

Surname		Other Names	
Centre Number		Candidate Number	
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General Certificate of Secondary Education
June 2006



BIOLOGY (SPECIFICATION B)
Higher Tier

3411/H
H

Wednesday 7 June 2006 1.30 pm to 3.45 pm

<p>For this paper you must have:</p> <ul style="list-style-type: none"> a ruler <p>You may use a calculator.</p>
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Time allowed: 2 hours 15 minutes

Instructions

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

Information

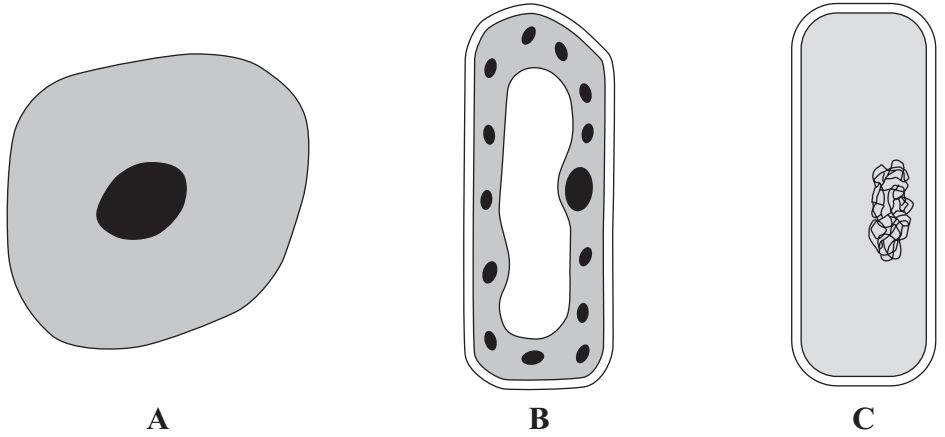
- The maximum mark for this paper is 135.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8		17	
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Total (Column 1) →			
Total (Column 2) →			
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Examiner's Initials			

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

1 Tuberculosis (TB) is a disease caused by a bacterium.

(a) The diagram shows three types of cell.



(not to scale)

(i) Which cell, **A**, **B** or **C**, is a bacterium?
(1 mark)

(ii) Describe **one** feature you can see in the diagram which helps you to identify this cell as a bacterium.
.....
(1 mark)

(b) TB is spread by coughs and sneezes. It is more common when people live together in crowded conditions. TB usually affects the lungs first, although other organs may later become infected.

(i) Why is TB more likely to spread when people live in crowded conditions?
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.....
(1 mark)

(ii) Why does TB affect the lungs first?
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(1 mark)

(iii) How could TB later spread to other regions of the body?

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.....

(1 mark)

(c) The human body has several natural defences against bacteria. Some of these prevent bacteria from entering the body. Others act once the bacteria have entered.

Give **two** ways in which the body stops bacteria from entering.

1

2

(2 marks)

7

Turn over for the next question

Turn over ►

2 A slice of bread contains 300 kilojoules of energy.
A typical teenage girl needs 10 200 kilojoules of energy each day.

- (a) A girl eats only bread and drinks only water for one day.
How many slices of bread must she eat to supply her energy needs for the day?

Show clearly how you work out your final answer.

.....
.....

..... slices of bread
(2 marks)

- (b) Most of the carbohydrate in bread is starch.

- (i) Name **one** part of the digestive system where starch is digested.

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(1 mark)

- (ii) Name the enzyme which digests starch.

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(1 mark)

- (iii) Name **one** product of starch digestion.

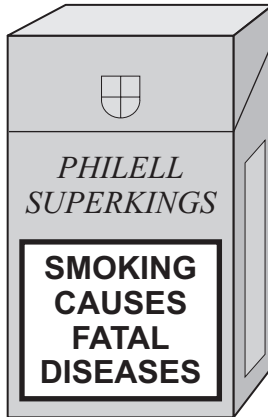
.....
(1 mark)

- (iv) Name **one** part of the digestive system where the products of starch digestion are absorbed into the blood.

.....
(1 mark)

6

3 The following warning was printed on a packet of cigarettes.



Explain how cigarette smoking can cause fatal diseases.

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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(5 marks)

5

- 4 The table shows gas production by a plant at different light intensities and at two different concentrations of carbon dioxide.

Light intensity in arbitrary units	Rate of gas production at 20 °C in cm ³ per hour	
	at 0.03 % carbon dioxide	at 1 % carbon dioxide
0	0.00	0.00
10	0.27	0.30
20	0.44	0.60
30	0.54	0.80
40	0.60	0.89
50	0.60	0.95

- (a) (i) Name the gas which was produced by the plant.

.....
(1 mark)

- (ii) Name the process which produced this gas.

.....
(1 mark)

- (b) The data obtained with 0.03 % carbon dioxide are plotted on the graph on the opposite page.

Draw a graph of the data obtained with 1 % carbon dioxide. Draw this on the same graph paper.

