A LEVEL CHEMISTRY

TOPIC 19 – AMINO ACIDS, POLYMERS, ORGANIC SYNTHESIS AND BIOCHEMISTRY

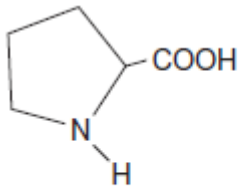
TEST

Answer all questions

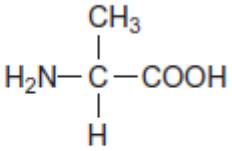
Max 50 marks

Name ……..
Mark ……../50 ……....% Grade ……

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



proline



alanine

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

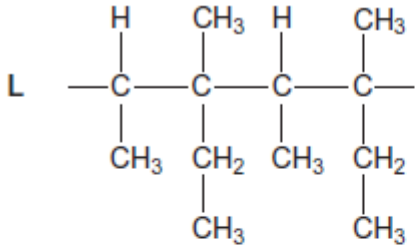
(1)

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

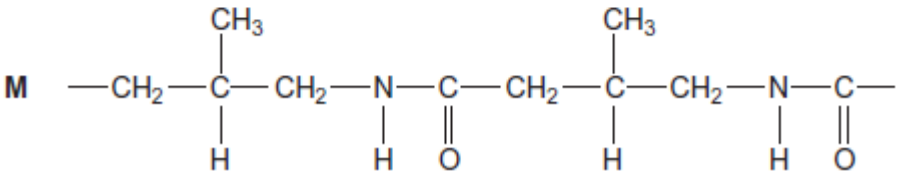
(2)

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

L



M



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

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(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.

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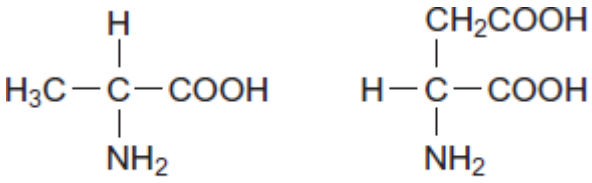
(1)

(Total 7 marks)

2. Alanine and aspartic acid are naturally occurring amino acids.



alanine

aspartic acid

(a) Draw the structure of the zwitterion formed by alanine.

(1)

(b) Draw the structure of the compound formed when alanine reacts with methanol in the presence of a small amount of concentrated sulfuric acid.

(1)

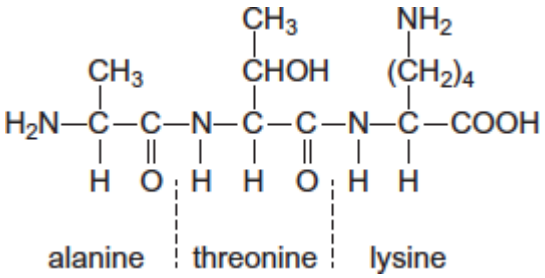
(c) Draw the structure of the species formed by aspartic acid at high pH.

(1)

(d) Draw the structure of a dipeptide formed by two aspartic acid molecules.

(1)
(Total 4 marks)

3. (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.

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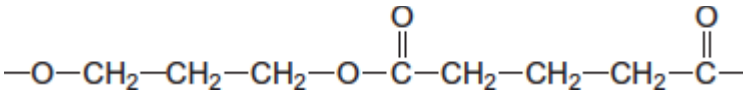
(1)

(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.

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(1)

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

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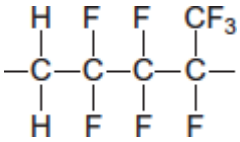
(1)

(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.

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(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 .....

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(2)
(Total 11 marks)

4. (a) The compound $H_2C=CHCN$ is used in the formation of acrylic polymers.

(i) Draw the repeating unit of the polymer formed from this compound.

(ii) Name the type of polymerisation involved in the formation of this polymer.

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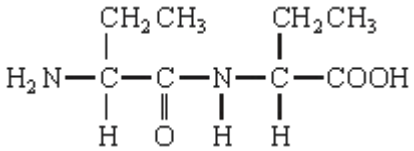
(2)

(b) When the dipeptide shown below is heated under acidic conditions, a single amino acid is produced.



(i) Name this amino acid.

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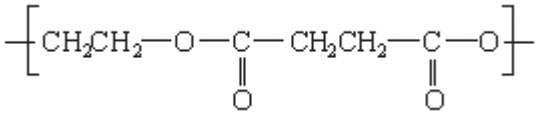
(ii) Draw the structure of the amino acid species present in the acidic solution.

(2)

(c) The repeating unit of a polyester is shown below.



(i) Deduce the empirical formula of the repeating unit of this polyester.

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(ii) Draw the structure of the acid which could be used in the preparation of this polyester and give the name of this acid.

Structure .....

Name .....

(iii) Give **one** reason why the polyester is biodegradable.

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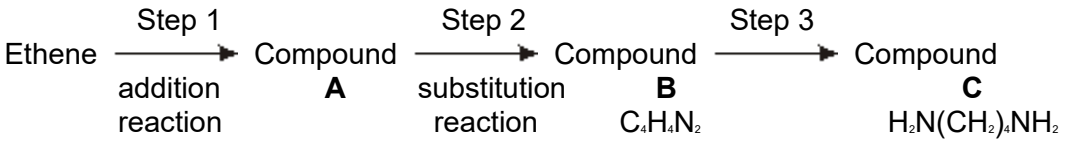
(4)
(Total 8 marks)

5. (a) Compound **C**, $H_2N(CH_2)_4NH_2$, can be synthesised from ethene in three steps as shown below.



