OCR GCSE GATEWAY BIOLOGY A · J247

# BIOLOGY



## EXAM QUESTION PACK

### WS1.3 ANALYSIS AND EVALUATION

| SCORE | PERCENTAGE |
| --- | --- |
| /159 | % |

STEMUP

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# Gateway Biology A (9-1)

## Analysis and evaluation

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

**OCR supplied materials:**
Additional resources may be supplied with this paper.

**Other materials required:**
- Pencil
- Ruler (cm/mm)

**Duration:** Not set

| Candidate forename | | Candidate surname | |
|---|---|---|---|

| Centre number | | | | | | Candidate number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

## INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

## INFORMATION FOR CANDIDATES

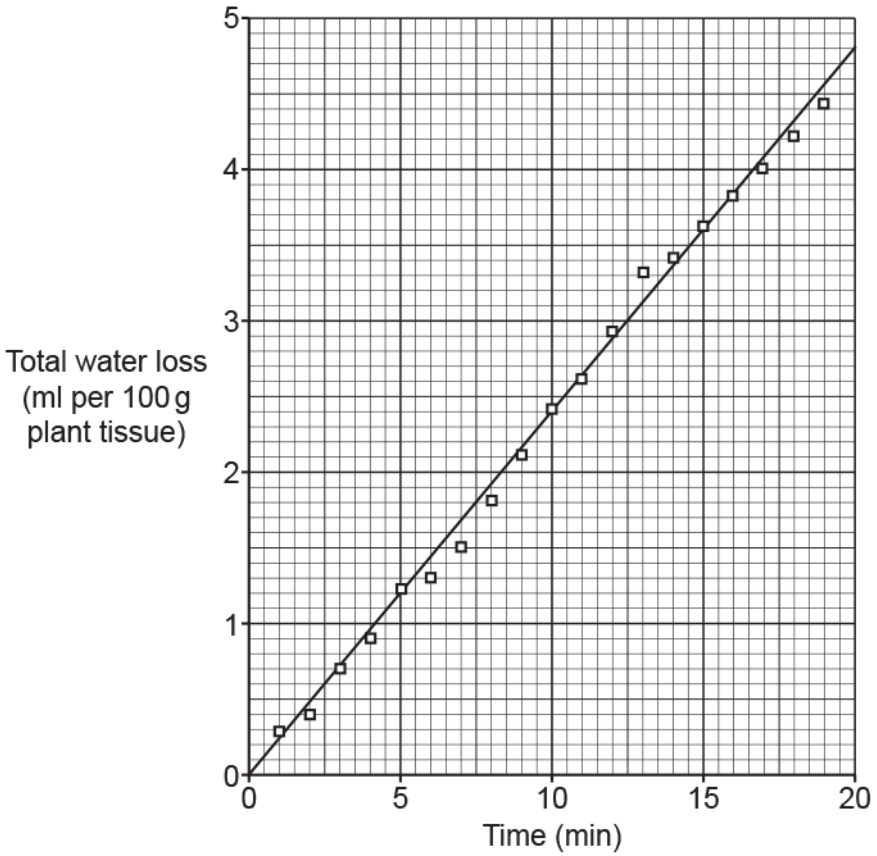
- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **159**.
- The total number of marks may take into account some 'either/or' question choices.

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1 The graph shows total water loss from a plant.




Calculate the water lost between 5 and 15 minutes using the line of best fit.

**A** 2.2 ml per 100 g
**B** 2.4 ml per 100 g
**C** 2.6 ml per 100 g
**D** 2.8 ml per 100 g

Your answer ☐ **[1]**

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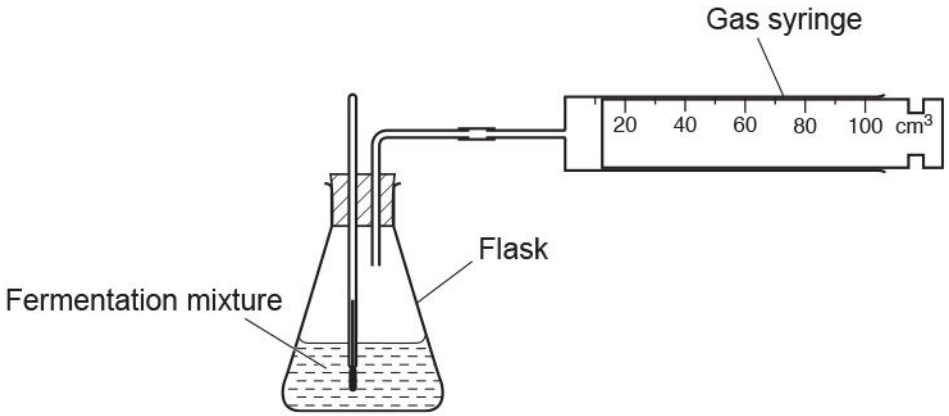
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2(a) Fermentation involves enzymes breaking down sugar and releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.
She measures the volume of carbon dioxide released in 10 minutes.
The diagram shows the apparatus she uses.




Using a Bunsen burner to heat a water bath is **one** way the student could keep the flask at a constant temperature.

(i) What other way could be used to keep the flask at a constant temperature?

[1]

(ii) She chooses to use a Bunsen burner and water bath.

Give **one** safety precaution she should take.

[1]

(iii) Explain why using a Bunsen burner and water bath may introduce errors into her results.

[2]

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(b) The table shows the student's results.

| Temperature (°C) | Volume of carbon dioxide gas released in 10 minutes ($cm^3$) | | | | |
|---|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean | Range |
| **25** | 23 | 25 | 22 | 23 | 22–25 |
| **30** | 34 | 29 | 33 | ..... | 29–34 |

(i) Calculate the **mean** for the results at 30 °C and **complete the table**.

**[2]**

(ii) The student repeated the experiment at two more temperatures, 20 °C and 35 °C, to get enough readings to plot a line graph.

Which measurement should the student plot on the **x-axis**?

**[1]**

(iii) Describe **one** way that the range would improve any conclusions made from the graph.

**[1]**

(iv) The mean volume at a temperature of 20 °C was 15 $cm^3$ and for a temperature of 35 °C it was 27 $cm^3$.

Describe what the student's results show about the effect of temperature on enzyme activity.

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[2]

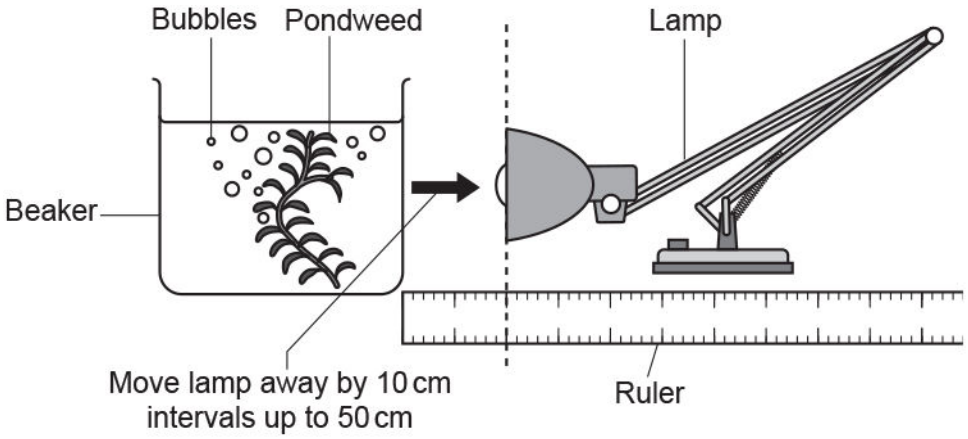
3(a) Two students investigate photosynthesis. Look at the notes from their investigation.

**Aim of the experiment**

To use pondweed to see how light intensity affects the rate of photosynthesis.

**Method**

1. Set up the apparatus as in the diagram.
2. Leave the pondweed for five minutes so it can adjust to the new light intensity.
3. Count the number of bubbles given off by the pondweed in one minute.
4. Move the lamp 10 cm further away from the beaker.
5. Leave the pondweed for five minutes so it can adjust again.
6. Count the number of bubbles given off by the pondweed in one minute.
7. Repeat by moving the lamp further away from the beaker by 10 cm intervals until 50 cm is reached.




What is the **independent** variable in their investigation?

[1]



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(b)

(i) Explain why counting the number of bubbles will not give an **accurate** measure of the rate of photosynthesis.

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**[2]**

(ii) Describe how the students could develop their investigation to improve the **accuracy** of their results.

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**[2]**

(c) The table shows the results.

| Distance from lamp to beaker (cm) | Number of bubbles given off (per minute) |
|---|---|
| 10 | 30 |
| 20 | 14 |
| 30 | 6 |
| 40 | 2 |
| 50 | 0 |

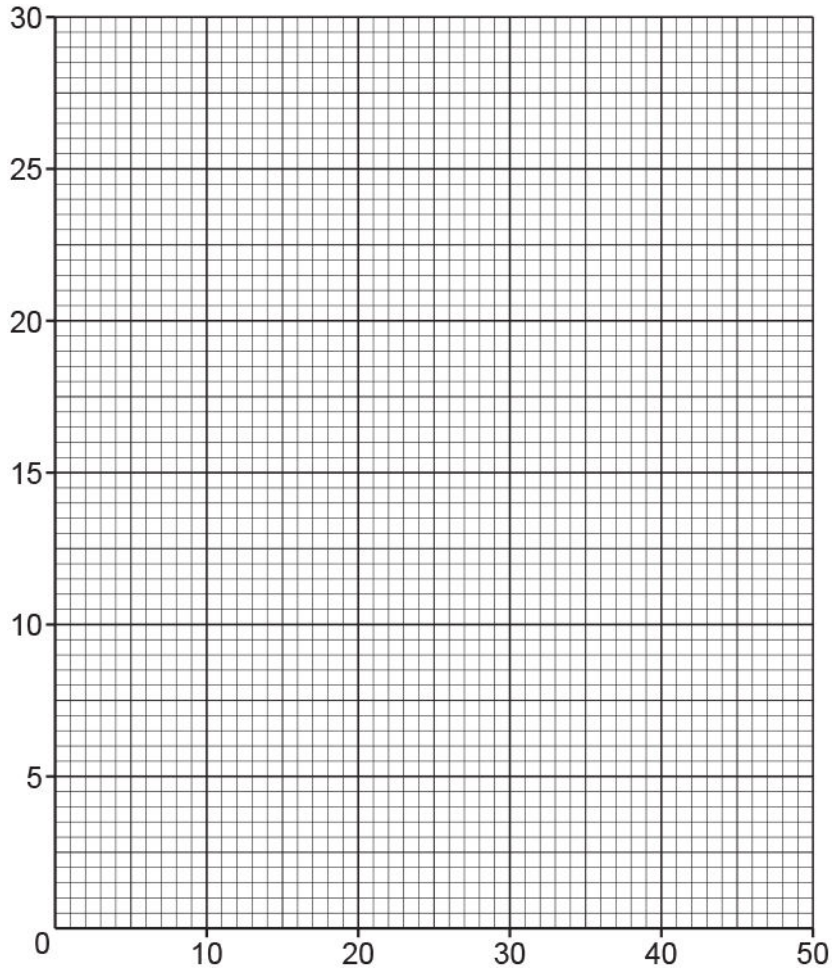
(i) One student started to draw a graph but did not finish.

