

OCR GCSE GATEWAY BIOLOGY A • J247

BIOLOGY



EXAM QUESTION PACK

B1.4 PHOTOSYNTHESIS

SCORE

/164

PERCENTAGE

%

STEMUP

These questions belong to OCR, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by OCR. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with OCR and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. OCR has not endorsed, approved or been involved in the production of it. OCR and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

OCR publishes its past papers, mark schemes and examiner reports. Always check the current specification at ocr.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Gateway Biology A (9-1)

Photosynthesis

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

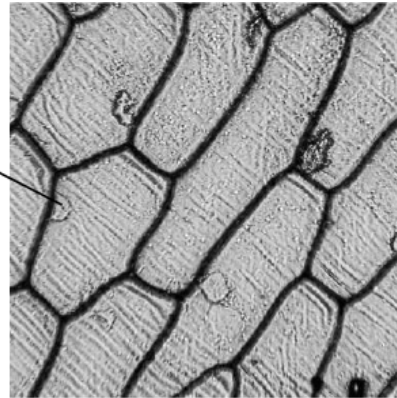
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure 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 **164**.
- The total number of marks may take into account some 'either/or' question choices.

- 1 Look at the image below of some onion cells.

nucleus



- (i) Explain how the contents of the nucleus allow it to carry out its function.

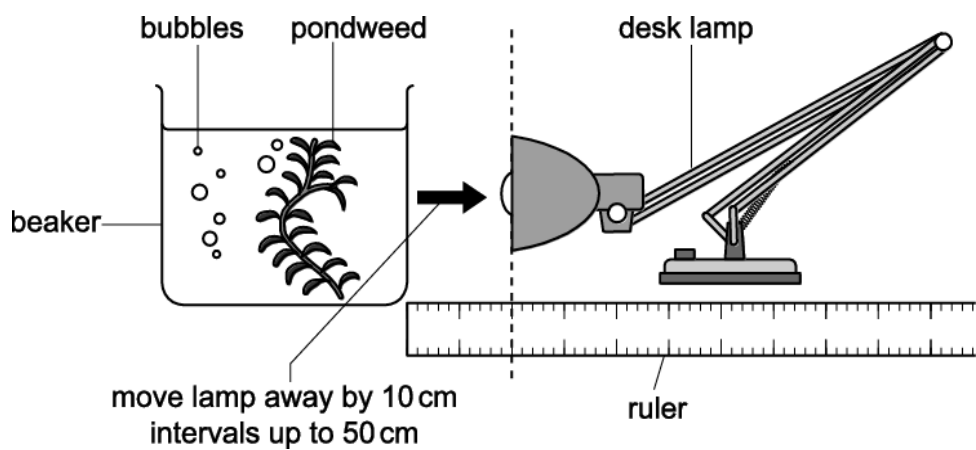
----- [2]

- (ii) Explain why there are **no** chloroplasts in these onion cells.

----- [2]

2 Puj investigates how light intensity affects the rate of photosynthesis in pondweed.

The diagram shows how he sets up his investigation.



Puj plans to place the lamp at distances 10 cm, 15 cm and 20 cm from the beaker.

Puj plans to measure how much gas the pondweed gives off in 10 seconds.

His teacher says he could improve his plan.

Write down two improvements he could make to his plan.

[2]

3 What type of reactions are photosynthesis and respiration?

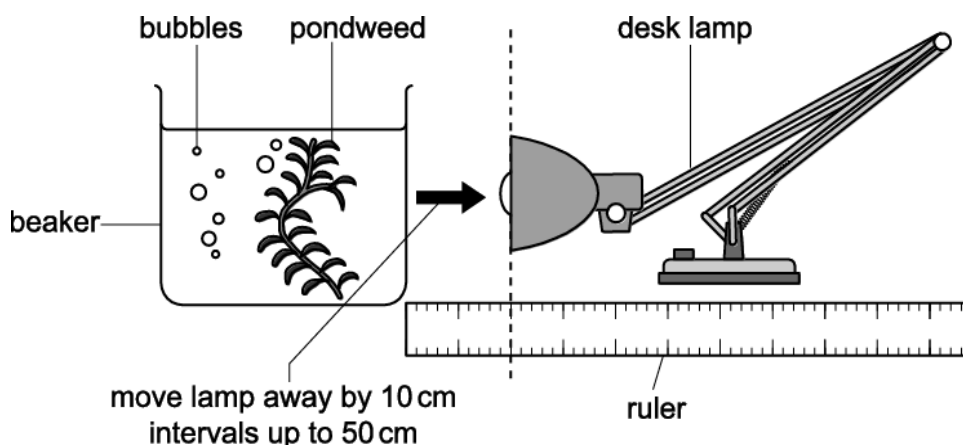
	photosynthesis	respiration
A	endothermic	endothermic
B	endothermic	exothermic
C	exothermic	endothermic
D	exothermic	exothermic

Your answer ☐

[1]

4(a) Puj investigates how light intensity affects the rate of photosynthesis in pondweed.

The diagram shows how he sets up his investigation.



Puj plans to place the lamp at distances 10 cm, 15 cm and 20 cm from the beaker.

Puj plans to measure how much gas the pondweed gives off in 10 seconds.

Puj counts the number of bubbles to get a measure of the amount of gas given off in photosynthesis.

Give **two** reasons why counting bubbles is **not** an accurate way of measuring the amount of gas given off.

----- [2]

(b) What is the gas given off in photosynthesis?

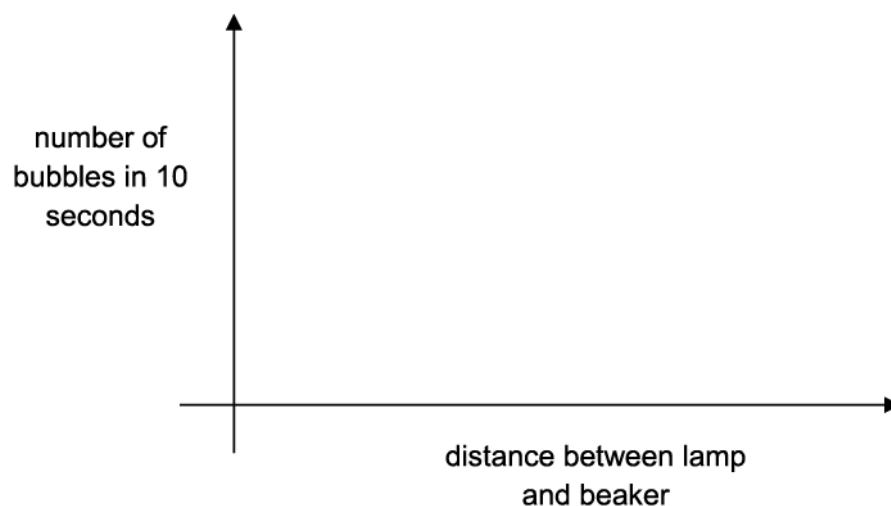
----- [1]

(c) Explain why the amount of this gas given off is **not** a true measure of the rate of photosynthesis.

----- [2]

(d)

(i) Sketch a line on the axes below to show the results you would expect.



[2]

(ii) Explain the shape of the graph. **Two** explanations are required.

[2]

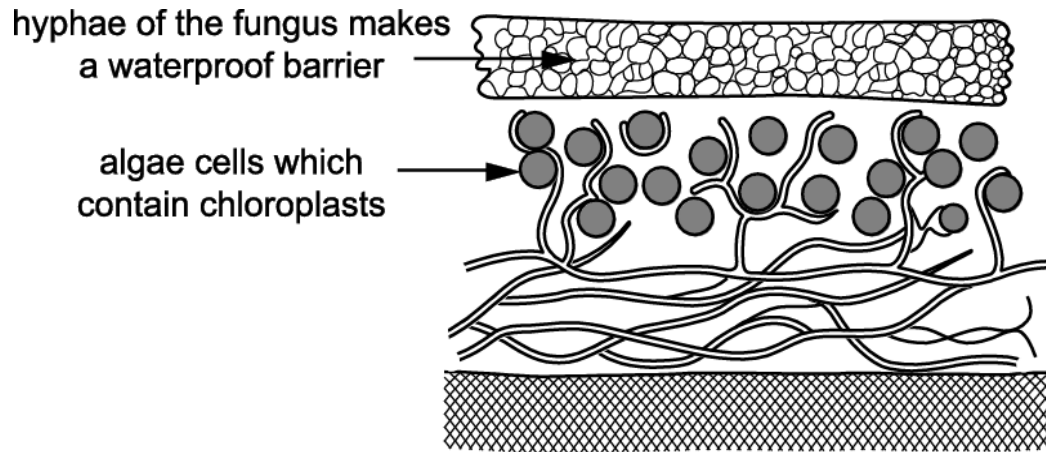
5 Some students are investigating lichens.

