Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Wednesday 4 June 2025

Afternoon (Time: 1 hour 45 minutes)

Paper reference **4HB1/02R**

Human Biology

UNIT: 4HB1

PAPER: 02R

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagram/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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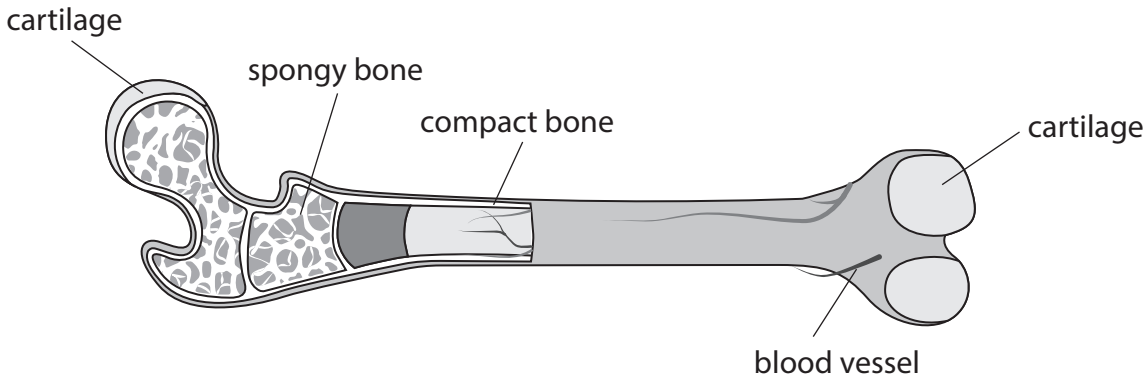
P 7 4 6 3 2 A 0 1 2 4

Pearson

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) The diagram shows a bone found in the human body.



(Source: adapted from: © Designua / Shutterstock)

(i) State the name of the type of bone shown in the diagram.

(1)

.....

(ii) Place one tick (✓) in each row to give the function of each part of the bone.

(3)

Part	Function		
	reduces friction	**where red blood cells are produced**	**provides strength**
compact bone			
spongy bone			
cartilage			

(iii) Describe the function of the blood vessel in the bone.

(2)

.....

.....

.....

DO NOT WRITE IN THIS AREA

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DO NOT WRITE IN THIS AREA

(b) Bones are moved by muscles.

(i) Use the words in the box to complete the passage about bones and muscles.

(4)

cartilage	contracts	ligaments	lowers	pulls
pushes	raises	relaxes	tendons	

Muscles are attached to bones by ..... .

To raise the lower arm, the biceps ..... and the triceps ..... .

The biceps ..... on the radius, which raises the lower arm.

(ii) Energy is transferred by the biceps muscle when raising the lower arm.

The biceps muscle applies a force of 125 N to raise the lower arm a distance of 0.50 m.

Use this formula to calculate the energy transferred by the biceps muscle when raising the lower arm 0.50 m.

energy transferred (J) = force (N) × distance (m)

(2)

energy transferred = ... J

(Total for Question 1 = 12 marks)

2 (a) Cells are made up of different components. Each component has a particular function.

Identify the cell component that transports substances inside the cell.

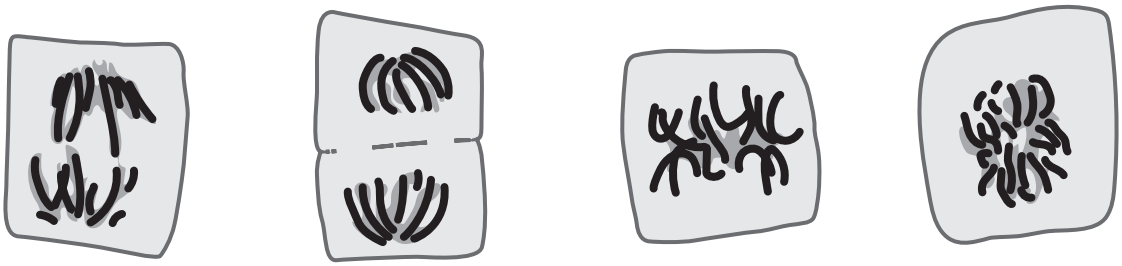
(1)

- ☒ **A** cell membrane
- ☒ **B** cytoplasm
- ☒ **C** endoplasmic reticulum
- ☒ **D** ribosomes

(b) Mitosis is a type of cell division.

