

OCR GCSE GATEWAY BIOLOGY A • J247

BIOLOGY



EXAM QUESTION PACK

WS1.2 EXPERIMENTAL SKILLS AND STRATEGIES

SCORE

/62

PERCENTAGE

%

STEMUP

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Gateway Biology A (9-1)

Experimental skills and strategies

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	
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Centre number						Candidate number				
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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 **62**.
- The total number of marks may take into account some 'either/or' question choices.

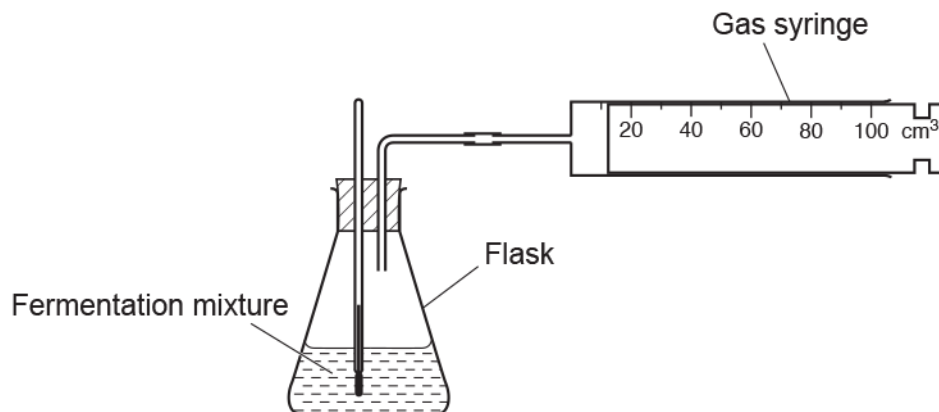
1(a) Fermentation involves enzymes breaking down sugar and releasing carbon dioxide gas.

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]

(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 cm³ and for a temperature of 35 °C it was 27 cm³.

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

[2]

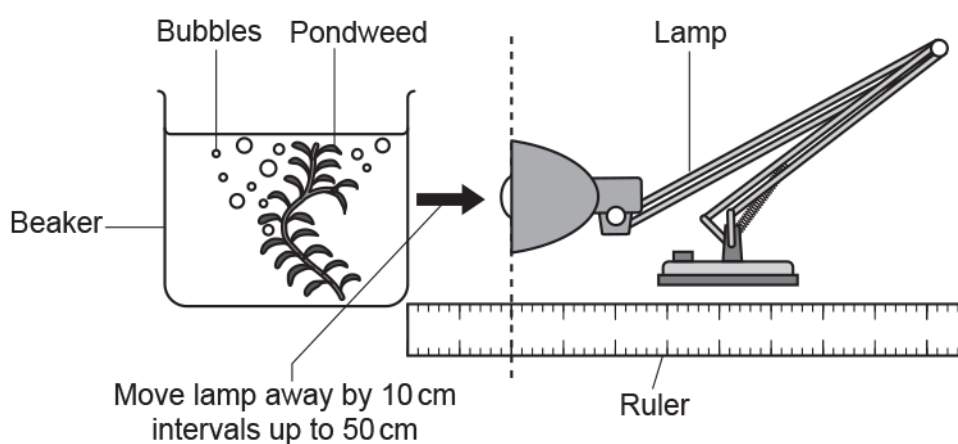
2(a) Two students investigate photosynthesis. Look at the notes from their investigation.

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]

(b)

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

[2]

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

[2]

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

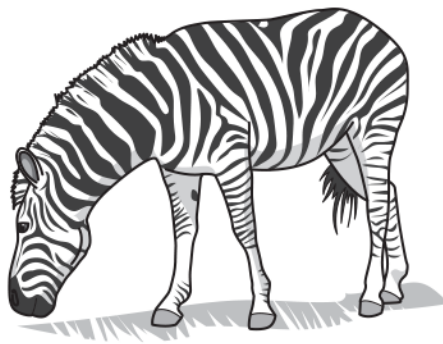


Fig. 23.1

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. 23.3 shows the number of insects that stuck to the tape.