Lichens are often studied because they are sensitive to pollution.

Lichens are made up of two different organisms: fungi and algae.

Both the fungus and the algae gain from living together.

The students find a diagram of a lichen.



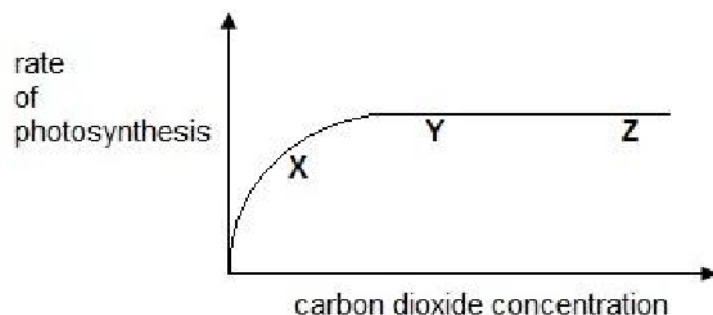
Using the information from the diagram suggest what the algae and fungi each gain from their relationship.

algae

fungus

[2]

- 6 The graph shows the effect of carbon dioxide concentration on the rate of photosynthesis.



Where on the graph is carbon dioxide a limiting factor?

- A X only
- B X and Y
- C Z only
- D Y and Z

Your answer

[1]

- 7 The inverse square law in relation to light intensity (i) and distance (d) from the light source is shown by:

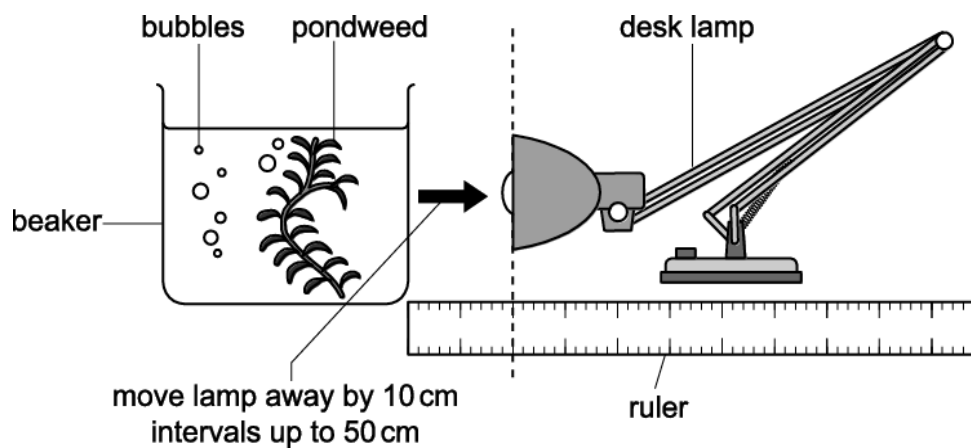
- A $i \propto d^2$
- B $i \propto 1/d^2$
- C $i^2 \propto 1/d$
- D $i^2 \propto d$

Your answer

[1]

- 8(a) Puj investigates how light intensity affects the rate of photosynthesis in pondweed.

The diagram shows how he sets up his investigation.



Puj places the lamp at distances 10 cm, 30 cm, 50 cm, 70 cm and 90 cm from the beaker.

At each distance he counts how many bubbles of oxygen gas the pondweed gives off in 1 minute.

- (i) Puj counts the number of bubbles to get a measure of the amount of gas given off in photosynthesis.

Why is counting bubbles **not** an accurate way of measuring the amount of gas given off?

----- [2]

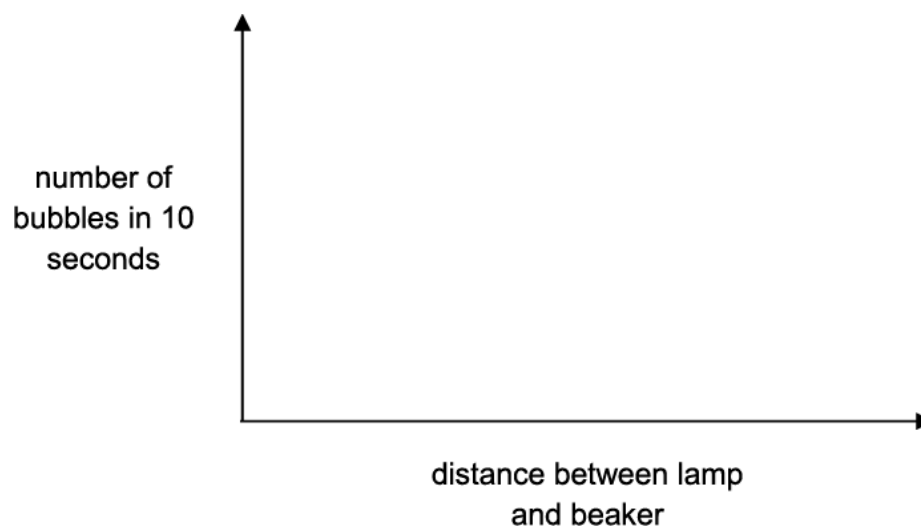
- (ii) Bob's teacher says that collecting the gas, for example in a gas syringe, would give a more accurate measurement.

Explain why.

----- [1]

(b)

(i) Sketch a line on the axes below to show the results you would expect.



[2]

(ii) Explain the shape of the graph. **Two** explanations are required.

[2]

(c)

(i) Describe how and where oxygen is produced in photosynthesis.

[3]

(ii) Explain why the amount of oxygen gas given off is **not** a true measure of the rate of photosynthesis.

[2]

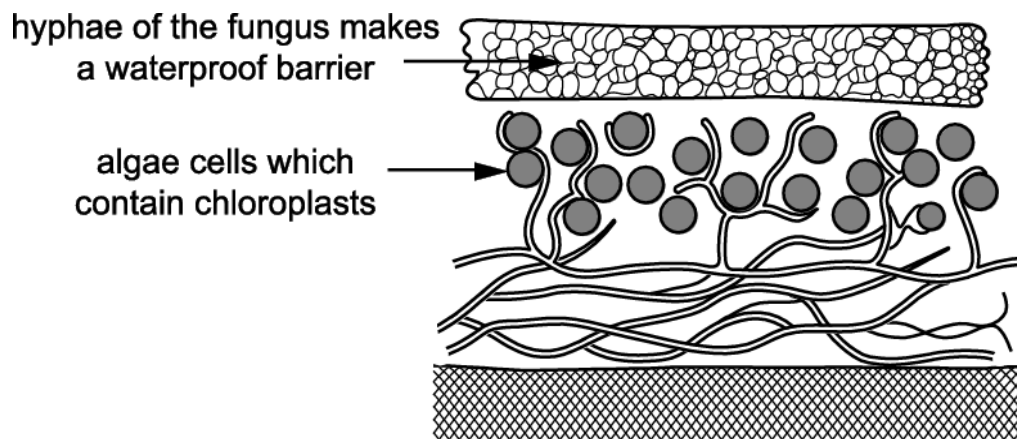
9 Some students are investigating lichens.

Lichens are often studied because they are sensitive to pollution.

Lichens are made up of two different organisms: a fungi and algae.

Both the fungus and the algae gain from living together.

The students find a diagram of a lichen.



Using the information from the diagram suggest what the algae and fungi each gain from their relationship.

algae

.....

fungus

..... [2]

10(a) Green plants contain chlorophyll.

The molecular formula of chlorophyll is $C_{55}H_{72}O_5N_4Mg$.

Plants get the magnesium (Mg) they need in the form of compounds, such as magnesium sulfate, through their roots.

How do plants get the carbon (C) they need to make chlorophyll?

.....

..... [1]

(b) How do plants get the hydrogen (H) they need to make chlorophyll?

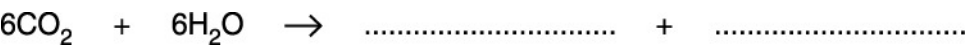
-----[1]

(c) How do plants get the oxygen (O) they need to make chlorophyll?

-----[1]

11(a) Carbon dioxide and water are needed for photosynthesis.

Finish the **balanced symbol equation** for photosynthesis.



[1]

(b) In 1649, scientists thought that plants grew by **only** taking in solid materials from the soil.

A scientist called van Helmont did an experiment to test this idea.

He grew a tree in a large pot of soil.

He measured the mass of the soil and the tree before the experiment.

