UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/04**

Paper 4 Structured Questions A2 Core **October/November 2007**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer **one** question.
Circle the number of the Section B question you have answered in the grid below.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Section B	
10 or 11	
Total	

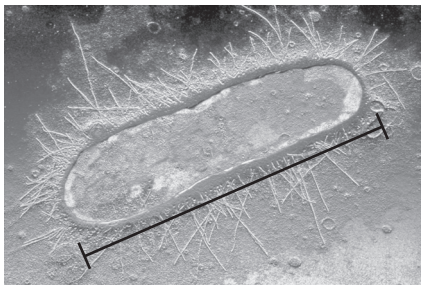
This document consists of **21** printed pages, **2** lined pages and **1** blank page.

Section A

Answer **all** questions.

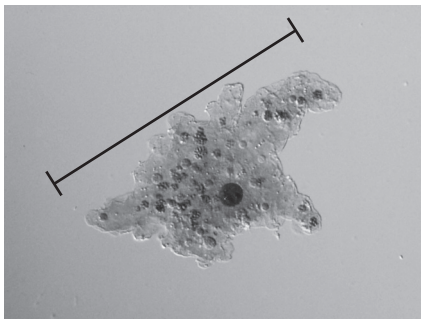
Write your answers in the spaces provided.

1 Fig. 1.1 shows two unicellular organisms, **P** and **R**. These organisms are members of **different** kingdoms.



X 20 000

P



X 2 000

R

Fig. 1.1

(a) Calculate the actual sizes, in µm, of **P** and **R**, as shown by the lines on Fig. 1.1.

Show your working.

P ..... µm

R ..... µm [3]

(b) Identify the kingdom to which each organism belongs. Write your answers in the table below. [1]

(c) Complete the table by listing five features which distinguish **P** from **R**.

One has been completed for you. [5]

	unicell **P**	unicell **R**
kingdom	.....	.....
features	1 cell wall present	cell wall absent
	2	....
	3	....
	4	....
	5	....
	6	....

[Total: 9]

2 Fig. 2.1 shows part of a tropical rainforest.

Tropical rainforests have a high biodiversity.

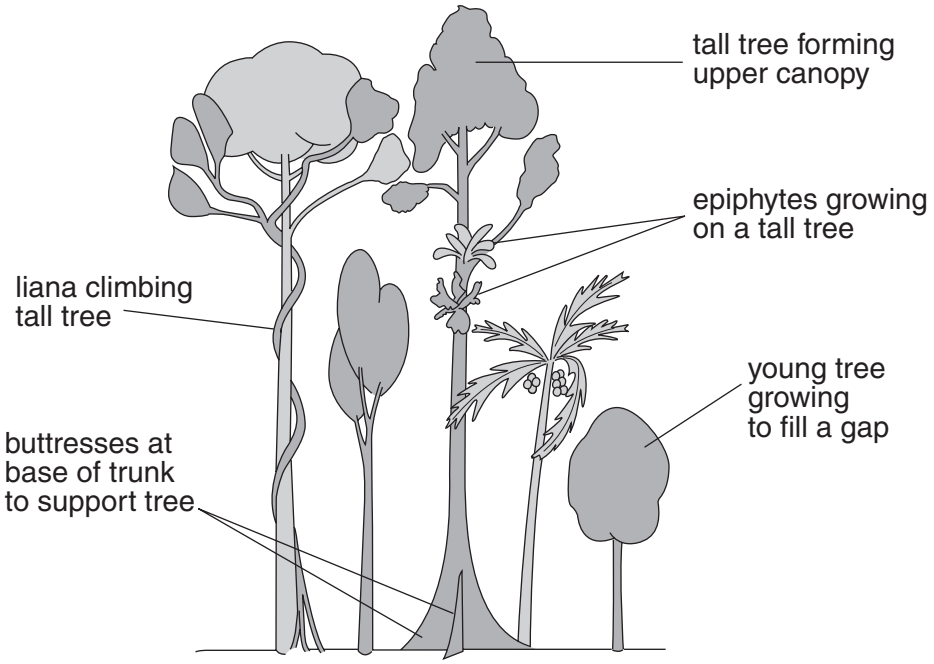


Fig. 2.1

(a) Explain what is meant by *biodiversity*.