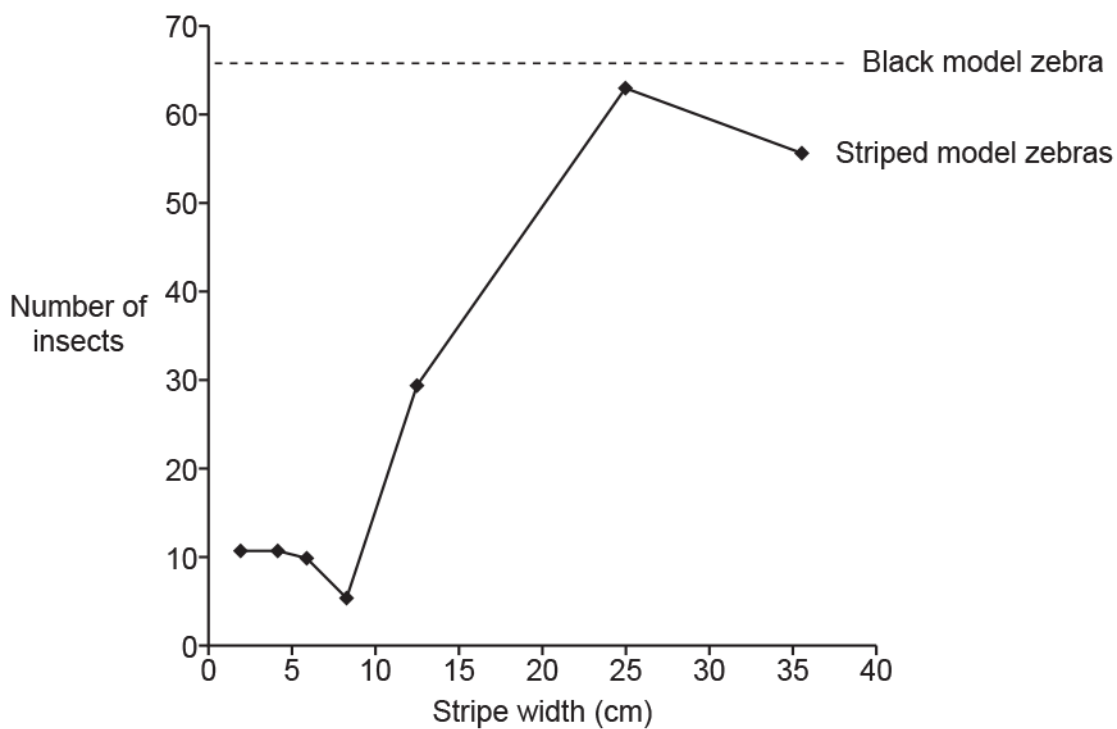


Fig. 23.3

(i) Describe what Fig. 23.3 shows about the link between zebra stripes and protection from insects.

[2]

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

Use the information in **Fig. 23.3** to suggest what width of stripe should be used to reduce insect bites. Explain your answer.

[1]

- (iii) Biting insects can spread pathogens between animals.

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

[3]

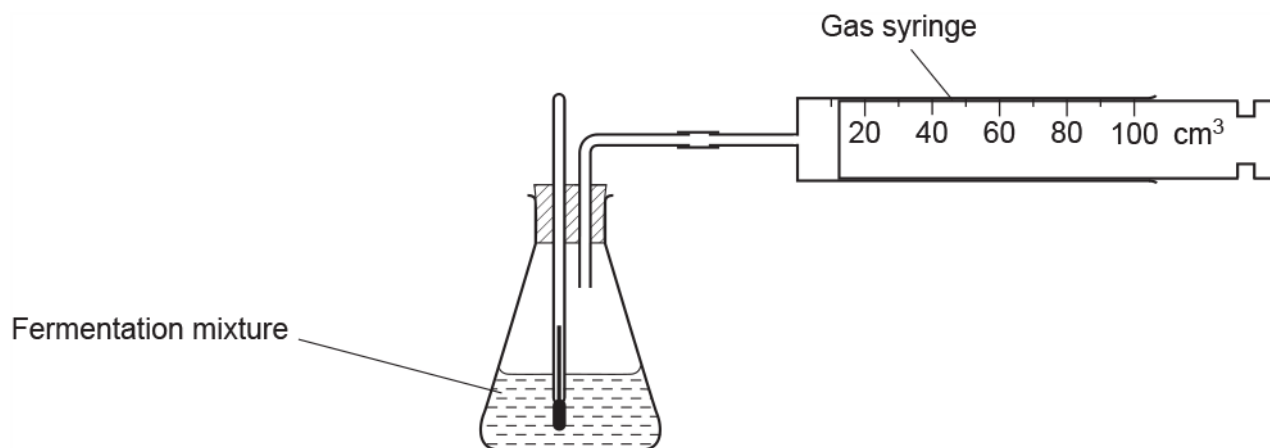
- 4 Fermentation involves enzymes that break down sugar releasing carbon dioxide gas.

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]

- (i) Describe **one** effect that gibberellin hormones have on plants.

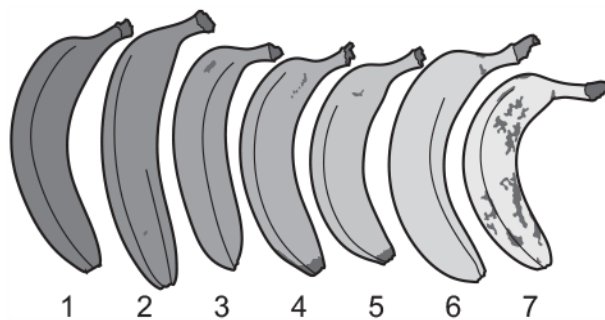
----- [1]

- (ii) A student investigates ripening in bananas.