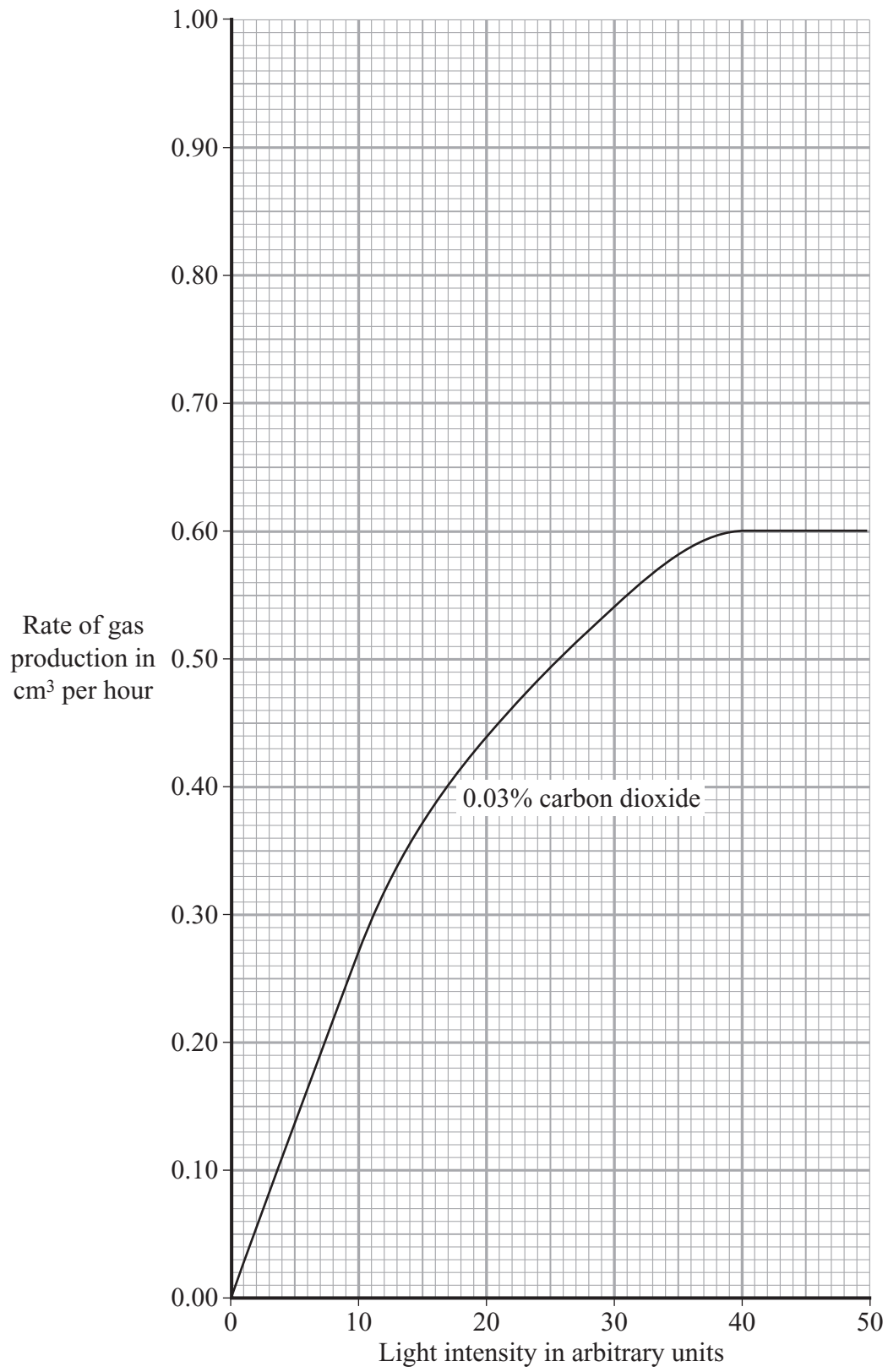
(3 marks)

- (c) Give **two** environmental factors which might have limited the rate of gas production at 50 units of light intensity and 0.03 % carbon dioxide.

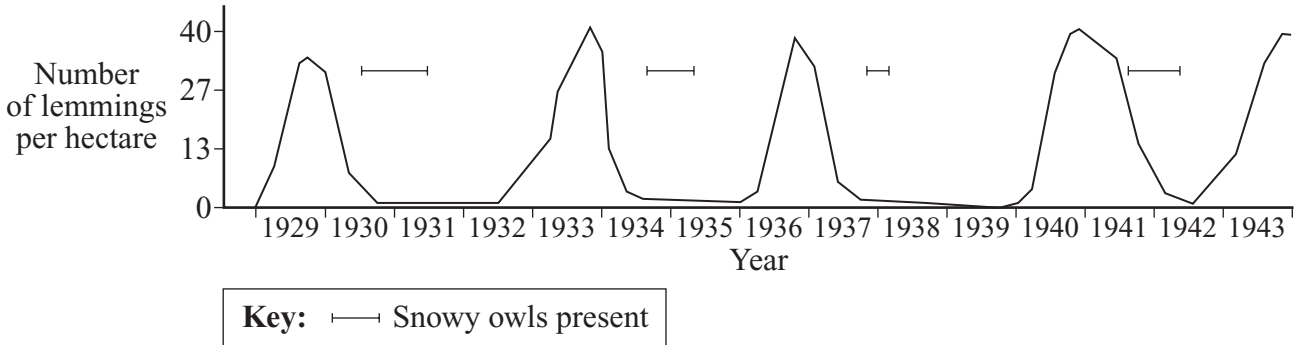
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(2 marks)



5 The lemming is a small mammal which eats plants. The snowy owl is a predator. The graph shows changes in the population of lemmings in one area of northern Canada.



(a) What is a *predator*?

.....

 (2 marks)

(b) It is unlikely that the snowy owls caused the decreases in the lemming population. What evidence from the graph supports this?

.....

 (1 mark)

(c) Suggest what environmental conditions might have caused the sudden decreases in the lemming population.

.....

 (3 marks)

6 Explain how the burning of fossil fuels can harm the environment.

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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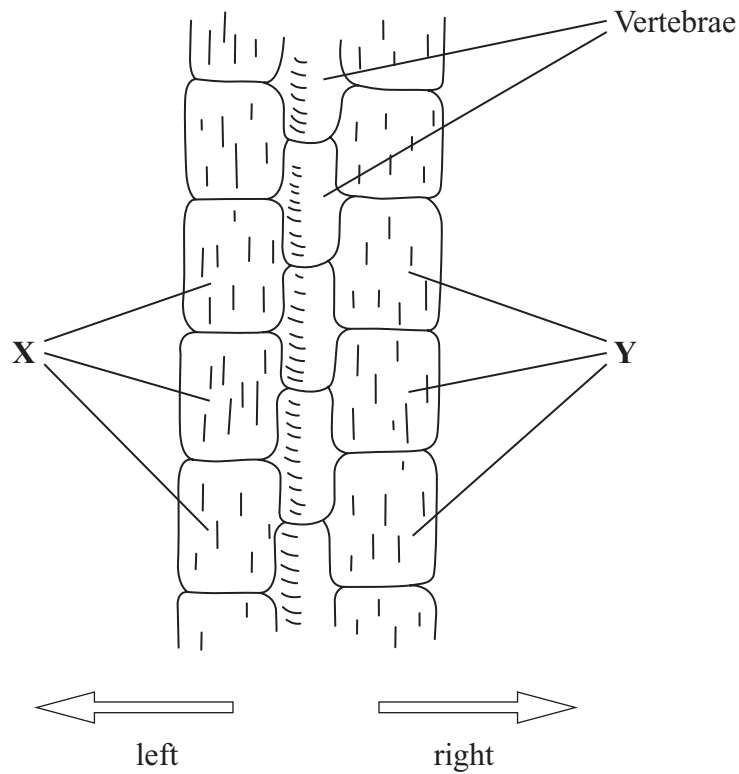
(5 marks)

5

Turn over for the next question

Turn over ►

7 The diagram shows the arrangement of bones and muscles in part of the body of a fish.



(a) To make the fish move forwards muscles **X** and **Y** create movements in the body. Suggest how muscles **X** and **Y** move the backbone left and right.