A student uses a light microscope to view a cell undergoing four stages in mitosis.

The diagrams, W, X, Y and Z, show the student's observations.



W X Y Z

(Source: https://www.pinterest.co.uk/pin/812547957739062607/)

(i) Give the letters to show the correct order of the diagrams in the process of mitosis.

(1)

.....

(ii) State one function of mitosis in body cells.

(1)

.....

.....

(c) Meiosis is another type of cell division.

Give two differences between the cells produced by meiosis and the cells produced by mitosis.

(2)

1 .....

.....

2 .....

.....

(Total for Question 2 = 5 marks)

3 (a) The nervous system is made up of sensory, motor and relay neurones.

(i) Draw a diagram of a motor neurone.

You should label these structures in your diagram.

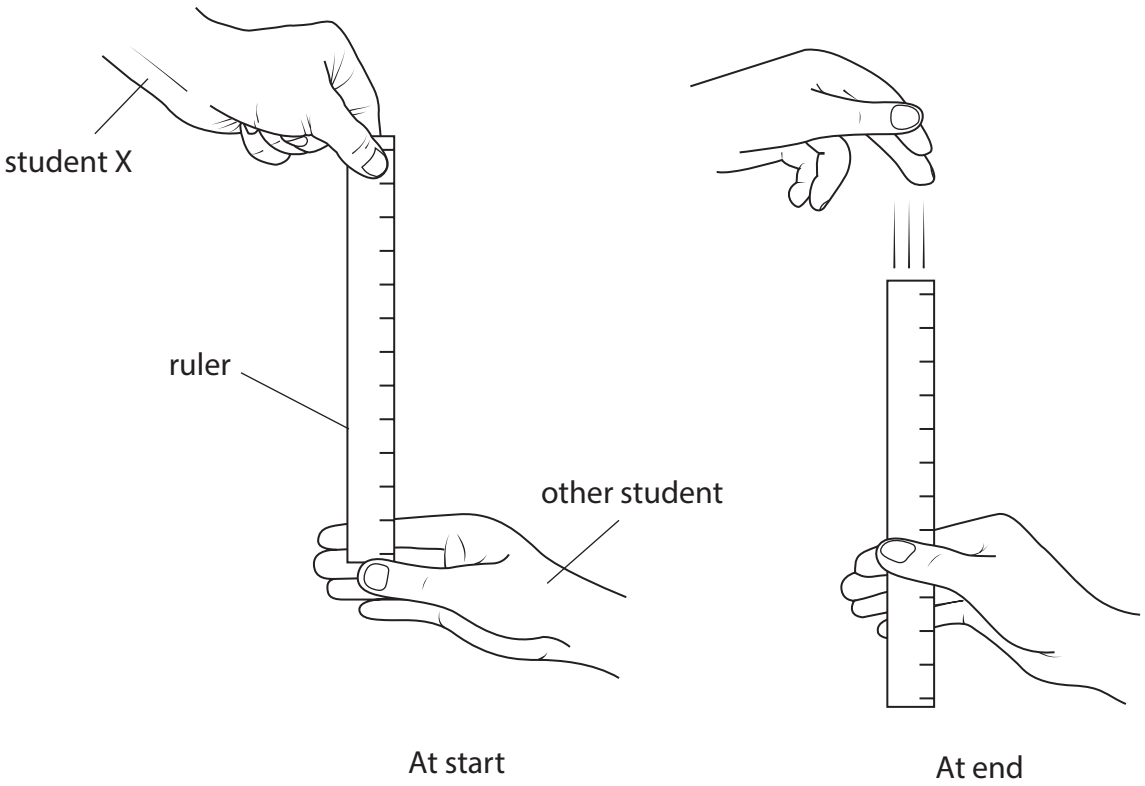
- nucleus
- axon
- myelin sheath

(4)

(ii) Describe the function of a motor neurone.

(2)

(b) Student X uses this equipment to investigate the reaction time of another student.