The student keeps bananas in different conditions. After 1 week he decides if each banana was **ripe** or **not ripe**.

The results were difficult to interpret so he planned to develop the experiment.

He found a picture that he thought he could use.



Explain how this could help develop his experiment.

----- [2]

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

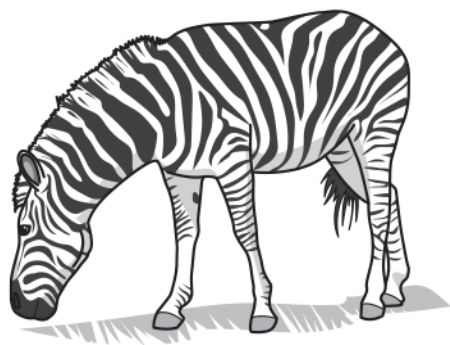


Fig. 17.1

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.

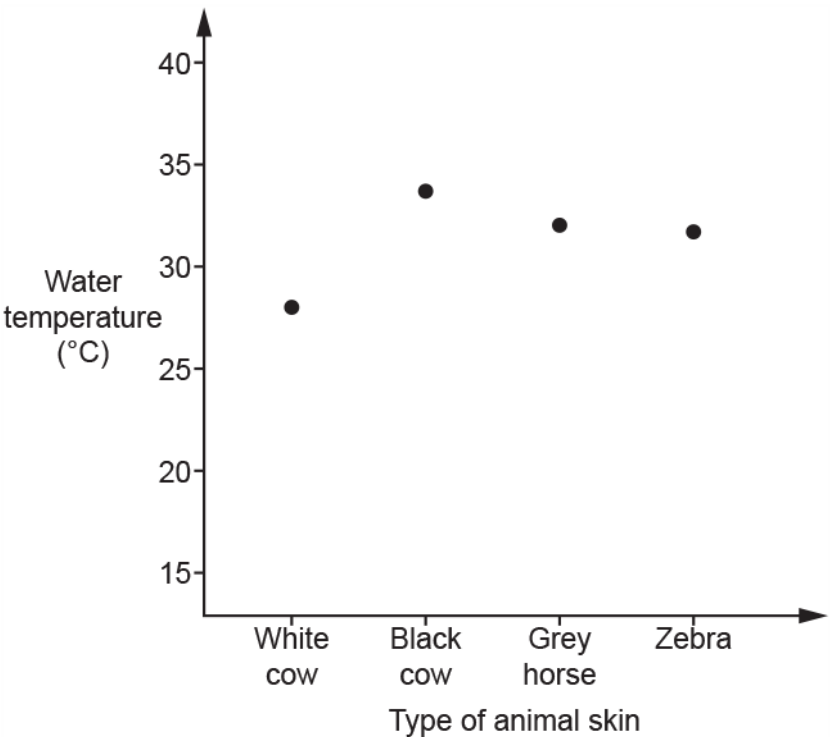


Fig. 17.2

- (i) Do the results in Fig. 17.2 support the theory that stripes keep zebras cool?

Explain your answer.

----- [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.

----- [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.

