

Name of the Student: _____

Max. Marks : 27 Marks

Time : 27 Minutes

Q1.

The amide or peptide link is found in synthetic polyamides and also in naturally occurring proteins.

- (a) (i) Draw the repeating unit of the polyamide formed by the reaction of propanedioic acid with hexane-1,6-diamine.

(2)

- (ii) In terms of the intermolecular forces between the polymer chains, explain why polyamides can be made into fibres suitable for use in sewing and weaving, whereas polyalkenes usually produce fibres that are too weak for this purpose.

(3)

- (b) (i) Name and outline a mechanism for the reaction of $\text{CH}_3\text{CH}_2\text{COCl}$ with CH_3NH_2

Name of mechanism _____

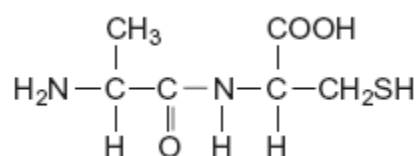
Mechanism

(5)

- (ii) Give the name of the product containing an amide linkage that is formed in the reaction in part (b) (i).

(1)

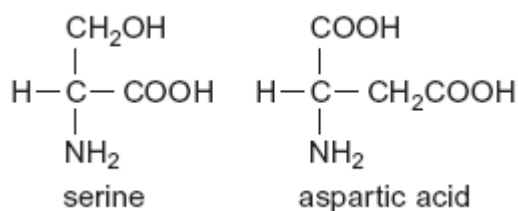
- (c) The dipeptide shown below is formed from two different amino acids.



Draw the structure of the alternative dipeptide that could be formed by these two amino acids.

(1)

- (d) The amino acids serine and aspartic acid are shown below.



- (i) Give the IUPAC name of serine.

(1)

- (ii) Draw the structure of the species formed when aspartic acid reacts with aqueous sodium

hydroxide.

(1)

- (iii) Draw the structure of the species formed when serine reacts with dilute hydrochloric acid.

(1)

- (iv) Draw the structure of the species formed when serine reacts with an excess of bromomethane.

(1)

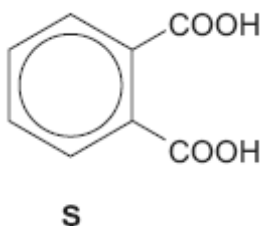
(Total 16 marks)

Q2.

Items softened with plasticisers have become an essential part of our modern society.

Compound **S**, shown below, is commonly known as phthalic acid.

Esters of phthalic acid are called phthalates and are used as plasticisers to soften polymers such as PVC, poly(chloroethene).



- (a) Give the IUPAC name for phthalic acid.

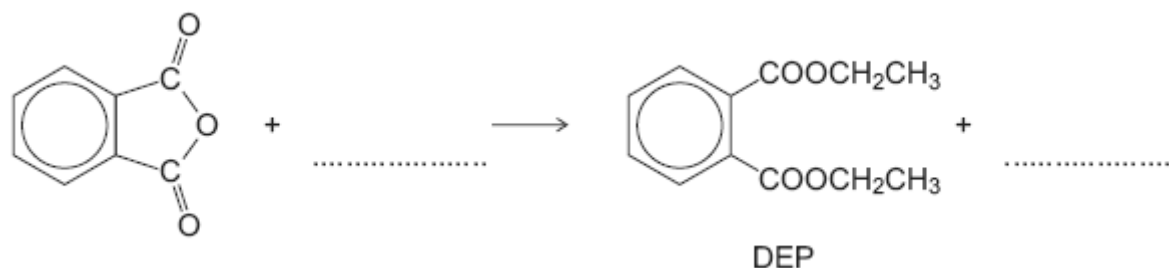
(1)

- (b) Draw the displayed formula of the repeating unit of poly(chloroethene).

(1)

- (c) The ester diethyl phthalate (DEP) is used in food packaging and in cosmetics.

- (i) Complete the following equation showing the formation of DEP from phthalic anhydride.



(2)

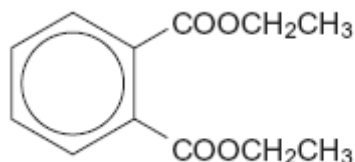
- (ii) Deduce the number of peaks in the ^{13}C n.m.r. spectrum of DEP.

(1)

- (iii) One of the peaks in the ^{13}C n.m.r. spectrum of DEP is at $\delta = 62$ ppm.

Table 3 on the Data Sheet can be used to identify a type of carbon atom responsible for this peak.

Draw a circle around **one** carbon atom of this type in the structure below.



(1)

- (d) The mass spectrum of DEP includes major peaks at $m/z = 222$ (the molecular ion) and at $m/z = 177$

Write an equation to show the fragmentation of the molecular ion to form the fragment that causes the peak at $m/z = 177$

(2)

- (e) Because of their many uses, phthalates have been tested for possible adverse effects to humans and to the environment.

An organisation that represents the manufacturers of plasticisers asserts that experimental evidence and research findings show that phthalates do not pose a risk to human health because they biodegrade in a short time scale.

According to the organization's research, phthalates do not represent a risk for humans or for the environment and they are biodegradable.

- (i) Hydrolysis of DEP in an excess of water was found to follow first order kinetics.

Write a rate equation for this hydrolysis reaction using DEP to represent the ester.

(1)

- (ii) Suggest what needs to be done so that the public could feel confident that the research discussed above is reliable.

(2)

(Total 11 marks)