Complete the graph using the results in the table and draw a curve of best fit.

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[4]

(ii) Write down what the students could conclude from their investigation.

Include data from the results table in your answer.

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[2]

4 Some students investigate the effect of the surface area : volume ratio on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes that have been stained blue using a pH indicator solution. The indicator will turn red in acidic conditions.

They put different sized cubes into 3 different test tubes of hydrochloric acid and time how long it takes for the cubes to completely change to red.

**Fig. 21.1** shows the apparatus they use.

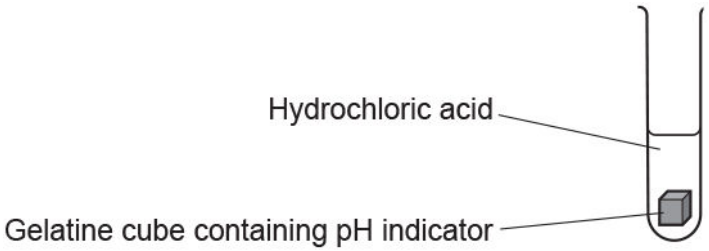



**Fig. 21.1**

The table shows the students' results.

| Length of each side of the cube (mm) | surface area : volume ratio | Time to completely change colour (seconds) |
|---|---|---|
| 2 | ..... | 32 |
| 4 | 3 : 2 | 61 |
| 6 | 1 : 1 | 170 |

(i) Calculate the surface area : volume ratio for the cube with sides of 2 mm.

surface area : volume ratio = ..... **[2]**

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(ii) What conclusion can be made about the effect of surface area : volume ratio on the rate of diffusion?

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[1]

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(iii) Emphysema causes some of the walls of alveoli in the lungs to break down. This produces a smaller number of larger air sacs.

Use the results to explain the effect of emphysema on oxygen diffusing into the blood.

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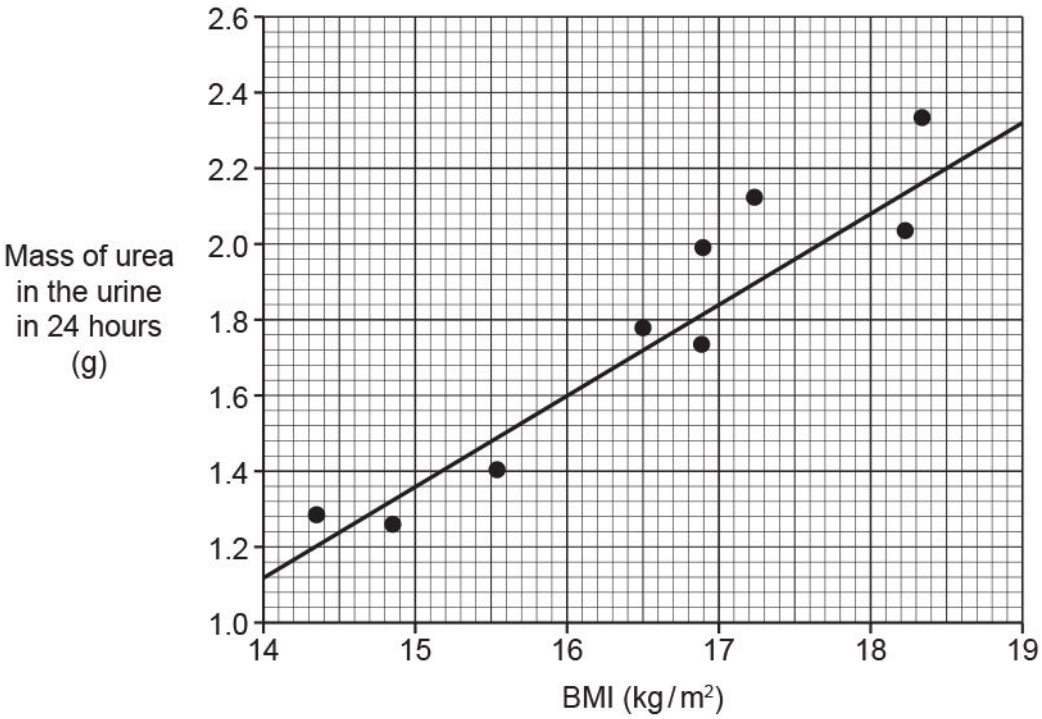
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[2]

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5 **Fig. 22.1** shows the mass of urea in the urine plotted against the BMI (Body Mass Index) for nine boys. BMI is a value often used to see if a person is a healthy mass for their height.




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Fig. 22.1

(i) What does the graph show about the relationship between BMI and the mass of urea in the urine?

[1]

(ii) A boy has a BMI of 16. He produces 1000 $cm^3$ of urine in 24 hours.

Calculate the concentration of urea in the boy's urine.

Concentration = .....g / $cm^3$

[2]

(iii) **Fig. 22.2** shows the mass of urea in the urine against the BMI for nine **different** boys.

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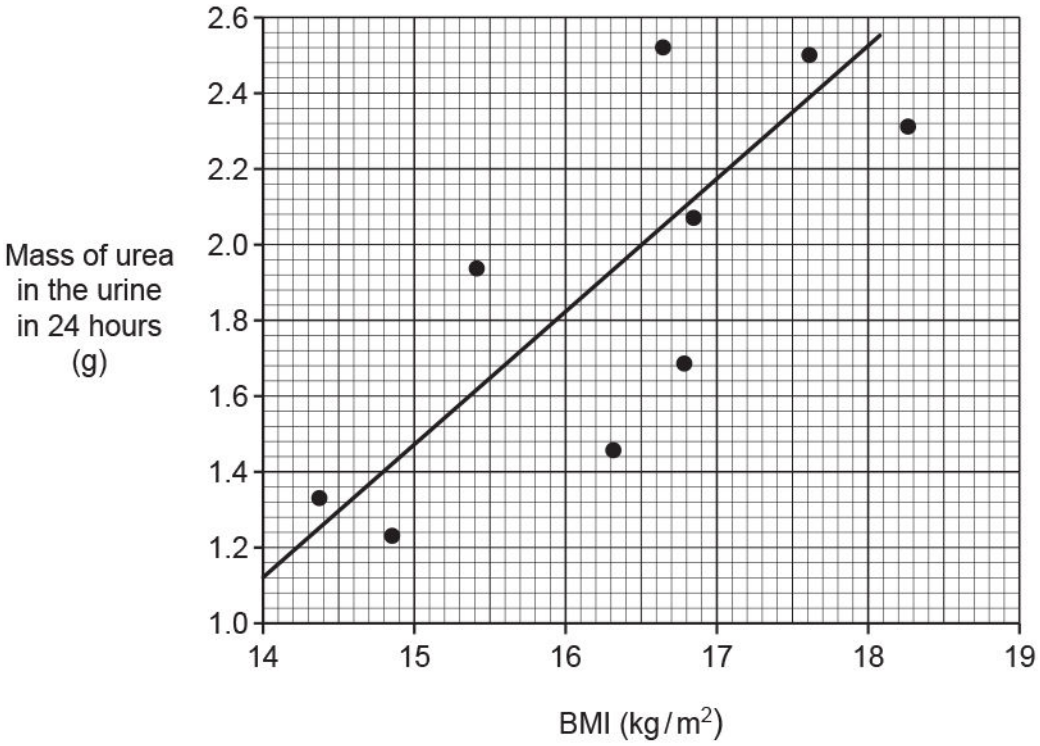



Fig. 22.2

Give **two** differences in the relationship between BMI and the mass of urea in the urine shown in **Fig. 22.1** and **Fig. 22.2**.

1 _____

_____

2 _____

_____

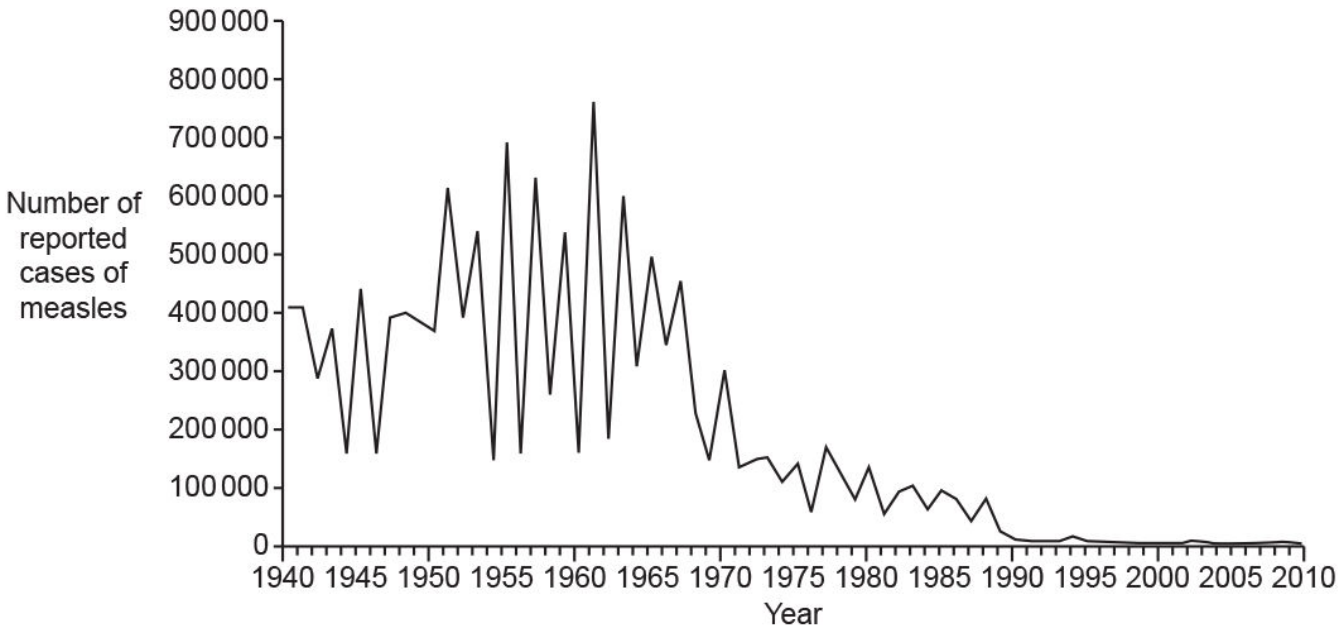
**[2]**

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6 The graph shows the number of reported cases of measles in England and Wales between 1940 and 2010.