He measured them again, five years later.

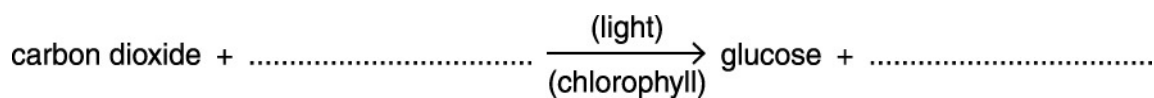


Explain how van Helmont's experiment proved the scientists wrong.

----- [2]

12(a) This question is about photosynthesis.

Complete the word equation for photosynthesis.



[2]

(b) Most photosynthesis happens in leaves.

How does carbon dioxide get into leaves?

-----[2]

(c) Many plants that grow on the ground in forests have darker green leaves than plants that grow in open spaces.

Suggest why they have darker green leaves.

-----[2]

13 Carbon dioxide and water are needed for photosynthesis.

Finish the **word** equation for photosynthesis.

carbon dioxide + water → ----- + -----

[1]

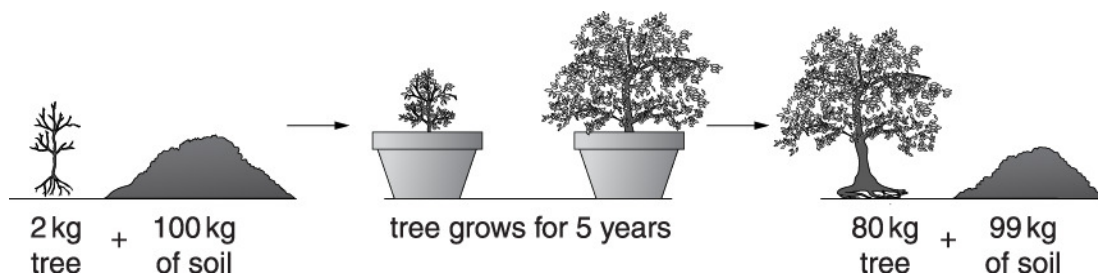
In 1649, scientists thought that plants grew by **only** taking in solid materials from the soil.

A scientist called van Helmont did an experiment to test this idea.

He grew a tree in a large pot of soil.

He measured the mass of the soil and the tree before the experiment.

He measured them again, five years later.



(i) Explain how van Helmont's experiment proved the scientists wrong.

----- [2]

(ii) During the five years, van Helmont watered the soil.

Describe how water enters the tree and what happens to the water once it has entered.

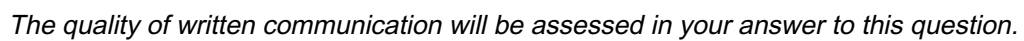
----- [3]

15(a) Bristlecone pine trees are among the longest living things on Earth.

One of them, called Methuselah, is in California and is over 4 800 years old.



Explain how and why these conditions affect both transpiration and photosynthesis.



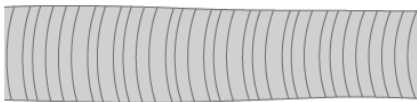
[6]

(b) Scientists worked out Methuselah’s age.

They drilled a narrow core from the trunk and then counted the rings.

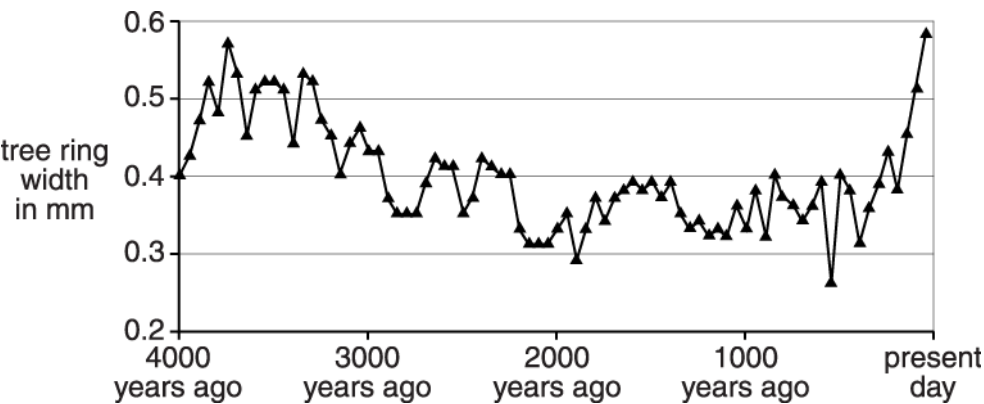
Each ring shows one year’s growth.

The wider a ring, the more growth in that year.



core showing tree rings

The graph shows the average tree ring widths from a sample of bristlecone pine trees in California.



(i) A scientist concludes that the graph shows an increase in tree ring width.

Look at the graph.

How well does the data support the scientist’s conclusion?

Explain your answer.

[2]

(ii) Many factors affect the width of the tree rings.

One of these factors is temperature. Higher temperatures mean wider rings.

The scientist says, “The data from this sample **proves** global warming has happened”.

Do you agree?

Explain your answer.

[2]

16(a) Bristlecone pine trees are among the longest living things on Earth.

One of them, called Methuselah, is in California and is over 4 800 years old.



Methuselah

Bristlecone pine trees live high up in the mountains.

The temperature, dry soil and strong wind make them grow very slowly.

Explain why these extreme conditions make the bristlecone pine trees grow very slowly.



The quality of written communication will be assessed in your answer to this question.

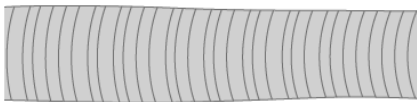
[6]

(b) Scientists worked out Methuselah's age.

They drilled a narrow core from the trunk and then counted the rings.

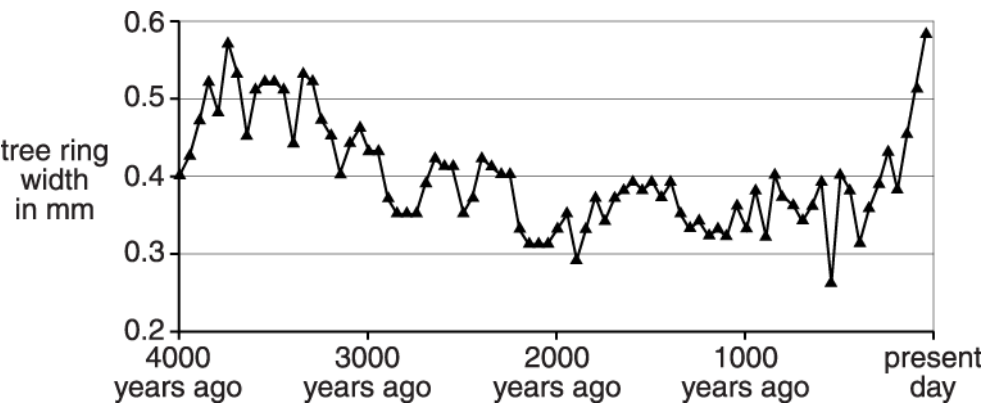
Each ring shows one year's growth.

The wider a ring, the more growth in that year.



core showing tree rings

The graph shows the average tree ring widths from a sample of bristlecone pine trees in California.



(i) A scientist concludes that the graph shows an increase in tree ring width.

Look at the graph.

How well does the data support the scientist's conclusion?

Explain your answer.

[2]

(ii) Many factors affect the width of the tree rings.

One of these factors is temperature. Higher temperatures mean wider rings.

The scientist says, “The data from this sample **proves** global warming has happened”.

Do you agree?

Explain your answer.

[2]

- 17 Jo planted a tree away from her house so it was **not** in the shade.

Explain why this is important for the tree.

[2]

18(a) Wilson grows tomatoes in a glasshouse.

The more the tomato plants photosynthesise, the bigger the crop of tomatoes.

(i) What is the word equation for photosynthesis?

Put a tick (✓) next to the correct equation.

carbon dioxide + water → glucose + oxygen

☐

carbon dioxide + glucose → water + oxygen

☐

water + oxygen → glucose + carbon dioxide

☐

glucose + oxygen → water + carbon dioxide

☐

[1]

(ii) Which of the following statements is correct?

