

Name:

Target grade:

Mark: / 38

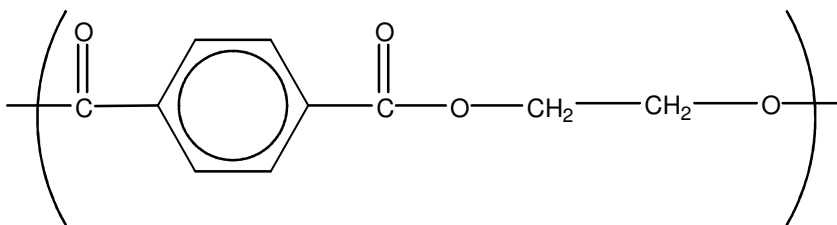
Actual grade:

Percentage:

Homework 7 – Polymerisation and chirality

1. Non-returnable drinks bottles are often made from PET. This produces a huge problem for waste disposal. However, this polymer cannot be used to make returnable bottles.

(a) PET is a polyester. The repeating unit for PET is given below.



Draw a ring around the ester group in the repeating unit above.

[1]

(b) Plastic waste is often buried for disposal.

Give two other methods which are used to deal with plastic waste and explain a different advantage for each method.

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[4]

Name:

- (c) PET is not used to make returnable bottles because its glass transition temperature, T_g , is too low.

Explain why lowering the temperature of PET below its T_g causes it to become brittle.

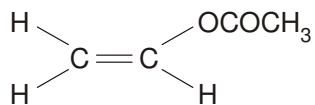
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[3]

[Total 8 marks]

2. The polymer commonly known as PVC exists in two forms. Plasticised PVC is used where flexibility is required. Unplasticised PVC, uPVC, is rigid at room temperature and is used to make things such as guttering for houses.

Bumpers and spoilers on cars are made from *plasticised* PVC. One way of making PVC more plastic is to incorporate another monomer unit into the polymerisation process. A monomer used in this way is ethenyl ethanoate.



ethenyl ethanoate

- (i) Draw out a section of the polymer formed from vinyl chloride and ethenyl ethanoate. Include **two** units of vinyl chloride and **one** unit of ethenyl ethanoate.

[2]

Name:

- (ii) What term is used to describe such a polymer that has more than one monomer in its structure?

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[1]
[Total 3 marks]

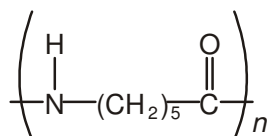
3. In the 1930s, chemists began to design polymers that had similar structures to those found in natural fibres. The first of these polymers, nylon-6,6, was quickly followed by the invention of nylon-6.

- (a) Suggest a reason why chemists wanted to find synthetic replacements for some natural fibres.

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[1]

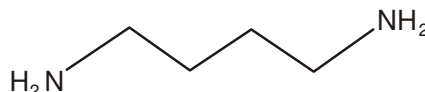
- (b) The repeating unit of nylon-6 is shown below.



Draw the structure of a monomer which can be used to make nylon-6.

[2]

- (c) At the same time that nylon-6,6 was invented, chemists also made a sample of a nylon by reacting hexanedioic acid with compound A. The nylon was found to have a low molecular mass and was therefore not developed any further.



compound A

Name:

- (i) Name compound **A**.

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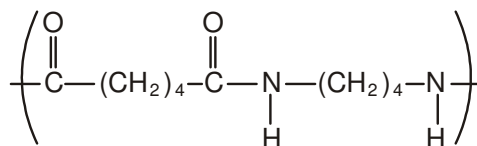
[2]

- (ii) Because of its low molecular mass, certain properties of the new nylon are different from those of nylon-6. Describe how two of these properties are different from those of nylon-6.

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[2]

- (d) Recently, chemists have been able to make samples of a polymer using compound A, but having a much higher M_r of 3×10^4 . The polymer was named *Stanyl* and is stronger and has a higher melting point than either nylon-6,6 or nylon-6. It is now used in manufacturing parts for car engines.



repeating unit of *Stanyl*

- (i) Approximately how many repeating units are there in a molecule of *Stanyl*?

number of repeating units =

[2]

Name:

- (ii) Name the functional group connecting the repeating units in *Stanyl*.

.....

[1]

- (iii) Explain why the melting point of *Stanyl* is higher than that of nylon-6,6 which has a similar molecular mass.

