Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Secondary Education
June 2003

AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

SCIENCE: DOUBLE AWARD (CO-ORDINATED) 3462/1H
HIGHER TIER
Paper 1

Monday 2 June 2003 1.30 pm to 3.00 pm

H

In addition to this paper you will require:
a ruler.
You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 90.
- Mark allocations are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7		14	
		15	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Answer **all** questions in the spaces provided.

1 (a) The equation describes the process of photosynthesis.

carbon dioxide + ... + light energy ⟶ glucose + ...

(i) Write in the names of the **two** missing substances. *(2 marks)*

(ii) Name the green substance which absorbs the light energy.

.....

(1 mark)

(b) (i) In bright sunlight, the concentration of carbon dioxide in the air can limit the rate of photosynthesis. Explain what this means.

.....

.....

.....

(2 marks)

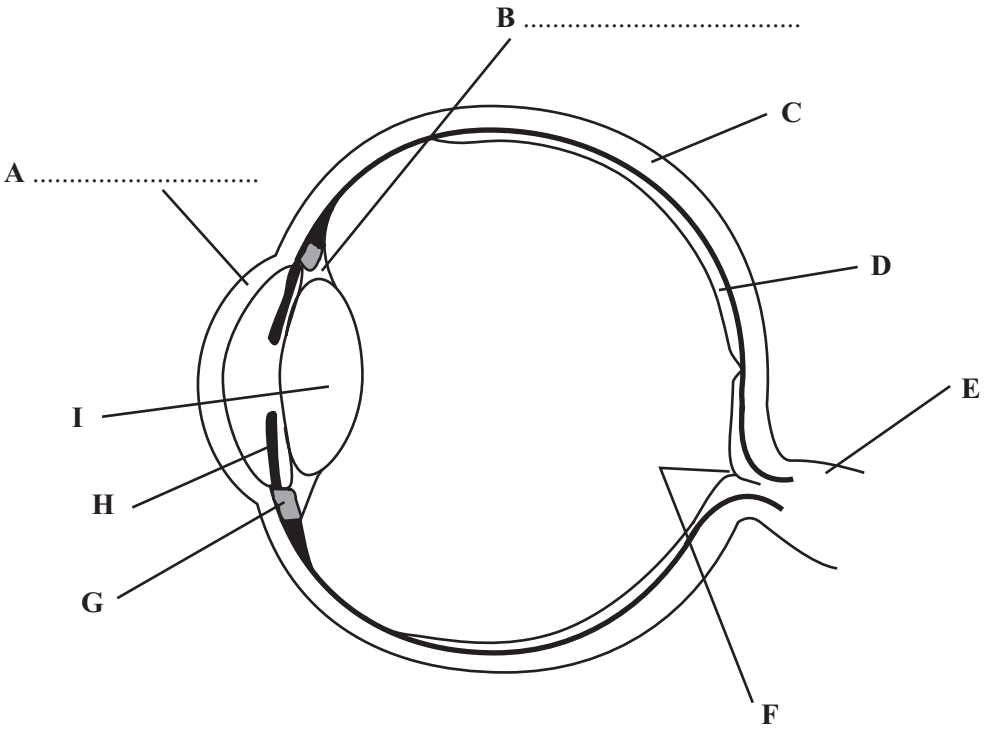
(ii) Give **one** environmental factor, other than light intensity and carbon dioxide concentration, which can limit the rate of photosynthesis.

.....

(1 mark)

6

2 The diagram shows a section through the eye.



(a) On the diagram, label parts **A** and **B**. *(2 marks)*

(b) Give the letter, **A** to **I**, of the part which controls the amount of light entering the eye.

Letter.....
(1 mark)

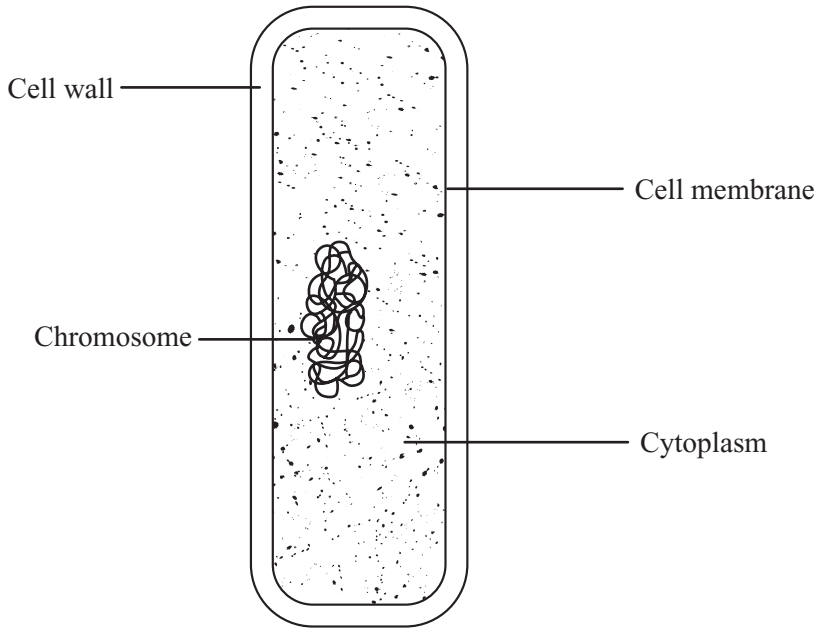
(c) What is the function of part **E**?