In which year was the measles vaccine likely to have been introduced?

**A** 1940
**B** 1952
**C** 1968
**D** 1982

Your answer ☐ **[1]**

7(a) Scientists can estimate the number of insects on a tree using capture-recapture.

First, they collect some insects from the tree.

**Fig. 18.2** shows the equipment they use.

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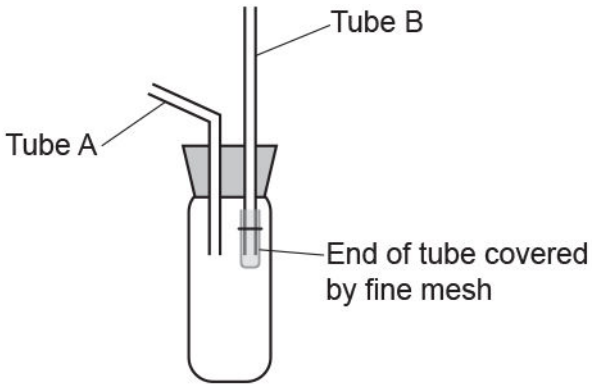



Fig. 18.2

They capture 25 insects from a tree and then mark them. This is their first sample.

They then release the insects and sample the tree again two days later. In this second sample there were 30 insects and 3 had been marked.

(i) Estimate the population size of insects on the tree.

Use this formula:

$$\text{Estimated population size} = \frac{\text{Number in first sample} \times \text{Number in second sample}}{\text{Number in second sample previously marked}}$$

Estimated population size = ..... **[2]**

(ii) To mark each insect the scientists put a small spot of paint on the underside of the insect.

Explain why they marked the underside of the insects and not the top.

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**[2]**

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(b) Scientists want to see if there is a link between the level of pollution in the air and the number of insects on trees.

They sample trees at different distances from a factory that was releasing sulfur dioxide.

**Fig. 18.3** shows their results.

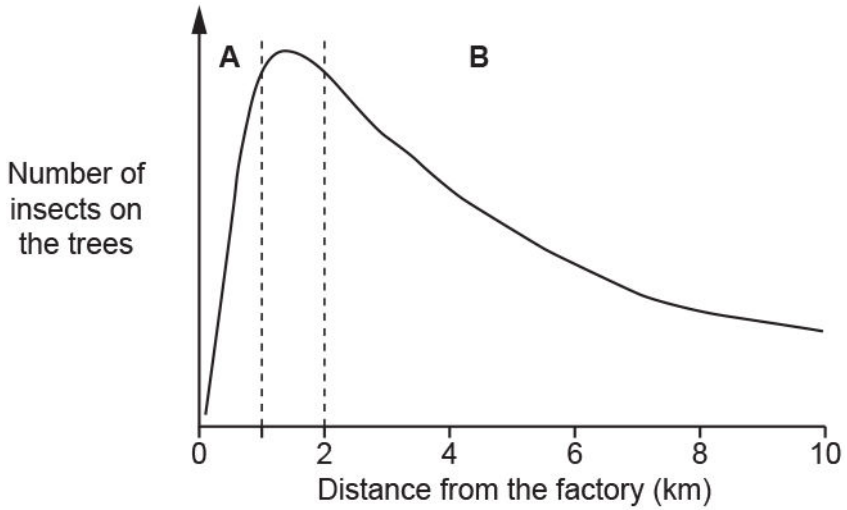



**Fig. 18.3**

(i) The scientists found that sulfur dioxide can make the waxy cuticle of leaves thinner.

Suggest how this could explain the number of insects on the trees, further from the factory, in section **B** of the graph in **Fig. 18.3**.

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**[2]**

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(ii) Look at section **A** of the graph in **Fig. 18.3**. Which is a possible explanation for the shape of the graph nearest the factory, in section **A**?

Tick (✓) **one** box.

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Low concentrations of sulfur dioxide kill the insects. ☐

Low concentrations of sulfur dioxide make the insects reproduce faster. ☐

Very high concentrations of sulfur dioxide kill the insects. ☐

Very high concentrations of sulfur dioxide make the insects reproduce faster. ☐

**[1]**

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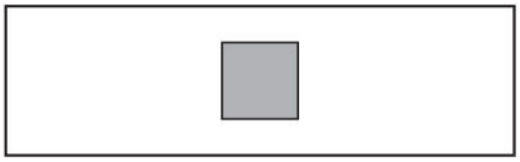
8 Fanconi anaemia is a genetic disorder. The disorder causes a decrease in the number of platelets in the blood.

Fanconi anaemia also causes a decrease in white blood cells and red blood cells.

The table shows ranges for blood components in people **without** Fanconi anaemia.

| Blood component | Number per $mm^3$ |
|---|---|
| red blood cell | 4.5 million – 6.5 million |
| white blood cell | 6.0 thousand – 16.0 thousand |
| platelet | 0.15 million – 0.40 million |

(i) The diagram shows a microscope slide containing blood from a patient.



The volume of blood under the slide is 0.1 $mm^3$ and it contains 1000 white blood cells.

Calculate the number of white blood cells per $mm^3$ of blood.

Number = ..... per $mm^3$ **[2]**

(ii) Does the blood sample provide evidence that the patient has Fanconi anaemia?

Use the table and your answer to part **(i)** to justify your answer.

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**[1]**

9(a) Gardeners use dead plant material to make compost. They add this compost to soil where they are growing plants.

A new way of making compost is called bokashi. In this process the compost is made **anaerobically** in a different type of composter.

Scientists compare the normal methods of making compost with bokashi.

This is their method:

- Take one large pile of dead plant material
- Divide the material into two samples of equal mass
- Place one sample into the normal composter and place one sample into the bokashi composter
- Measure the temperature in each composter every 10 days
- After 40 days, measure the mass of the compost.

Why did the scientists put the same mass of compost in each composter?

Tick (✓) **one** box.

To allow valid comparisons of the results. ☐

To decrease the temperature. ☐

To make the measurements more accurate. ☐

To make the results repeatable. ☐

**[1]**

(b) **Table 20.1** shows the scientists' temperature measurements.

| | Temperature of the compost (°C) | |
|---|---|---|
| Time (days) | Normal compost | Bokashi compost |
| 0 | 26 | 26 |
| 10 | 70 | 27 |
| 20 | 53 | 29 |
| 30 | 42 | 31 |
| 40 | 28 | 28 |

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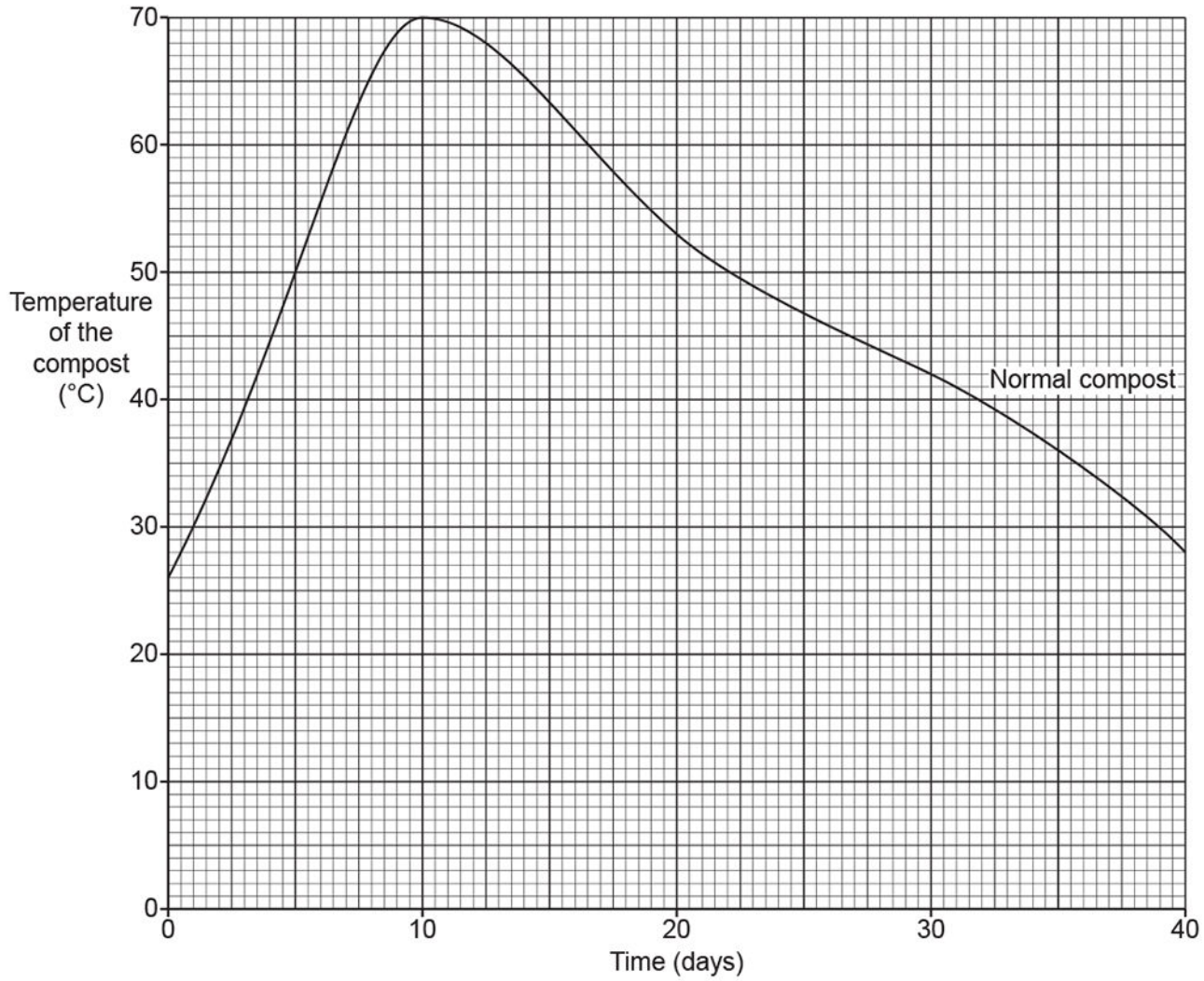
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Table 20.1

(i) The scientists' results for the normal compost are plotted on the grid.

Complete the graph by plotting the results for the **bokashi** compost and draw a curve of best fit.




[3]

(ii) Describe the change in the temperature of the **normal** compost during the investigation.

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[2]

(iii) Use data from **Table 20.1** to calculate the difference between the maximum temperature of the normal compost and the maximum temperature of the bokashi compost.

Difference = ..... °C **[2]**

(iv) Which **two** statements explain this difference in temperature between the two types of compost?

Tick (✓) **two** boxes.

