms.

Name: Ethyl ethanoate OR methyl propanoate OR propyl methanoate.

Formula: $\text{CH}_3\text{COOCH}_2\text{CH}_3$ OR $\text{CH}_3\text{CH}_2\text{COOCH}_3$ OR $\text{HCOOCH}_2\text{CH}_2\text{CH}_3$.

d) Name the types of compounds that are formed when an ester is boiled with a strong alkali.

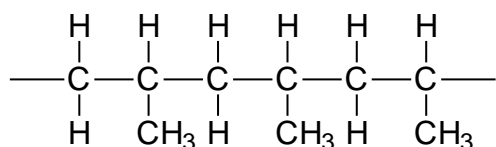
The salt of a carboxylic acid and an alcohol.

e) *Terylene* does not have a sharp melting point. What does this suggest about *Terylene*?

Terylene is not a pure compound. It is a mixture of polyesters of different chain lengths.

Question 2.

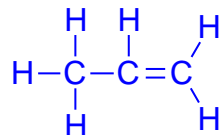
The structure of a polymer is shown below:



a) i) Name the monomer from which this polymer is made.

Propene.

ii) Give the full structural formula of the monomer from which this polymer is made.



b) Is this polymer an addition polymer or a condensation polymer? Explain your answer.

The polymer, poly(propene), is an addition polymer. It is formed when the *unsaturated* monomer, propene, polymerises to form the *saturated* polymer, poly(propene). It is not a condensation polymer because no water molecules (or any other type of small covalent molecule) is formed as a side-product. It is composed of only one type of monomer. The monomer and polymer have the same empirical formula.

c) Give the empirical formula of this polymer.



d) Calculate the percentage carbon, by mass, in this polymer.

$$\text{Relative molecular mass of CH}_2 = 12 + 1 + 1 = 14$$

$$\text{Percentage carbon in CH}_2 = (12 \div 14) \times 100 = 85.7\% \text{ to 3 s.f.}$$

Question 3.

The following substances have macromolecular structures:

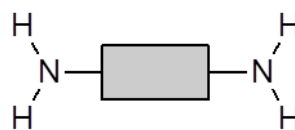
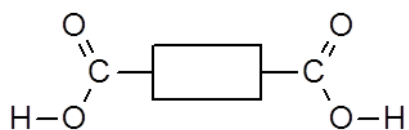
Diamond	Poly(propene)	Nylon
Poly(ethene)	Graphite	Proteins
Starch	Terylene	Silica (Sand)

Choose from the list:

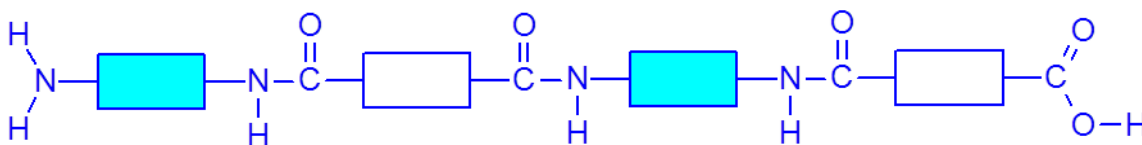
- a) All of the addition polymers: Poly(propene) and poly(ethene).
- b) All of the allotropes of carbon: Diamond and graphite.
- c) All of the synthetic polymers: Poly(propene), nylon, poly(ethene) and Terylene.
- d) All of the condensation polymers: Nylon, proteins, starch and Terylene.
- e) All of the polymers that contain an amide link: Nylon and proteins.

Question 4.

Nylon is a polyamide that can be synthesised from the monomers shown below:



- a) Using the monomers shown above, draw the structure of nylon showing three repeating units.



- b) i) Name the structural linkage that joins the monomers in nylon together.
Amide.
- ii) Name one group of naturally occurring compounds that have the same structural link as nylon.
Proteins.

- c) State the conditions under which nylon can be hydrolysed to reform the original monomers.

Nylon can be hydrolysed by warming it with a dilute aqueous acid or alkali.

- d) Sea fishing nets used to be made from natural fibres. Many nets are now made from nylon. Suggest **one advantage**, other than strength, and **one disadvantage** of using nylon rather than natural fibres to make fishing nets.

Advantage:

Nylon is more durable (more resistant to wear and tear) compared to natural fibres. This means that fishing nets made of nylon last longer than fishing nets made of natural fibres and therefore do not need to be replaced as often.

Disadvantage:

Natural fibres are biodegradable, but nylon is non-biodegradable. Nylon will accumulate in the environment, trapping and killing animals. Disposing of nylon through incineration may produce toxic gases such as carbon monoxide and hydrogen cyanide.