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CHEMISTRY

INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	POLYMERS
PAPER TYPE:	QUESTION PAPER - 4
TOTAL QUESTIONS	10
TOTAL MARKS	34

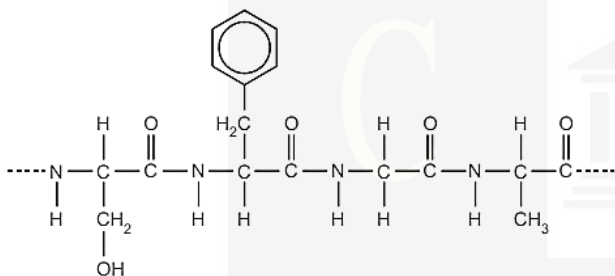
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Polymers - 4

1. Wool is a protein.

It is a natural polymer made by the same type of polymerisation as nylon-6,6.

A section of the polymer chain in a protein is shown below.



(a) How many monomer units does this section contain?

(1)

(b) Draw the structure of one of the monomer molecules that was used to form this section.

(1)

(c) State three ways in which the monomer units of a protein differ from those of nylon-6,6.

(3)

2. The repeating unit of a polymer is shown.

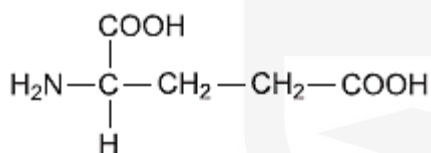


Which monomer or pair of monomers could be used to make this polymer?

- A. $\text{ClOC}(\text{CH}_2)_4\text{NH}_2$ only
- B. $\text{ClOC}(\text{CH}_2)_4\text{COCl}$ only
- C. $\text{ClOC}(\text{CH}_2)_4\text{COCl}$ and $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$
- D. $\text{ClOC}(\text{CH}_2)_6\text{COCl}$ and $\text{H}_2\text{N}(\text{CH}_2)_4\text{NH}_2$

(1)

3. The amino acid, glutamic acid, is shown below.



Draw the structure of the organic species formed when glutamic acid reacts with each of the following.

(a) an excess of sodium hydroxide

(1)

(b) an excess of methanol in the presence of concentrated sulfuric acid

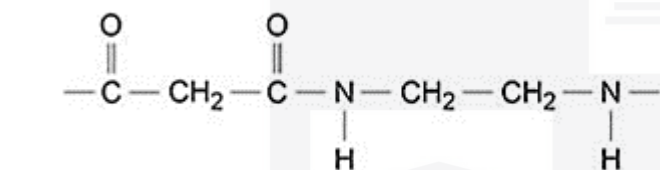
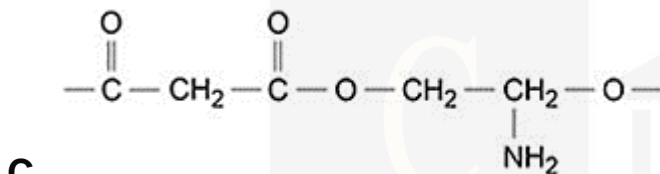
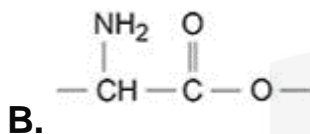
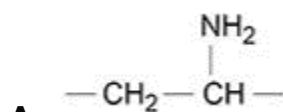
(1)

(c) ethanoyl chloride

(1)

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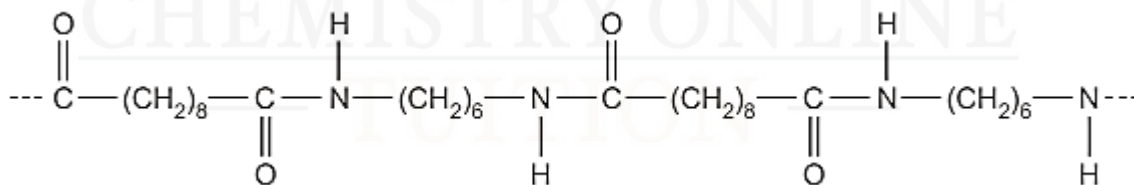
4. Which is the repeating unit of a polyamide?



(1)

5. Synthetic polyamides, such as nylon, contain the same link as polypeptides.

Nylon is the general name for a family of polyamides. A short section of a nylon polymer is shown below.



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(2)

6. Poly(phenylethene) is one of the most versatile and successful polymers.

The 3-D skeletal formula of a section of atactic poly(phenylethene) is shown in the diagram below.



(a) State the type of polymerisation used to make poly(phenylethene).

(1)

(b) Draw a skeletal or displayed formula to show the monomer used to make poly(phenylethene).

(1)

(c) Outline how the polymer is formed from the monomer molecules. (You do not need to give any details of the catalyst or conditions involved.)

(2)

7. When $\text{Na}_2\text{C}_2\text{O}_4(\text{aq})$ is added to a solution containing $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ ions, a reaction occurs in which all six water ligands are replaced by ethanedioate ions.

Explain why the replacement of the water ligands by ethanedioate ions is favourable.

In your answer refer to:

- the enthalpy and entropy changes for the reaction
- how the enthalpy and entropy changes influence the free-energy change for the reaction.

(5)

8. A compound Y, is as $\text{HOCH}_2\text{CH}_2\text{COOH}$

(a) Name compound Y, $\text{HOCH}_2\text{CH}_2\text{COOH}$

(1)

(b) Under suitable conditions, molecules of Y can react with each other to form a polymer.

Draw a section of the polymer showing two repeating units.

Name the type of polymerisation involved.

(2)

9. Explain why the melting point of aminoethanoic acid is much higher than that of hydroxyethanoic acid, HOCH_2COOH

(2)

10. This question is about ethanedioic acid (HOCCOOH) and the ethanedioate ion ($^{-}\text{OCCOO}^{-}$).

(a) Ethanedioic acid reacts with propane-1,3-diol ($\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$) to form a polyester.

Draw the repeating unit of this polyester.

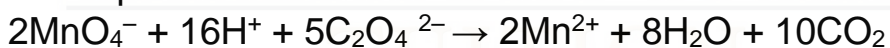
(2)

(b) Explain why polyesters are biodegradable but polyalkenes are not biodegradable.

(2)

(c) Sodium ethanedioate is used to find the concentration of solutions of potassium manganate(VII) by titration.

The equation for this reaction is



A standard solution is made by dissolving 162 mg of $\text{Na}_2\text{C}_2\text{O}_4$

($M_r = 134.0$) in water and making up to 250 cm^3 in a volumetric flask.

25.0 cm^3 of this solution and an excess of sulfuric acid are added to a conical flask.

The mixture is warmed and titrated with potassium manganate(VII) solution.

The titration is repeated until concordant results are obtained. The mean titre is 23.85 cm^3

Calculate the concentration, in mol dm^{-3} , of the potassium manganate(VII) solution.



(4)

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