.....
(1 mark)

4

TURN OVER FOR THE NEXT QUESTION

3 (a) The diagram shows a bacterial cell.



A bacterial cell is smaller than a human cell. Give **two** other ways in which the bacterial cell is different from a cell in the human body.

1 .....

2 .....

(2 marks)

(b) Describe and explain **two** natural defences which help to prevent bacteria entering and harming the human body.

1 .....

.....

2 .....

.....

(2 marks)

(c) The table shows changes in resistance to the antibiotic penicillin in one species of bacterium between 1991 and 1996.

Years	Percentage of cases where bacteria were resistant to penicillin
1991–92	7
1993–94	14
1995–96	22

A doctor was asked to treat a patient who had a sore throat.

(i) How does penicillin help to treat infection?

.....

(1 mark)

(ii) Use the data in the table to suggest why the doctor should **not** prescribe penicillin.

.....

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.....

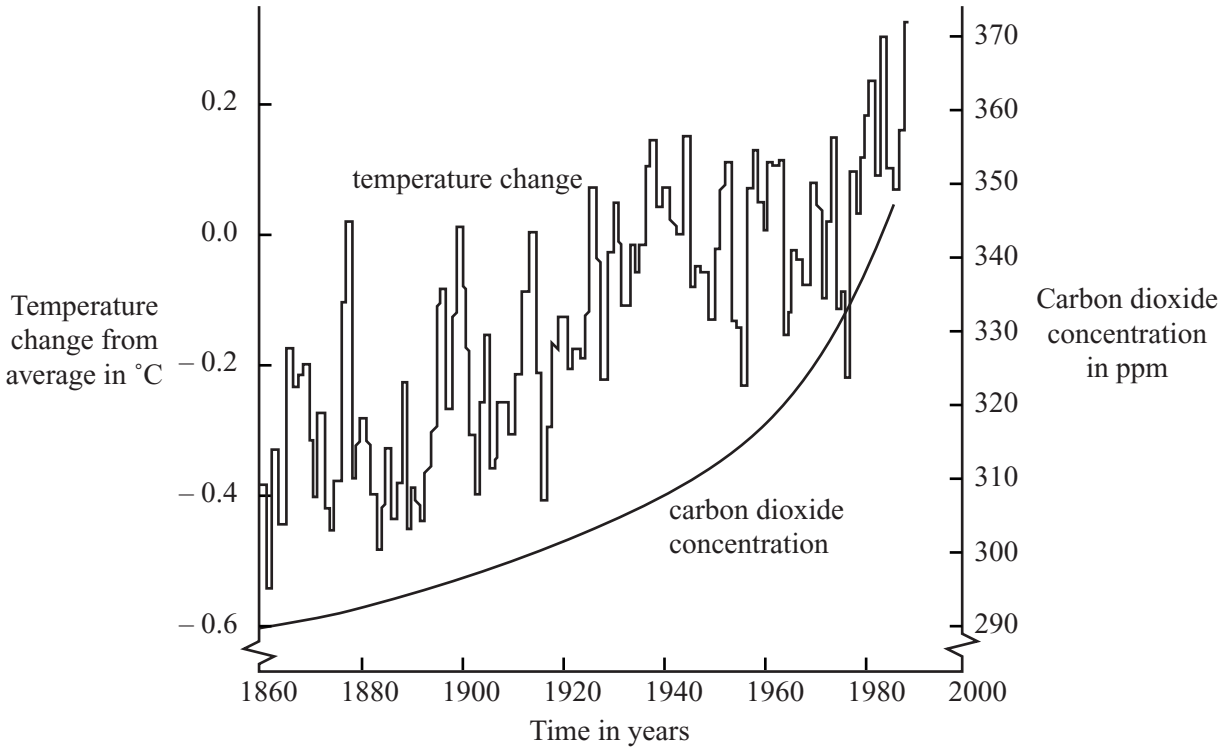
.....

(2 marks)

7

TURN OVER FOR THE NEXT QUESTION

4 The graph shows changes in temperature and in carbon dioxide concentration in the earth's atmosphere between 1860 and 1990.



(a) Give **two** human activities which may have helped to increase the concentration of carbon dioxide in the atmosphere.

1 .....

2 .....

(2 marks)

(b) (i) Describe the changes in temperature shown by the graph between 1860 and 1990.

.....

.....

.....

(2 marks)

(ii) Do the data in the graph prove that increased carbon dioxide concentrations in the atmosphere caused the changes in temperature you described in part (b) (i)?
Give a reason for your answer.

.....

.....

(1 mark)

(c) Describe **one** way in which a change in temperature such as that shown in the graph might affect the environment.

.....

.....

(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

5 (a) New plants can be produced from a parent plant by taking cuttings. The diagram shows how this is done.

Stage 1

Cut off the top part of the stem

Stage 2

Remove the lower leaves

Stage 3

Dip the cut end into hormone rooting powder

Stage 4

Place the cutting in compost and cover with a plastic bag

(i) Hormone rooting powder stimulates the growth of new roots (Stage **3**). Why would the cutting die without roots?

.....

(1 mark)

(ii) Why were the cutting and the pot of soil covered with a plastic bag (Stage **4**)?

.....

(1 mark)

(b) A new variety of plant was developed by a gardener. Would the first plant of this new variety have been grown from a seed or from a cutting taken from another plant? Explain your answer as fully as you can.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

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.....