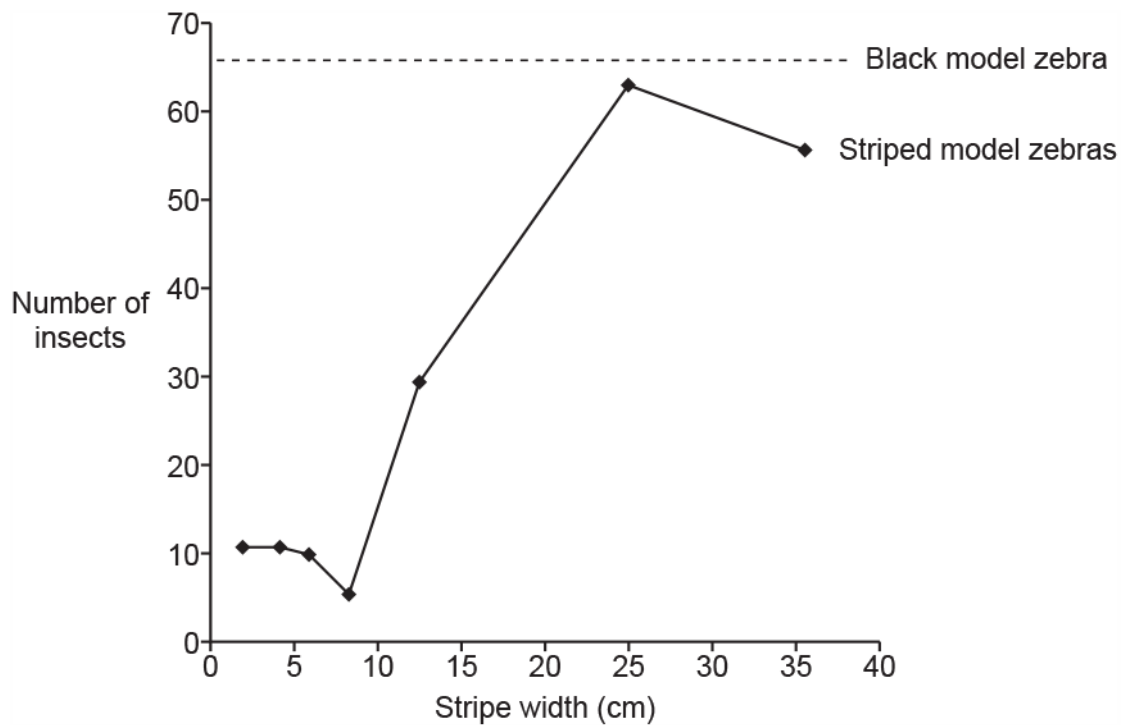


Fig. 17.3

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

[2]

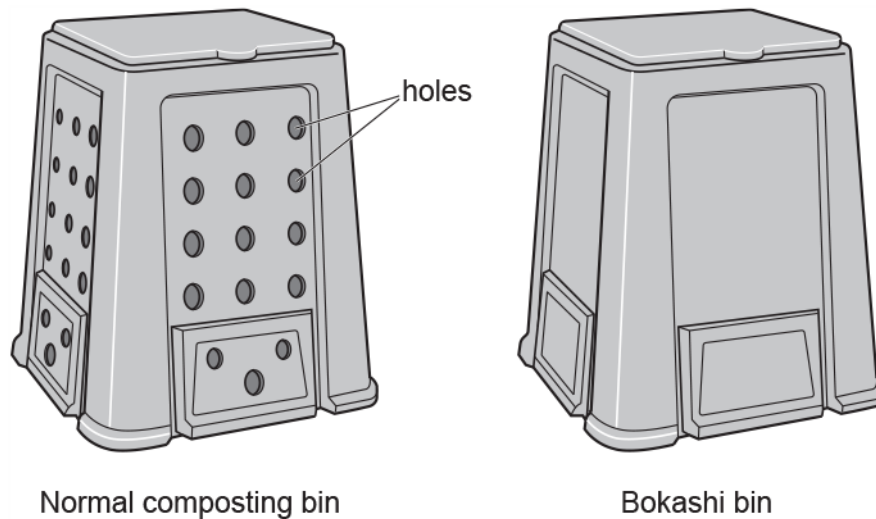
- (ii) Horse blankets are used to cover horses when they are outside. Companies have started to produce horse blankets with zebra stripes.

7(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.

[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.

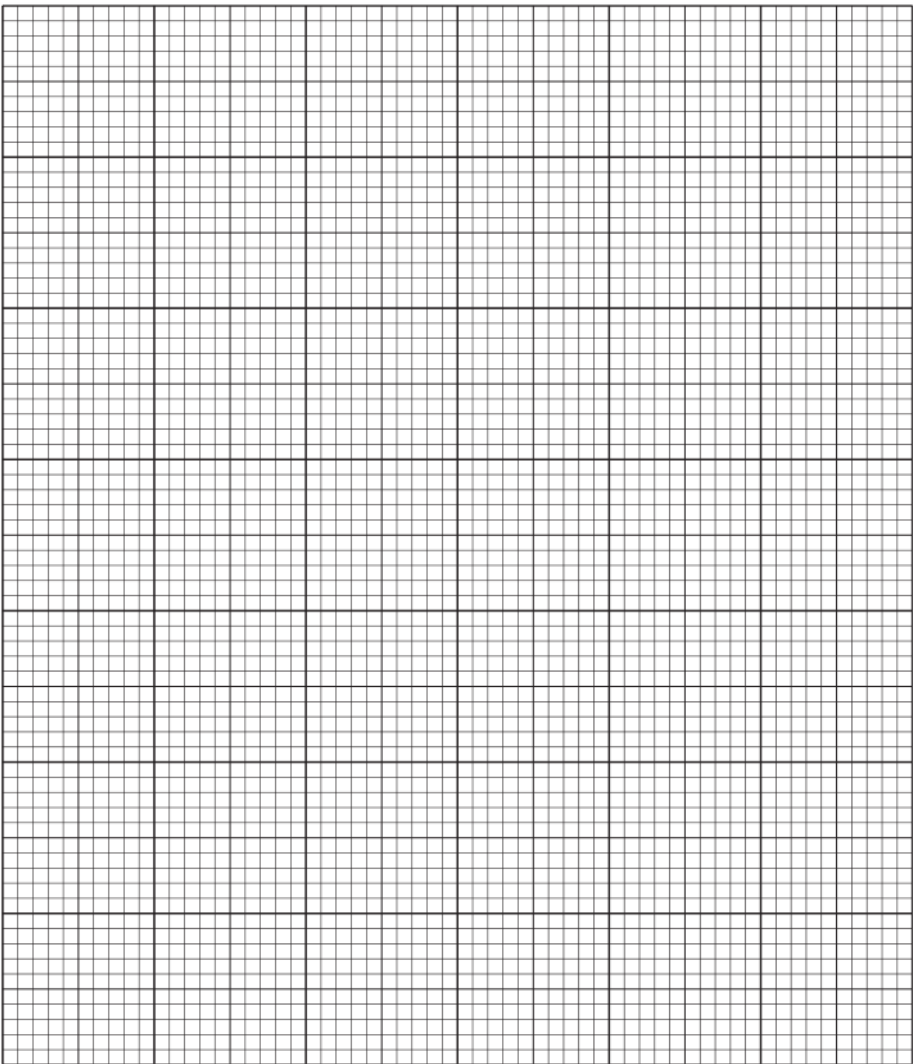
----- [1]