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(b) Suggest why tropical rainforests have a high biodiversity of animal species.

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(c) Discuss why it is important to maintain biodiversity.

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[Total: 9]

3 **(a)** Outline the symptoms of cystic fibrosis (CF).

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(b) CF is caused by a recessive mutation, **b**, on an autosome.

Draw a genetic diagram to show, for parents with genotypes **BbXX** and **BbXY**, the **probability** of having a daughter who suffers from CF.

In your genetic diagram, show the genotypes of the gametes and the genotypes and phenotypes of the offspring.

genetic diagram

parental genotypes **BbXX** x **BbXY**

genotypes of gametes

genotypes and phenotypes of offspring

[4]

(c) One of the many mutations for CF results in the amino acid arginine being replaced by histidine in the polypeptide encoded by the CF gene.

Explain how a mutation may cause such a change in the amino acid sequence of a polypeptide.

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..... [4]

(d) A genetic test was performed on two individuals, **D** and **E**, to find the base sequences of a small part of the CF gene. The different base sequences are shown diagramatically in Fig. 3.1. Individual **E** has CF.

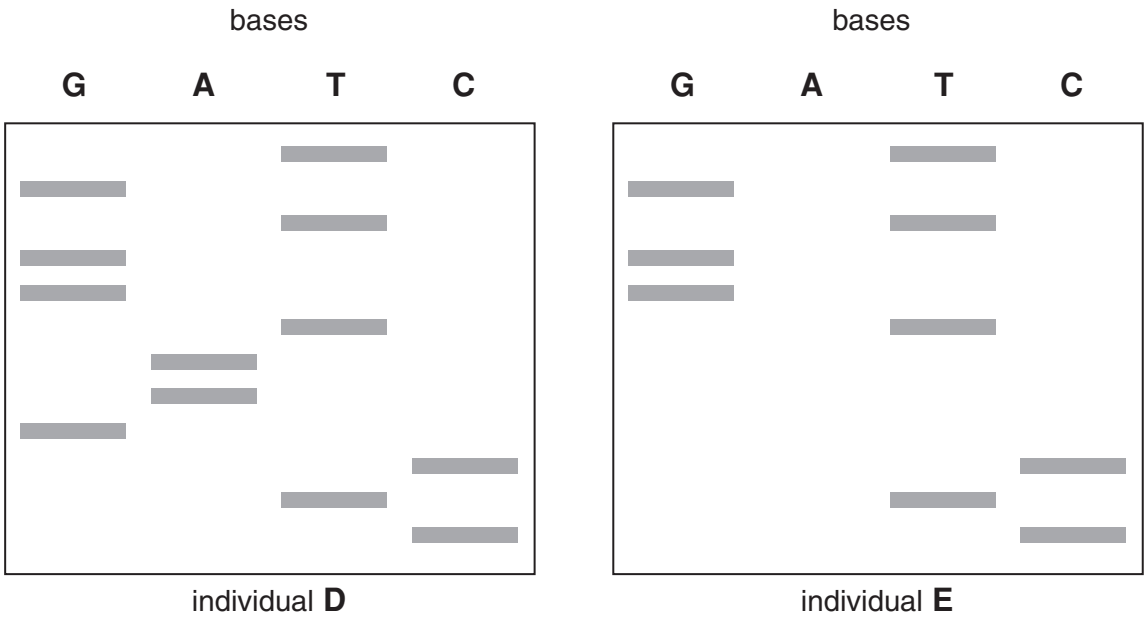

Fig. 3.1

With reference to Fig. 3.1, state,

(i) how the base sequence of **E** differs from that of **D**

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..... [1]

(ii) the effect of this difference in the polypeptide produced by the two individuals.