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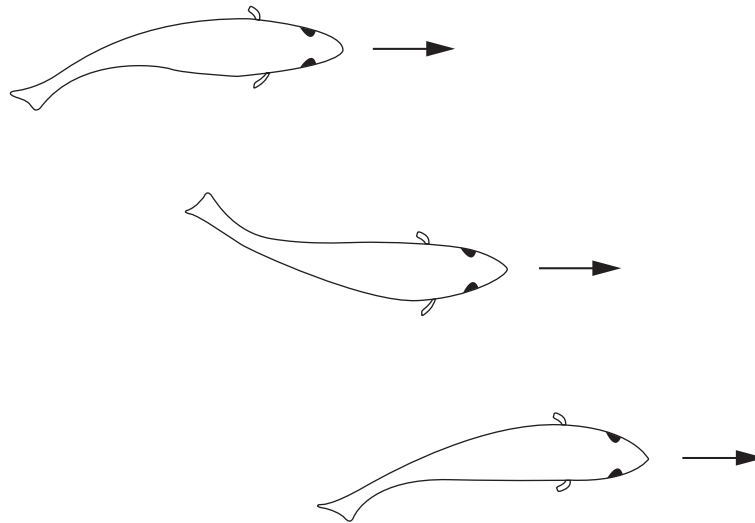
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(3 marks)

(b) The diagram below shows the position of the body of a fish as it moves forward.



Describe how the tail fin and muscles move the fish forwards.

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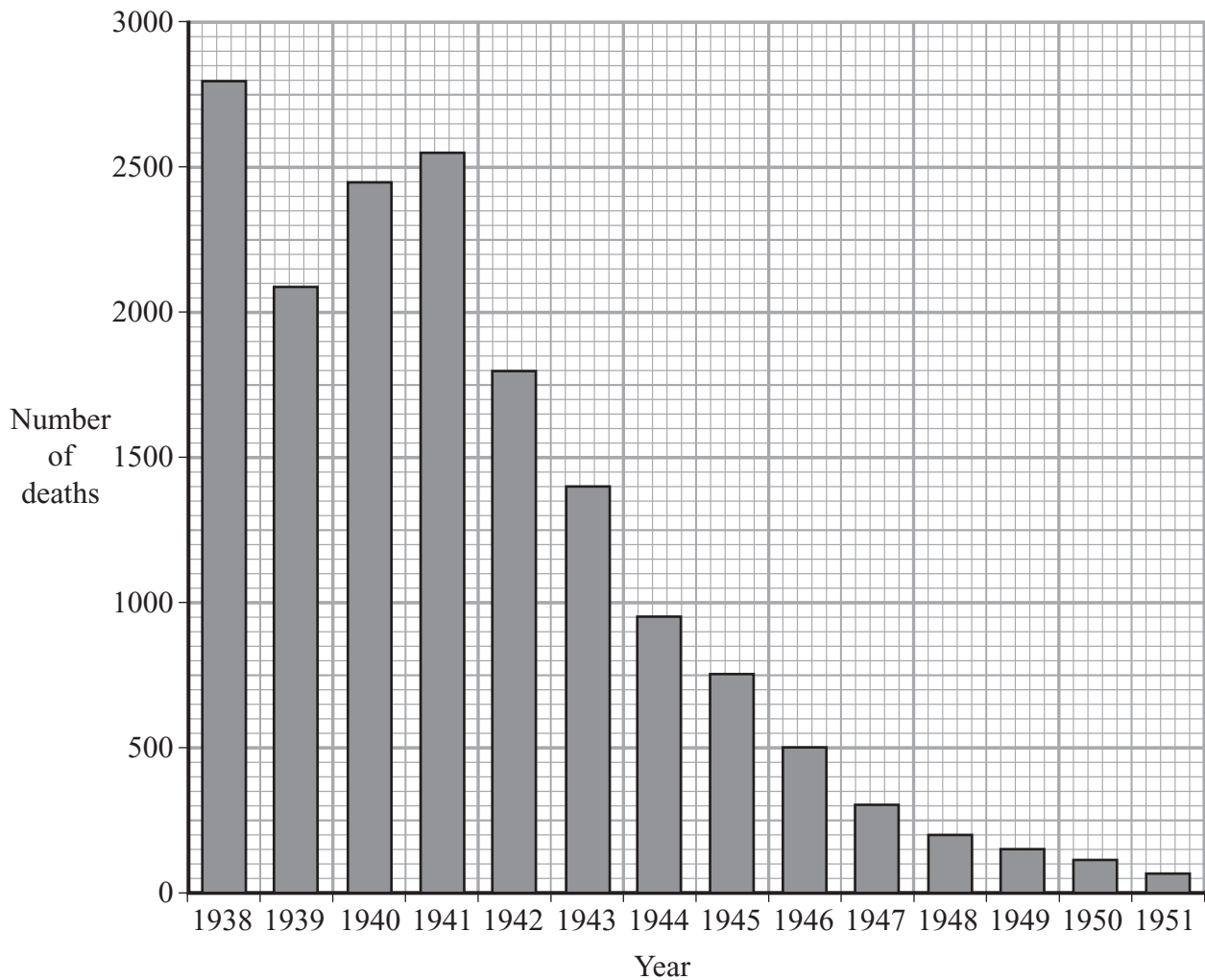
(3 marks)

6

Turn over for the next question

Turn over ▶

- 8 The chart shows the number of people, in England, that died from the disease diphtheria between 1938 and 1951.



- (a) (i) How many people died from diphtheria in England in 1941?

.....
(1 mark)

- (ii) In what year was the number of deaths half that of 1938?

.....
(1 mark)

- (b) Both vaccination and antibiotics can be used to destroy the microorganism that causes diphtheria.

What type of microorganism is most likely to cause diphtheria?

.....
(1 mark)

- (c) One of the early symptoms of diphtheria in children is a headache.

What type of drug can be used to get rid of a headache?

.....
(1 mark)

- (d) Treatments such as vaccinations can be used to protect children from diphtheria. Treatments can provide either active immunity or passive immunity.

Compare active and passive immunity as ways of protecting a child from diseases such as diphtheria.