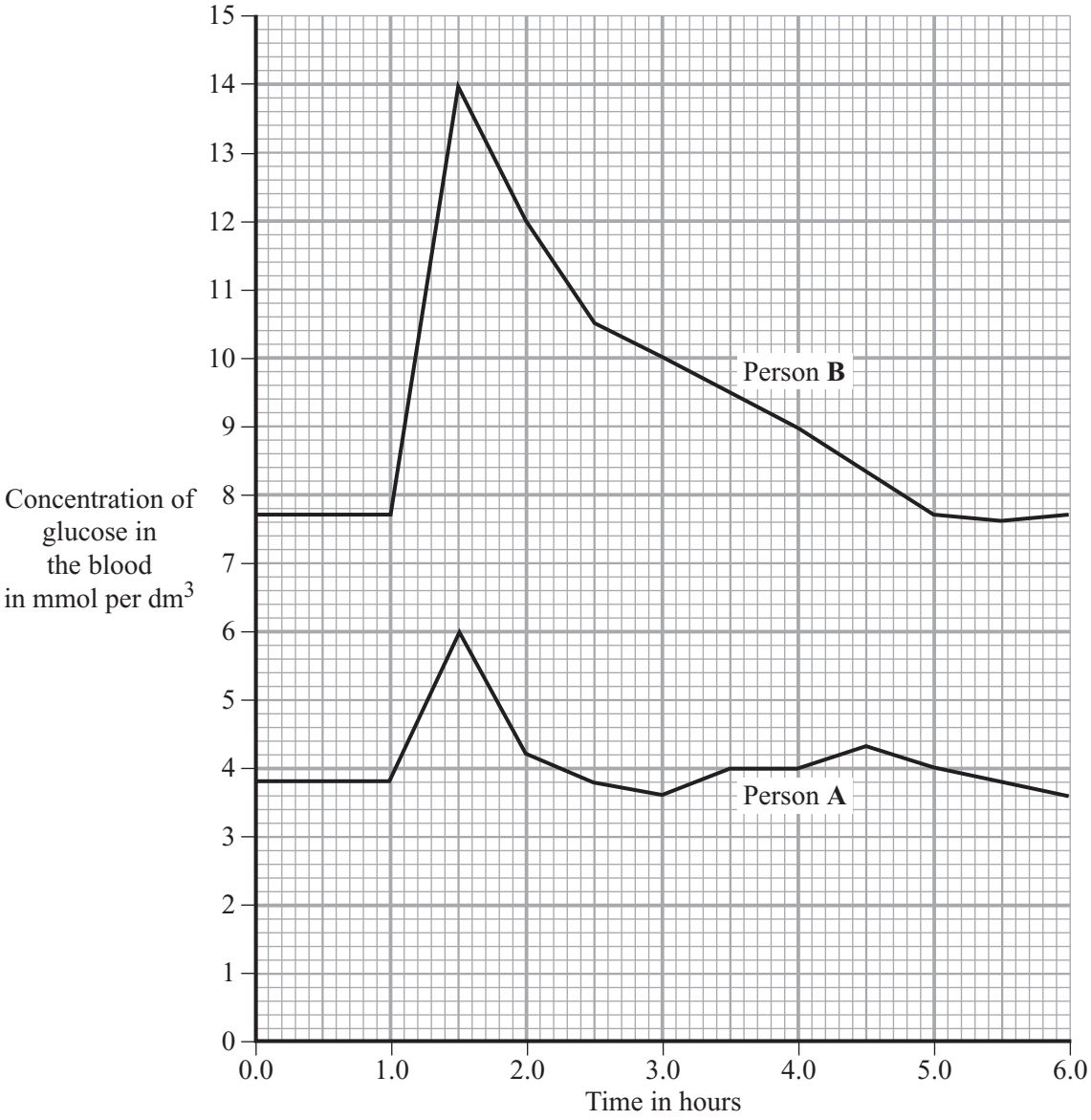
.....

(3 marks)

5

TURN OVER FOR THE NEXT QUESTION

6 The graph shows the concentration of glucose in the blood of two people. Person **A** is a non-diabetic. Person **B** has diabetes. Each person ate 75 grams of glucose at 1.0 hours.



(a) (i) What was the maximum concentration of glucose in the blood of Person **A**?

.....mmol per dm^3
(1 mark)

(ii) After eating the glucose, how long did it take for the concentration of glucose in the blood of Person **B** to return to normal?

.....hours
(1 mark)

(b) A diabetic person does not produce enough insulin.

(i) Which organ produces insulin?

.....

(1 mark)

(ii) Write the letter **X** on the graph to show one time when the blood of Person **A** would contain large amounts of insulin. *(1 mark)*

(c) A high concentration of glucose in the blood can harm body cells as a result of osmosis. Explain why.

.....

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.....

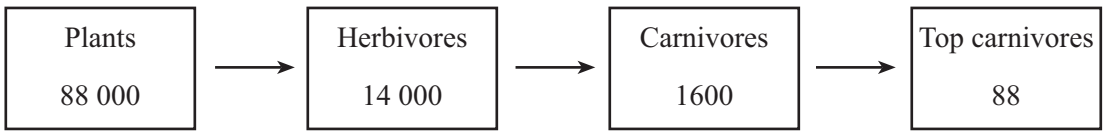
.....

(4 marks)

8

TURN OVER FOR THE NEXT QUESTION

7 The diagram shows a food chain in a pond. The figures show the amounts of energy in each type of organism, in kilojoules per m^2 of pond per year.