Name compound **C** and draw a structure for each of compounds **A** and **B**.
State the reagent(s) required for each step and name the type of reaction involved in the conversion of **B** into **C**.

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(7)

(b) Draw the repeating unit of the polyamide formed when **C** reacts with hexanedioic acid. Discuss the interactions between the chains of the polyamide.

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(4)

(c) Explain why polyamides are degraded by sodium hydroxide whereas polymers such as poly(ethene) are not.

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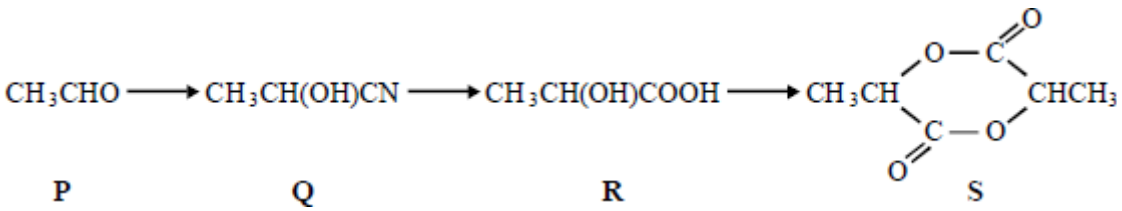
(3)
(Total 14 marks)

6. This question refers to the reaction sequence below.



Which one of the following is **not** involved in the reaction sequence?

A esterification

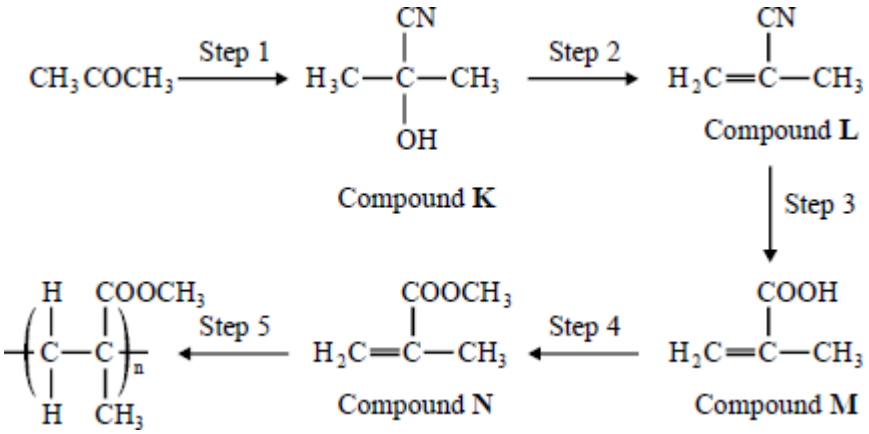
B hydrolysis

C nucleophilic addition

D reduction

(Total 1 mark)

7. This question concerns the preparation of the plastic poly(methyl 2-methylpropenoate) (*Perspex*), starting from propanone.



Which one of the following sets of reagents is **not** suitable for the step indicated?

A Step 1 HCN (NaCN then dilute HCl)

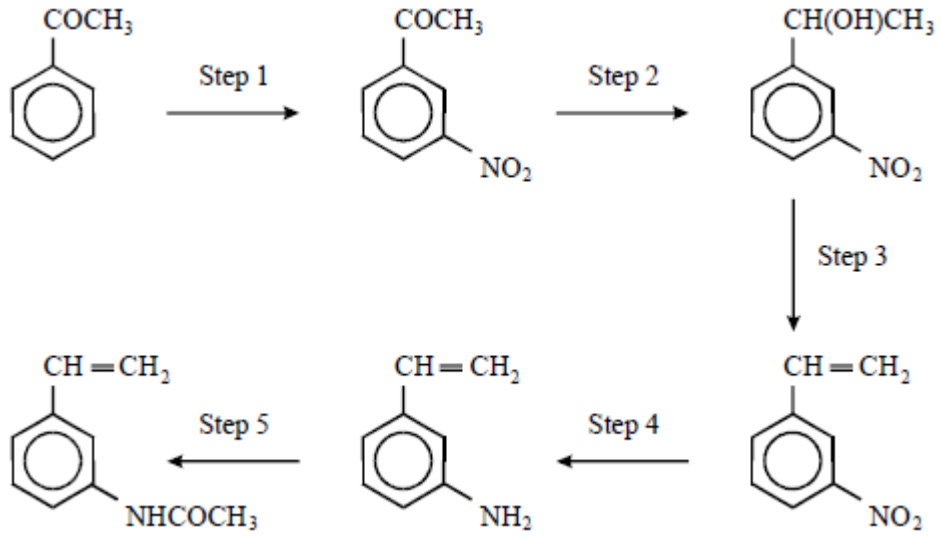
B Step 2 hot ethanolic KOH

C Step 3 warm aqueous H_2SO_4

D Step 4 CH_3OH with an acid catalyst

(Total 1 mark)

Refer to the following reaction sequence for Questions 8, 9 and 10:



8. Which one of the following types of reaction is **not** involved in the above sequence?

A acylation

B oxidation

C reduction

D dehydration

(Total 1 mark)

9. Which one of the following types of reaction mechanism is **not** involved in the above sequence?

A electrophilic addition

B electrophilic substitution

C addition−elimination

D elimination

(Total 1 mark)

10. Which one of the following would be the most appropriate to carry out Step 2?

A H_2 / Ni

B Sn / HCl

C $NaBH_4$

D Fe / HCl

(Total 1 mark)

11. Terylene is made by reacting benzene-1,4-dicarboxylic acid and ethane-1,2-diol.

Terylene is

A an addition polymer.

B a polyamide.

C a polyester.

D a nylon.

(Total 1 mark)