Put a tick (✓) next to the correct statement.

plants photosynthesise only when it is light

☐

plants respire only when it is light

☐

plants respire only when it is dark

☐

plants photosynthesise only when it is dark

☐

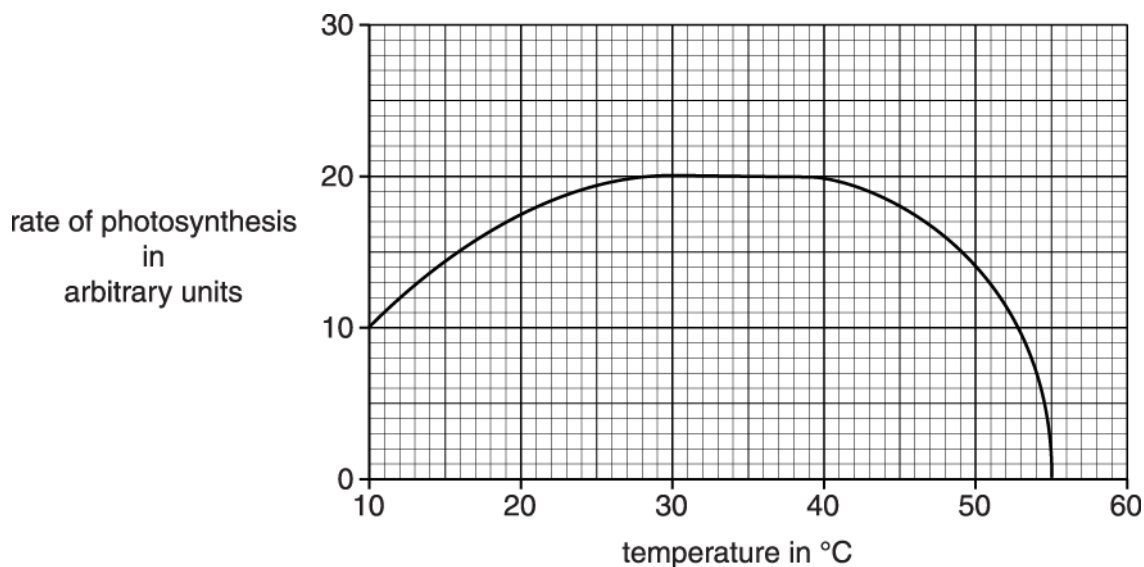
[1]

(b) Wilson knows that the rate of photosynthesis depends on temperature.

He wants to use heaters in his glasshouse to make his tomato plants photosynthesise faster.

He wants to find out the best temperature to have in his glasshouse.

Look at the graph.



(i) **Describe** what the graph shows. Use data in your answer.

[3]

(ii) According to the graph, what is the best temperature for Wilson to have in his glasshouse?

----- °C

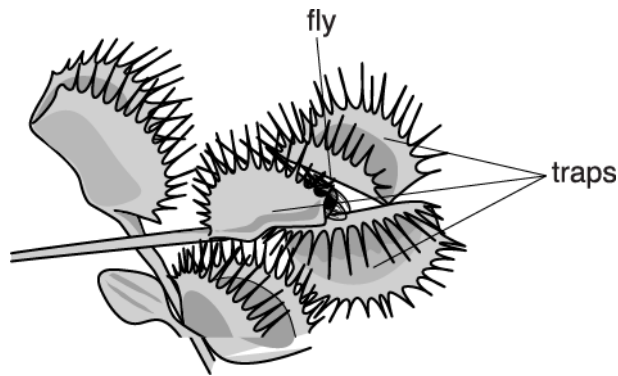
Explain your answer.

- (iii) Before Wilson decides to use heaters in his glasshouse, suggest what else he should consider, apart from the increased rate of photosynthesis.

- 19 The venus flytrap is a plant that lives in very wet ground, such as bogs.

Bogs contain very low levels of minerals, such as nitrates, that plants need for growth.

The venus flytrap catches insects which it digests to get minerals.



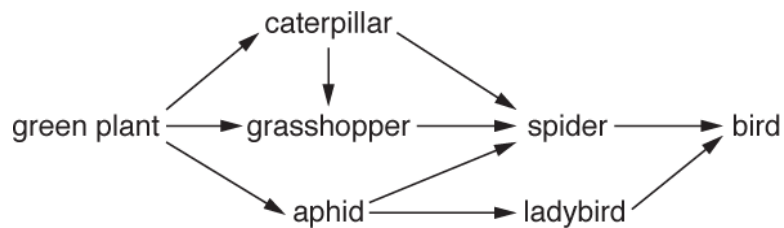
The traps on the venus flytrap are modified leaves.

The traps are green.

Suggest why they are green.

20

The diagram shows a garden food web.



(i) What is the source of energy for this food web?

-----[1]

(ii) The grasshopper is **both** a primary and a secondary consumer.

Explain why it is both.

-----[2]

(iii) The people who own the garden buy a cat.

The cat spends a lot of time in the garden and frightens away birds.

Explain what might happen to the numbers of ladybirds in the garden.

-----[2]

21 Wilson grows tomatoes in a glasshouse.

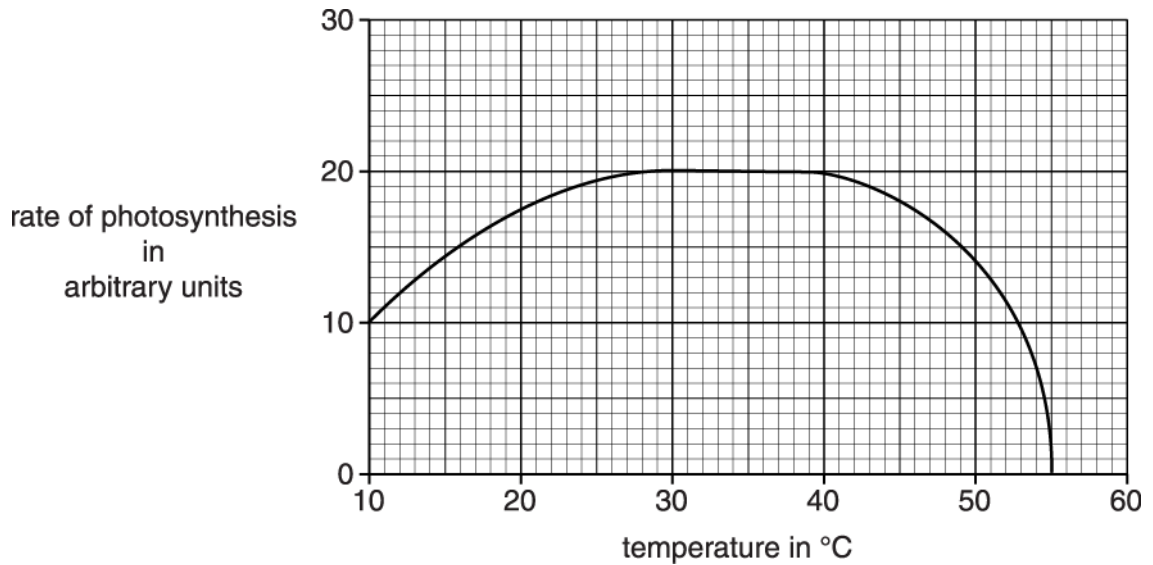
The more the tomato plants photosynthesise, the bigger the crop of tomatoes.

Wilson knows that the rate of photosynthesis depends on temperature.

He wants to use heaters in his glasshouse to make his tomato plants photosynthesise faster.

He wants to find out the best temperature to have in his glasshouse.

Look at the graph.



(i) **Describe** what the graph shows. Use data in your answer.

[3]

(ii) **Explain** the shape of the graph.

-----[3]

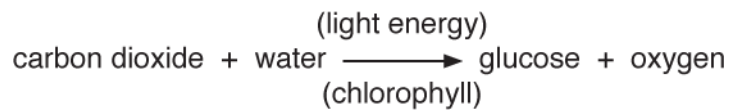
(iii) According to the graph, what is the best temperature for Wilson to have in his glasshouse?

----- °C

Explain your answer.

-----[2]

22(a) Look at the equation for a process that occurs in plants.



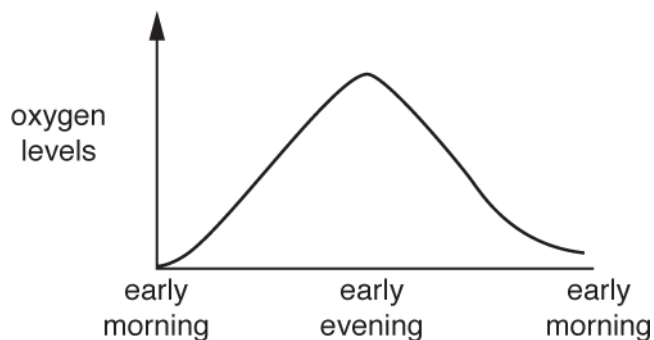
What is the name of the process shown in the equation?

-----[1]

(b) Josh investigates how oxygen levels change in a pond.

