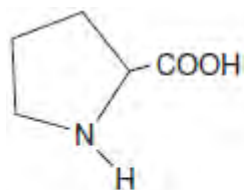
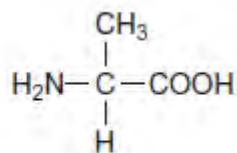


Q1.(a) The structures and common names of two amino acids are shown.



proline



alanine

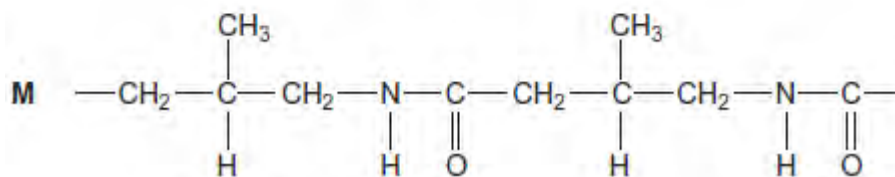
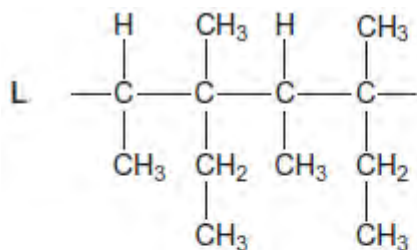
(i) Draw the structure of the zwitterion of proline.

(1)

(ii) Draw the structure of the tripeptide formed when a proline molecule bonds to two alanine molecules, one on each side.

(2)

(b) Sections of two polymers, **L** and **M**, are shown.



(i) Give the IUPAC name of a monomer that forms polymer **L**.

.....

(1)

(ii) Give the IUPAC name of the monomer that forms polymer **M**.

.....

(1)

(iii) Draw the section of a polymer made from a dicarboxylic acid and a diamine that is isomeric with the section of polymer **M** shown.

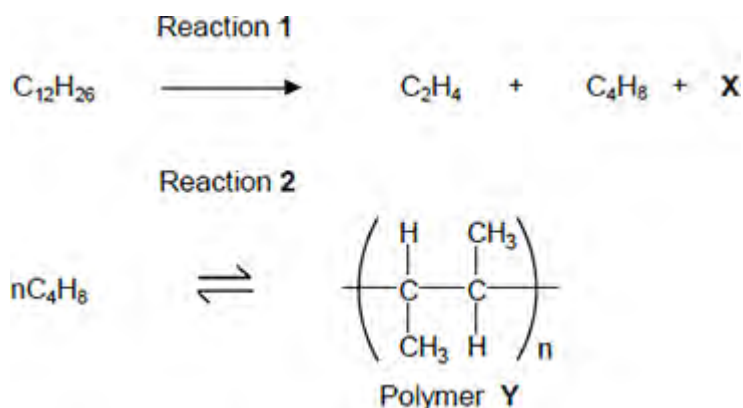
(1)

(vi) Explain why polymer **L** is non-biodegradable.

.....

(1)
(Total 7 marks)

Q2. Dodecane ($C_{12}H_{26}$) is a hydrocarbon found in the naphtha fraction of crude oil. Dodecane can be used as a starting material to produce a wide variety of useful products. The scheme below shows how one such product, polymer **Y**, can be produced from dodecane.



(a) Name the homologous series that both C_2H_4 and C_4H_8 belong to.
 Draw a functional group isomer of C_4H_8 that does **not** belong to this homologous series.

Name

Functional group isomer

(2)

(b) Identify compound **X**.

.....

(1)

(c) Name polymer **Y**.

.....

(1)

(d) Reaction **1** is an example of thermal cracking and is carried out at a temperature of 750 °C.

State **one other** reaction condition needed.

.....

(1)

(e) Reaction **2** is exothermic. A typical compromise temperature of 200 °C is used industrially for this reaction.

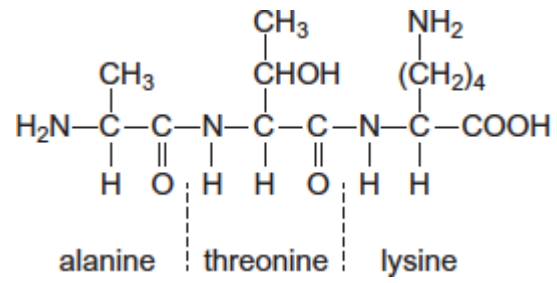
Explain the effect of a change of temperature on both the position of equilibrium and the rate of reaction, and justify why a compromise temperature is used industrially.

