Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5801386919

BIOLOGY **9700/22**

Paper 2 Structured Questions AS **October/November 2015**

1 hour 15 minutes

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.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **16** printed pages.

CAMBRIDGE International Examinations

Answer **all** the questions

1 A student compared an image of a plant cell with an image of an animal cell. Both images were at the same magnification.

Parts **(a)** to **(c)** are four correct comparative statements about these images.

(a) Both cells contain large numbers of an organelle, bound by a double membrane. The inner membrane of these organelles is folded. These organelles all have a similar structure but do not always appear to have the same shape.

(i) State the name of the organelles described.

..... [1]

(ii) Suggest **one** reason why the organelles described do not always seem to have the same shape.

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(b) Both cells contain cell structures that are approximately 25 nm in diameter and are **not** bound by a membrane.

(i) State the name of the cell structures described.

..... [1]

(ii) Draw a circle around the measurement that has the same value as 25 nm.

0.00025 μm **0.0025 μm** **0.025 μm** **0. 25 μm** **2.5 μm**

[1]

(c) There are strands of cytoplasm passing through channels in the cell wall of the plant cell. These are not visible in the animal cell.

(i) State the name of the cell structures described.

..... [1]

(ii) Explain **one** advantage to the plant cell of having these structures.

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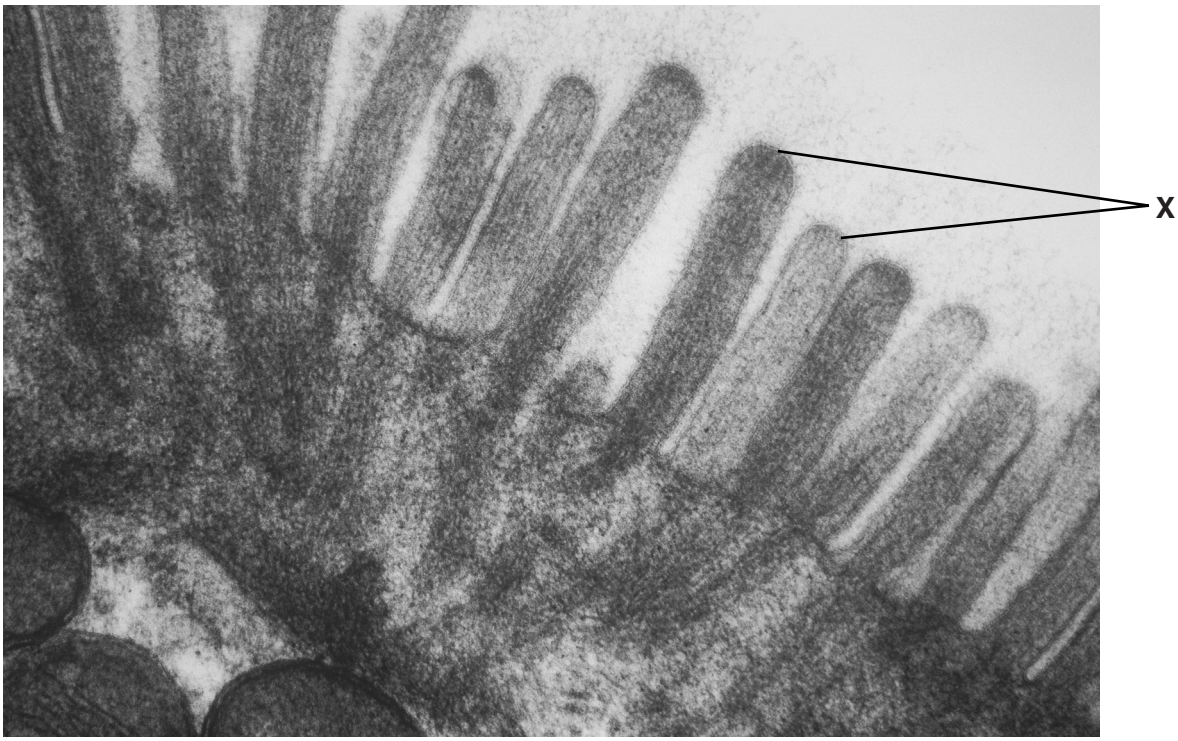
(d) Fig. 1.1 is a transmission electron micrograph of part of an epithelial cell from the small intestine of a mammal.



magnification × 65000

Fig. 1.1

Name the cell structures labelled **X** in Fig. 1.1 **and** state their function.