(a) Calculate the percentage of the energy in the plants that is passed to the top carnivores. Show clearly how you work out your final answer.

.....

.....

.....

Answer .....%

(2 marks)

(b) In the space below, draw a pyramid of biomass for this food chain. Label your drawing with the names of the organisms.

(2 marks)

(c) If humans ate organisms from this food chain, it would be more efficient to eat plants than to eat herbivores. Why is this?

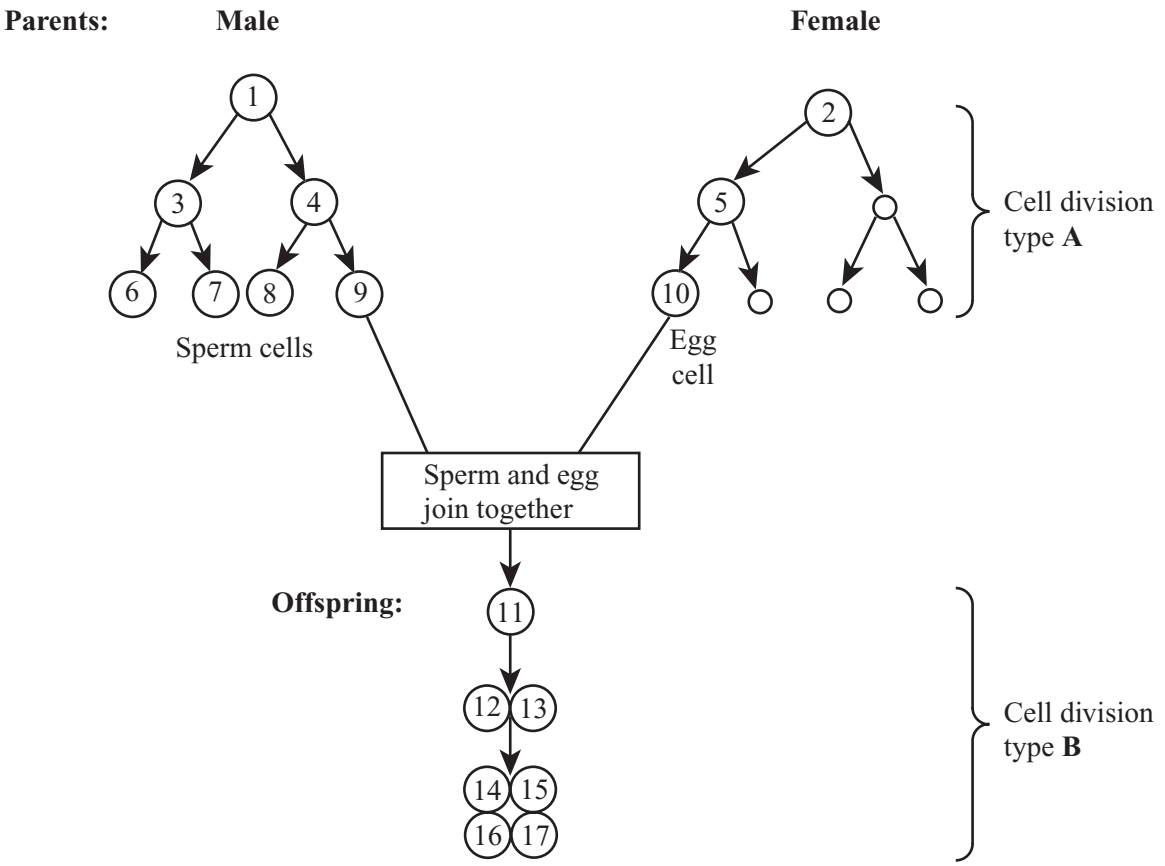
.....

.....

(1 mark)

5

8 The diagram shows two patterns of cell division. Cell division type **A** is used in gamete formation. Cell division type **B** is used in normal growth.



(a) Name the two types of cell division, **A** and **B**, shown in the diagram.

Type **A** .....

Type **B** .....

(2 marks)

(b) Name the process in which an egg and sperm join together.

.....

(1 mark)

(c) Cell **1** contains 46 chromosomes. How many chromosomes will there be in:

(i) cell **10**; .....

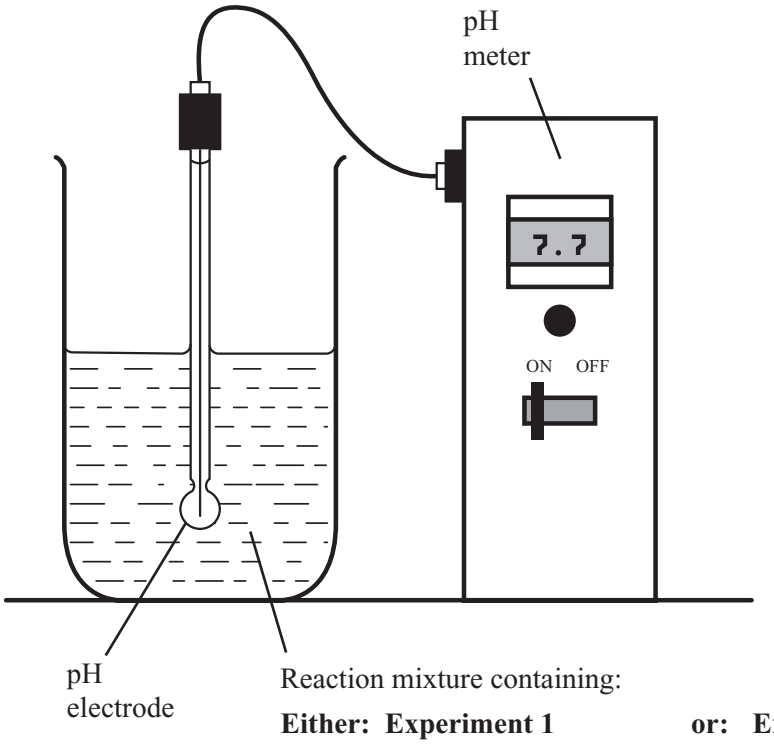
(1 mark)

(ii) cell **14**? .....