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

Time (days)	Temperature of the compost (°C)	
	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]

(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]

(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.

[2]

8(a) Scientists investigate antibiotic pollution in two different lakes.

They collect samples of water from the two lakes. The scientists then use aseptic techniques to investigate how

resistant the bacteria in the water are to antibiotics. Fig. 22.2 shows the apparatus they use.

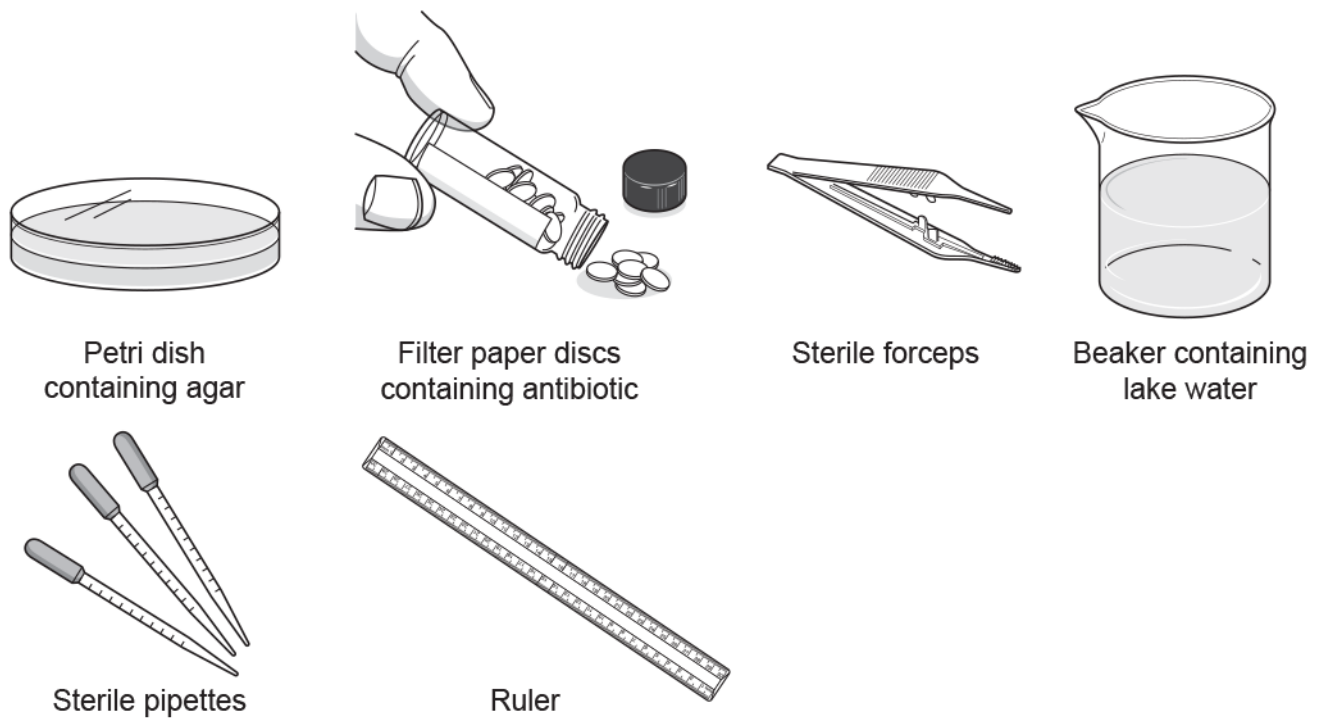


Fig. 22.2

Describe how the scientists could use **this** apparatus to **measure** how resistant the bacteria are to antibiotics.

[4]

- (b) The scientists also counted how many species of bacteria were resistant to antibiotics and how many species of bacteria were killed by antibiotics.

The scientists found these results.

	Number of different species of bacteria	
	In Lake Bellandur	In Lake Jakkur
Resistant to antibiotics	53	35
Killed by antibiotics	28	37

Which lake has the **highest** levels of antibiotic pollution?

Tick (✓) **one** box.

Lake Bellandur

☐

Lake Jakkur

☐

Explain your answer.