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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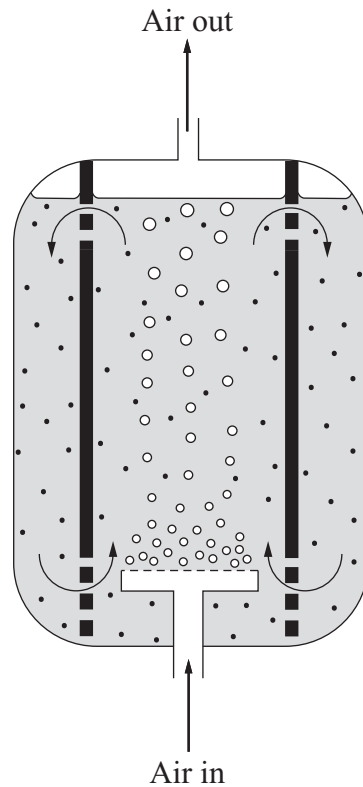
(4 marks)

8

Turn over for the next question

Turn over ▶

9 The diagram shows a fermenter used to make useful products from microorganisms.



In this type of fermenter air is pumped in at the bottom.

(a) Suggest **two** reasons why air needs to be pumped into the mixture in this fermenter.

1

2

(2 marks)

(b) The mixture in the fermenter can become hot enough to kill the microorganisms.

(i) At what temperature is this most likely to happen normally?
Choose from the list. Draw a ring around your answer.

20 °C

37 °C

40 °C

60 °C

(1 mark)

(ii) Explain why the mixture gets hot.

.....

.....

(1 mark)

(iii) Suggest how the heat could be removed in order to keep the microorganisms alive.

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(1 mark)

(c) Antibiotics, such as penicillin, can be made in a fermenter, by growing a mould.

Name the mould that is used to produce penicillin.

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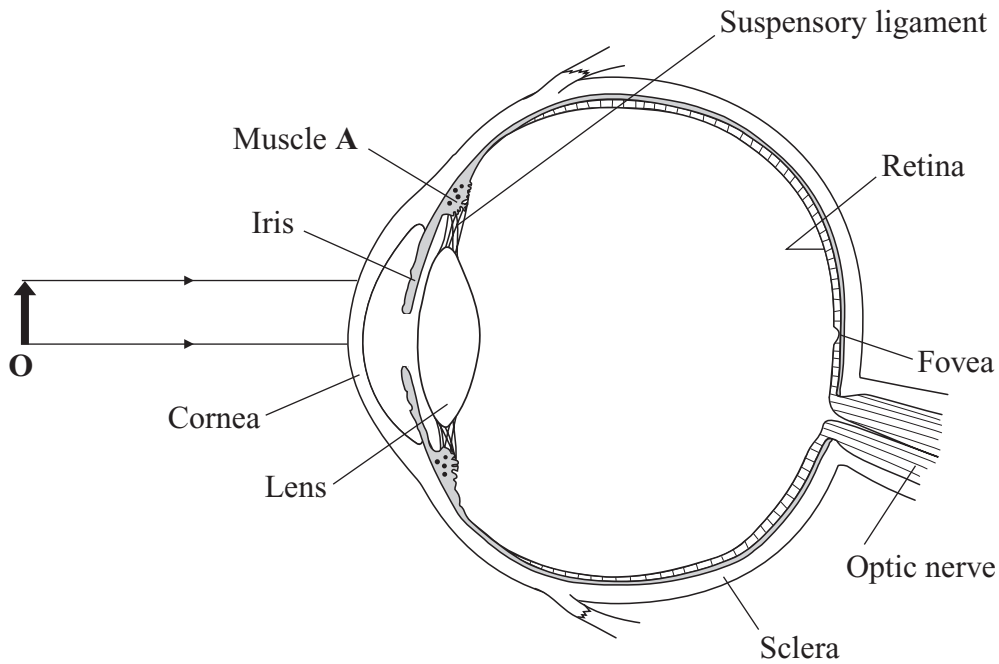
(1 mark)

6

Turn over for the next question

Turn over ►

10 The diagram shows a section through the human eye.



(a) Which **two** parts of the eye help to bend the light rays to bring them to a focus?

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(1 mark)

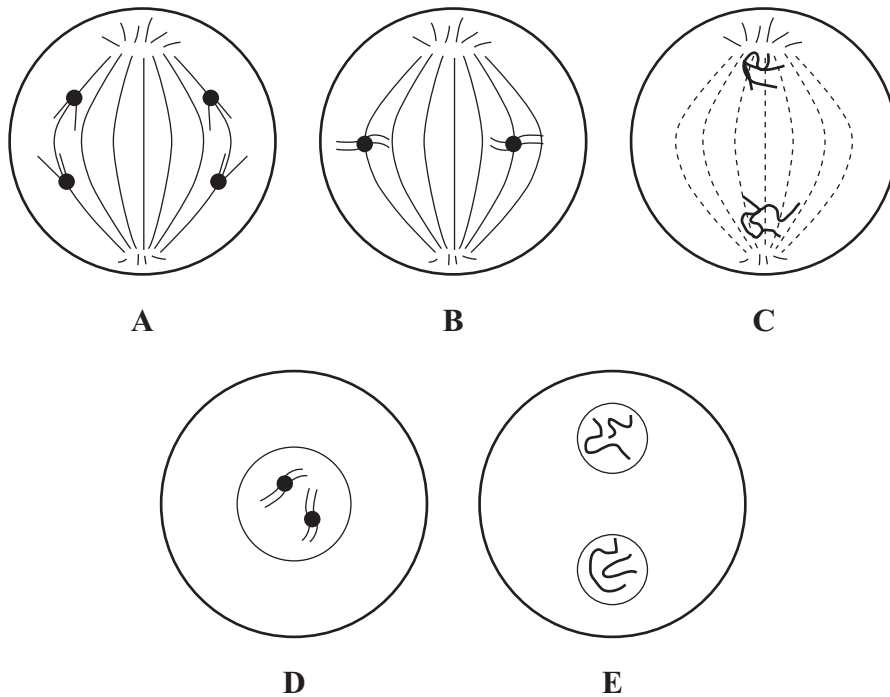
(b) If object **O** were moved closer to the eye, what would muscle **A** do and how would this help to bring the light to a focus?

.....

(2 marks)

3

11 The diagram shows five stages in one type of cell division. The stages are not in the correct order. Cells produced by this type of cell division are genetically identical.