He uses a probe to measure the levels of oxygen in the pond at different times of the day.

The graph shows his results.

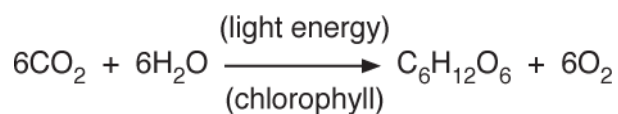


The pond is full of plant life.

Use the equation to explain the pattern in the graph.

----- [2]

23(a) Look at the equation for a process that occurs in plants.



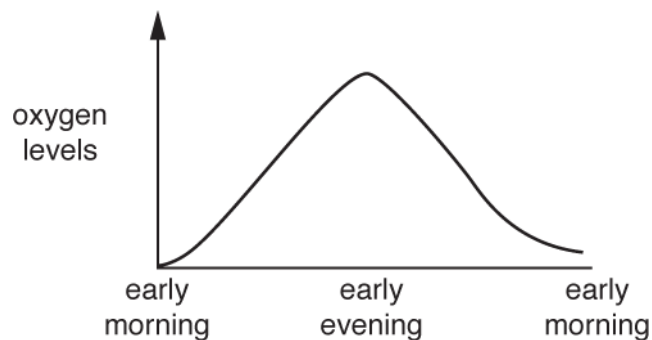
Write down the name of this process.

----- [1]

(b) Josh investigates how oxygen levels change in a pond.

He uses a probe to measure the levels of oxygen in the pond at different times of the day.

The graph shows his results.



The pond is full of plant life.

Use the equation to explain the pattern in the graph.

[2]

24 The diagram shows a variegated leaf.



Which diagram shows the correct starch test results for the variegated leaf?

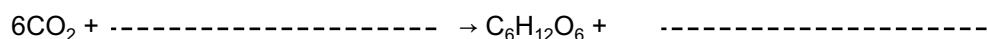


Your answer

[1]

25(a) Photosynthesis takes place inside chloroplasts.

(i) Complete the chemical equation for photosynthesis.



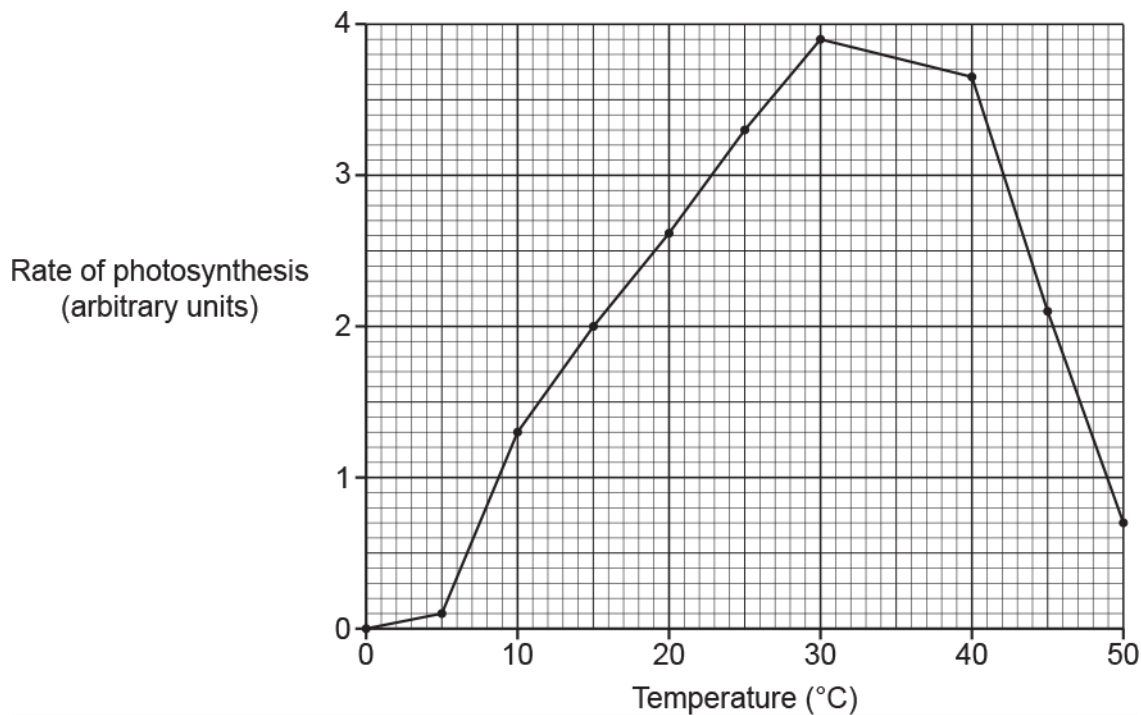
[2]

(ii) Energy is taken in from the surroundings for photosynthesis to take place.

What name is used to describe reactions that take in energy?

-----[1]

(b) The graph is from an experiment to show the effect of temperature on the rate of photosynthesis.



(i) What is the optimum temperature for photosynthesis in this experiment?

-----[1]

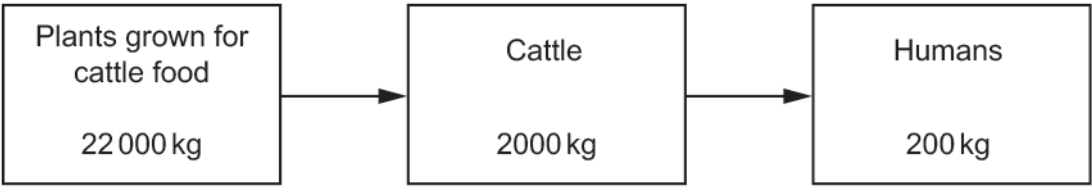
(ii) The rate of photosynthesis was recorded in 5°C intervals.

The experiment could be improved to get a more **precise** value for the optimum temperature.

Explain how.

-----[2]

26 The diagram shows the flow of biomass through an agricultural food chain.



The plants grown for cattle food often have their leaves eaten by insects.

Scientists have produced genetically modified (GM) plants that make insecticide in their leaves.

(i) Explain why these GM plants would make more biomass available to humans.

In your answer use the diagram of the agricultural food chain and ideas about photosynthesis.

(ii) Suggest **two** reasons why some people are against this type of genetic engineering.

1 -----

2 -----

[2]

27 A student investigates plants growing underneath a tree.



He lays out a tape measure on the ground, starting at the tree. He then places a quadrat on the ground.

He measures the percentage of the ground in the quadrat that is covered by plants. He repeats this every metre away from the tree.

The table shows his results.

Distance from the tree (m)	Percentage of ground covered by
----------------------------	---------------------------------

	plants (%)
1	10
2	15
3	18
4	22
5	50
6	58
7	62
8	64

The student thinks that shade from the tree is affecting the plants.

Explain how the student's results show this.

[4]

28 A light source is placed 0.5 m from a plant. The relative light intensity falling on the plant is 2 units.

The light source is moved to 1 m away.

What is the relative light intensity falling on the plant now?

A 0.125

B 0.25

C 0.5

D 1.0

Your answer

[1]

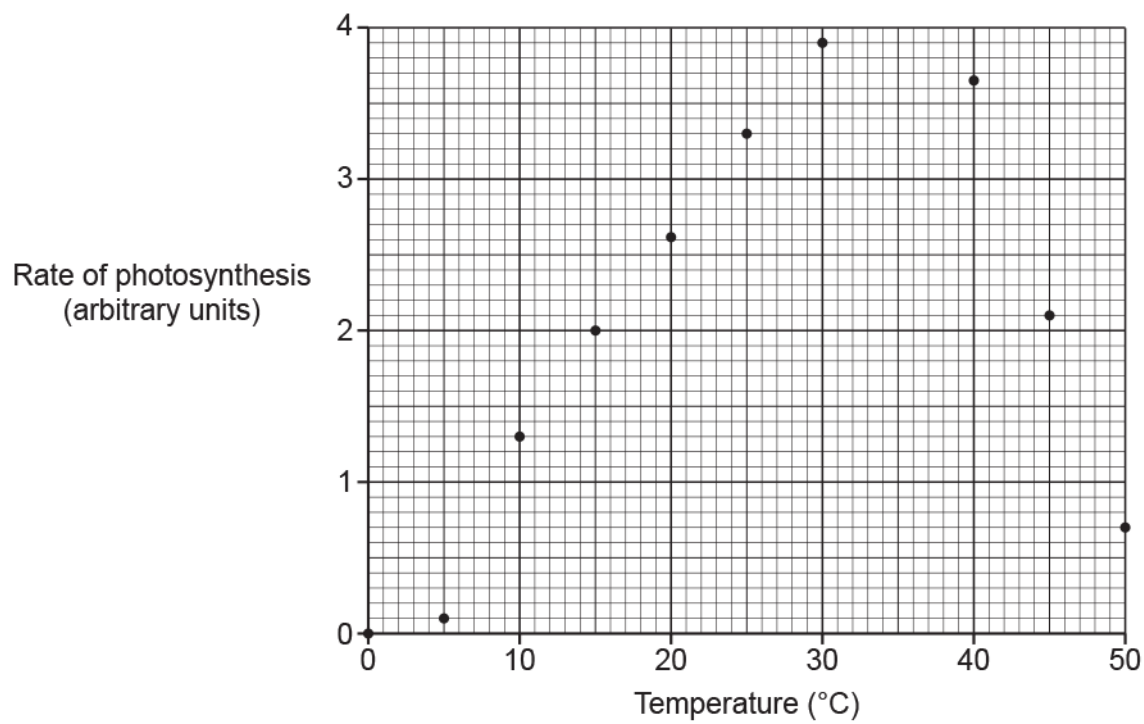
29(a)

Photosynthesis involves reactions that are endothermic.