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..... [1]

[Total: 7]

2 Tobacco smoking is known to be associated with atherosclerosis and emphysema.

(a) Outline ways in which tobacco smoking can contribute to atherosclerosis.

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(b) Fig. 2.1 is a scan of the lungs of a person with emphysema. One common feature in the damaged areas labelled is a loss of the elastic fibres of the alveoli. Another feature is an increased number of macrophages and neutrophils.

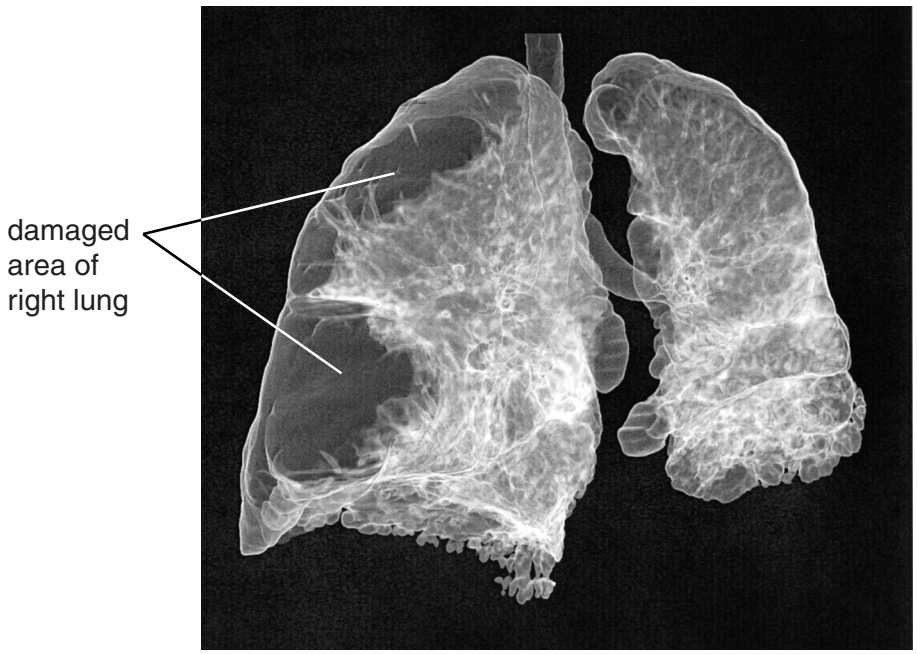

Fig. 2.1

(i) State the general role shared by macrophages and neutrophils.

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..... [1]

(ii) Suggest how the loss of the elastic fibres would cause the enlargement of the lung shown in Fig. 2.1.

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(c) The synthesis and release of elastase enzymes by macrophages and neutrophils is an important feature in the development and progression of emphysema. Elastase causes the breakdown of the protein elastin, the main component of elastic fibres.

(i) Explain what is meant by an enzyme.

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..... [2]

(ii) Elastase has an active site with a specific shape. The mode of action of this enzyme supports the lock and key hypothesis.

Explain the mode of action of elastase.

You may use the space below to draw a diagram or diagrams to help your answer.

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..... [3]

(d) There are two inhibitors of elastase that are produced in the body, TIMP-1 and A1AT:

- macrophage elastase is inhibited by TIMP-1
- neutrophil elastase is inhibited by A1AT.

The inhibitors can be inactivated by the elastase enzymes:

- macrophage elastase can inactivate A1AT
- neutrophil elastase can inactivate TIMP-1.

In healthy lungs, the activity of elastase enzymes is regulated. Tobacco smoke can disrupt this regulation.

(i) One effect of tobacco smoke is to cause changes in the structure of A1AT, a competitive inhibitor.

Suggest how structural changes to A1AT will affect its mode of action.

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..... [1]

(ii) A1AT is a protein. Some non-smokers have a mutation in the gene coding for A1AT and are at risk of developing emphysema as there is a lack of A1AT in the lung tissue.

Explain why a lack of A1AT in these non-smokers means that they are at risk of developing emphysema.