[2]

- 9(a) Scientists investigate antibiotic pollution in two different lakes.

They collect samples of water from the two lakes. The scientists then use aseptic techniques to investigate how resistant the bacteria in the water are to antibiotics. **Fig. 16.2** shows the apparatus they use.

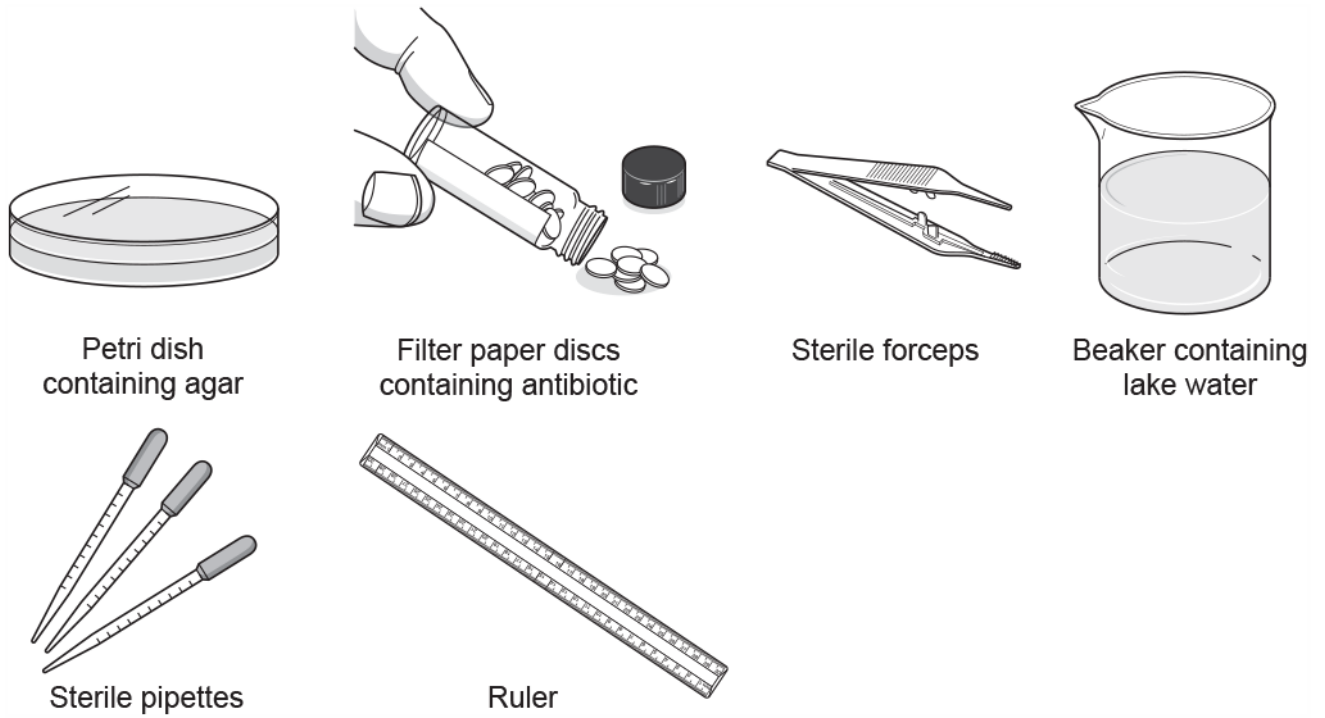


Fig. 16.2

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Which lake has the **highest** levels of antibiotic pollution?

Tick (✓) **one** box.

Lake Bellandur

☐

Lake Jakkur

☐

Explain your answer.

[2]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1	a	i	electric heater ✓	1 (AO2.2)	ALLOW electric incubator / <u>electric</u> (water) bath
		ii	wear goggles / tie (long) hair back / secure loose clothing ✓	1 (AO1.2)	ALLOW wear gloves / use gauze under flask / use heatproof mat IGNORE face mask / do not touch hot equipment
		iii	Any two from: difficult to keep constant/regulate temperature ✓ uneven heating of flask creating hot/cold spots ✓ human error in reading thermometer ✓	2 (AO2.2)	ALLOW water may overheat ALLOW may become hot and denature enzyme ALLOW flask may have slightly raised temperature ALLOW temperature in water bath may not reflect temperature in the flask
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 32 award 2 marks $34 + 29 + 33 = 96$ ✓ $96 \div 3 = 32$ ✓	2 (AO2.2)	ALLOW answer in the space under the table but answer on answer line in table takes preference ALLOW ECF for mean calculation
		ii	temperature ✓	1 (AO2.1)	
		iii	identifies variability in each point plot / gives an estimate of level of uncertainty ✓	1 (AO1.2)	ALLOW can plot range/error bars ALLOW large error bars variability is high/OR ALLOW high variability then reliability is low/OR ALLOW idea of the spread of data at each point and possibly identify/eliminate outlier/anomaly ALLOW ranges overlap the data at those 2 points isn't significantly different