What is meant by the term endothermic reaction?

-----[1]

(b) The graph is from an experiment to show the effect of temperature on the rate of photosynthesis.

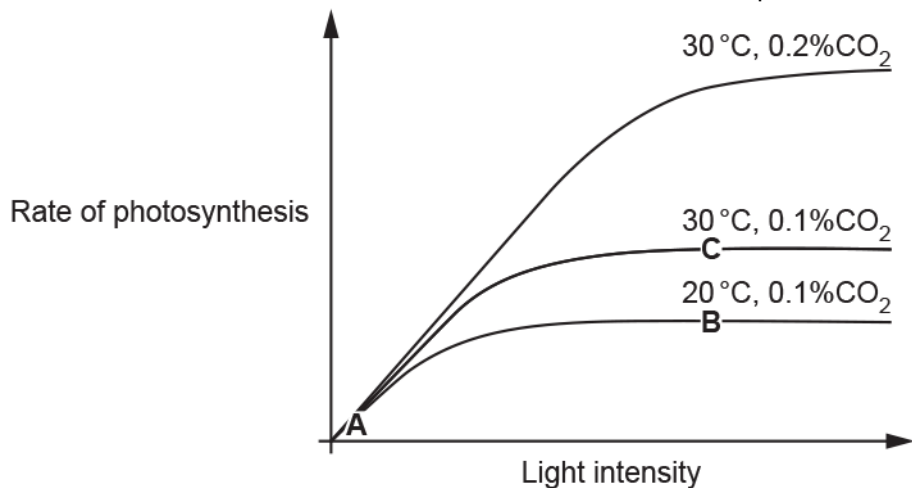


Draw a line of best fit.

[1]

(c) Look at the graph. It shows how light intensity affects the rate of photosynthesis.

The lines show different carbon dioxide concentrations and temperatures.



Explain what is limiting the rate of photosynthesis at the three points A, B and C on the graph.

Use evidence from the graph in your answer.

[3]



He lays out a tape measure on the ground, starting at the tree. He then places a quadrat on the ground.

He measures the percentage of the ground in the quadrat that is covered by plants. He repeats this every metre away from the tree.

The table shows his results.

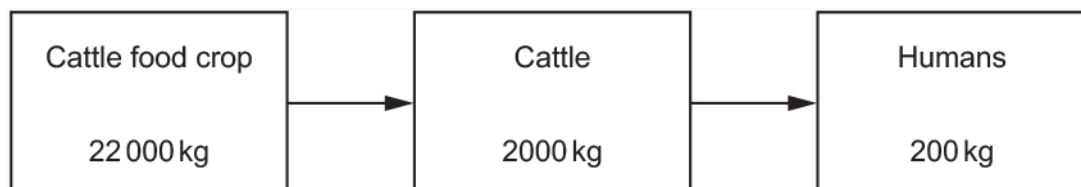
Distance from the tree (m)	Percentage of ground covered by plants (%)
1	10
2	15
3	18
4	22
5	50
6	58
7	62
8	64

The student thinks that shade from the tree is affecting the plants.

Explain how the student's results show this.

[4]

- 31 The diagram shows the flow of biomass through an agricultural food chain.



High levels of light intensity can damage plants. To prevent damage, plants have a protection mechanism.

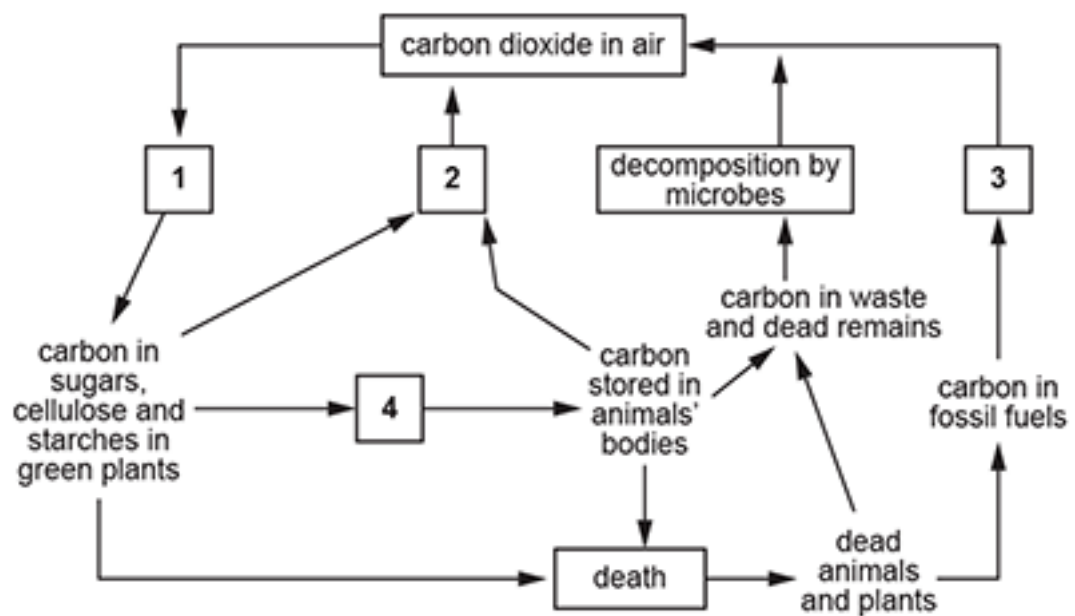
When light intensity levels get **too high**, the protection mechanism switches on. This stops the plant absorbing too much light.

When the light intensity drops to safe levels, the protection mechanism switches off **slowly**.

Explain why this mechanism would **reduce** the biomass available to humans.

[6]

32 The diagram shows the carbon cycle.



Scientists investigated if crops can be grown on the planet Mars.

They used a soil that was similar to the soil found on Mars. The soil contained some minerals but no living organisms.

- (i) The scientists managed to grow crops in the soil. However on Mars, the minerals in the soil would soon run out.

Explain why.

[2]

- (ii) Living organisms could be added to the soil but there is no air on Mars. The plants would need to be grown in an enclosed structure.

At first, air would need to be added, but after a while the organisms in the soil and the plants would supply each other with the gases they need.

Explain how this would happen.

[2]

33 Scientists investigated if crops could be grown on the planet Mars.

They used a soil that was similar to the soil found on Mars. The soil contained some minerals but no living organisms.

- (i) The scientists managed to grow crops in the soil. However on Mars, the minerals in the soil would soon run out.

Explain why.

----- [2]

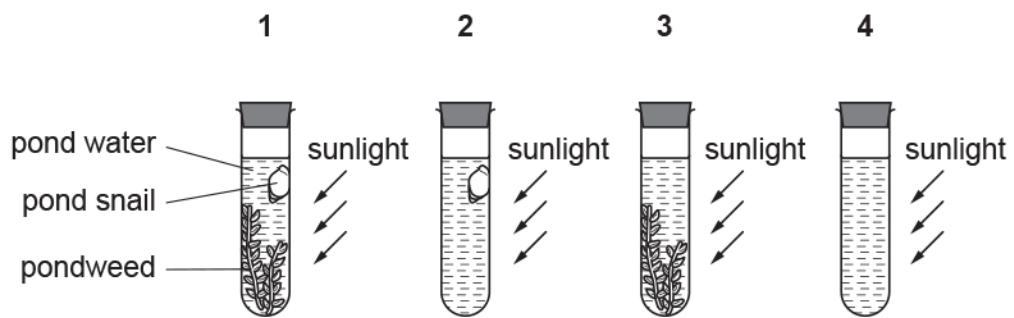
- (ii) Living organisms could be added to the soil but there is no air on Mars. The plants would need to be grown in an enclosed structure.