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..... [2]

[Total: 15]

4 **(a)** Explain the role of negative feedback in homeostasis in mammals.

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..... [4]

(b) The enzyme glucose oxidase catalyses the conversion of glucose to gluconic acid.

$$\text{glucose} + O_2 + H_2O \longrightarrow \text{gluconic acid} + H_2O_2$$

Describe how glucose oxidase in a biosensor can give warning of low blood glucose concentration (hypoglycaemia).

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..... [4]

[Total: 8]

5 Wheat, maize and sorghum are three of the most important cereal crops in the world.

(a) Fig. 5.1 shows the effect of temperature on the rate of photosynthesis of wheat plants.

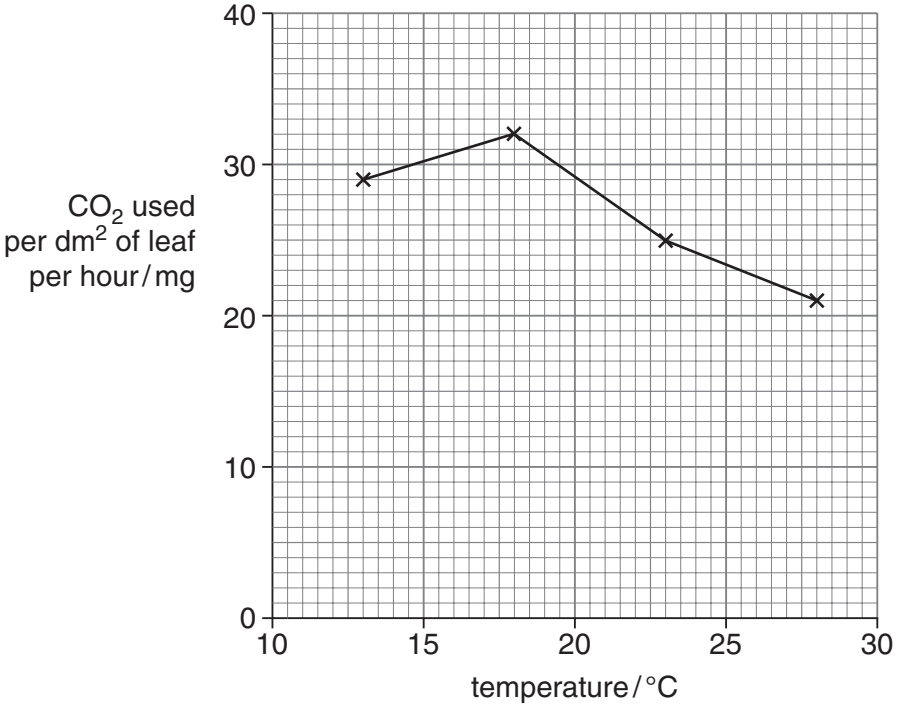

Fig. 5.1

(i) With reference to Fig. 5.1, describe the effect of temperature on the rate of photosynthesis of wheat plants.

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..... [2]

(ii) Suggest why temperature affects the rate of photosynthesis in the way you have described in **(i)**.

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..... [2]

(b) The conditions in which young plants of wheat and maize are grown affects their ability to photosynthesise at high and low temperatures when they are mature.

Young maize and wheat plants were grown to maturity at high and low temperatures. When they were mature, their rate of photosynthesis was measured at different temperatures. The results are shown in Fig. 5.2.