(1 mark)

5

9 The diagram shows the apparatus used to investigate the digestion of milk fat by an enzyme. The reaction mixture contained milk, sodium carbonate solution (an alkali) and the enzyme. In Experiment **1**, bile was also added. In Experiment **2**, an equal volume of water replaced the bile. In each experiment, the pH was recorded at 2-minute intervals.



The results of the two experiments are given in the table.

Time in minutes	pH	
	Experiment 1: with bile	Experiment 2: no bile
0	9.0	9.0
2	8.8	9.0
4	8.7	9.0
6	8.1	8.8
8	7.7	8.6
10	7.6	8.2

(a) Milk fat is a type of lipid. Give the name of an enzyme which catalyses the breakdown of lipids.

.....

(1 mark)

(b) What was produced in each experiment to cause the fall in pH?

.....

(1 mark)

(c) (i) For Experiment **1**, calculate the average rate of fall in pH per minute, between 4 minutes and 8 minutes. Show clearly how you work out your final answer.

.....

.....

.....

.....pH units per minute

(2 marks)

(ii) Why was the fall in pH faster when bile was present?

.....

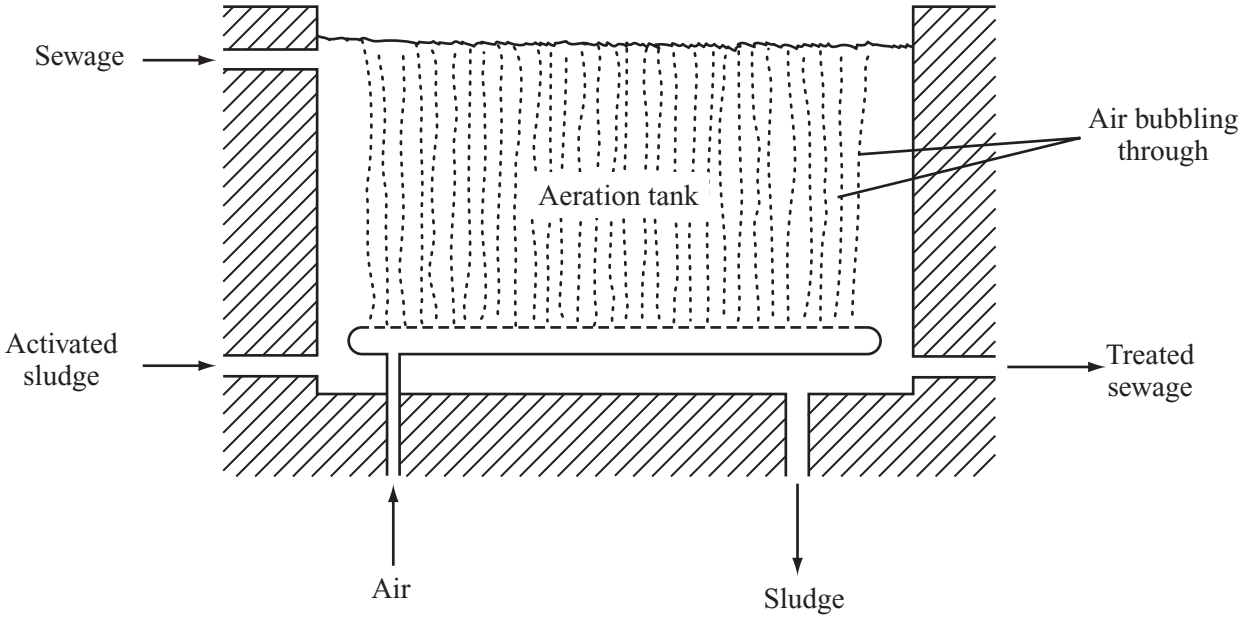
.....

(1 mark)

5

TURN OVER FOR THE NEXT QUESTION

10 The diagram shows how sewage may be treated in an aeration tank, by the activated sludge process. The sewage is mixed with 'activated sludge' (organic matter rich in microorganisms). Many tiny bubbles of air are blown through the mixture.



(a) Many types of bacteria are present in the activated sludge. These include putrefying bacteria and nitrifying bacteria. Both of these are aerobic bacteria.

(i) What gas, present in the air, is used by these bacteria?

.....

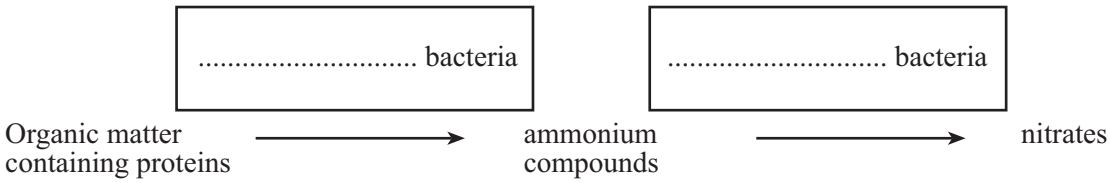
(1 mark)

(ii) Why do the bacteria need this gas?