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(e) Tobacco smoke is known to cause increased production of macrophage elastase. *MMP12* is the gene coding for macrophage elastase. Copies of this gene are produced as messenger RNA (mRNA).

Describe how this mRNA is used in translation to produce macrophage elastase.

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[Total: 20]

[Turn over

3 The photomicrographs in Fig. 3.1 show stages of the mitotic cell cycle occurring in the root tip of the onion, *Allium sp*. They are all of the same magnification. Stages **A** to **C** are in the correct sequence and stages **K** to **N** are **not** in the correct sequence.

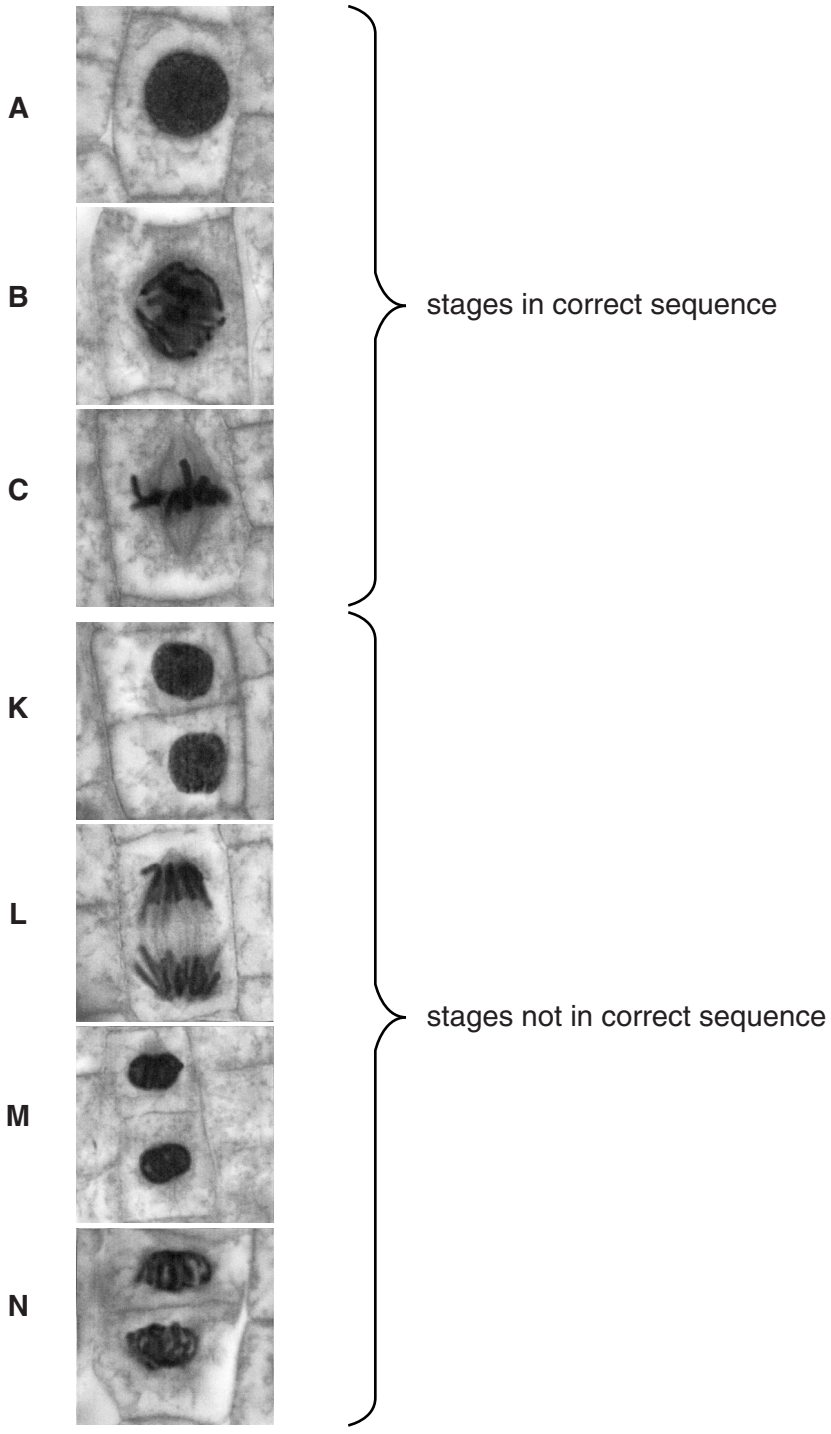

Fig. 3.1

(a) Name stages **A** and **C**.