At first, air would need to be added, but after a while the organisms in the soil and the plants would supply each other with the gases they need.

Explain how this would happen.

----- [2]

34 Pond snails and pondweed are living in water in sealed test tubes.



Carbon dioxide dissolves in water and forms an acid.

In which test tube would the water become most acidic?

- A 1
- B 2
- C 3
- D 4

Your answer

[1]

35 Aerobic respiration occurs all the time in plant cells but photosynthesis only occurs in daylight.

Why is more energy released by a plant cell during the night?

- A Photosynthesis is endothermic taking in energy and aerobic respiration is exothermic.
- B Photosynthesis is exothermic taking in energy and aerobic respiration is endothermic.
- C Aerobic respiration is exothermic taking in energy and photosynthesis is endothermic.
- D Aerobic respiration is endothermic taking in energy and photosynthesis is exothermic.

Your answer

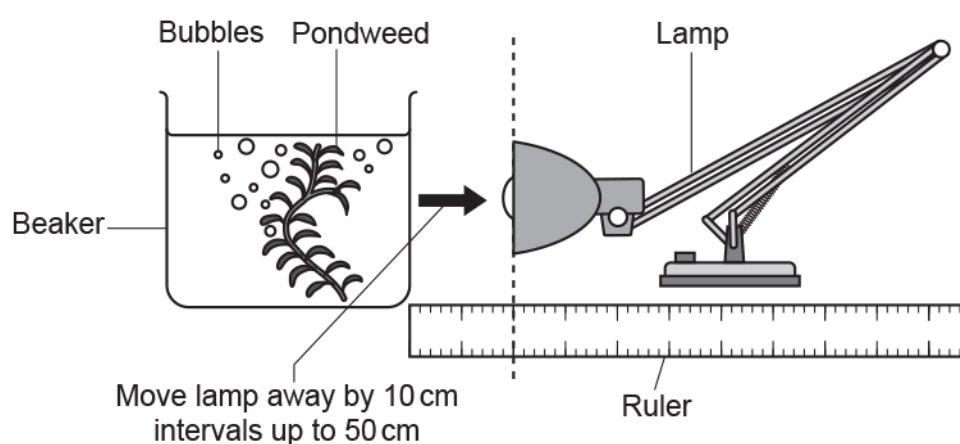
[1]

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.

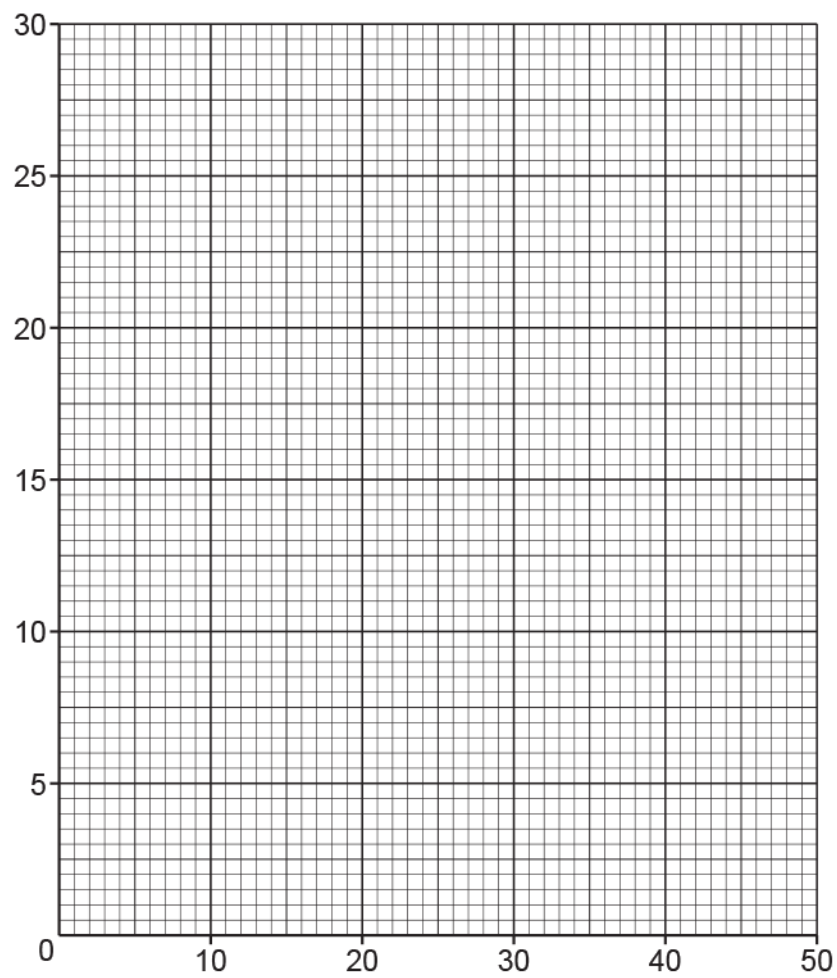
----- [2]

- (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.



[4]

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

Include data from the results table in your answer.

[2]



Fig. 16.1

(i) Write down the number of trophic levels in this food web.

----- [1]

(ii) What is the source of energy for this food web?

----- [1]

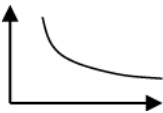
(iii) Septoria fungus is a parasite of stevia.

Explain what is meant by the term **parasite**.

----- [2]