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iv	Any two from: as temperature increases enzyme activity increases ✓ optimum enzyme activity between 25°C and 35°C enzyme activity ✓ but somewhere between 30°C and 35°C enzyme activity starts to decrease ✓ idea decrease in rate (after 35°C) due to denaturing ✓	2 (AO3.1a)	ALLOW idea that as temperature increases/gets higher so does rate of (enzyme) reaction / gas release / ORA ALLOW higher temperature the faster the enzyme activity ALLOW enzyme starts to denature above 30°C/between 30°C and 35°C
			Total	10	
2	a		distance of lamp/light source ✓	1 (AO2.2)	ALLOW light intensity IGNORE the lamp with no mention of distance or intensity
	b	i	Any two from: bubbles are different sizes / has different volume of gas ✓ some bubbles may also be missed/miscounted ✓ so volume at each point may not be representative of rate ✓	2 (AO2.2)	ALLOW amount of oxygen varies / bubbles burst IGNORE the pondweed could be different sizes
		ii	Any two from: measure volume (of gas released) ✓ names a suitable apparatus for measuring for volume ✓ use a heat sink ✓	2 (AO2 x 3.3a)	IGNORE measure amount ALLOW e.g. measuring cylinder / gas syringe / Audus apparatus / graduated pipette
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
3		i	Any two from: zebras with stripes attracts less/fewer insects / ORA ✓ narrower stripes attract less insects / ORA ✓ stripe width for least number of insects/optimum protection is about 8cm / stripe width for most number of insects is about 25cm ✓	2 (AO2 x 3.1a)	ALLOW insect bites for insects IGNORE length of stripe ALLOW width range between 5-10cm for least number of insects / most number of insects is 22-27cm
		ii	stripe width of 8cm because it is the lowest point on the graph/fewest number of insects ✓	1 (AO3.2a)	ALLOW width tolerance between 7-9cm and least number of insects (on tape)
		iii	Any three from: stripes developed as a mutation / variation for skin stripes ✓ (animals with stripes) less likely to be bitten by insects / more healthy / spread less pathogens / ORA ✓ (striped animals) more likely to survive ✓ (striped animals) more likely to reproduce ✓ pass on allele/gene for stripes / ORA ✓ process occurs over many generations ✓	3 (AO3 x 2.1)	ALLOW some more striped than others ALLOW offspring produced / breed together IGNORE selective breeding ALLOW pass on advantageous gene IGNORE trait is passed on / genes are passed on IGNORE over time
			Total	6	
4			more accurate/precise measurement (of volume/amount of gas) ✓	1 (AO3.3b)	ALLOW gas could dissolve in water / less gas can escape IGNORE gives exact measurement of gas release
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5		i	breaks seed dormancy / elongation of shoots ✓	1 (AO1.1)	ALLOW (stimulates) flowering/ fruit development / fruit growth / seed formation / germination / growth of shoots / seedless fruits DO NOT ALLOW fruit ripening / seed growth
		ii	Idea that the ripeness colour scale can be used for comparison ✓ idea that a numerical estimate/quantitative measure for level of ripeness is better / idea that it gives multiple measures and not just two/ripe or unripe / removes objectivity / allows reproducibility ✓	2 (AO2 x 3.3a)	ALLOW can be used to choose from a selection of ripeness levels
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6	a	i	Yes (no marks) cooler than black/grey skin OR Yes (no marks) lighter skin is cooler OR No (no marks) zebra skin was similar temperature to the other barrels OR No (no marks) idea it is warmer than the barrel covered by the white skin / ORA ✓	1 (AO3.2a)	argument must support decision
		ii	paint the barrels different colours rather than using the skins / use the same type of skin painted different colours OR idea to make sure that thicknesses/SA/V /volume/temperature of water in barrel need to be controlled ✓	1 (AO3.3a)	ALLOW use painted towels to cover barrels ALLOW for same type of skin e.g. hair-free skin
	b	i	Any two from: zebras with stripes attracts less/fewer insects / ORA✓ narrower stripes attract less insects / ORA ✓ stripe width for least number of insects/optimum protection is about 8cm / stripe width for most number of insects is about 25cm ✓	2 (AO2x3.1 a)	ALLOW insect bites for insects IGNORE length of stripe ALLOW width range between 5-10cm for least number of insects / most number of insects is 22-27cm
		ii	stripe width of 8cm because it is the lowest point on the graph/fewest number of insects ✓	1 (AO3.2a)	ALLOW width tolerance between 7-9cm and least number of insects (on tape)