Student X knows that the reaction time can be calculated using this formula.

$$\text{reaction time} = \sqrt{\frac{\text{measurement from ruler}}{5}}$$

(i) Describe a method the student could use to compare the reaction times of 10 students.

(6)

(ii) Name the dependent variable in this investigation.

(1)

(iii) Give a reason why the student should display the results using a bar chart instead of a line graph.

(1)

(iv) The reading on the ruler for one of the students is 0.15 m.

Calculate the reaction time of this student.

Use this formula.

$$\text{reaction time} = \sqrt{\frac{\text{measurement from ruler}}{5}}$$

(2)

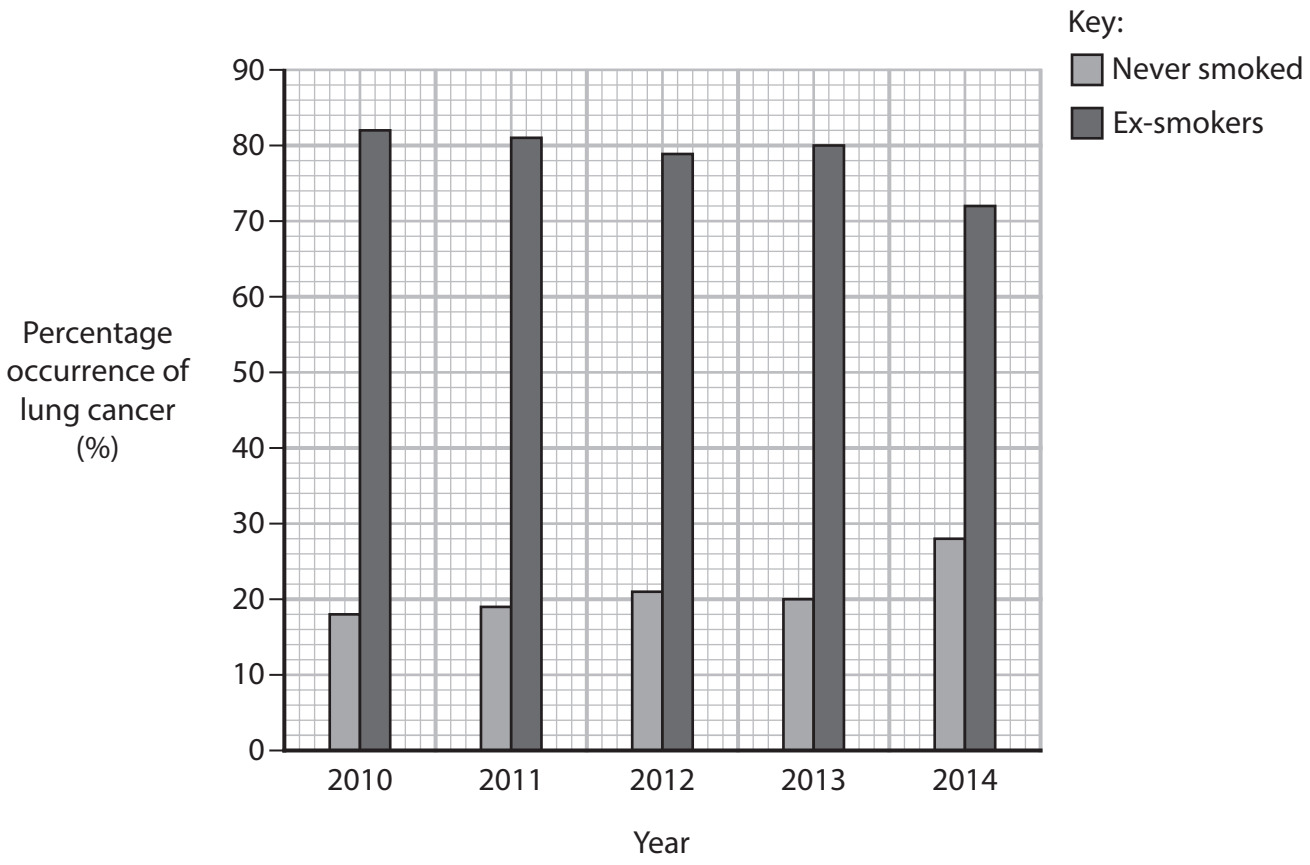
reaction time = ... s

(Total for Question 3 = 16 marks)

4 (a) Cigarette smoking is the biggest cause of lung cancer worldwide.