A .....

C ..... [1]

(b) Put stages **K** to **N** in the correct sequence, starting with the stage that immediately follows stage **C**.

C ⟶ ..... ⟶ ..... ⟶ ..... ⟶ ..... [1]

(c) Explain how the behaviour of the chromosomes and spindle during stage **L** in Fig. 3.1 ensures that the two daughter cells will be genetically identical.

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[Total: 5]

4 **(a)** Table 4.1 describes three examples of substances moving into or out of cells.

Complete Table 4.1 by identifying the transport mechanism involved for each example.

Table 4.1

example	transport mechanism involved
uptake of magnesium ions from a lower concentration in the soil solution to a higher concentration in the cytoplasm of a root hair cell	
release of antibodies from an active B-lymphocyte (plasma cell)	
movement of sucrose from a companion cell into a phloem sieve tube element via plasmodesmata	

[3]

(b) Oxygen moves into and out of red blood cells. Fig. 4.1 shows an oxygen dissociation curve for adult human haemoglobin.

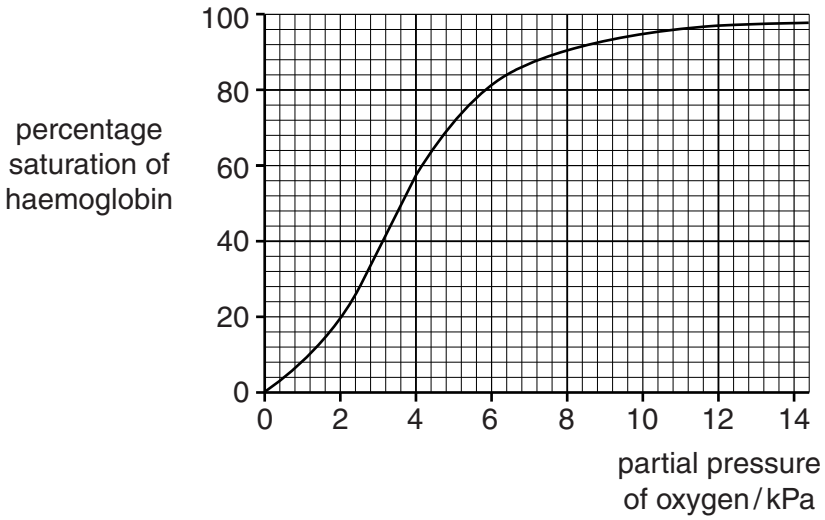

Fig. 4.1

The steepest part of the curve is between 2.6 kPa and 4.2 kPa.

Explain the importance of this for respiring tissues.

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[Total: 5]

5 Diseases can be infectious or non-infectious.

(a) Explain the difference between an infectious and a non-infectious disease.

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Malaria is an infectious disease caused by *Plasmodium*. *Plasmodium* requires two hosts to complete its complex life cycle. One of the hosts is the *Anopheles* mosquito, which acts as a vector of malaria.

Transmission of malaria occurs when females of some species of *Anopheles* take blood meals from humans infected with *Plasmodium*, and then feed on uninfected individuals.

Both male and female *Anopheles* mosquitos have piercing and sucking mouthparts. The female mosquito is shown in Fig. 5.1.