(a) (i) Name the type of cell division shown in the diagram.
(1 mark)

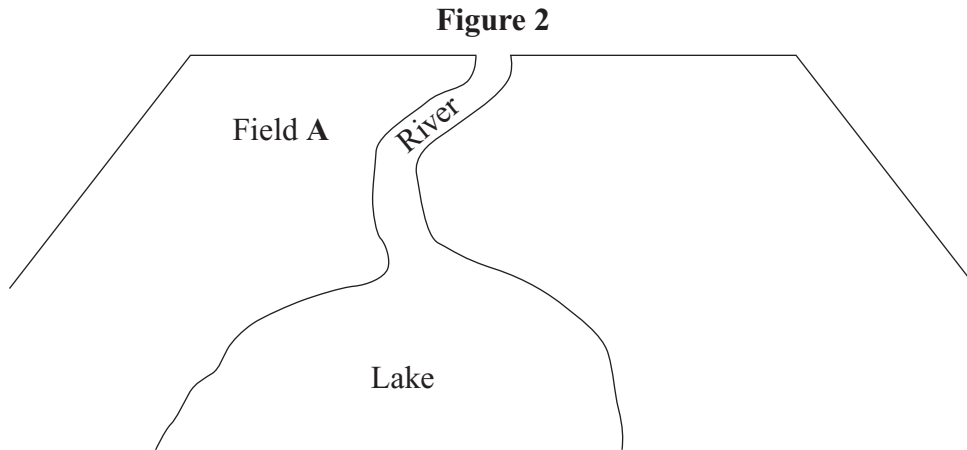
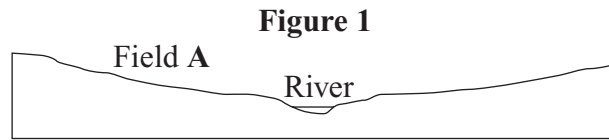
(ii) What is the correct order of stages **A**, **B**, **C**, **D** and **E**?
.....
(1 mark)

(b) Approximately one in every million cells produced by this type of cell division will be genetically different.

(i) What name do scientists use to describe a change in a gene?
.....
(1 mark)

(ii) The rate of genetic change can be increased by some environmental factors.
Give **one** environmental factor that would cause an increase in the rate of genetic change.
.....
(1 mark)

12 **Figure 1** shows a section through part of a farm. **Figure 2** shows a map of the farm. A river flows through the farm and then enters a small lake.



The farmer added inorganic fertiliser to Field A. This was followed by heavy rainfall and then several weeks of hot, sunny weather. The water in the lake turned green and cloudy and many fish died.

Explain what caused these changes in the lake.

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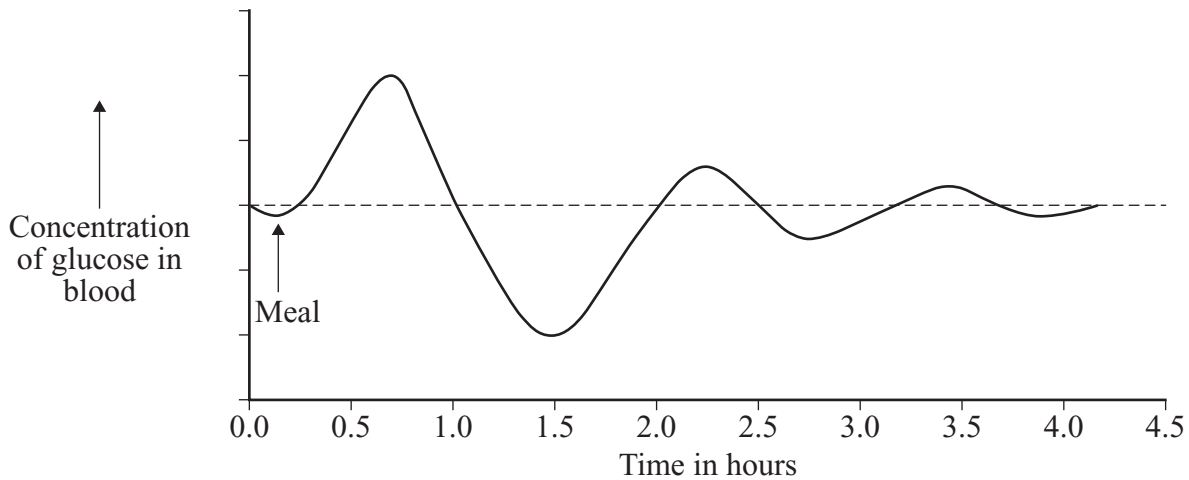
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(4 marks)

4

- 13 (a) The graph shows changes in the concentration of glucose in a person's blood following a meal.



Changes in the concentration of glucose are controlled by the hormones glucagon and insulin.

Write the letters **X** and **Y** on the graph to show:

X a time when glucagon secretion will be highest;

Y a time when insulin secretion will be highest.

(2 marks)

- (b) Many diabetics require injections of insulin. The insulin is made by genetically-engineered bacteria which contain the gene for human insulin.

Suggest why treating diabetics with insulin made by genetically-engineered bacteria may be better than treating them with insulin made by pigs and cattle.

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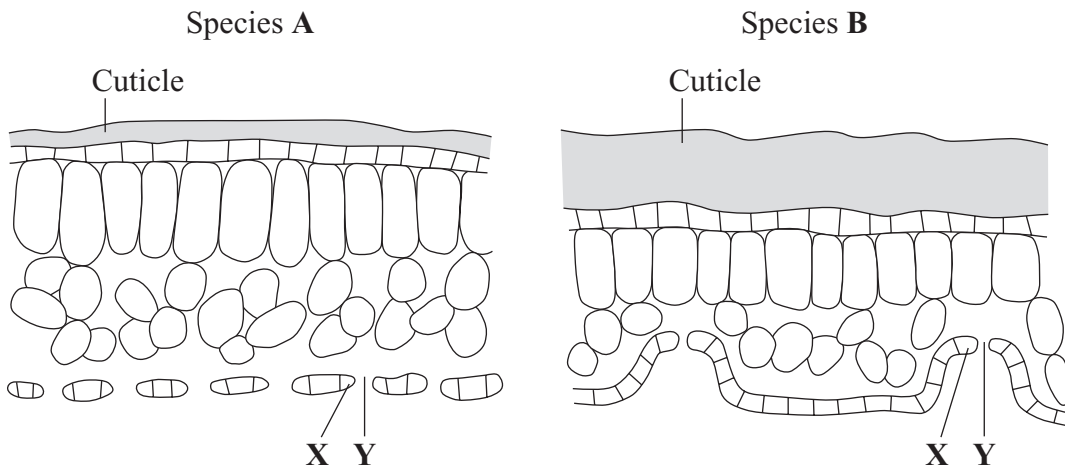
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(2 marks)

4

Turn over ►

14 The diagram shows sections through leaves from two different plant species.



(a) (i) Name cell **X** and space **Y**.