The bar chart shows the percentage occurrence of lung cancer, from 2010 to 2014, in ex-smokers and in people who have never smoked cigarettes.

People who still smoke are not included in the bar chart.



(Source adapted from: https://www.thetimes.co.uk/article/pollution-blamed-for-lung-cancer-in-people-who-have-never-smoked-r52fr7m89)

(i) Describe the trend in the percentage occurrence of lung cancer in ex-smokers, from 2010 to 2014.

(2)

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DO NOT WRITE IN THIS AREA

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(ii) Calculate the ratio of the percentage occurrence of lung cancer in ex-smokers to people who have never smoked, in 2012.

Give your answer in the form n : 1

(2)

ratio = ... : 1

(iii) Suggest two reasons for the difference in the percentage occurrence of lung cancer, from 2010 to 2014, in people who have never smoked, compared with ex-smokers.

(2)

.....

.....

.....

.....

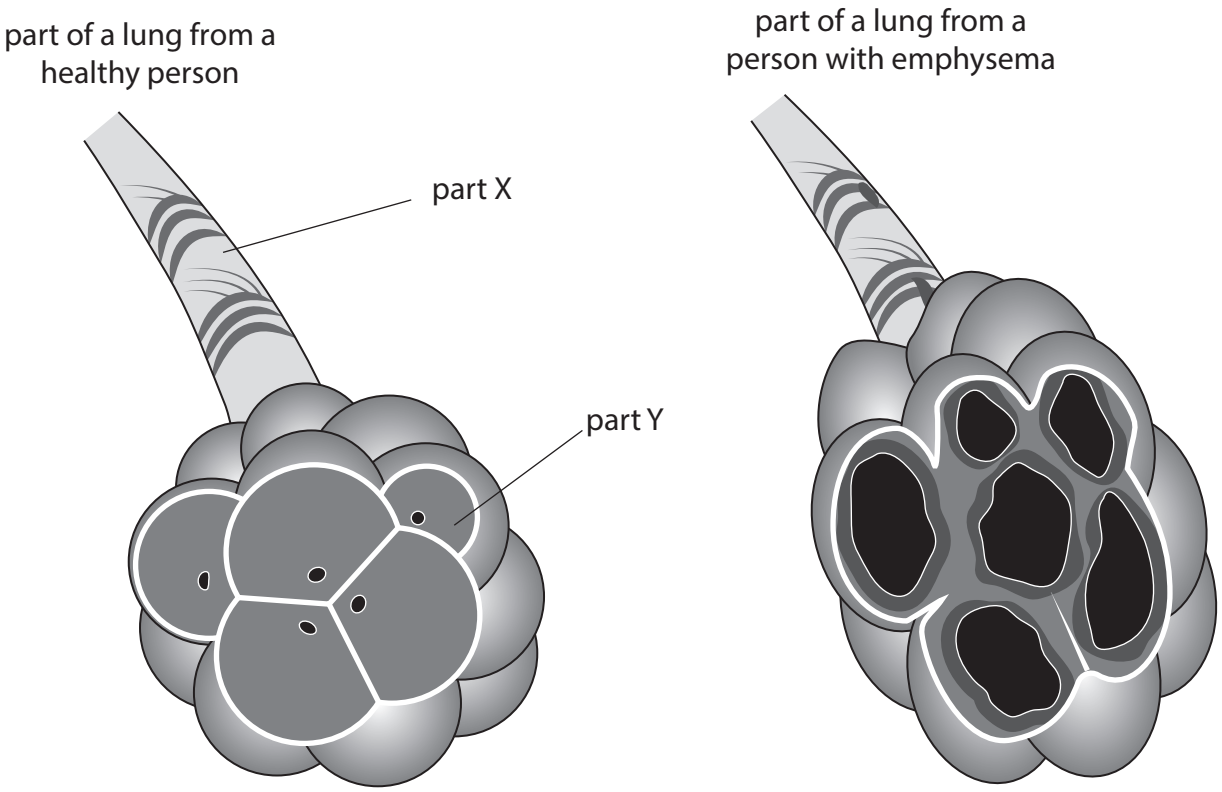
(iv) Name the substance in cigarette smoke that causes lung cancer.