.....

(1 mark)

(b) Write the names of the bacteria in the correct boxes in the flow-chart.



(1 mark)

(c) The sludge from the aeration tank is processed further in a 'sludge digester' tank containing anaerobic bacteria. The equation below shows how these anaerobic bacteria break down glucose.

glucose ⟶ methane + carbon dioxide + energy

(i) How is anaerobic breakdown of glucose in human muscle different from its breakdown by these bacteria?

.....

.....

(2 marks)

(ii) The sludge digester tank is kept at about 35 ºC. Suggest a reason for this.

.....

(1 mark)

(d) Explain how a large amount of untreated sewage entering a river could cause the death of the fish in the river.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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.....

(4 marks)

10

11 The table shows the concentrations of some substances in human blood plasma, in the filtrate produced by the kidney and in the urine.

	Concentration in grams per dm^3		
Substance	**Blood plasma**	**Filtrate**	**Urine**
Glucose	1.0	1.0	0.0
Amino acids	0.5	0.5	0.0
Urea	0.3	0.3	20.0
Protein	80.0	0.0	0.0
Ions	7.2	7.2	15.0
Water	912.0	990.0	970.0

(a) Explain why:

(i) the concentration of glucose in the filtrate is the same as in the blood plasma;

.....

.....

(1 mark)

(ii) there is no glucose present in the urine.

.....

.....

(1 mark)

(b) Suggest why there is no protein present in either the filtrate or the urine.

.....

.....

(1 mark)

(c) The volume of water removed in the urine is variable. Explain how the human body reduces the volume of urine produced when less water is consumed.

.....

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.....

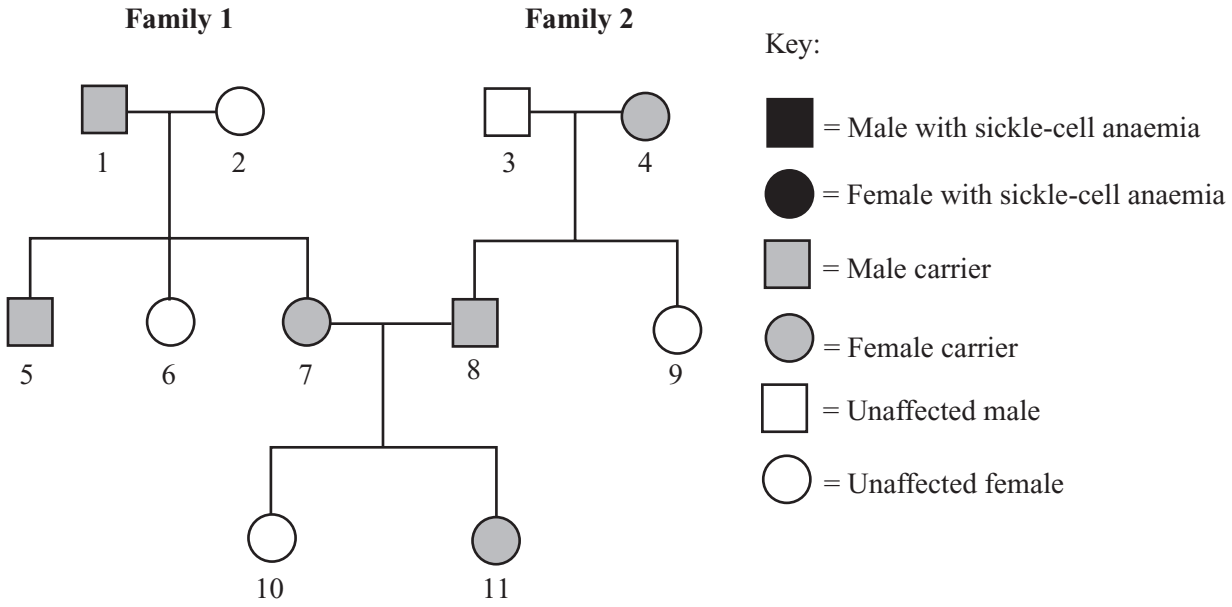
.....

(3 marks)

6

TURN OVER FOR THE NEXT QUESTION

12 The diagram shows the inheritance of sickle-cell anaemia in two families. A person with sickle-cell anaemia has red blood cells which form a 'sickle' shape at low oxygen concentrations. In the sickled condition, the red cells may block tiny blood vessels and, while normal red blood cells may live for about 120 days, sickled red cells die after about 10 to 20 days. A person who is a carrier usually shows no ill effects.



(a) Sickle-cell anaemia is caused by a change in a gene which codes for the production of haemoglobin.

(i) What biological term describes a change in a gene?

.....

(1 mark)

(ii) Suggest why a person with sickle-cell anaemia may become breathless during even light exercise.

.....

.....

(1 mark)

(b) Person **7** is pregnant with her third child. The father is Person **8**.

(i) Use a genetic diagram to show how it is possible for this child to have sickle-cell anaemia.

Use the following symbols:

$\mathbf{H^A}$ = allele for unaffected haemoglobin;
$\mathbf{H^S}$ = allele for sickle haemoglobin.

	Person 7	**Person 8**
Phenotype:	Carrier	Carrier

(4 marks)

(ii) What is the probability that Person **7**'s third child will have sickle-cell anaemia?