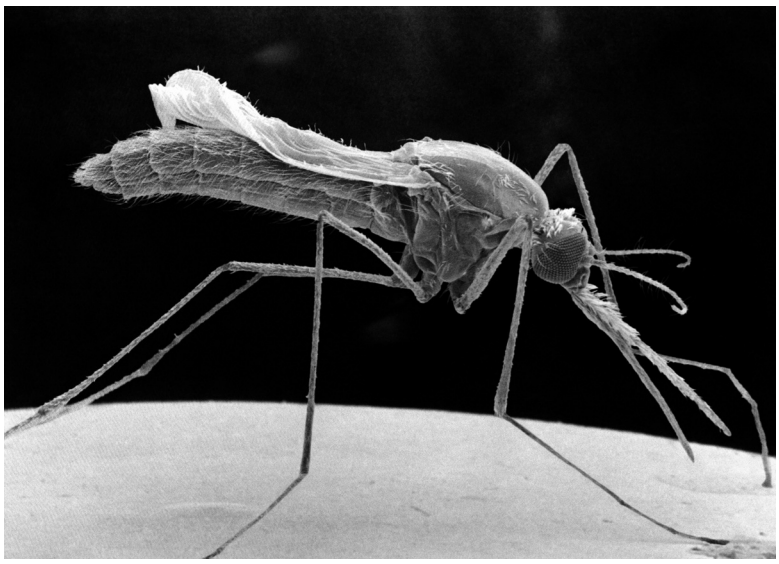

Fig. 5.1

(b) The blood meals are a good source of protein for *Anopheles* for the production of eggs.

Explain why blood is a good source of protein.

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(c) Fig. 5.2 shows the global distribution of those species of *Anopheles* that are able to act as hosts for Plasmodium.

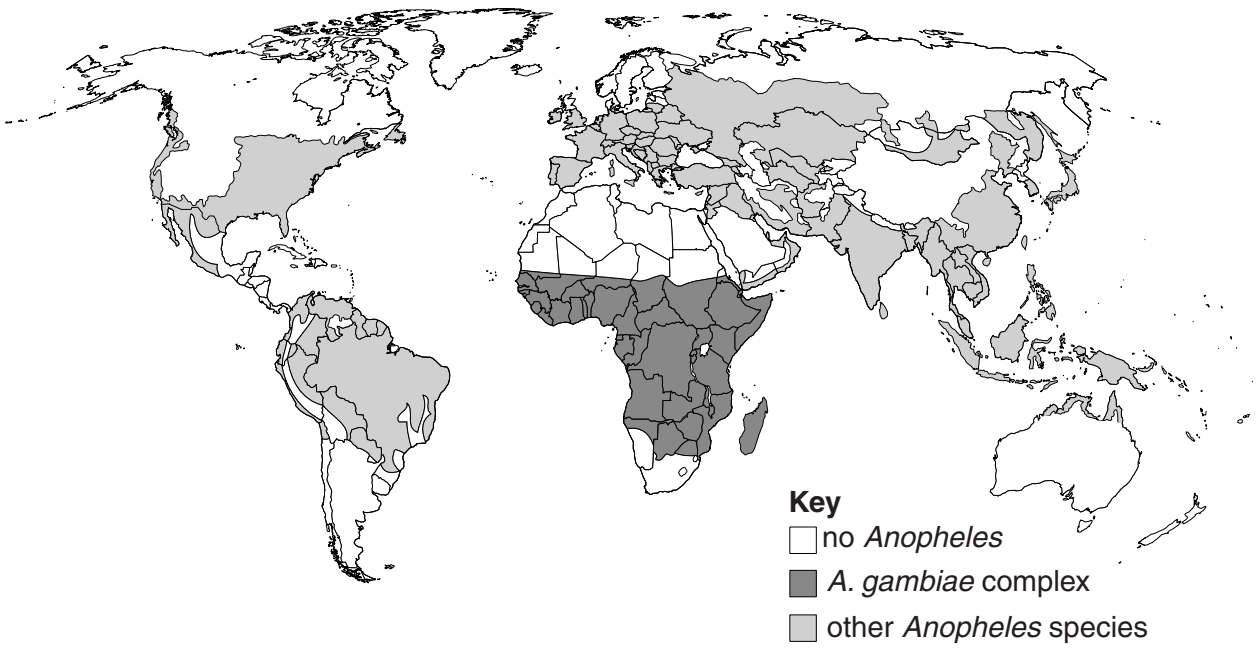

Fig. 5.2

(i) Describe **and** explain the difference between the global distribution of *Anopheles* shown in Fig. 5.2 and the global distribution of malaria.

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(ii) The distribution of *Anopheles* shown in Fig. 5.2 includes over forty different species that are vectors of malaria. The areas with the highest number of cases of malaria are also the areas where *Anopheles gambiae* occurs. *A. gambiae* is responsible for most of the transmission of the disease in these areas.

Suggest why *A. gambiae* is responsible for most of the transmission of *Plasmodium*.

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Fig. 5.3 is part of a complex food web in an area of Kenya where the larvae and adults of *A. gambiae* occur.