X:

Y:

(2 marks)

(ii) Which species, **A** or **B**, is better adapted to living in dry conditions?

Give **two** reasons for your answer.

Species

Reason 1

Reason 2

(2 marks)

(b) The leaves on both plants wilted in hot, dry, windy conditions.

Explain why.

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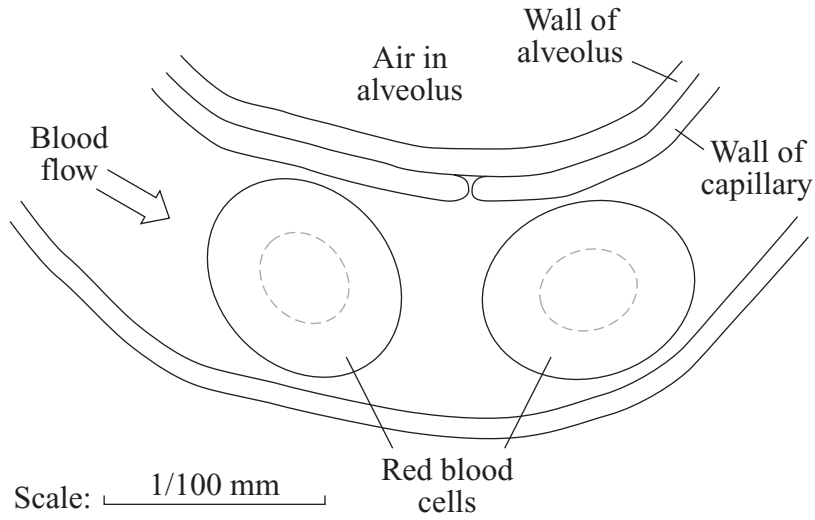
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(3 marks)

- 15 There are about 400 million alveoli in the human lung.
The diagram shows some red blood cells in a capillary next to an alveolus.
Each red blood cell contains about 500 million molecules of haemoglobin.



Use this information and your own knowledge to explain how a large amount of oxygen enters the blood in the capillary.

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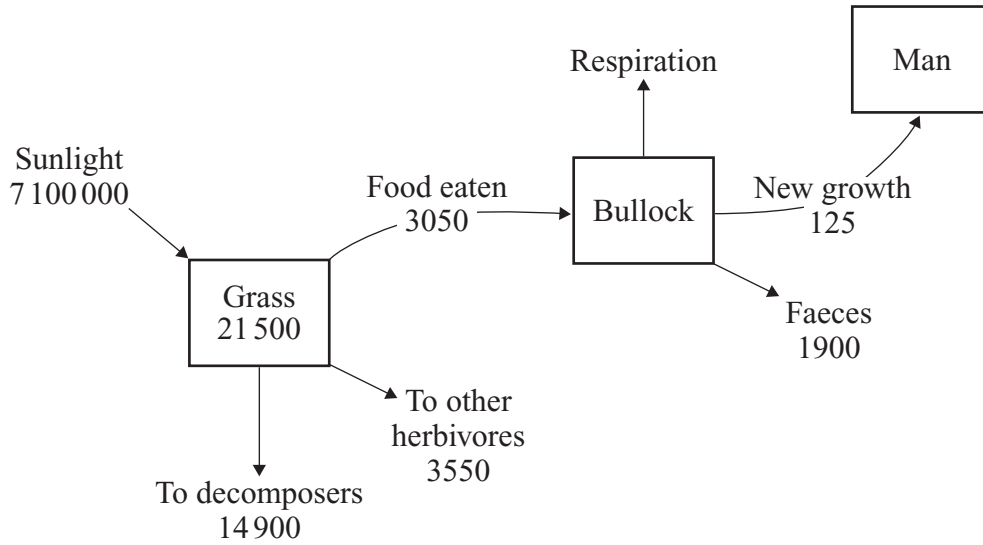
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(5 marks)

5

Turn over ►

16 The diagram shows the flow of energy through a food chain. The figures are in kilojoules of energy per square metre per year.



(a) How do decomposers break down carbon-containing compounds from the dead remains of grass plants?

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(3 marks)

(b) When the bullock eats the grass, much of the energy from the grass is released in respiration.

(i) How much energy is released by the bullock in respiration?

..... kJ per m² per year
(1 mark)

(ii) Give **one** use of the energy released in respiration.

.....
(1 mark)

- (c) Intensive rearing of cattle indoors is an attempt to reduce energy losses. The table shows the energy balance for indoor and outdoor meat production from cattle.

	kJ per m ² per year	
	Indoors	Outdoors
Energy input as food	10 000	5 950
Energy input as fossil fuel	6 000	50
Energy trapped in meat	40	1.8

- (i) The percentage efficiency of rearing cattle indoors is 0.25 %.
Use the following formula to calculate the percentage efficiency of rearing cattle outdoors.

$$\text{Percentage efficiency} = \frac{\text{Energy trapped in meat}}{\text{Total energy input}} \times 100$$

Show clearly how you work out your answer.

.....
.....

..... Percentage efficiency
(2 marks)

- (ii) Suggest **two** reasons why rearing cattle indoors is more efficient than rearing them outdoors.

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(2 marks)

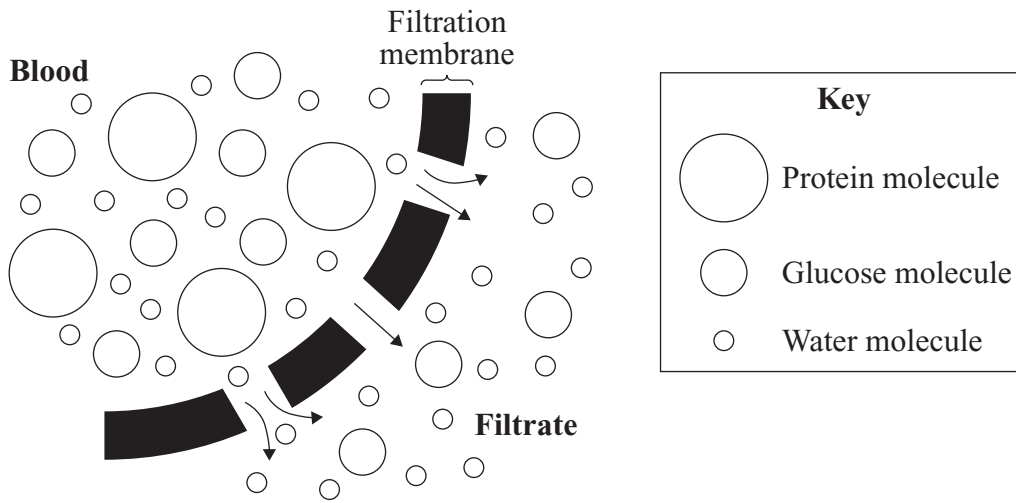
- (iii) Suggest **two** possible disadvantages of rearing cattle indoors.