.....

(1 mark)

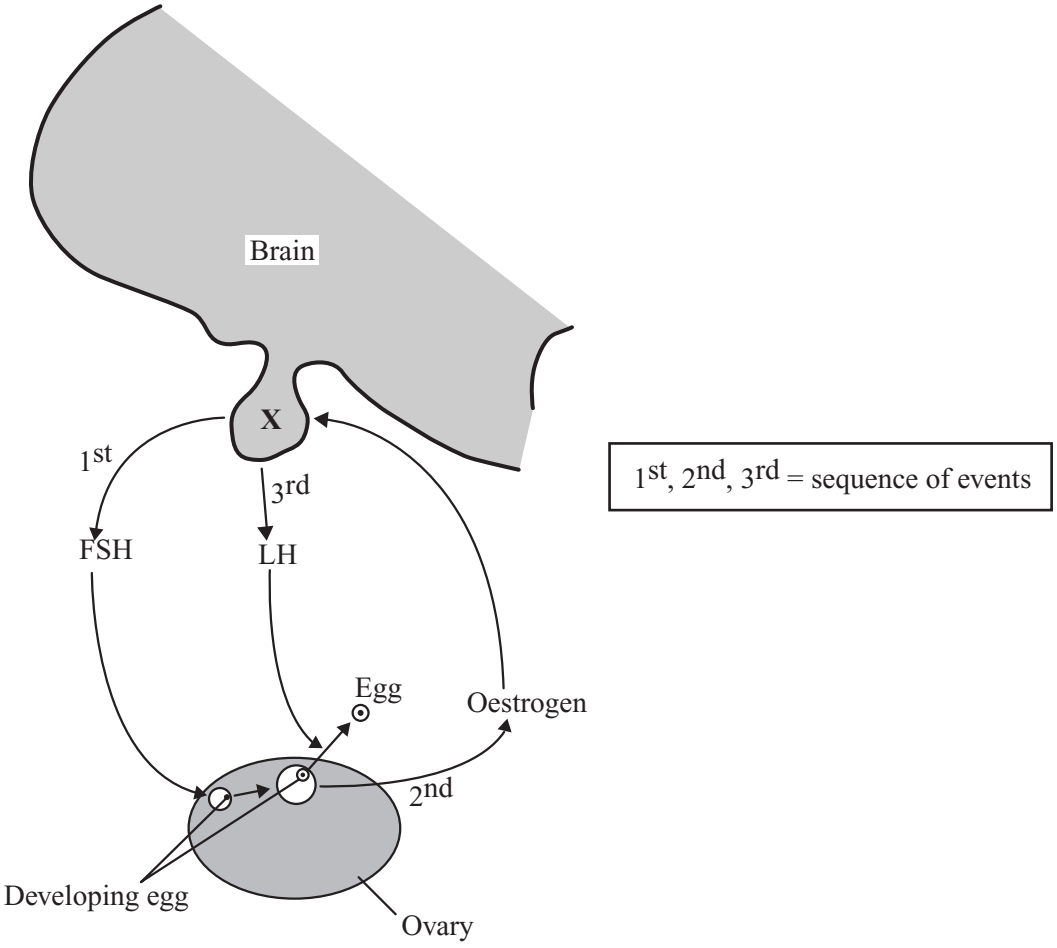
(c) Give the number of any **one** person from the families on the opposite page who would **not** have been resistant to malaria.

.....

(1 mark)

8

13 The diagram shows how three hormones, FSH, LH and oestrogen, work together in a woman's body.



(a) Name the part of the brain labelled **X**.

.....

(1 mark)

(b) Use information from the diagram and your own knowledge to explain why some oral contraceptive pills contain oestrogen.

.....

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.....

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(3 marks)

4

14 (a) How does contraction of the muscles between the ribs and contraction of muscles in the diaphragm help to take air into the lungs?

.....

.....

.....

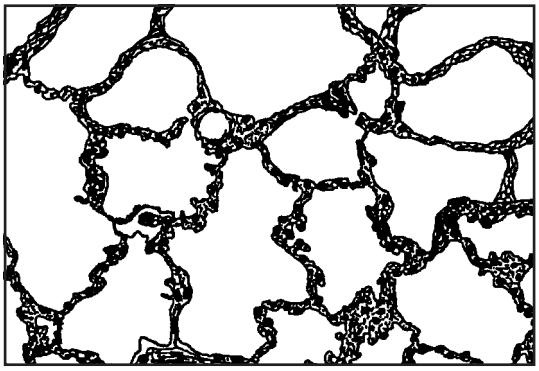
.....

.....

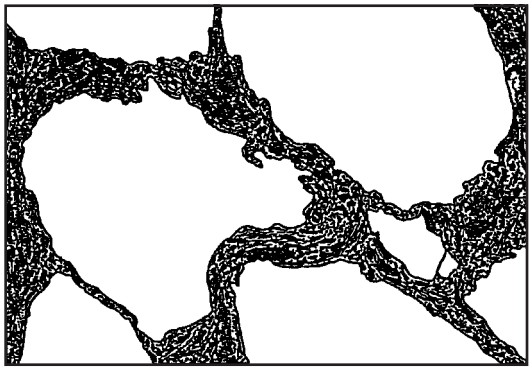
.....

(3 marks)

(b) Emphysema is a disease of the lungs. People who smoke cigarettes are more likely to suffer from emphysema. The diagrams show lung tissue from a healthy person and lung tissue from a person with emphysema. The diagrams are drawn to the same scale.