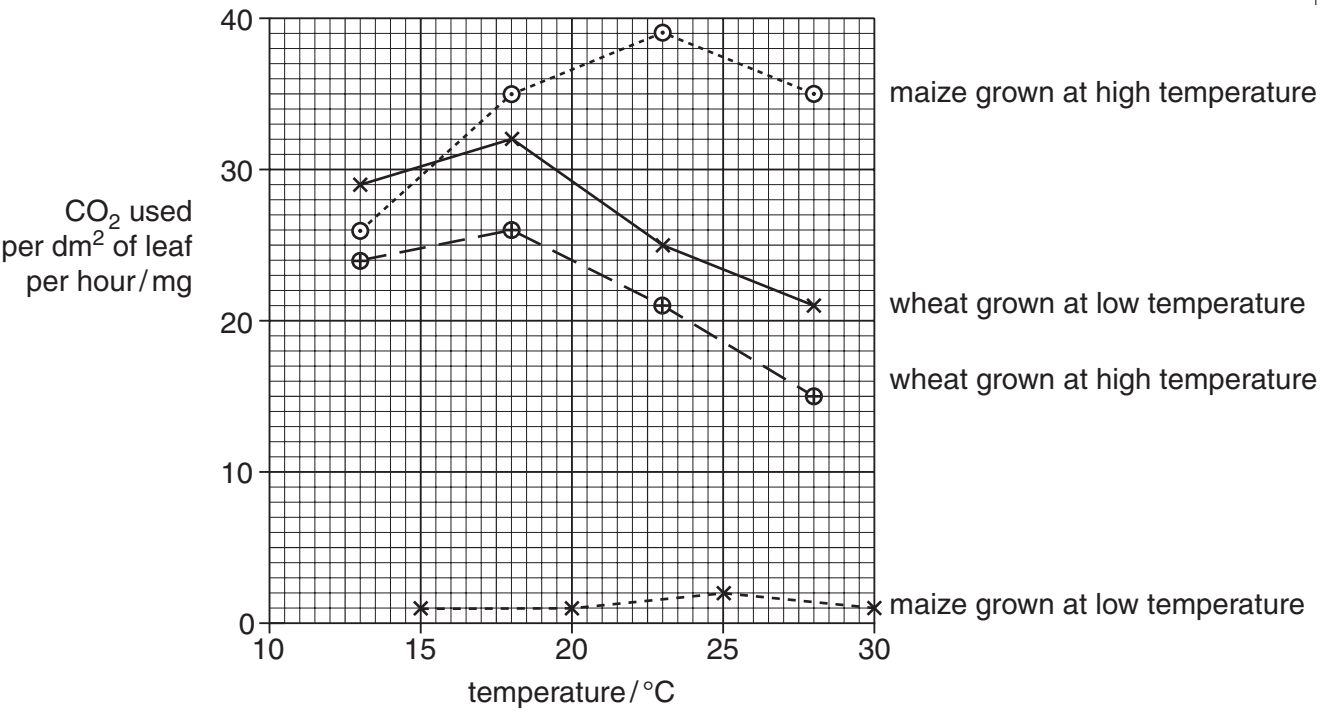

Fig. 5.2

(i) With reference to Fig. 5.2, compare the effect of temperature on the rate of photosynthesis of maize plants and wheat plants that were grown at a high temperature when they were young.

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(ii) Maize is a C4 plant.
Explain how the structure of the leaves of maize plants enables them to photosynthesise more effectively at high temperatures than wheat plants.

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(iii) Low temperatures slow down the formation of the membranes inside chloroplasts in maize leaves, but not in wheat leaves.
Use this information to explain the differences between the results for maize and wheat grown at low temperatures, shown in Fig. 5.2.

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..... [2]

(c) Cereal crops frequently form the staple diet of human populations. Table 5.1 shows the oil and starch content of maize and sorghum grains.

Table 5.1

	percentage of dry mass	
	maize	sorghum
oil	4.7	3.8
starch	62.2	70.1

(i) Name the part of the maize grain in which oil and starch are stored.

..... [1]

(ii) With reference to Table 5.1, compare the energy values of maize and sorghum grains when the oil and starch they contain are used as respiratory substrates.

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..... [3]

[Total: 15]

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6 Couples who are unable to conceive naturally may be able to have fertility treatment involving in-vitro fertilisation (IVF).