Both types of compost are made by aerobic respiration. ☐

Normal compost is made by aerobic respiration. ☐

Normal compost is made by anaerobic respiration. ☐

Aerobic respiration and anaerobic respiration release the same amount of energy. ☐

Aerobic respiration releases more energy than anaerobic respiration. ☐

Aerobic respiration releases less energy than anaerobic respiration. ☐

**[2]**

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(c) **Table 20.2** shows the scientists' results for the mass of the compost.

| | Normal compost | Bokashi compost |
|---|---|---|
| Mass at start (kg) | 1500 | 1500 |
| Mass after 40 days (kg) | 760 | 1200 |

Table 20.2

(i) The mass of the normal compost has decreased by 19 kg per day.

Calculate the decrease in mass of the bokashi compost per day.

Give your answer to the nearest **whole** number.

Decrease = .....kg per day **[3]**

(ii) Carbon dioxide is given off in the making of the compost. This causes most of the decrease in mass.

Scientists think that the bokashi method of composting might be better for the environment.

Use your answer from part **(i)** to justify the scientists' conclusion.

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**[1]**

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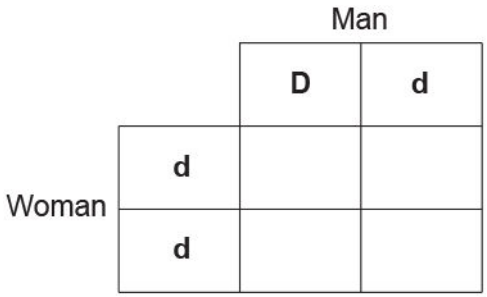
10(a) Hypercholesterolemia (HC) is caused by a dominant allele on chromosome 19. This allele has mutations which cause a change in the order of DNA nucleotides.

A woman who does **not** have HC and a man who is heterozygous are expecting a baby.

What is the probability of the baby having HC?

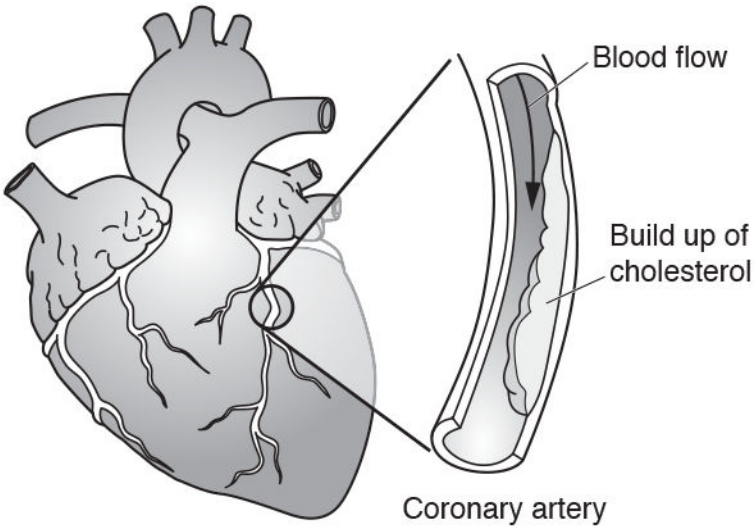
Complete the genetic diagram to explain your answer.

**D** is the dominant HC allele and **d** is the recessive allele.

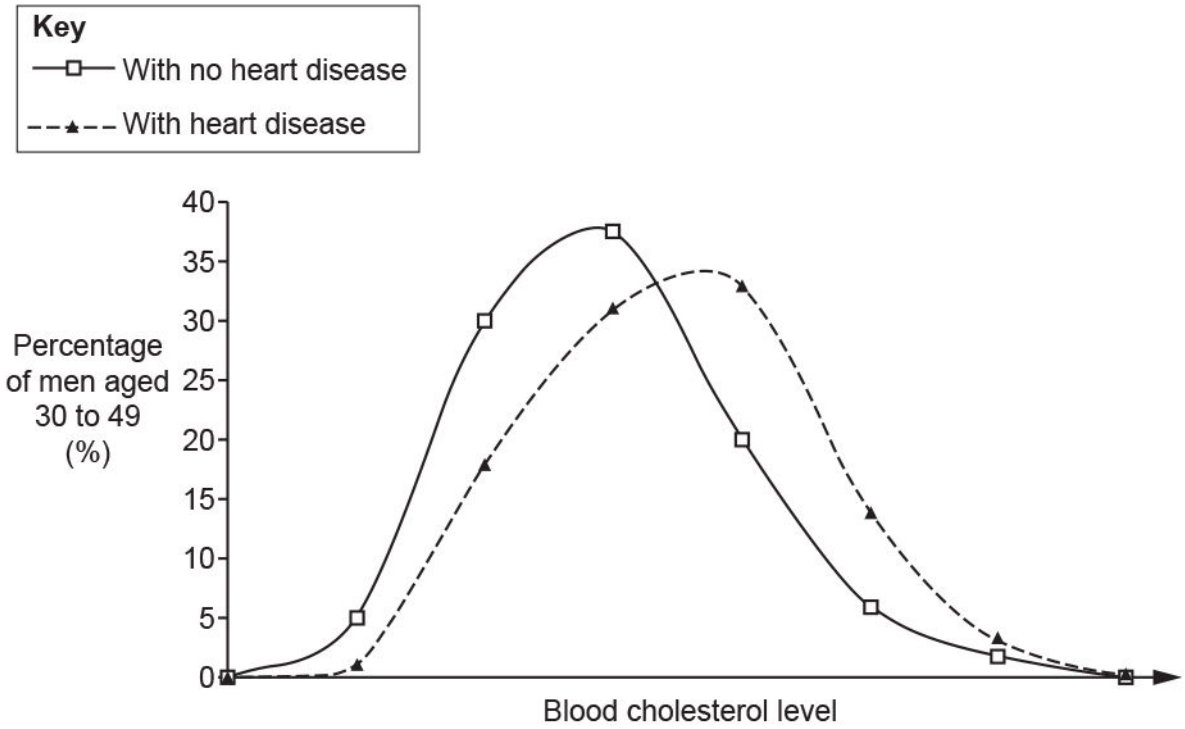



Probability = ..... **[2]**

(b) * People with HC are more likely to get heart disease. The diagram shows the heart of a person who has heart disease.




The graph shows the results of a study of men aged 30 to 49. The study measured the cholesterol levels in the blood of the men. It also recorded if the men developed signs of heart disease.




Explain the possible link between cholesterol and heart disease and if this link is supported by the graph.

Use evidence from the diagram and the graph in your answer.

[6]

11 Zebras (**Fig. 23.1**) have evolved to live in hot grassland in Africa.

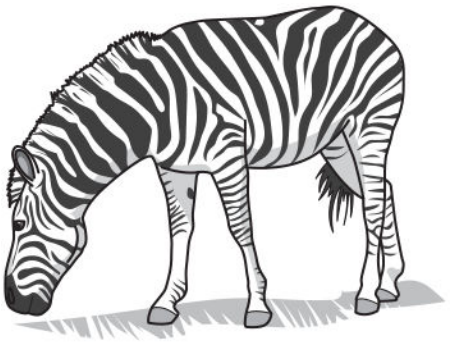


**Fig. 23.1**

Scientists have tried to find out why zebras have evolved stripes on their body.

One theory is that the stripes help to keep the zebra cooler than other colours. Scientists did an experiment to test this theory. They covered barrels of cold water with the skin of different animals. Then they measured the temperature of the water several hours later.

The results are shown in **Fig. 23.2.**

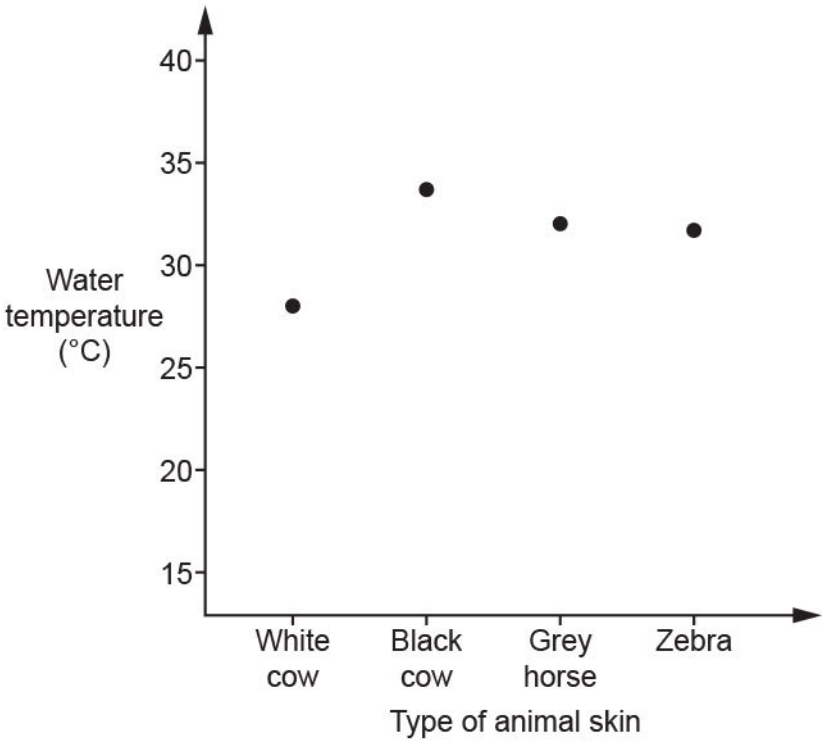



**Fig. 23.2**

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(i) Do the results in **Fig. 23.2** support the theory that stripes keep zebras cool?
Explain your answer.

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**[1]**

(ii) The scientists were aiming to investigate if it was **only** the colour of the skin that affected temperature regulation.

Suggest **one** improvement the scientists could make to ensure they **only** investigate the **colour** of the skin.
Explain your answer.

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**[1]**

12 Some students investigate the effect of the surface area : volume ratio on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes that have been stained blue using a pH indicator solution. The indicator will turn red in acidic conditions.

They put different sized cubes into 3 different test tubes of hydrochloric acid and time how long it takes for the cubes to completely change to red.

**Fig. 16.1** shows the apparatus they use.

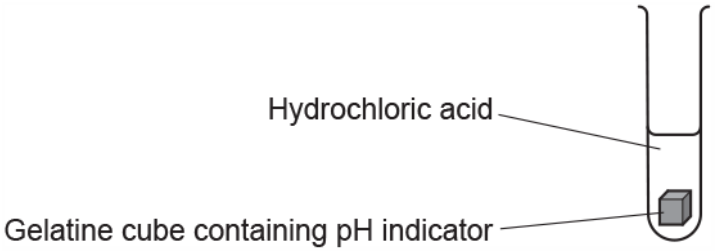



**Fig. 16.1**

The table shows the students' results.

| Length of each side of the cube (mm) | surface area : volume ratio | Time to completely change colour (seconds) |
|---|---|---|
| 2 | ..... | 32 |
| 4 | 3 : 2 | 61 |
| 6 | 1 : 1 | 170 |

(i) Calculate the surface area : volume ratio for the cube with sides of 2 mm.

