

Past-paper walk-through

Amino acids ■ 34.4

eXercise

Questions in this set

- 9701/42 N25 Q8 ■ 16 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 8

9701/42 N25 ■ Q8 ■ 16 marks

- 8 Asparagine and aspartic acid are two naturally occurring amino acids. Their structures and isoelectric points are shown in Table 8.1.

Table 8.1

amino acid	structure	isoelectric point
asparagine	$\text{HOOCCH}(\text{NH}_2)\text{CH}_2\text{CONH}_2$	5.41
aspartic acid	$\text{HOOCCH}(\text{NH}_2)\text{CH}_2\text{COOH}$	2.77

- (a) Define isoelectric point.

Question 8

(b) Draw the structures of asparagine and aspartic acid at pH2.

asparagine at pH2

aspartic acid at pH2

Question 8

[2]

(c) Asparagine and aspartic acid are treated separately with an excess of LiAlH_4 .

Draw the structures of the organic products of these reactions.

product of asparagine treated with an excess of LiAlH_4

product of aspartic acid treated with an excess of LiAlH_4

Question 8

121

(d) Propanedioic acid, $\text{HOOCCH}_2\text{COOH}$, is treated with an excess of thionyl chloride, SOCl_2 . Propanedioyl chloride, $\text{ClOCCH}_2\text{COCl}$, is formed.

(i) Write an equation for this reaction.

Question 8

- (ii) Propanedioyl chloride reacts with an excess of asparagine to form compound **G** with molecular formula $\text{C}_{11}\text{H}_{16}\text{N}_4\text{O}_8$.

Each molecule of compound **G** has four amide groups.

Draw the structure of compound **G**.

Compound **G**, $\text{C}_{11}\text{H}_{16}\text{N}_4\text{O}_8$

Question 8

[2]

- (e) Asparagine is hydrolysed with an excess of hot NaOH(aq) .

Draw the structure of the organic product of this reaction.

Question 8

[2]

- (f) A polymer can form from asparagine, $\text{HOOCCH}(\text{NH}_2)\text{CH}_2\text{CONH}_2$, as the only monomer.

Draw a length of the polymer chain containing **three** monomer residues.

Clearly label the repeat unit of the polymer on your diagram.

Question 8

[3]

- (g) Aspartic acid exists in two optically active forms.
- (i) Plane polarised light is passed through pure samples of these two optically active forms in solutions of the same concentration.

Describe **two** similarities and **one** difference in their effect on the plane polarised light.

Question 8

Question 8

Question 8

Question 8

[2]

- (ii) Give the term used to describe a mixture of equal amounts of the two optically active forms.

Question 8

[Total: 16]

Question 8

Question 9 starts on page 20.

Solution 8

(a)

Mark scheme

- the pH at which an amino acid exists as a zwitterion
- 1

Solution 8

(b)

Mark scheme

- M1: $[\text{HOOCCH}(\text{NH}_3)\text{CH}_2\text{CONH}_2]^+$
- M2: $[\text{HOOCCH}(\text{NH}_3)\text{CH}_2\text{COOH}]^+$
- 2
- 9701/42
- October/November 2025

Solution 8

(c)

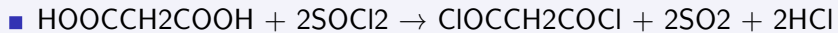
Mark scheme

- M1: $\text{HOCH}_2\text{CH}(\text{NH}_2)\text{CH}_2\text{CH}_2\text{NH}_2$
- M2: $\text{HOCH}_2\text{CH}(\text{NH}_2)\text{CH}_2\text{CH}_2\text{OH}$
- 2

Solution 8

(d)(i)

Mark scheme



1

■ 1

Solution 8

(d)(ii)

Mark scheme

- $\text{HOOCCH}(\text{CH}_2\text{CONH}_2)\text{NHCOCH}_2\text{CONHCH}(\text{CH}_2\text{CONH}_2)\text{COOH}$
- M1: three molecules joined, with four correct amide groups only
- M2: whole structure correct as above, displayed formula accepted, skeletal formula as below accepted
- 2

Solution 8

(e)

Mark scheme

- M1: hydrolysis of amide to carboxylate ion
- M2: hydrolysis of -COOH to carboxylate ion and rest of molecule
- $\text{-OOCCH(NH}_2\text{)CH}_2\text{COO-}$
- 2
- 9701/42
- October/November 2025

Solution 8

(f) Mark scheme

- ■
- three monomer residues
- ■
- all linkages correct
- ■
- correct trailing bonds
- ■
- repeat unit marked contains correct atoms

Solution 8

- Any two [1], any three [2], all four [3]
- CH_2CONH_2 CH_2CONH_2
- $\begin{array}{c} | \quad | \end{array}$
- $-\text{COCHNH}-[-\text{COCHNH}-]-\text{COCHNH}-$
- $\begin{array}{c} | \end{array}$
- CH_2CONH_2
- 3

Solution 8

(g)(i) Mark scheme

- ■
- rotate the plane of the plane polarised light
- ■
- by the same angle
- ■
- in opposite directions
- Any two [1], all three [2]
- 2

Solution 8

(g)(ii)

Mark scheme

- racemic mixture
- 1