.....
.....
.....
.....
.....
.....
.....
.....

.....

(6)
 (Total 11 marks)

Q3.(a) The tripeptide shown is formed from the amino acids alanine, threonine and lysine.



(i) Draw a separate circle around **each** of the asymmetric carbon atoms in the tripeptide. (1)

(ii) Draw the zwitterion of alanine. (1)

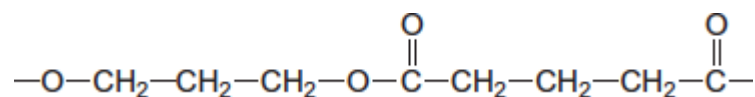
(iii) Give the IUPAC name of threonine. (1)

.....

(iv) Draw the species formed by lysine at low pH.

(1)

- (b) The repeating unit shown represents a polyester.



- (i) Name this type of polymer.

.....

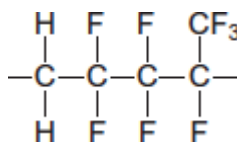
(1)

- (ii) Give the IUPAC name for the alcohol used to prepare this polyester.

.....

(1)

- (c) The repeating unit shown represents a polyalkene co-polymer. This co-polymer is made from two different alkene monomers.



- (i) Name the type of polymerisation occurring in the formation of this co-polymer.

.....

(1)

- (ii) Draw the structure of each alkene monomer.

Alkene monomer 1

Alkene monomer 2

(2)

- (d) One of the three compounds shown in parts (a), (b) and (c) cannot be broken down by hydrolysis.

Write the letter **(a)**, **(b)** or **(c)** to identify this compound and explain why hydrolysis of this compound does **not** occur.

Compound

Explanation

.....

.....

(2)
(Total 11 marks)

Q4. The carbonyl compound $\text{CH}_3\text{CH}_2\text{CHO}$ reacts very slowly with HCN

- (a) Name and outline a mechanism for the reaction of $\text{CH}_3\text{CH}_2\text{CHO}$ with HCN

Name of mechanism

Mechanism

(5)

- (b) The reaction in part (a) produces a pair of enantiomers.

- (i) Draw the structure of each enantiomer to show how they are related to each other.

(2)

- (ii) State and explain how you could distinguish between the two enantiomers.

.....

.....
.....
.....

(2)

- (c) Give the IUPAC name of the product of the reaction in part (a).

.....

(1)

- (d) In practice, KCN rather than HCN is added to the carbonyl compound.

Given that K_a for HCN = $4.0 \times 10^{-10} \text{ mol dm}^{-3}$, suggest why the reaction with HCN is very slow.

.....
.....
.....
.....

(2)

- (e) Acrylic fibres are used as a substitute for wool. Acrylics are copolymers of acrylonitrile with other compounds.

Acrylonitrile is the common name for the following compound.



- (i) Acrylonitrile can be formed from propene.

Write an equation for the reaction of propene with ammonia and oxygen to form acrylonitrile and one other product.

.....

(1)

- (ii) The term copolymer is used to describe the product obtained when two or more different monomers form a polymer.

Draw the repeating unit of the acrylic copolymer that contains 75% acrylonitrile monomer and 25% chloroethene monomer.

(1)

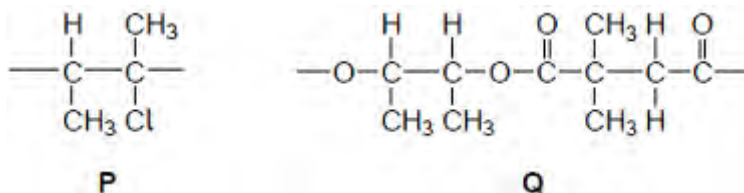
(iii) Name the type of polymerisation involved in part (ii)

.....

(1)

(Total 15 marks)

Q5. Repeating units of two polymers, **P** and **Q**, are shown in the figure below.



(a) Draw the structure of the monomer used to form polymer **P**.
Name the type of polymerisation involved.

Monomer

Type of polymerisation

(2)

(b) Draw the structures of **two** compounds that react together to form polymer **Q**.

Structure of compound 1

Structure of compound 2

(2)

- (c) Suggest an environmental advantage of polymer **Q** over polymer **P**.
Justify your answer.

Advantage

Justification

.....

.....

.....

.....

(3)
(Total 7 marks)