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surface area : volume ratio = ..... [2]

(ii) What conclusion can be made about the effect of surface area : volume ratio on the rate of diffusion?

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[1]

(iii) Emphysema causes some of the walls of alveoli in the lungs to break down. This produces a smaller number of larger air sacs.

Use the results to explain the effect of emphysema on oxygen diffusing into the blood.

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[2]

13 Fig. 17.1 shows the mass of urea in the urine plotted against the BMI (Body Mass Index) for nine boys. BMI is a value often used to see if a person is a healthy mass for their height.

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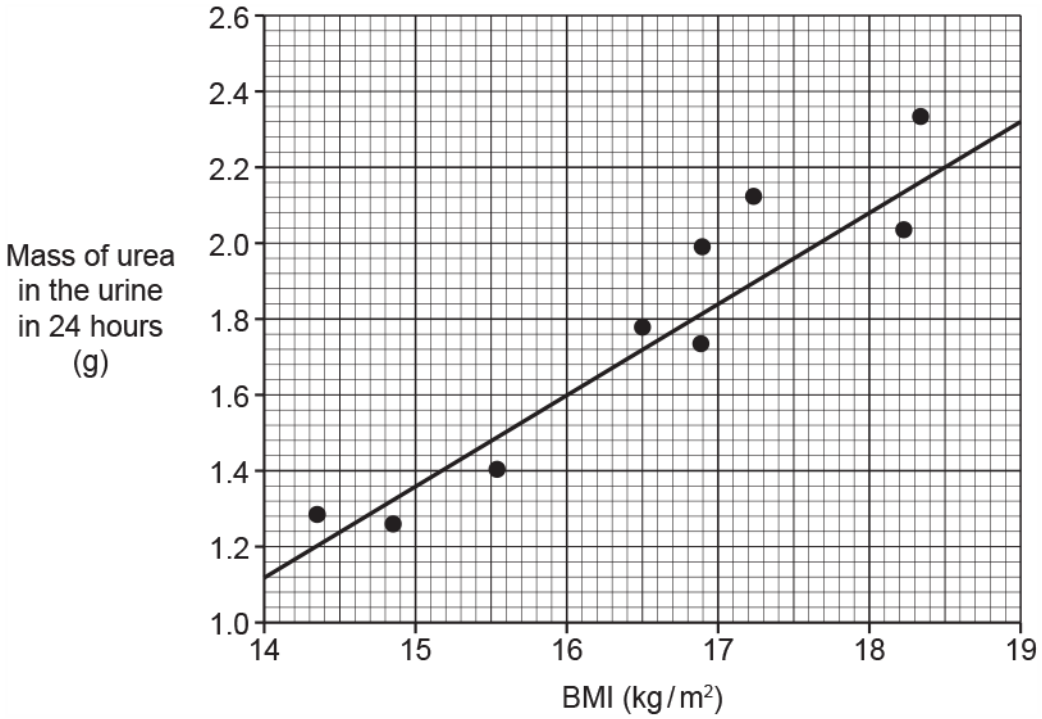



Fig. 17.1

(i) What does the graph show about the relationship between BMI and the mass of urea in the urine?

[1]

(ii) A boy has a BMI of 16. He produces 1000 $cm^3$ of urine in 24 hours.

Calculate the concentration of urea in the boy's urine.

Concentration = ..... g / $cm^3$ **[2]**

(iii) **Fig. 17.2** shows the mass of urea in the urine against the BMI for nine **different** boys.

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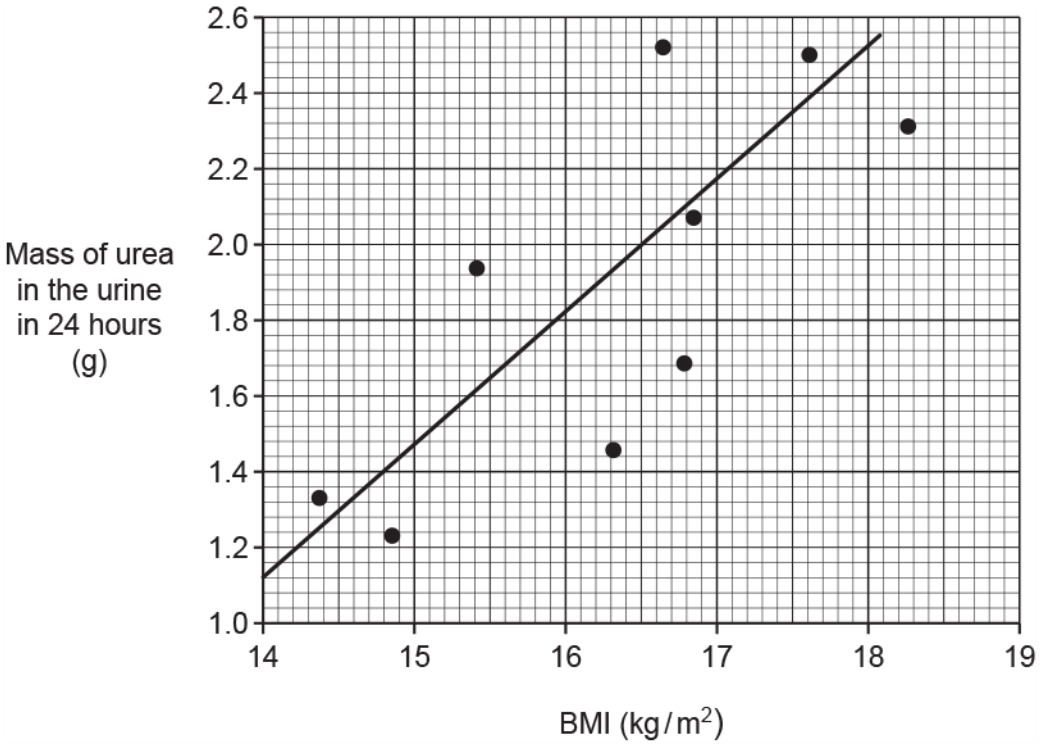



Fig. 17.2

Give **two** differences in the relationship between BMI and the mass of urea in the urine shown in **Fig. 17.1** and **Fig. 17.2.**

1 _____

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2 _____

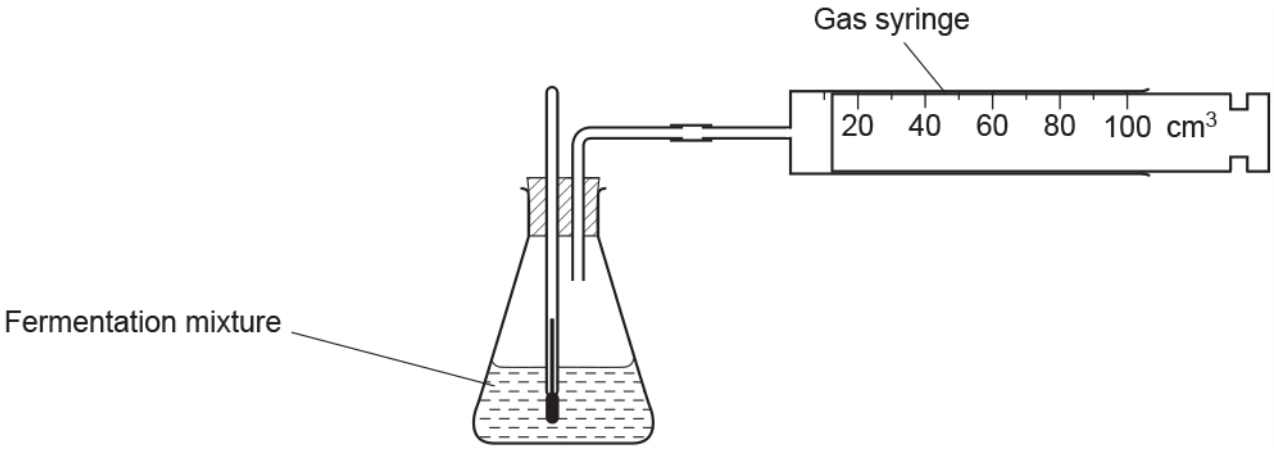
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**[2]**

14(a) Fermentation involves enzymes that break down sugar releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.
She measures the volume of carbon dioxide released in 10 minutes.
The diagram shows the apparatus she uses.




The student could have measured the volume of carbon dioxide by collecting the gas over water in a measuring cylinder.

Why is it better to use a gas syringe?

[1]

(b) The student's results are shown in the table.

| Temperature (°C) | Volume of carbon dioxide gas ($cm^3$) released in 10 minutes | | |
|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 |
| 25 | 23 | 25 | 22 |
| 30 | 34 | 27 | 33 |

(i) Calculate the **mean** rate of gas produced at **25 °C** in $cm^3$ / minute.

Give your answer to **1** decimal place.

Mean rate of gas produced at 25 °C = ..... $cm^3$ / minute **[3]**

(ii) The rate of gas produced at 30 °C is greater than at 25 °C.

Use ideas about enzymes to explain why.

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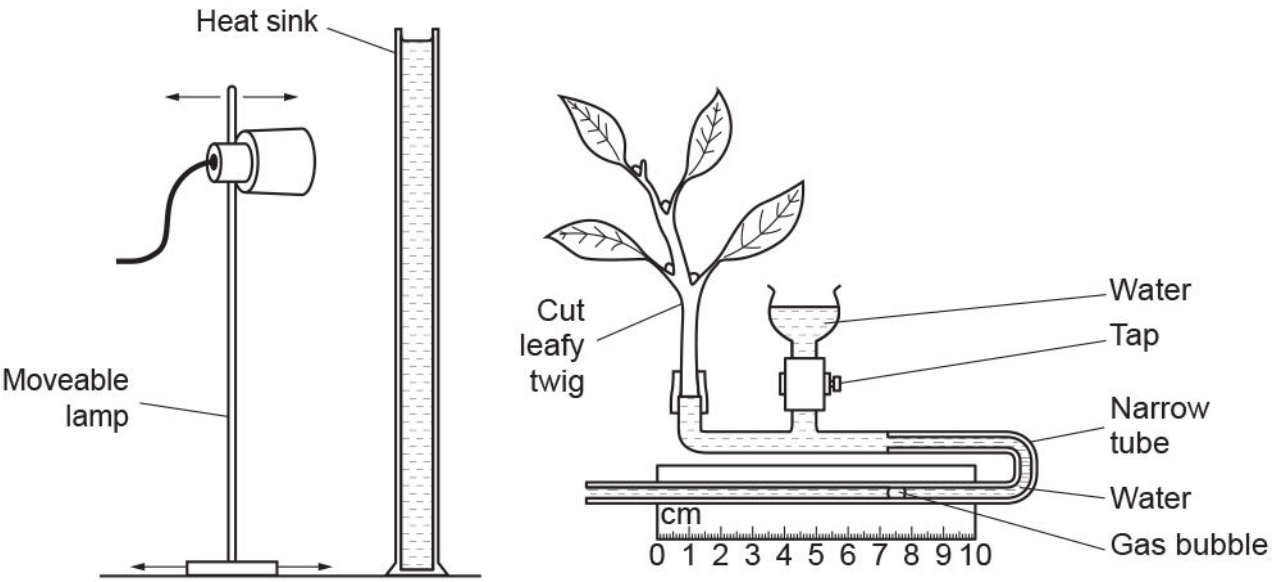
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**[3]**

15(a) The diagram shows a simple potometer.