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2.....
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(2 marks)

17 The diagram shows the process of filtration in the kidney.



(a) Use information in the diagram and your own knowledge of how the kidney works to explain why:

(i) protein molecules are not normally present in urine;

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.....

(1 mark)

(ii) glucose molecules are not normally present in urine.

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(3 marks)

- (b) An athlete trained for two hours on a hot summer's day. At the end of the training session, the athlete had a higher concentration of antidiuretic hormone (ADH) in his blood than at the start of the training session.

Explain why.

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(4 marks)

8

Turn over for the next question

Turn over ►

18 (a) Explain what happens within muscle tissue in order to pull on a bone.

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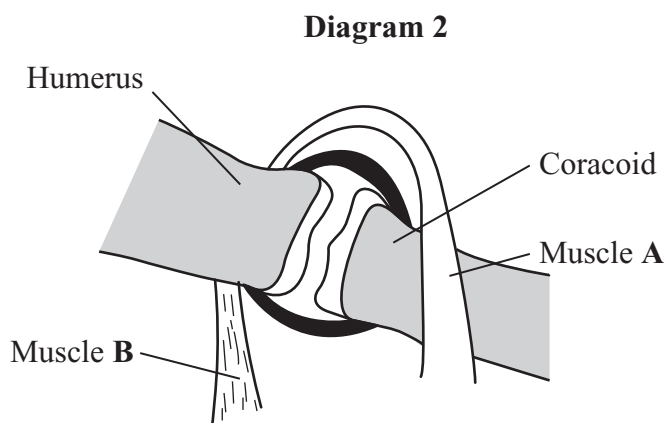
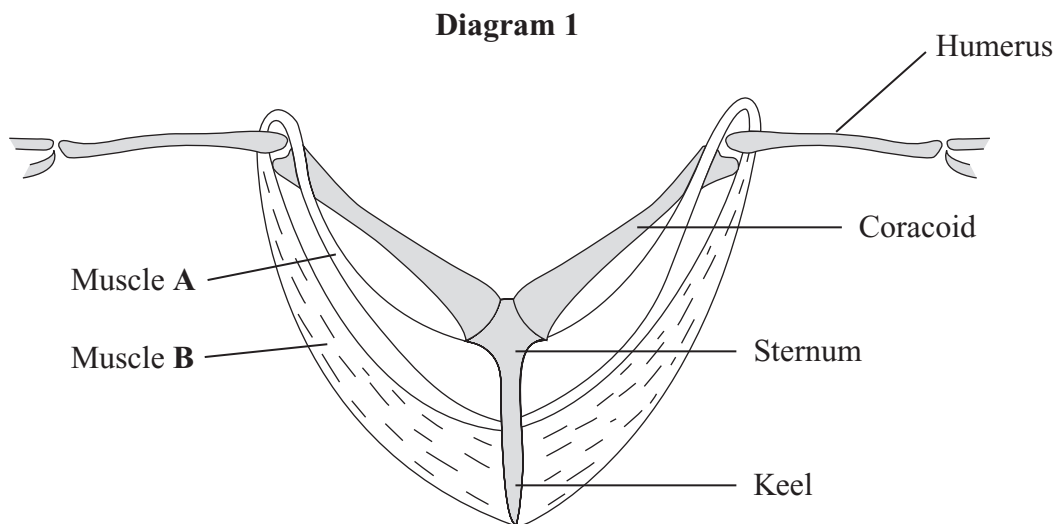
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(3 marks)

Diagram 1 shows a view from the front of part of a bird skeleton, along with some of the attached muscles.

Diagram 2 shows the joint between two of the bones.



- (b) Structures at a joint include ligaments, tendons and cartilage.
Draw a line from each structure to its position in a joint and then to its description.

Structure	Position in a joint	Description
ligament	joins muscles to bones	strong but not rigid
tendon	joins bones to other bones	has tensile strength and little elasticity
cartilage	covers the ends of bones	has tensile strength and some elasticity

(3 marks)

- (c) An ostrich is a flightless bird.

- (i) Suggest and explain why an ostrich has a much smaller keel than most other birds.

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(2 marks)

- (ii) Suggest and explain **one** other difference between the bones of an ostrich and those of most other birds.

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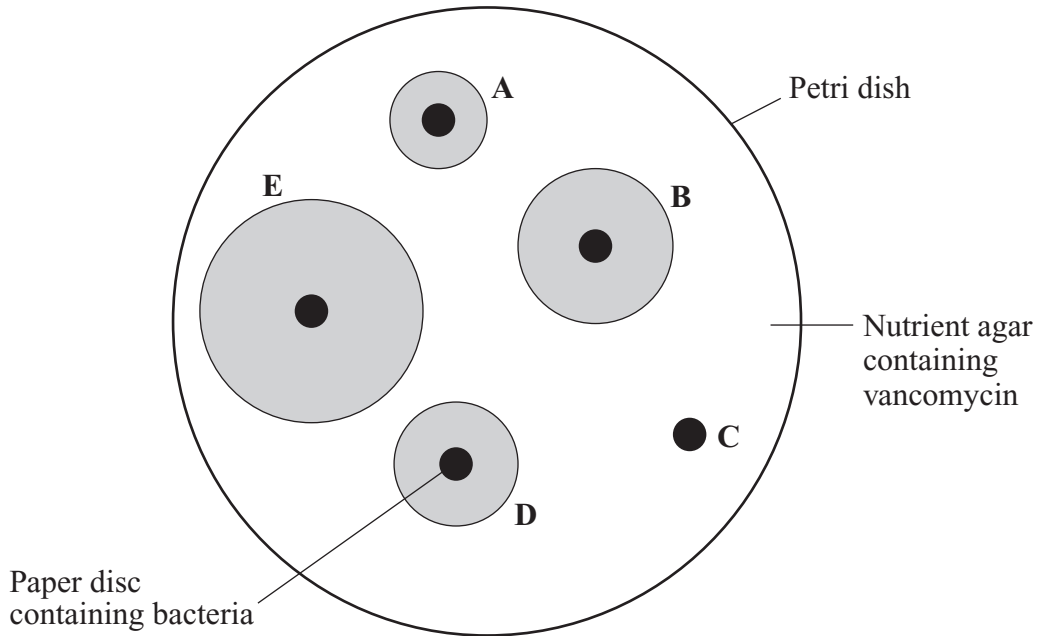
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(2 marks)

- 19** The diagram shows the growth of five different bacteria, **A**, **B**, **C**, **D** and **E**, on nutrient agar in a Petri dish.
This agar also contains the antibiotic vancomycin.
The bacteria are added to the agar on small discs of paper.