(1)

.....

(b) Emphysema is a lung condition that can be caused by cigarette smoking.

The diagram shows part of a lung from a healthy person and part of a lung from a person with emphysema.



(Source: © ttsz / Getty Images)

(i) Name part X.

(1)

.....

(ii) Name part Y.

(1)

.....

(iii) Explain the effect that emphysema has on the health of a person.

(4)

(Total for Question 4 = 13 marks)

5 Glucose is a product of digestion.

Glucose moves from the small intestine into the blood by diffusion.

(a) Explain why the rate of diffusion of glucose into the blood stream is affected by the concentration of glucose in the small intestine.

(3)

(b) A student uses different concentrations of glucose solution to investigate the rate of diffusion from the small intestine into the blood.

The list gives some of the equipment that the student uses in the investigation.

- Visking tubing (to represent the small intestine)
- boiling tube
- different concentrations of glucose solutions
- stop clock

(i) Name the chemical the student uses to test for glucose.

(1)

(ii) Name one other piece of equipment that the student would need to use to test for glucose.

(1)

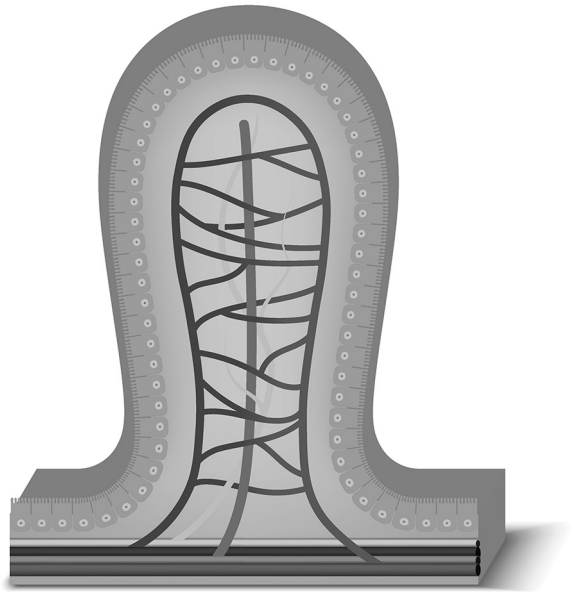
(iii) Draw a diagram to show how the student could use the equipment to investigate the effect of glucose concentration on the rate of diffusion.

You should add these labels to your diagram.

- Visking tubing
- boiling tube
- sugar solution
- water

(3)

(c) The diagram shows a structure found in the small intestine. This structure increases the rate of diffusion of molecules such as glucose from the small intestine into the blood stream.



(Source: © Dee-sign / Shutterstock)

(i) Name this structure.

(1)

.....

(ii) Explain how these structures increase the rate of diffusion of glucose from the small intestine into the blood stream.

(3)

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(Total for Question 5 = 12 marks)

6 (a) Individuals vary in their phenotypes.

State what is meant by the phenotype of an individual.

(1)

(b) (i) Cystic fibrosis is a disorder that affects epithelial membranes.

Describe what causes an individual to have cystic fibrosis.

(2)

(ii) Describe the effects of cystic fibrosis on the health of an individual.

(4)

(iii) Explain why two parents who do not have cystic fibrosis can have a child who has cystic fibrosis.

(2)

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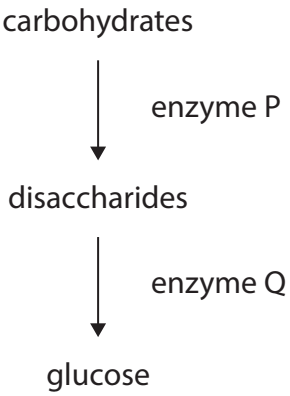
(Total for Question 6 = 9 marks)

7 (a) The diagram shows how carbohydrates are broken down to glucose by two different enzymes, enzyme P and enzyme Q.

These enzymes are found in different regions of the digestive system.



Name enzyme P.

(1)

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(b) People with diabetes can use glucose testing strips to test their urine.

Describe how enzymes are used in glucose testing strips.

(2)

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(c) People with type 1 diabetes are unable to produce hormones to control their blood glucose levels.