The apparatus can be used to investigate the effect of light intensity on transpiration rates.




(i) Describe what happens during transpiration.

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[2]

(ii) Describe how the apparatus can be used to investigate the effect of light on transpiration rates.

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[3]



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(iii) The heat sink is a transparent tube of cold water.

Explain why a heat sink is used in this experiment.

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[2]

(b) The table shows the results from using the potometer.

| Distance of potometer from the light (cm) | Distance gas bubble moved in one minute (mm) | | |
|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 |
| 10 | 70 | 74 | 72 |
| 20 | 73 | 75 | 71 |
| 30 | 52 | 49 | 51 |
| 40 | 42 | 30 | 31 |
| 50 | 12 | 14 | 13 |

(i) The mean distance the gas bubble moved along the tube at 10 cm from the light was 72 mm.

The diameter of the narrow tube was 1 mm.

Calculate the volume of water taken up by the plant.

Use the equation: volume = $\pi r^2 l$
where r is the radius of the tube and $l$ is the distance the bubble moves
$\pi = 3.14$

Give your answer to **2** significant figures.

Volume of water = ..... $mm^3$ / minute **[3]**

(ii) Identify the anomalous reading in their recorded results and suggest a possible reason for this.

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**[2]**

(iii) How should the scientists deal with this anomalous reading when they process the data?

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**[1]**

(iv) The scientists described their results for **20 cm** as 73 ± 2.
Explain why they did this.

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**[2]**

16(a) Carolina horsenettle is a weed that grows in crop fields in the USA.

New horsenettle shoots develop from buds on roots in spring. The shoots die in the autumn but the roots remain alive under the ground.

Effective weed control involves stopping seed production and killing the root system.

Selective herbicides are used to control Carolina horsenettle.

The best time to apply selective herbicide is when the horsenettle is actively growing between the bud and flower stage.

(i) Describe how a selective herbicide works.

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[2]

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(ii) **Fig. 20.1** and **Table 20.1** show information about four different herbicides **A, B, C** and **D**.

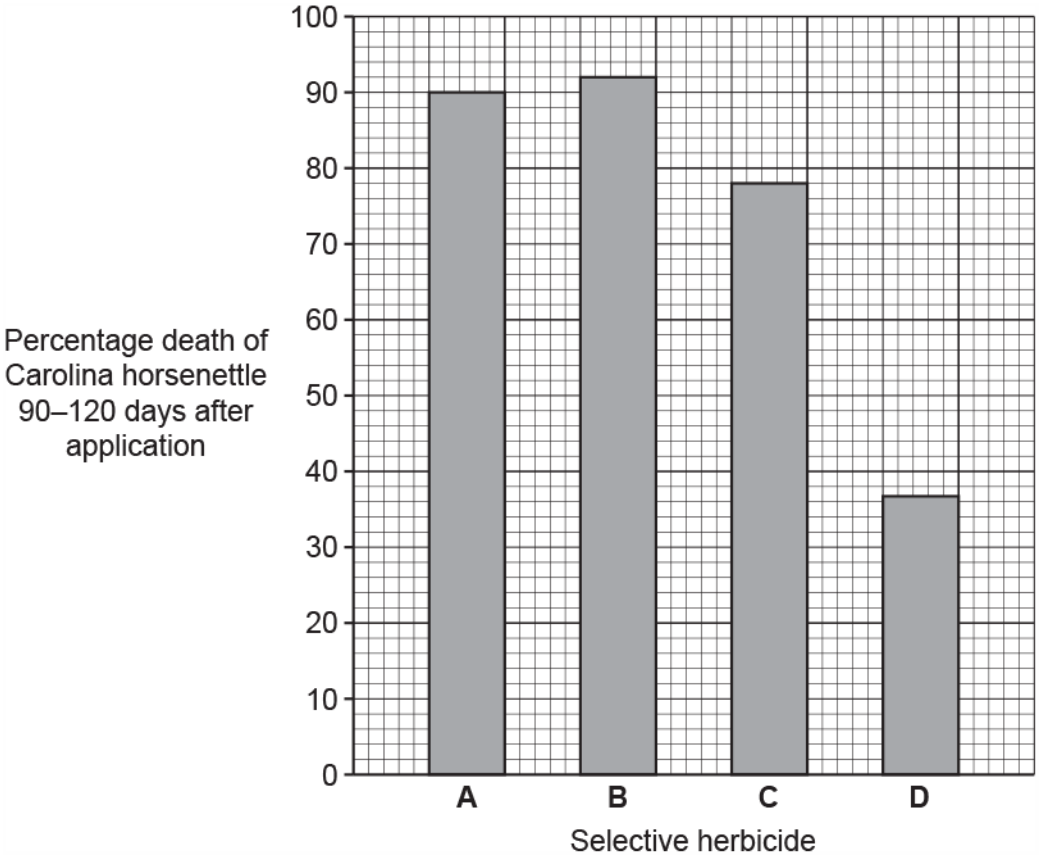



**Fig. 20.1**

| **Selective herbicide** | A | B | C | D |
|---|---|---|---|---|
| **Effect on Carolina horsenettle** | prevents seeds and roots of plants growing | prevents seeds and roots of plants growing | prevents seeds and roots of plants growing | prevents shoot growth and fruiting but minimal damage to roots |
| **What plants herbicide works on** | Carolina horsenettle | Carolina horsenettle and several other broad-leaved plant species | Carolina horsenettle | Carolina horsenettle and most other broad-leaved plant species |
| **Cost of herbicide** | medium | high | medium | low |

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Table 20.1

Carolina horsenettle is growing in a field with a crop and other broad-leaved weeds.
Evaluate the information on selective herbicides **A**, **B**, **C** and **D**.

Which selective herbicide would be best to use and when it should be applied?
Explain your decision.

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**[4]**

(b) A process in cells is involved in producing a chemical that causes ripening of fruit.
Look at **Fig. 20.2**.

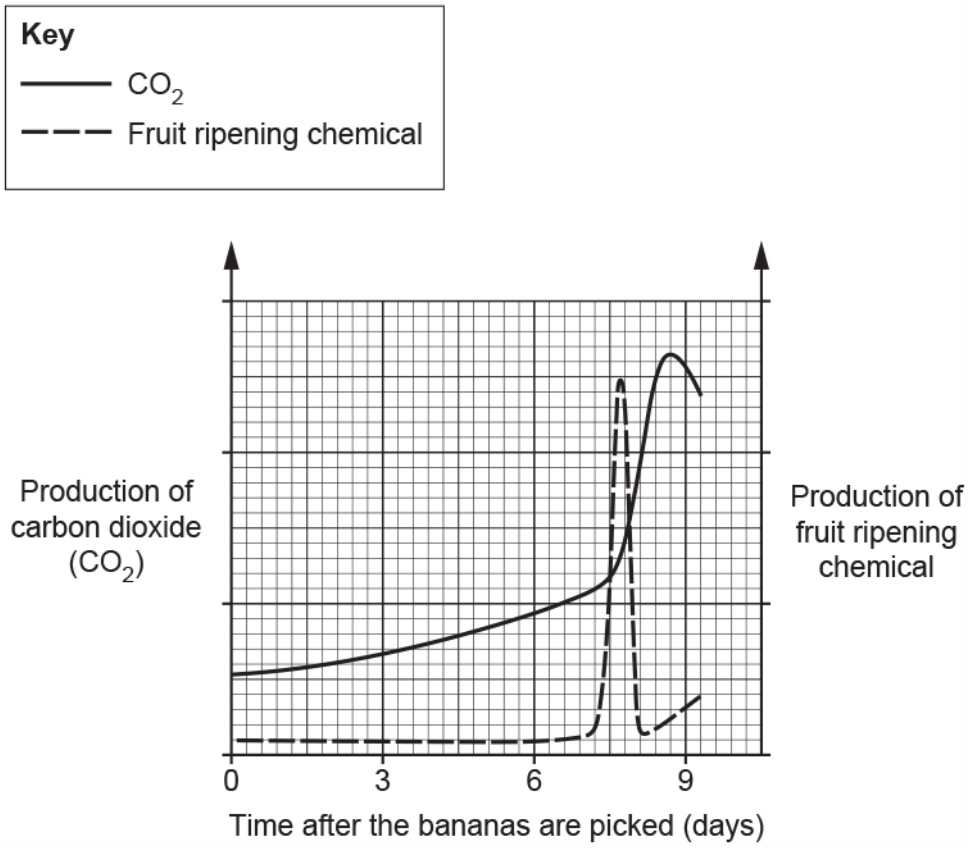



Fig. 20.2

Use evidence from **Fig. 20.2** to suggest what this process might be.

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**[2]**

17(a) Zebras (**Fig. 17.1**) have evolved to live in hot grassland in Africa.

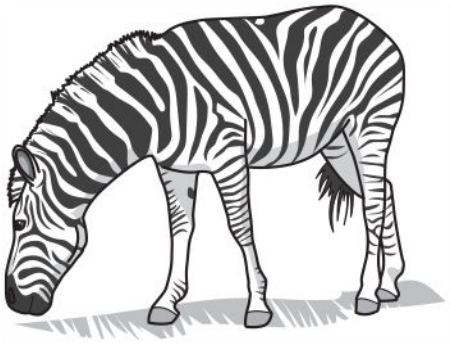


**Fig. 17.1**

Scientists have tried to find out why zebras have evolved stripes on their body.

One theory is that the stripes help to keep the zebra cooler than other colours. Scientists did an experiment to test this theory. They covered barrels of cold water with the skin of different animals. Then they measured the temperature of the water several hours later.

The results are shown in **Fig. 17.2**.