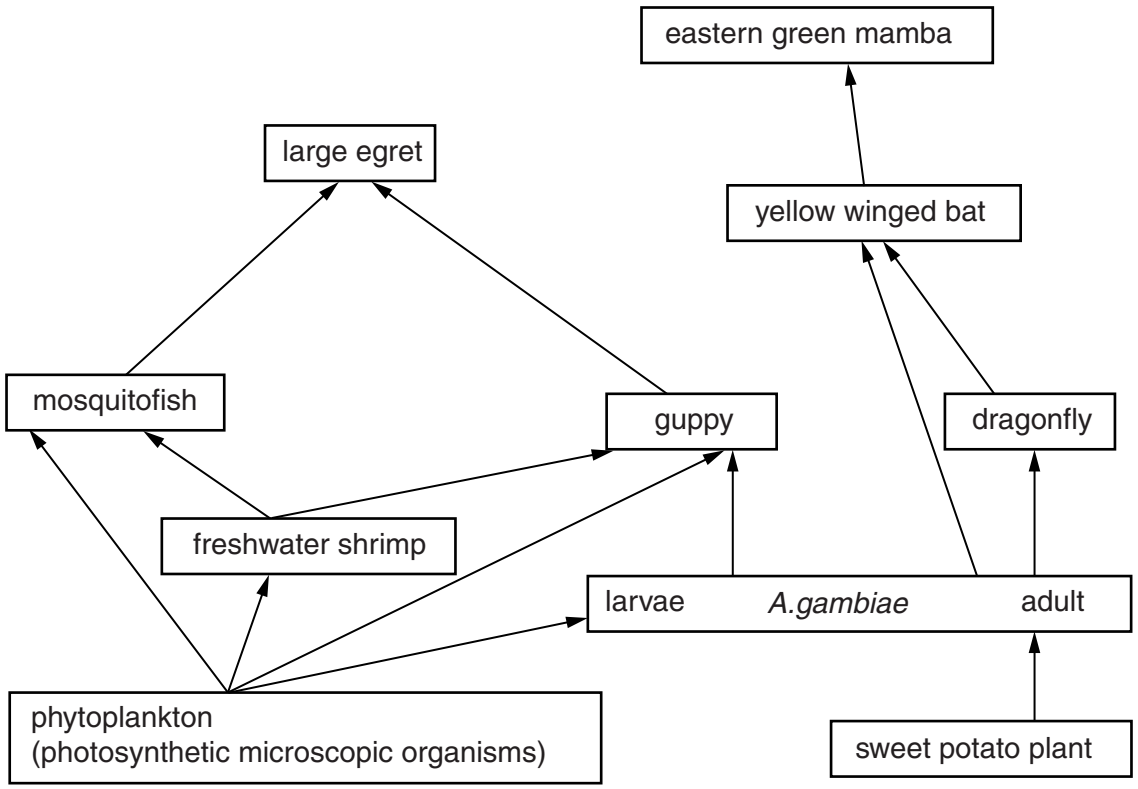

Fig. 5.3

(d) (i) Name **one** organism in Fig. 5.3 that is a tertiary consumer.

..... [1]

(ii) Explain, in terms of energy transfer, why it is likely that the eastern green mamba feeds on other organisms in addition to yellow winged bats.

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(iii) Suggest how the information in Fig. 5.3 can be used in the control of malaria in other areas of Kenya.

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(e) Both male and female adult *A. gambiae* feed on sweet potato plants. Fig. 5.4 shows a sweet potato plant.

Fig. 5.4

Suggest the parts of the sweet potato plants that are the main source of food for adult *A. gambiae* **and e**xplain your answer.

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[Total: 18]

6 **(a)** The thickness of the different chambers of the mammalian heart is due to the amount of cardiac muscle present. The atria have less cardiac muscle than the ventricles, and hence thinner walls.

In terms of their functions, explain why the atria have thinner walls than the ventricles.

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(b) Name the dividing wall separating the right and left sides of the mammalian heart.

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(c) Transpiration and translocation are both processes occurring in plants.

(i) State **one** way in which transpiration differs from translocation.

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(ii) State **one** way in which transpiration and translocation are similar.

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..... [1]

[Total: 5]