Lung tissue from a healthy person



Lung tissue from a person with emphysema

Explain how emphysema reduces the amount of oxygen which diffuses into the blood.

.....

.....

.....

.....

(2 marks)

5

15 (a) The table shows the concentrations of some mineral ions in the cells of a pond plant and in the surrounding pond water.

	Concentration in mmol per dm^3		
	Potassium	**Calcium**	**Sulphate**
Plant cells	49.0	7.0	7.0
Pond water	0.5	0.7	0.4

(i) The plant cells would not have been able to absorb these mineral ions from the pond water by diffusion. Explain why not.

.....

.....

(2 marks)

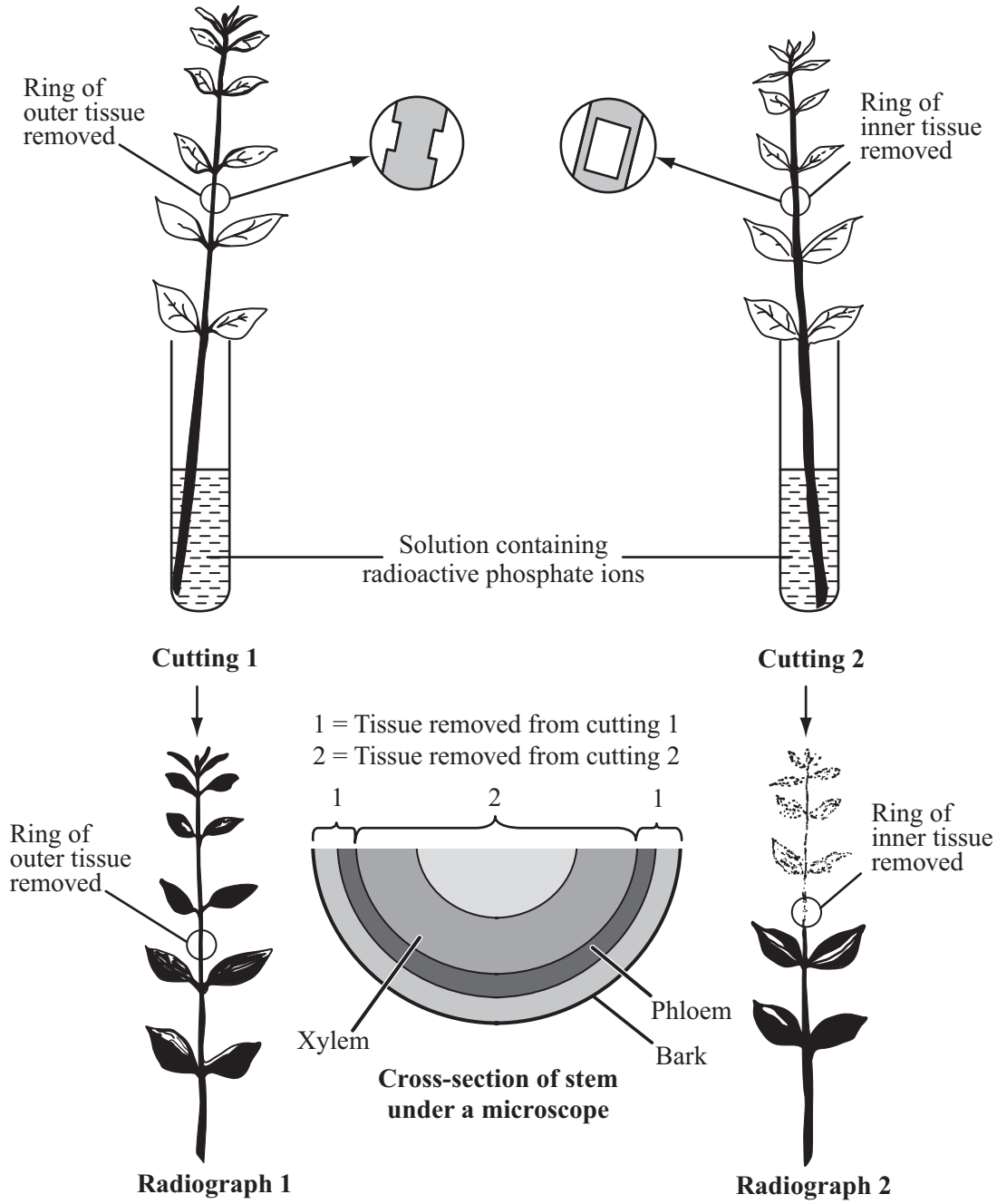
(ii) Suggest a process which would allow these ions to be absorbed from the pond water by the plant cells.

.....

(1 mark)

(b) Absorbed mineral ions must be transported to all parts of the plant. The following experiment was carried out to discover which tissue transported phosphate ions up a plant.

A complete ring of tissue was cut from the outside of a woody stem cutting. The cutting was then placed with its base in a solution containing radioactive phosphate ions. After one hour the cutting was removed from the solution and left in contact with some X-ray film for several days. The film was then developed, giving a 'radiograph' of the cutting (the film was turned black by radiation from the radioactive phosphate ions). A second cutting was treated in the same way except that the inner tissue was removed from part of the stem, leaving the top and bottom of the stem connected by a few strands of the outer tissue. The diagram on the opposite page shows the stages of this experiment.



Use the information from the diagram to draw conclusions from this experiment.

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(3 marks)

END OF QUESTIONS