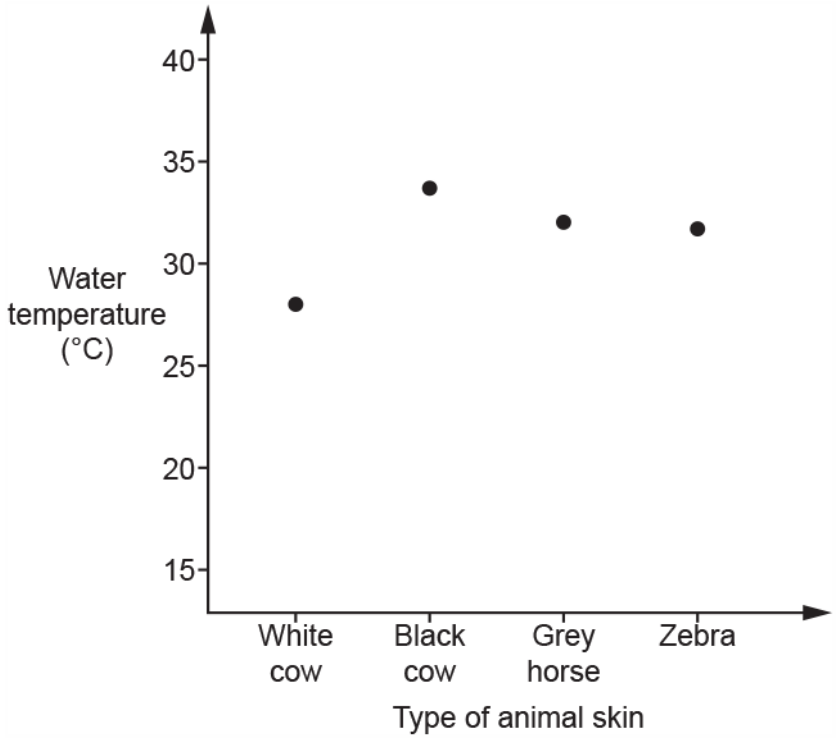



**Fig. 17.2**

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(i) Do the results in **Fig. 17.2** support the theory that stripes keep zebras cool?
Explain your answer.

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**[1]**

(ii) The scientists were aiming to investigate if it was **only** the colour of the skin that affected temperature regulation.

Suggest **one** improvement the scientists could make to ensure they **only** investigate the **colour** of the skin.

Explain your answer.

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**[1]**

(b) Another theory says that the stripes make a zebra less likely to be bitten by insects.

To test this theory scientists made models of zebras and covered them with sticky tape. One model was black. The other models had different widths of stripes.

**Fig. 17.3** shows the number of insects that stuck to the tape.

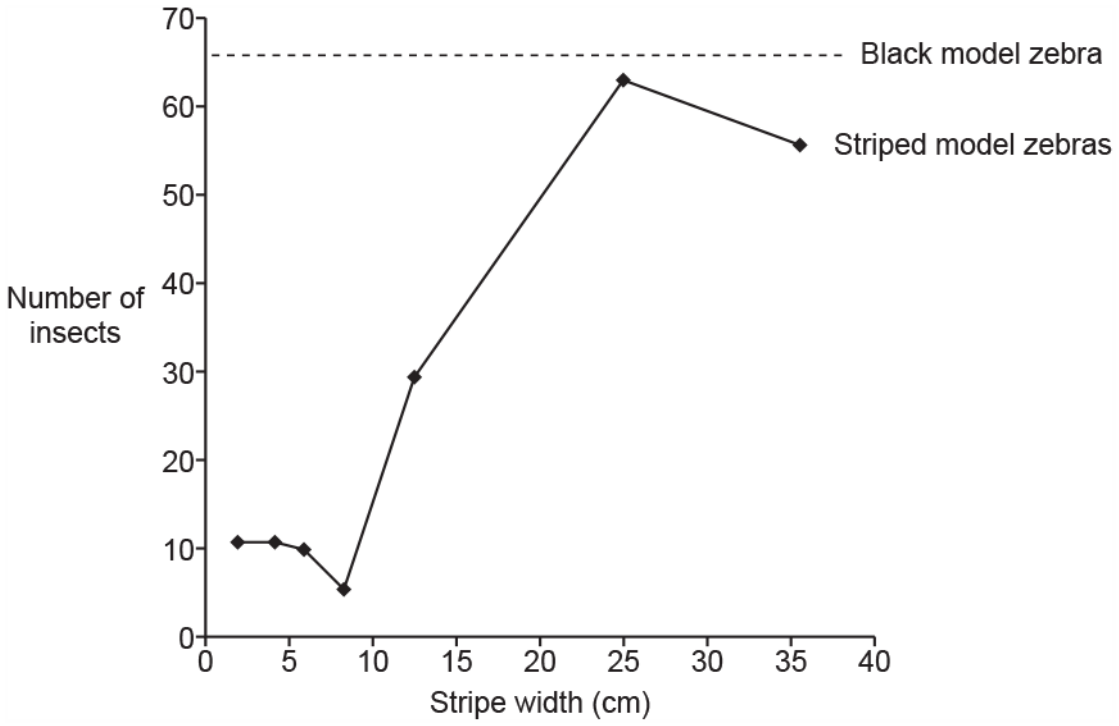



**Fig. 17.3**

(i) Describe what **Fig. 17.3** shows about the link between zebra stripes and protection from insects.

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**[2]**

(ii) Horse blankets are used to cover horses when they are outside. Companies have started to produce horse blankets with zebra stripes.

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Use the information in **Fig. 17.3** to suggest what width of stripe should be used to reduce insect bites.

Explain your answer.

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**[1]**

(iii) Biting insects can spread pathogens between animals.

Use the theory of natural selection to explain how zebra stripes could have developed.

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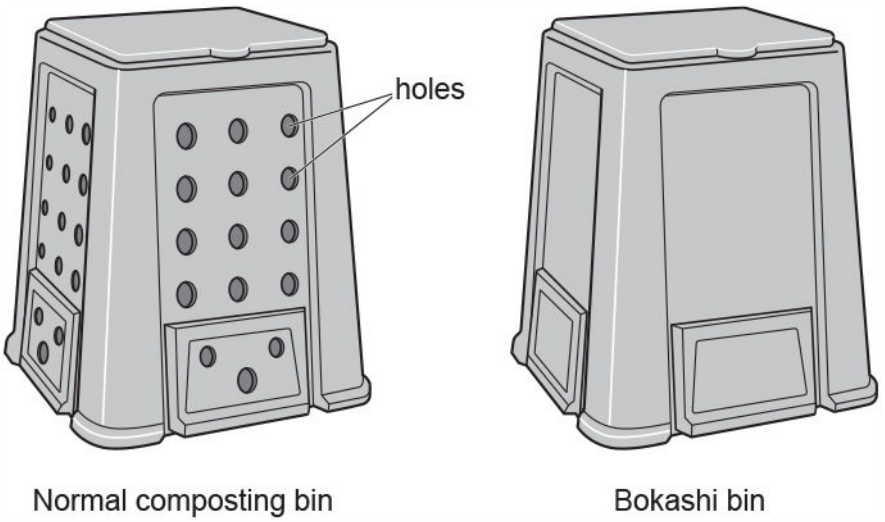
**[3]**

18(a) Gardeners often turn dead plant material from their garden into compost. They then add this compost to the soil where they are growing plants.

Compost can be made in a composting bin. In the bin **aerobic bacteria** turn dead plant material into compost.

Some people use a different way of making compost, called bokashi. In this process the compost is made **anaerobically.**

The drawings show a normal composting bin and a bokashi bin.




Explain the difference in the design of the two composting bins.

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**[2]**

(b) Scientists investigate the two methods of making compost.

This is their method:

- Take one large pile of dead plant material
- Divide the material into two samples of equal mass
- Place one sample into the normal composter and place one sample into the bokashi composter
- Measure the temperature in each composter every 10 days
- After 40 days, measure the mass of the compost.

Write down **one** way that the scientists make sure that they can draw valid conclusions.

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[1]

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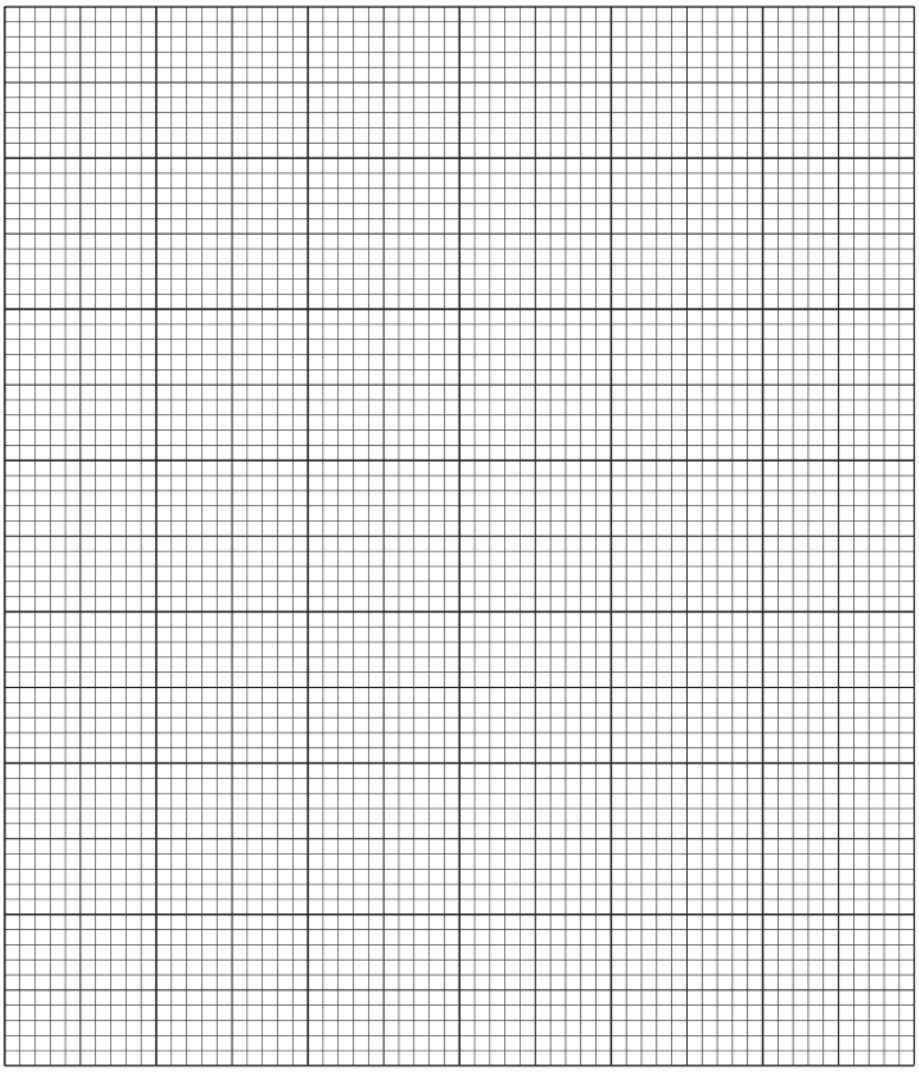
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(c) **Table 18.1** shows the scientists' temperature readings.

| | Temperature of the compost (°C) | |
|---|---|---|
| **Time (days)** | normal compost | bokashi compost |
| 0 | 26 | 26 |
| 10 | 70 | 27 |
| 20 | 53 | 29 |
| 30 | 42 | 31 |
| 40 | 28 | 28 |

**Table 18.1**

(i) Plot the scientists' results on the grid for normal and bokashi compost, and draw **two** curves of best fit.