(a) Outline the technique of IVF.

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(b) Table 6.1 shows the success rate, in terms of live births, for IVF using eggs from women of different ages.

Table 6.1

age of woman	percentage success rate of IVF
under 35	27.6
35 to 37	22.3
38 to 39	18.3
40 to 42	10.0
above 42	less than 5.0

(i) Suggest reasons for the trend shown in Table 6.1.

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..... [2]

(ii) The cost of one IVF treatment is about US$ 5000. In some countries, in-vitro fertilisation is offered free of charge to couples who have not conceived within two years of trying. With reference to Table 6.1, put forward an argument against the public funding of in-vitro fertilisation to all couples who request it.

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..... [2]

[Total: 8]

7 In aerobic respiration, the Krebs cycle is regarded as a series of small steps. One of these steps is the conversion of succinate to fumarate by an enzyme, succinate dehydrogenase.

(a) State the role played by dehydrogenase enzymes in the Krebs cycle **and** explain briefly the importance of this role in the production of ATP.

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(b) An investigation was carried out on the effect of different concentrations of aluminium ions on the activity of succinate dehydrogenase. The enzyme concentration and all other conditions were kept constant. Fig 7.1 shows the results of this investigation.

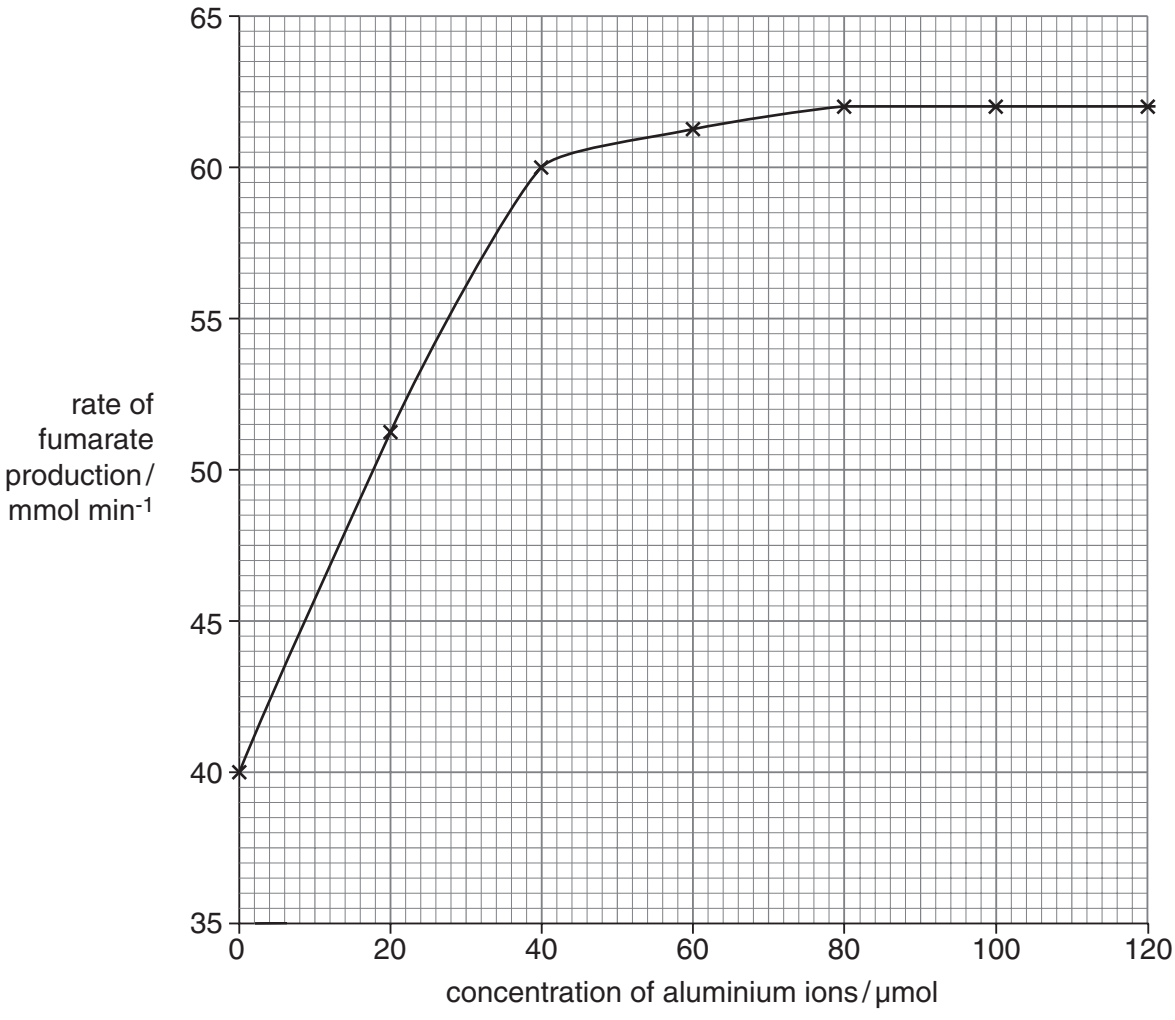

Fig. 7.1

With reference to Fig. 7.1,

(i) describe the effect of the concentration of aluminium ions on the rate of production of fumarate

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(ii) suggest an explanation for this effect.

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[Total: 7]

8 Fig. 8.1 shows the changes in potential difference (p.d.) across the membrane of a neurone over a period of time. The membrane was stimulated at time **A** and time **B** with stimuli of different intensities.