Name the organ responsible for producing hormones to control levels of glucose in the blood.

(1)

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(d) Insulin is a hormone used to treat people with diabetes.

Until recently insulin was obtained from animals for human use.

Suggest why this type of insulin can cause health complications in people with diabetes.

(2)

(e) Describe how yeast cells can be modified to produce the human form of insulin.

(2)

(Total for Question 7 = 8 marks)

8 (a) Read the passage below.

Use the information in the passage and your own knowledge to answer the questions that follow.

The human body has physical and chemical barriers that reduce the risk of pathogens entering the body. These barriers are known as the first line of defence. If the barriers are penetrated, then the second line of defence comes into action.

The cells involved in the second line of defence form part of the non-specific line of defence. They do not target specific pathogens but they play an important role in stimulating cells involved in the next stages of defence against disease.

The third line of defence involves specific immune responses by cells. These cells rely on the presence and detection of marker chemicals found on the surface of microscopic invaders. The cells of the specific immune system have receptor proteins that interact with the marker chemicals. The marker chemicals cause the cells to become activated and produce antibodies. The production of antibodies in this way is known as natural, active immunity and results in long-term immunity. However, there are other ways that antibodies can provide protection against disease. Natural passive immunity and artificial passive immunity are two similar processes that minimise the risk of too much harm being caused by pathogens in the body.

(i) Name a physical barrier that prevents the entry of pathogens into the body. (lines 1 to 3)

(1)

.....

(ii) Suggest how chemical barriers can reduce the harm caused to the body by pathogens. (lines 1 to 3)

(1)

.....

(iii) Phagocytes are one type of cell involved in the second line of defence.

Describe the process of phagocytosis. (lines 4 to 6)

(2)

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(iv) State the scientific name for the marker chemicals found on the surface of microscopic invaders. (lines 7 to 11)

(1)

.....

(v) Suggest what is meant by a specific immune response. (line 7)

(2)

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(vi) Describe the differences between natural passive immunity and artificial passive immunity. (lines 14 to 16)

You should give examples in your answer.

(2)

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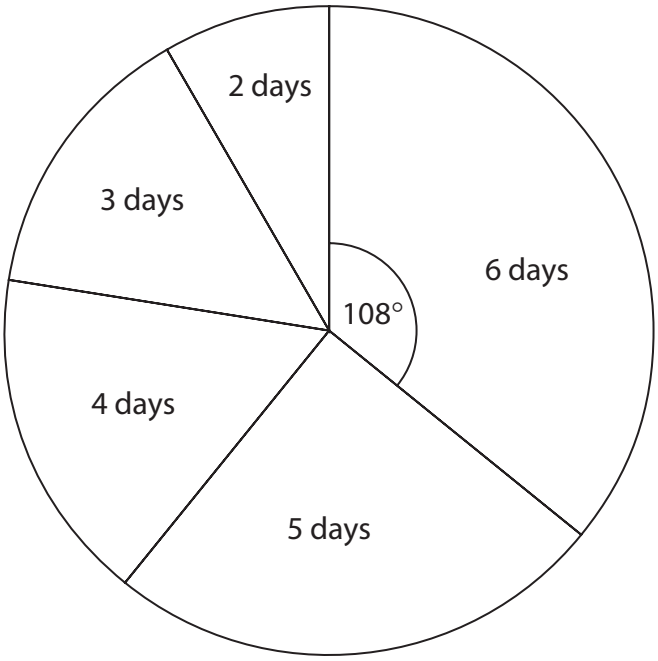
(b) Scientists test how quickly 30 different types of antibiotic reduce the population size of a resistant strain of bacteria.

The scientists record the number of antibiotics that reduce the population of the resistant strain of bacteria by half.

They do this after 2 days, 3 days, 4 days, 5 days or 6 days.

Each section of the pie chart represents the number of antibiotics.



(i) Calculate the number of types of antibiotic that reduce the population size of the resistant strain of bacteria by half in 6 days.

(3)

number of types of antibiotic = ...

(ii) State a reason why it is important to wear gloves and a face mask when investigating bacteria.

(1)

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(iii) Describe how the use of antibiotics can cause antibiotic-resistant strains of bacteria.

(2)

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(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 90 MARKS