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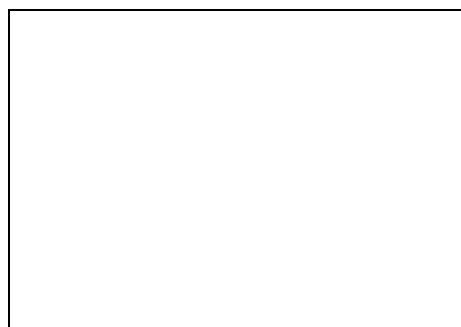
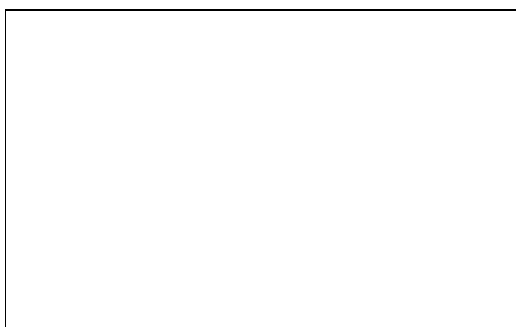
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[3]

- (e) The manufacturers of *Stanyl* state that 'as with all other polyamides, *Stanyl* is attacked by strong mineral acids and absorbs polar solvents'.

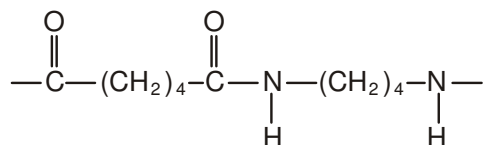
- (i) Draw the structures of the two organic products formed when *Stanyl* is hydrolysed with a strong acid. (The structure of *Stanyl* is repeated below.)



[2]

Name:

- (ii) Show using the diagram below how part of a *Stanyl* chain can form an intermolecular bond with a water molecule. Show any partial charges.

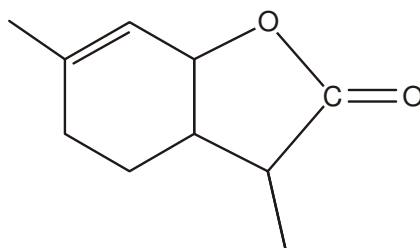


[2]

[Total 17 marks]

4. The smell and flavour of many white wines are due to the presence of an ester called a lactone.

The lactone shown below has a sweet coconut odour.



molecular formula C₁₀H₁₄O₂

- (a) Ring the part of the molecule that shows you that this lactone is an ester.

[1]

- (b) How many chiral carbons are present in the lactone molecule?

number of chiral carbons =

[1]

Name:

- (c) Thin layer chromatography (t.l.c.) can be used to show that this lactone is present in white wine.

However, the lactone is colourless.

Suggest one method of treating the t.l.c. plate to make the spot visible.

.....

[1]

- (d) The structure of the lactone can be identified by using mass spectrometry and nuclear magnetic resonance spectroscopy.

- (i) In the mass spectrum of the lactone, at what mass value would you expect to see the molecular ion peak?

mass value =

[1]

- (ii) Also in the mass spectrum there is a peak at a mass value of 15.

Give the formula of the ion responsible for this peak.

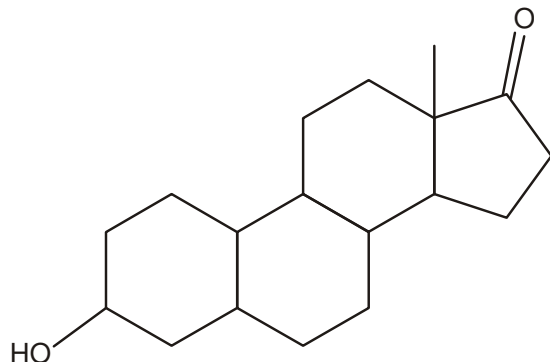
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[2]

[Total 6 marks]

Name:

5.



norandrosterone
 $C_{18}H_{28}O_2$

Norandrosterone has several chiral carbon atoms in its structure.

(i) Circle **two** chiral carbon atoms on the norandrosterone structure above.

[1]

(ii) Say how you recognise that these carbon atoms are chiral.

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[1]

(iii) For a molecule with one chiral carbon atom, state how the shapes of the two optical isomers are related.

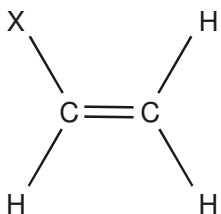
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[1]

[Total 3 marks]

Name:

6. When products containing myrcene are stored for long periods, they can become cloudy. This is because the myrcene forms a polymer. Using the structure



to represent a molecule of myrcene, draw the structure of the repeating unit of the polymer.

[Total 1 mark]