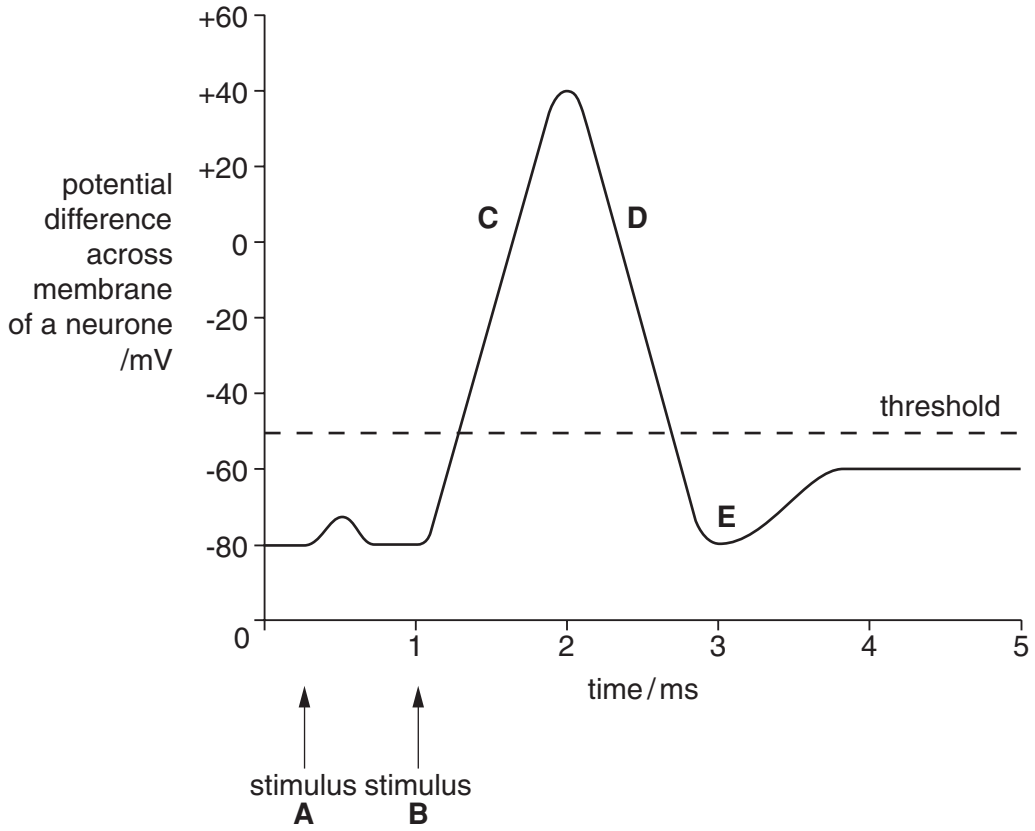

Fig. 8.1

(a) Stimulus **B** resulted in an action potential. Describe what is occurring at **C**, **D** and **E**.

C .....

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D .....

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E .....

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..... [6]

(b) Suggest why stimulus **A** did not result in an action potential being produced whereas stimulus **B** did.

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..... [2]

[Total: 8]

9 Sickle cell anaemia is a genetic disorder that is caused by the presence of two recessive alleles. It is common amongst people of African origin.

Malaria is a major cause of death in sub-Saharan Africa where 90% of the world's cases occur.

Fig. 9.1 shows the distribution of sickle cell anaemia and malaria in Africa.

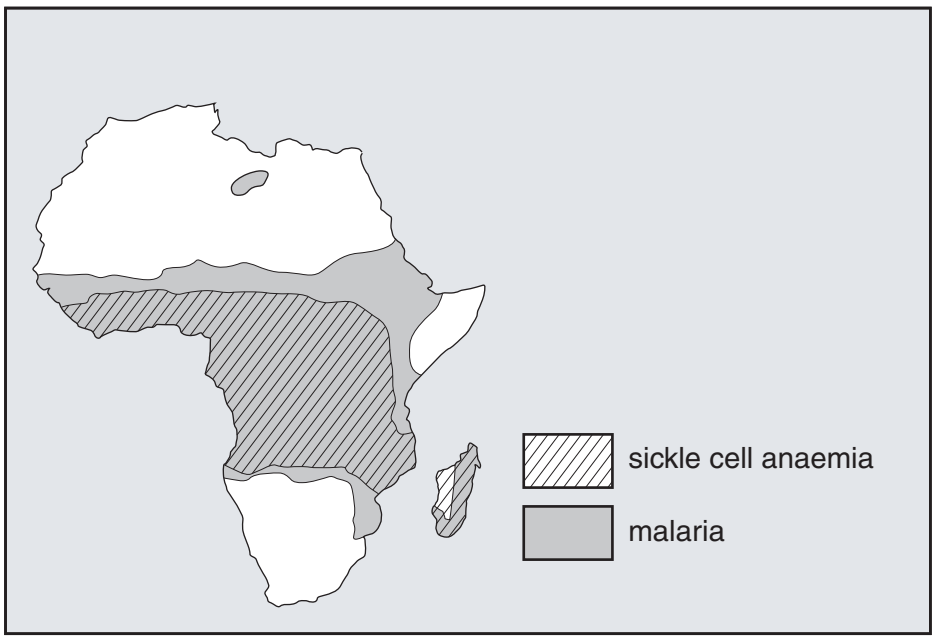

Fig. 9.1

(a) Explain why malaria is found in the areas shown but not in areas such as northern Europe and South Africa.

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(b) With reference to Fig. 9.1, explain the relationship between the distribution of sickle cell anaemia and malaria.

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[Total: 6]

Section B

Answer **one** question.

Circle the number of the question you have answered in the grid on the front cover.

10 **(a)** Describe the structure of photosystems and explain how a photosystem functions in **cyclic** photophosphorylation. [9]

(b) Explain briefly how reduced NADP is formed in the light-dependent stage of photosynthesis and is used in the light-independent stage. [6]

[Total: 15]

11 **(a)** Explain how meiosis and fertilisation can result in genetic variation amongst offspring. [7]

(b) Explain, using examples, how the environment may affect the phenotype of an organism. [8]

[Total: 15]

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