

**A Level Biology B**

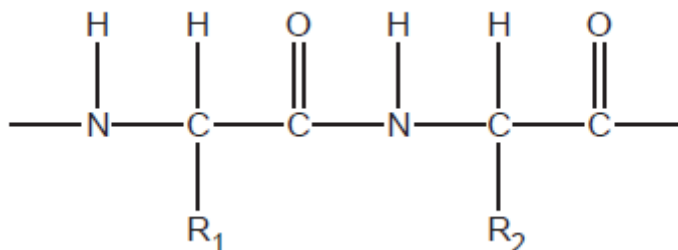
**H422/02** Scientific literacy in biology

**Question Set 15**

1. (a) (i) Antimicrobial peptides (AMPs) are peptides found in animals and plants that destroy a wide range of pathogenic bacteria, fungi and viruses.

The  $\alpha$ -defensins are a group of AMPs that contain 18–45 amino acids.

The diagram below shows part of the structure of an  $\alpha$ -defensin molecule.



Draw a circle around the part of the structure that represents the peptide bond.

*[The response to this question should be drawn on the diagram.]*

[1]

- (ii) Name the chemical reaction that joins the amino acids together in a peptide.

[1]

- (b) (i) A student used paper chromatography to investigate the amino acid composition of a sample of  $\alpha$ -defensin.

Suggest the importance of the following steps in the paper chromatography procedure.

1. The sample of  $\alpha$ -defensin was heated with hydrochloric acid.
2. Care was taken not to touch the paper with fingers.

[2]

(ii) Fig. 2 shows the results of one analysis.

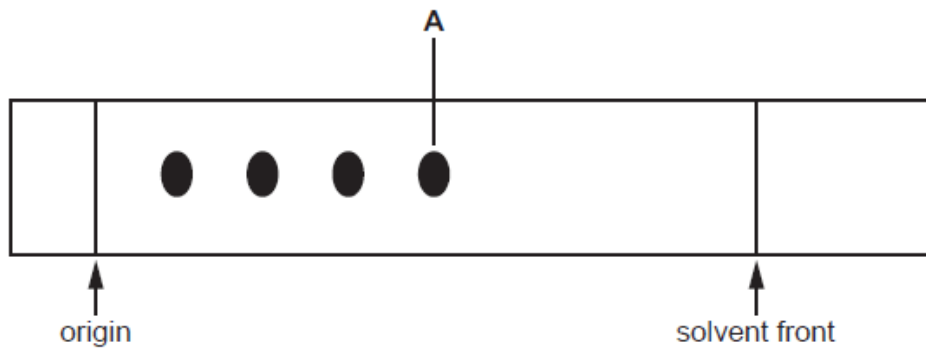


Table 2 shows  $R_f$  values for six different amino acids.

Amino acid	$R_f$
Arginine	0.16
Cysteine	0.37
Glutamic acid	0.31
Isoleucine	0.53
Methionine	0.51
Tyrosine	0.55

Using Fig. 2 and Table 2, calculate the  $R_f$  value for spot **A** and identify the amino acid.

[2]

(c)\* Antimicrobial peptides (AMPs) are produced by epithelial cells in the intestines, respiratory tract, urinary tract and vagina.

The actions of AMPs include:

- destruction of many pathogenic bacteria, fungi and viruses
- stimulation of mast cells
- attraction and activation of phagocytes
- aggregation of pathogens (bacteria, fungi, viruses).

Use this information to explain how AMPs play an important role in the body's **non-specific** defence mechanisms.

[6]

(d) (i) The  $\beta$ -defensins are another group of peptides found in the male reproductive tract.

One  $\beta$ -defensin is coded for by the *DEFB126* gene. Men who are homozygous for a mutation in *DEFB126* have a normal sperm count with normal motility, but the sperm have a reduced ability to penetrate hyaluronic acid (a model for female cervical mucus).

Suggest why it is thought that the *DEFB126* mutation reduces the chance of successful fertilisation.

[2]

- (ii) It is estimated that 22% of all Europeans are homozygous for the recessive mutant form of *DEFB126*.

Calculate the allele frequency of the mutant form of *DEFB126* in all Europeans (men and women).

Use the Hardy-Weinberg equations:

$$p + q = 1 \qquad p^2 + 2pq + q^2 = 1$$

Give your answer to **2 significant figures**.

[2]

- (iii) The fact that the *DEFB126* mutation reduces the chances of successful fertilisation means that, in theory, the allele frequency should have fallen.

Suggest why the allele frequency of the *DEFB126* mutation remains high.

[1]

**Total Marks for Question Set 15: 17**

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