**[5]**

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(ii) Explain why the temperature of the compost in the **normal** bin changed as shown in the graph.

[2]

(iii) Explain the difference in the temperature changes between the aerobic normal compost and the anaerobic bokashi compost.

[2]

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(d) **Table 18.2** shows the scientists' results for the mass of the compost.

| | Normal compost | Bokashi compost |
|---|---|---|
| Mass at start (kg) | 1500 | 1500 |
| Mass after 40 days (kg) | 750 | 1100 |

Table 18.2

A gas is given off in the formation of the compost. This causes most of the decrease in mass.

(i) The percentage decrease in the mass of the normal compost is 50%.

Calculate the percentage decrease in the mass of the bokashi compost.

Give your answer to **2** significant figures.

Percentage decrease = ..... % **[3]**

(ii) The scientists concluded that the bokashi method of composting might be better for the environment.

Use your answer from part **(i)** to justify the scientists' conclusion.

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**[2]**

19(a) Fanconi anaemia is a genetic disorder. It results in the bone marrow being destroyed.
This causes a decrease in the numbers of red blood cells, white blood cells and platelets.

Explain **two** possible symptoms of Fanconi anaemia.

1 ---

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2 ---

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**[2]**

(b) **Table 19.1** shows normal ranges for blood components in people **without** Fanconi anaemia.

| Blood component | Number per $mm^3$ |
|---|---|
| red blood cell | $4.5 – 6.5 \times 10^6$ |
| white blood cell | $6.0 – 16.0 \times 10^3$ |
| platelet | $1.5 – 4.0 \times 10^5$ |

**Table 19.1**

(i) Suggest why there is such a wide range of white blood cell numbers.

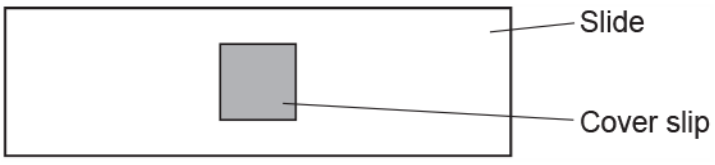
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**[2]**

(ii) The diagram shows a microscope slide containing blood from a patient.




The square cover slip is 10 mm wide and the thickness of the blood underneath is 0.001 mm.

Calculate the volume of blood under the cover slip.

Volume of blood = ..... $mm^3$ **[1]**

(iii) Under the cover slip are 1000 white blood cells.

Does the blood sample provide evidence that the patient has Fanconi anaemia?

Use **Table 19.1** and your answer to part **(ii)** to justify your answer.

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**[3]**

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(c) There are many different genetic disorders that can affect blood cells. Details of three of these are found in **Table 19.2**.

| Name of disorder | Cause of disorder | Symptom |
|---|---|---|
| D-B anaemia | dominant allele | low red blood cell numbers |
| S-D syndrome | recessive allele | low white blood cell numbers |
| Fanconi anaemia | recessive allele | small numbers of all blood cells |

**Table 19.2**

A blood smear from another patient shows that he has $3 \times 10^6$ red blood cells per $mm^3$ of blood. Neither of his parents have a blood disorder.

Use **Table 19.1** and **Table 19.2** to explain which blood disorder the patient could have.

Name of disorder ----------

Explanation ----------

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**[3]**

20(a) Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

Write the words **allele, chromosome, genome** and **nucleotide** in the boxes to show their size from smallest feature to largest feature.

| | |
|---|---|
| Smallest feature | |
| | |
| | |
| Largest feature | |

**[1]**

(b) One in 500 people are heterozygous for HC.

There are 66 000 000 people in the UK.

Calculate how many people in the UK are heterozygous for HC.

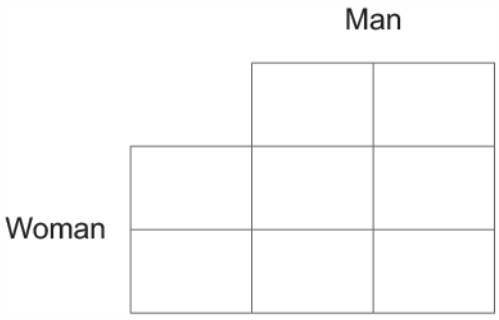
Number of people = ..... **[1]**

(c) A woman who does not have HC and a man who is heterozygous are expecting a baby.

What is the probability of the baby having HC?

Complete the genetic diagram to explain your answer.

Use **D** for the dominant HC allele and **d** for the recessive allele.




Probability = ..... **[2]**

(d) People with HC are more likely to develop heart disease. **Fig. 21.1** shows the heart of a person who has heart disease.

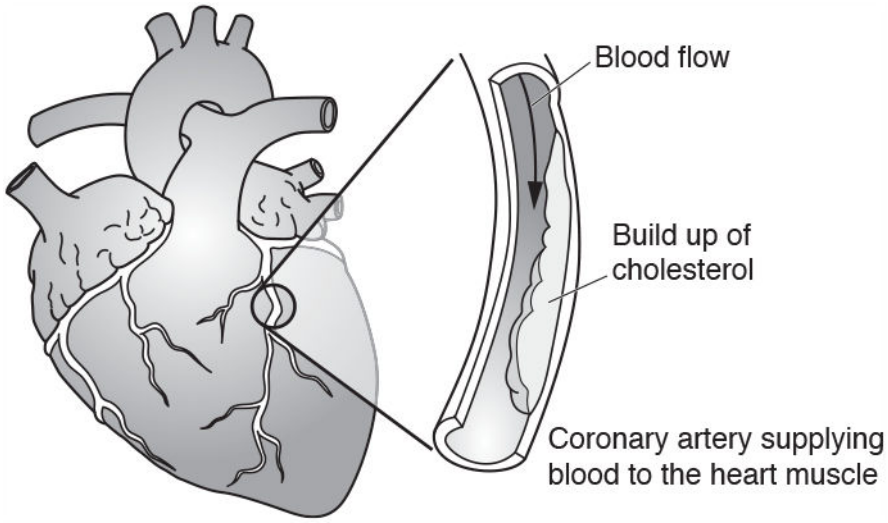



**Fig. 21.1**

The LDL receptor protein is found on the cell membrane of liver cells. The receptor picks up cholesterol from the blood and transports it into the liver cell. Inside the liver cell the cholesterol is broken down or used.

Explain why people who have the mutation in the allele for the LDL receptor are much more likely to develop heart disease.

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[6]

(e) A drug is being developed that might help protect people from heart disease.
To test the drug patients were divided into three groups.
Each group was given a different treatment and their blood cholesterol measured.

The results are shown in **Fig. 21.2.**

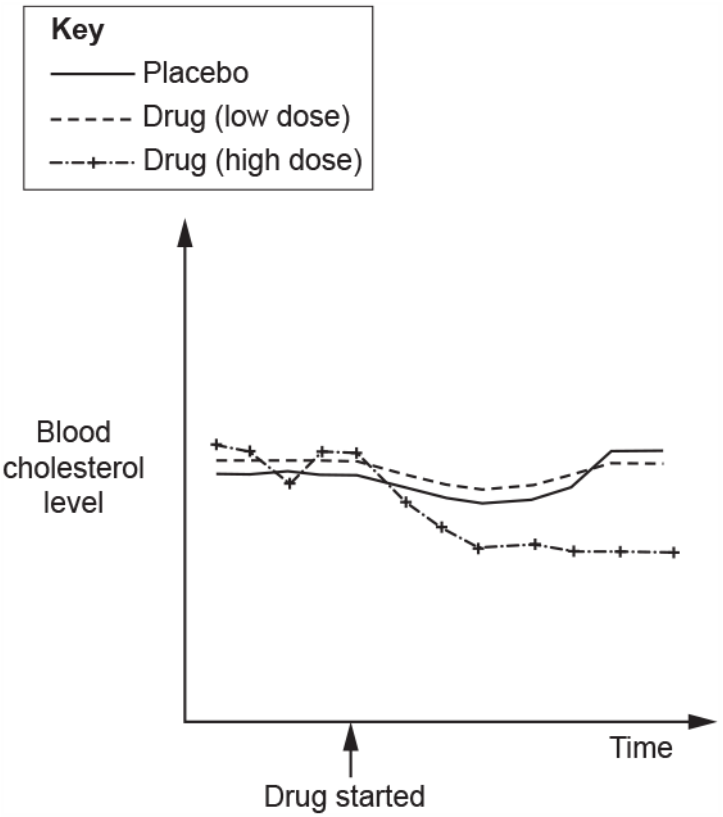



**Fig. 21.2**

Evaluate the results of the test.



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[3]

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21 **Fig. 16.2** shows a food web containing stevia.

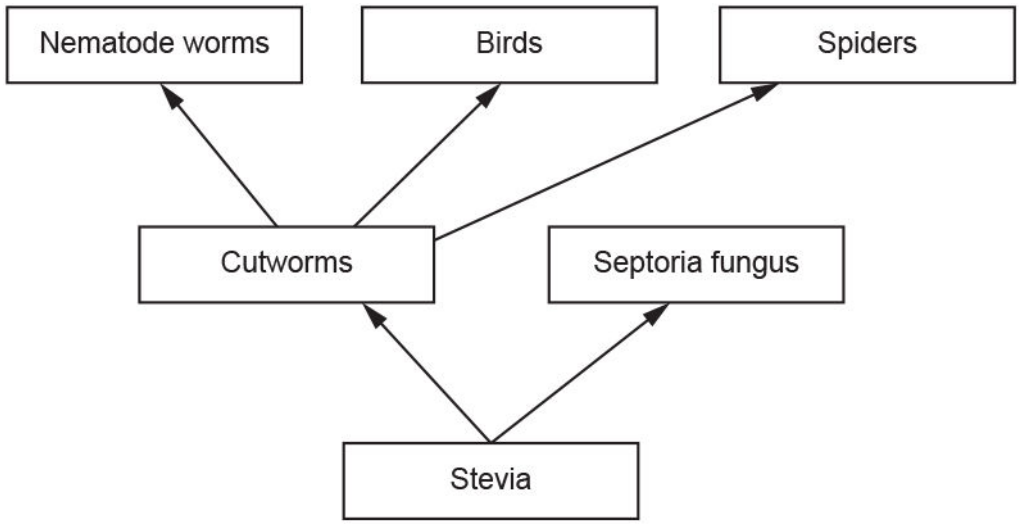



**Fig. 16.2**

The leaves of stevia taste very sweet. People are now trying to grow stevia as a crop.

Stevia farmers often add nematode worms to their fields.

Explain why farmers do this.

Use **Fig. 16.2** in your answer.

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**[3]**

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## END OF QUESTION PAPER