Q1.

Endomorphin-2 is a peptide with the amino acid sequence shown.

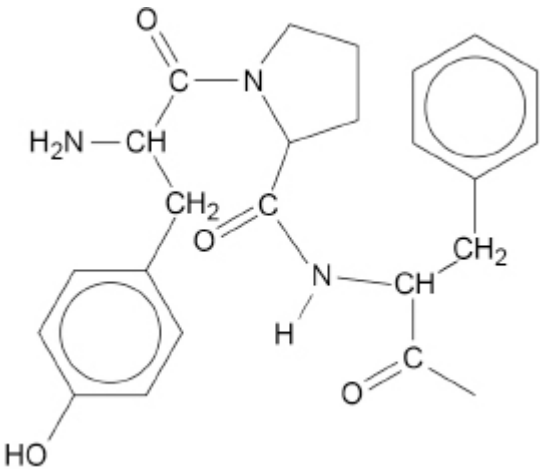
Tyr–Pro–Phe–Phe–NH_2

Each amino acid is represented by a three-letter abbreviation.

Tyr = tyrosine Pro = proline Phe = phenylalanine

Figure 1 shows part of the structure of endomorphin-2, showing the Tyr–Pro–Phe– part of the molecule.

Figure 1



(a) The $-NH_2$ at the end of the amino acid sequence of endomorphin-2 shows that the terminal functional group is an amide, not an acid.

Complete the structure of endomorphin-2 in **Figure 1**.

(2)

(b) Use the structure in **Figure 1** to draw the skeletal formula of proline, Pro.

(1)

A student hydrolyses a sample of endomorphin-2 to break it down into its constituent amino acids.

The student analyses the resulting mixture by thin-layer chromatography, TLC.

(c) State a reagent and the conditions needed for the hydrolysis.

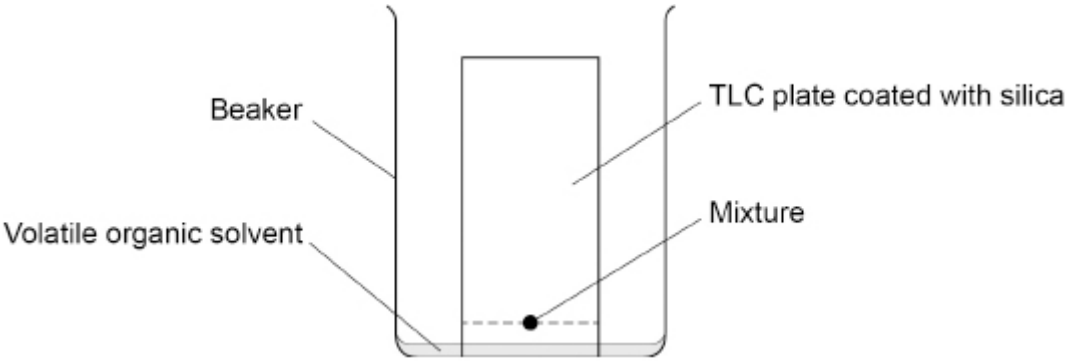
Reagent _____

Conditions _____

(2)

(d) **Figure 2** shows the apparatus used for the TLC.

Figure 2



There is a piece of the apparatus missing from **Figure 2**. This omission will result in an inaccurate chromatogram.

Identify the missing piece of the apparatus.

State and explain why this piece of the apparatus is needed.

Missing piece _____

Explanation _____

_____

_____

_____

(3)

(e) State why the amino acids separate on the TLC plate.

_____

_____

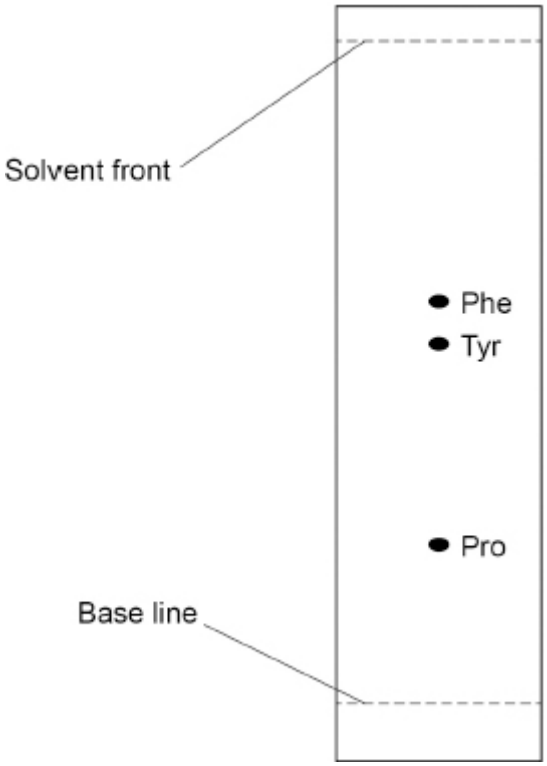
_____

(1)

When the solvent has risen up the TLC plate, the student removes the plate from the beaker and sprays it with a developing agent.

Figure 3 shows the result.

Figure 3



(f) Name a suitable developing agent.

State why the developing agent is needed.

Name _____

Why needed _____

_____

_____

(2)

(g) Determine the R_f value for Tyr.

R_f _____

(1)

(Total 12 marks)

Q2.

Proteins are polymers made from amino acids.
Part of the structure of a protein is shown.

–Cys–Ser–Asp–Phe–

Each amino acid in the protein is shown using the first three letters of its name.

(a) Identify the type of protein structure shown.

Tick (✓) **one** box.

Primary	☐
Secondary	☐
Tertiary	☐

(1)

(b) Draw a structure for the –Cys–Ser– section of the protein.
Use the Data Booklet to help you answer this question.

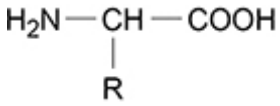
(2)

(c) Name the other substance formed when two amino acids react together to form part of a protein chain.

_____

(1)

The general structure of an amino acid is shown.



R represents a group that varies between different amino acids.
R groups can interact and contribute to protein structure.

(d) Explain why the strength of the interaction between two cysteine R groups differs from the strength of the interaction between a serine R group and an aspartic acid R group.

Use the Data Booklet to help you answer this question.

(4)

(e) Deduce the type of interaction that occurs between a lysine R group and an aspartic acid R group.

(1)

(Total 9 marks)