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	Any three from: stripes developed as a mutation / variation for skin stripes ✓ (animals with stripes) less likely to be bitten by insects / more healthy / spread less pathogens / ORA ✓ (striped animals) more likely to survive ✓ (striped animals) more likely to reproduce ✓ pass on allele/gene for stripes / ORA ✓ process occurs over many generations ✓	3 (AO3 x 2.1)	ALLOW some more striped than others ALLOW offspring produced / breed together IGNORE selective breeding ALLOW pass on advantageous gene IGNORE trait is passed on / genes are passed on IGNORE over time
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7	a		normal bin has holes to allow in air / oxygen ✓ (making normal compost) so aerobic respiration occurs ✓	2 (AO2.1) (AO1.1)	ALLOW converse arguments for bokashi bin ALLOW aerobic bacteria carry out respiration IGNORE bacteria work aerobically
	b		used the same pile of dead plant material for both composters / used same plant type / used equal mass in both composters ✓	1 (AO2.2)	ALLOW used the same time interval for both composters ALLOW used the same water/moisture content for both composters ALLOW idea of same external conditions e.g. put both in same place / external temperature kept the same / kept in the same environment IGNORE references to fair testing
	c	i	Axes – both correctly labelled, including units ✓ Axes - even scales occupying more than half of the grid ✓ Plotting - all points correctly plotted ✓ Line - lines labelled or a key ✓ Line - points with curve of best-fit lines ✓	5 (AO5 x 2.2)	Must have time on x-axis and temperature on y-axis ALLOW +/- half a square at least 8 points correctly plotted IGNORE extrapolated lines
		ii	temperature increased as compost decomposed / bacteria released heat by respiration ✓ temperature starts to drop as decomposition slows down/complete / bacterial respiration slows ✓	2 (AO2 x 2.1)	ALLOW rise in temperature due to energy released by respiration ✓ ALLOW bacterial activity slows (if respiration already mentioned) ALLOW temperature starts to drop as enzymes in respiration denature at high temperatures
		iii	idea that decomposition in bokashi (method) bin much slower ✓ anaerobic respiration releases less heat/energy than aerobic respiration ✓	2 (AO2 x 2.1)	Enter text here.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	d	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 27 (%) award 3 marks 400 / 1500 x 100 ✓ 26.6 (%) ✓ = 27 (%) ✓	3 (AO2.2) (AO2.2) (AO1.2)	If answer = 26.6 (%) award 2 marks ALLOW ECF for correct rounding
		ii	idea that the gas given off is carbon dioxide ✓ less greenhouse gas produced / less likely to result in global warming / less contribution to greenhouse effect ✓	2 (AO2.2) (AO3.1b)	ALLOW for 2 marks less carbon dioxide produced which is a greenhouse gas ALLOW correct formula ALLOW explanations of the greenhouse effect IGNORE references to environmental damage/not environmentally friendly/pollution/not good for the environment
			Total	17	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a		idea that water is added from (each) lake to a (separate) Petri dish using (sterile) pipette ✓ filter paper/antibiotic disc is placed in (the centre of) each dish with the (sterile) forceps ✓ Petri dishes are incubated ✓ idea that the inhibition zone/clear area/area with no bacteria growth around the discs is measured ✓	4 (AO4 x 1.2)	ALLOW idea of repeats ALLOW idea of setting up a control
	b		Lake Bellandur– no mark Any two from: more (antibiotic) resistant bacteria / more species of bacteria are resistant to antibiotics / ORA ✓ Lower number of bacteria killed by antibiotics / less species of bacteria killed by antibiotics / ORA ✓ this lake contains a higher ratio of resistant bacteria compared to bacteria killed by antibiotics✓ (antibiotic) resistant bacteria more likely to survive/reproduce with more (antibiotic) pollution ORA✓	2 (AO2 x 3.2a)	Incorrect or no lake given then no marks ALLOW bacteria are more resistant (antibiotic) DO NOT ALLOW more resistant to bacteria IGNORE immune ALLOW only 28 species are killed ALLOW idea of natural selection causing increased resistant bacteria with more (antibiotic) pollution
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9	a		idea that water is added from (each) lake to a (separate) Petri dish using (sterile) pipette ✓ filter paper/antibiotic disc is placed in (the centre of) each dish with the (sterile) forceps ✓ Petri dishes are incubated ✓ idea that the inhibition zone/clear area/area with no bacteria growth around the discs is measured ✓	4 (AO4 x 1.2)	ALLOW idea of repeats ALLOW idea of setting up a control
	b		Lake Bellandur– no mark Any two from: more (antibiotic) resistant bacteria / more species of bacteria are resistant to antibiotics / ORA ✓ Lower number of bacteria killed by antibiotics / less species of bacteria killed by antibiotics / ORA ✓ this lake contains a higher ratio of resistant bacteria compared to bacteria killed by antibiotics✓ (antibiotic) resistant bacteria more likely to survive/reproduce with more (antibiotic) pollution ORA ✓	1 (AO2 x 3.2a)	Incorrect or no lake given then no marks ALLOW bacteria are more resistant (antibiotic) DO NOT ALLOW more resistant to bacteria IGNORE immune ALLOW only 28 species are killed ALLOW idea of natural selection causing increased resistant bacteria with more (antibiotic) pollution
			Total	6	