- (a) The bacteria need carbohydrates and water in order to grow.

Suggest **two** other nutrients in agar which are necessary for the bacteria to grow.

1

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(2 marks)

- (b) Which of the bacteria, **A**, **B**, **C**, **D** or **E**, shows the most resistance to the antibiotic?

Explain your answer.

.....

.....

(1 mark)

- (c) How do bacteria develop resistance to antibiotics?

.....

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(1 mark)

(d) Describe **two** steps that can be taken to reduce the development of antibiotic resistance in bacteria.

1

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(2 marks)

(e) Explain why antibiotics cannot be used to kill viruses.

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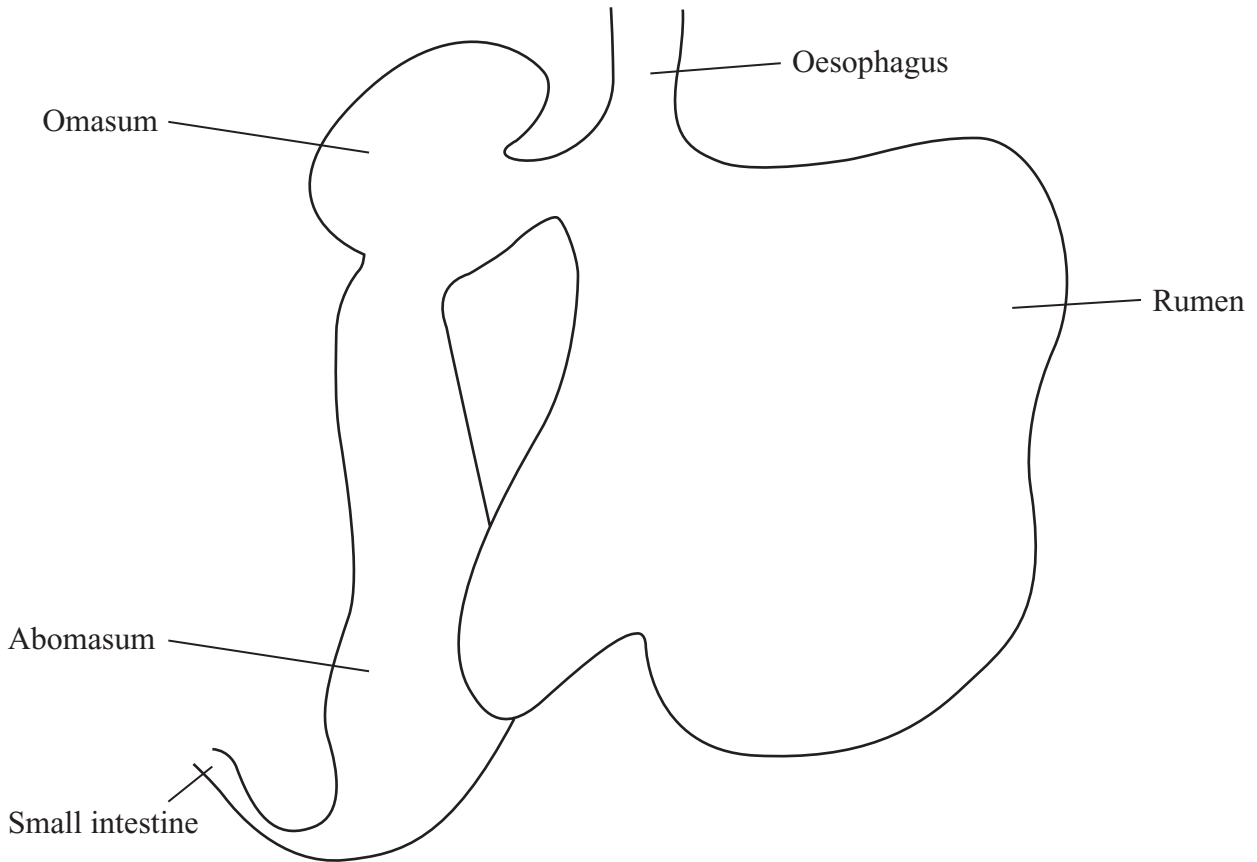
(2 marks)

8

Turn over for the next question

Turn over ►

20 The diagram shows part of the digestive system of a cow. The omasum and abomasum are parts of the stomach.



(a) Describe the diet of a cow.

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(1 mark)

(b) Explain how the function of the digestive system of the cow allows the cow to digest its food efficiently.

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(3 marks)

(c) Rabbits have a similar diet to cows.

(i) How does the structure of the rabbit's intestine differ from that of the cow?

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(1 mark)

(ii) Explain why the structure of the digestive system of a rabbit means that rabbits must eat their own faeces.

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(2 marks)

7

Turn over for the next question

Turn over ►

21 Cystic fibrosis is an inherited disorder caused by a recessive allele, **n**. People with cystic fibrosis produce thick, sticky mucus in their lungs which makes breathing difficult. Heterozygous individuals are unaffected because they have the dominant allele, **N**, in their genotype.

(a) What is the genotype of:

(i) a person with cystic fibrosis;

(ii) a person who is heterozygous for cystic fibrosis?

(2 marks)

(b) A man and his wife have a child with cystic fibrosis. Neither the man nor his wife has cystic fibrosis. What is the probability that their next child will have cystic fibrosis?

Use a genetic diagram to explain your answer.

Probability =

(4 marks)

(c) Gene therapy is being developed to treat cystic fibrosis. The patient breathes in tiny droplets from an inhaler which contain the functional gene wrapped up in fatty material. The fatty droplets are taken in through the surfaces of cells lining the lung, delivering the gene into these cells.

(i) Name the structure which controls the passage of substances into a cell.

.....

(1 mark)

(ii) Suggest why someone treated by gene therapy would not be able to pass on the functional gene to any offspring.

.....

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(1 mark)

END OF QUESTIONS