END OF QUESTION PAPER

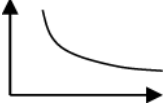
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	contains genes / genetic material / DNA (1)	1	allow protein synthesis
		i	controls cell (functions) (1)	1	
		ii	(onion cells) do not photosynthesize (1)	1	
		ii	(because) they are underground / in the dark (1)	1	
			Total	4	
2			do more repeats / more distances / greater range of distances (1)	1	allow specific values if they match the marking points
			longer than 10 seconds (1)	1	ignore simply do more measurements
			Total	2	
3			B	1	
			Total	1	
4	a		bubbles may be different sizes (1)	1	
			may miscount / difficult to count (1)	1	
	b		oxygen (1)	1	
	c		respiration (is also occurring) (1)	1	allow idea that oxygen given out is the net production
			some oxygen is used up (in respiration) / AW (1)	1	
	d	i	 as the light intensity decreases (1) there are fewer bubbles in 10 seconds (inverse proportional relationship) (1)	2	
		ii	any two from as the distance increases, the light intensity decreases (1) as the light intensity decreases, there is less light / energy for photosynthesis (1) the line curves because the light will not decrease to zero / AW (1)	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Total	9	
5			algae gain protection (1)	1	allow idea about prevention of drying out / absorbing water / minerals
			fungi gain sugars (1)	1	
			Total	2	
6			A	1	
			Total	1	
7			B	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a	i	bubbles may be different sizes (1)	1	
		i	may miscount / difficult to count (1)	1	
		ii	would measure total volume (1)	1	
	b	i	 line decreasing = (1) but curved line decreasing = (2)	2	
		ii	any two from as the distance increases, the light intensity decreases (1) as the light intensity decreases, there is less light / energy for photosynthesis (1) the line curves because the light will not decrease to zero / AW (1)	2	
	c	i	light energy (1)	1	
		i	splits water (1)	1	
		i	in chloroplasts (1)	1	
		ii	respiration (is also occurring) (1)	1	
		ii	some oxygen is used up (in respiration) / AW (1)	1	allow idea that oxygen given out is the net production
			Total	12	
9			algae gain protection (1)	1	allow idea about prevention of drying out / absorbing water / minerals
			fungi gain sugars (1)	1	
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10	a		from carbon dioxide (from the air / through leaves) (1)	1	allow from glucose allow correct formula ignore from food ignore photosynthesis / respiration / breathing Examiner's Comments Half the candidates knew that plants get the element carbon from carbon dioxide.
	b		from water (from the soil / through roots) (1)	1	allow from glucose allow correct formula ignore from food ignore photosynthesis / respiration / breathing Examiner's Comments Two thirds of candidates knew that plants get the element hydrogen from water.
	c		from carbon dioxide (from the air / through leaves) (1)	1	not from water allow from glucose allow correct formula ignore from food ignore photosynthesis / respiration / breathing Examiner's Comments This question was targeted at A* and accordingly very few candidates correctly stated that plants get the element oxygen from carbon dioxide. The majority thought it came from water, not realising that the oxygen in water is what is released from the plant as oxygen gas.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
11	a		$C_6H_{12}O_6$ and $6O_2$ (1)	1	any order must use subscripts Examiner's Comments The majority of candidates correctly completed the symbol equation for photosynthesis.
	b		idea that not enough mass / materials / substances / nutrients lost from soil to supply the mass / material / substances / nutrients gained by the tree (1) correct calculation: soil lost 1kg but tree gained 78kg (1)	2	allow the tree gained (much) more mass than the soil lost allow total weight changed from 102kg ? 179kg allow soil would have been 22kg (if scientists were correct) allow the tree gained 77kg from somewhere else (not soil) = 2 marks allow tree gains 78kg but soil only lost 1kg = 2 bod Examiner's Comments To gain both marks candidates had to both explain that the tree took on more mass than the soil lost, and support this with an appropriate calculation using the figures provided.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12	a		water (1) oxygen (1)	2	allow formulae if correct: H₂O (1) O₂ (1) Examiner's Comments This question was generally well answered with the most common errors being water and oxygen the wrong way round or energy instead of oxygen.
	b		through stomata (1) by diffusion (1)	2	allow pores ignore holes in leaves Examiner's Comments Many candidates appreciated the importance of stomata (sometimes referred to as pores). Reference to diffusion was less frequently seen.
	c		more chlorophyll / more chloroplasts (1) to absorb more light / to absorb as much light as possible / because less light (to absorb) / more shading (1)	2	allow less access to sun(light) ignore cannot reach sunlight / sunlight cannot reach the plant not any reference to availability of gases or water Examiner's Comments Most candidates identified the reduction in light as being important but only the best answers linked this to chlorophyll content of the leaves.
			Total	6	
13			glucose and oxygen (1)	1	any order allow sugar Examiner's Comments The majority of candidates correctly identified glucose but many lost the mark by including energy rather than oxygen in their answer.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14		i	idea that not enough mass / materials / substances / nutrients lost from soil to supply the mass / material / substances / nutrients gained by the tree (1) correct calculation: soil lost 1kg but tree gained 78kg (1)	2	allow the tree gained (much) more mass than the soil lost allow total mass changed from 102kg ? 179kg (1) allow soil would have been 22kg (if scientists were correct)(1) allow the tree gained 77kg from somewhere else (not soil) = 2 marks allow tree gained 78kg but soil only lost 1kg = (2) (BOD) Examiner's Comments Many candidates realised the soil only lost 1kg of mass and the tree gained 78kg. However a number of candidates failed to use the data to answer the question, simply stating the mass must have come from somewhere else.
		ii	any three from: enters through root (hairs) (1) by osmosis (1) transported up the stem (1) passes through xylem (1) lost from the leaves by evaporation (1) by the process of transpiration (1)	3	allow correct description of osmosis (1) ignore diffusion / active transport for extra marking point allow allow a (small amount) used in photosynthesis (1) Examiner's Comments The majority of candidates gained one mark, normally for the idea that the roots take in water and a second for the water moving up the stem or xylem. Few candidates mentioned that water is lost by evaporation from the leaves.
			Total	5	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
15	a	[Level 3] Explanation of why rate of photosynthesis is reduced AND Explanation of how and why transpiration is affected. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Description of reduced photosynthesis AND Description of effects on transpiration. OR Explanation of why rate of photosynthesis is reduced OR explanation of how and why transpiration is affected. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Description of reduced photosynthesis OR Description of effects on transpiration. OR attempts one explanation without stating if they are increased or decreased Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A Indicative scientific points on explanations may include: Explanations of reduced photosynthesis • photosynthesis reduced because of fewer collisions • photosynthesis reduced because reduced enzyme activity • photosynthesis reduced because high winds cause stomata to close so less carbon dioxide taken in Explanation of effects on transpiration. • transpiration increased because of increased diffusion (gradient) or increased evaporation • transpiration increased because of decreased humidity • transpiration may be reduced by low temperatures reducing evaporation or diffusion • transpiration decreased as dry soils means there is less water and the guard cells become flaccid Indicative scientific points on descriptions may include: Description of reduced photosynthesis • lower temperatures or high winds decrease the rate of photosynthesis • high winds close stomata ignore effect of dry soil or sunlight on photosynthesis Description of effects on transpiration. • high winds increase rate of transpiration • high winds cause stomata to close so less transpiration • dry soils may reduce transpiration • low temperatures can reduce transpiration

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					allow absolute ideas e.g. no photosynthesis when cold Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question discriminated the different levels well, the less able candidates would mention that transpiration and photosynthesis were affected by the different conditions but not actually say that the rates increased or decreased. Only the more able candidates used the correct terminology linked to evaporation from the leaves or enzyme activity. A large proportion of the candidates described the processes of photosynthesis and transpiration without actually linking them to the conditions.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	any two from: idea that graph shows an increase in recent times (1) idea that there was a decrease until recently (1) idea that there have been great fluctuations (1) there have been wider rings at other times (in the past) / e.g. 3800 years ago (1) idea that results might not be representative of all trees (1)	2	ignore yes / no allow increases starting in any correct year (between 2000 years ago to present) allow trees are wider in present day (1) allow shows an overall increase (1) allow decreases (from 4000) to any correct year (between 2000 years ago to 500) (1) allow the pattern is random (1) allow it has gone up and down (1) BUT allow it has gone up and down but there is an increase in recent years (2) allow only shows bristlecone pine trees (1) allow only shows some bristlecone pine trees (1) allow only measured in California (1) ignore it is warmer in California Examiner's Comments Most candidates showed that they understood that the statement could not be completely supported by the data.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	any two from: there is not enough evidence (to support theory) (1) other factors could have caused wider rings (1) only provides information about tree rings in one location (1)	2	ignore yes / no allow idea that correlation does not mean causation (1) ignore no evidence ignore not enough proof allow named factors such as rainfall or light (intensity) (1) ignore other things could have caused the wider rings ignore idea that graph supports global warming recently as rings are getting wider Examiner's Comments Only the most able candidates realised that although the tree rings were increasing in size there was no actual evidence to link the change to global warming. The candidates that got one mark tended to state that there were other factors such as water or mineral availability that might have caused the change.
			Total	10	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
16	a	[Level 3] Answer includes two adverse environmental condition with at least one fully explained. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Answer includes two adverse environmental conditions coupled with at least one explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Answer includes two adverse environmental conditions. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Explanations at level 3 may include: • lower temperatures decrease the rate of photosynthesis • less water uptake or more water loss may reduce photosynthesis as water is required Explanations at level 2 may include: • lack of water in the soil results in lack of water uptake / gets less water • windy so more water lost by transpiration / via stomata / less braches so less photosynthesis Indicative scientific points about the adverse environmental conditions may include: • low temperatures / too cold • lack of water (in soil) (not just dry) • windy so more water loss / damage to branches Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments Most candidates commented on the adverse conditions, lack of water or cold temperatures. A smaller number could go further and link the wind to larger water loss or the lack of water and cold temperatures to a reduction in photosynthesis.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	any two from: idea that graph shows an increase in recent times (1) idea that there was a decrease until recently (1) idea that there have been great fluctuations (1) there have been wider rings at other times (in the past) / e.g. 3800 years ago (1) idea that results might not be representative of all trees (1)	2	ignore yes / no allow increases starting in any correct year (between 2000 years ago to present) allow trees are wider in present day (1) allow shows an overall increase (1) allow decreases (from 4000) to any correct year (between 2000 years ago to 500) (1) allow the pattern is random (1) allow it has gone up and down (1) BUT allow it has gone up and down but there is an increase in recent years (2) allow only shows bristlecone pine trees (1) allow only shows some bristlecone pine trees (1) allow only measured in California (1) ignore it is warmer in California Examiner's Comments Well answered by many, with references to the increase in recent years, the fluctuations and the decrease until recent years.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	any two from: there is not enough evidence (to support theory) (1) other factors could have caused wider rings (1) only provides information about tree rings in one location (1)	2	ignore yes / no allow idea that correlation does not mean causation (1) ignore no evidence ignore not enough proof allow named factors such as rainfall or light (intensity) (1) ignore other things could have caused the wider rings ignore idea that graph supports global warming recently as rings are getting wider Examiner's Comments Although the word proves was emboldened few candidates appreciated the difference between proof and a correlation. Answers often repeated those given to the previous question.
			Total	10	
17			gets enough / more light (1) light needed for photosynthesis (1) for more growth / bigger crop (1)	2	ignore simply 'gets light' ignore to grow allow won't grow as much in the shade Examiner's Comments Answers to this question highlighted the need to make comparative comments with candidates failing to score marks by simply stating that plants in the shade get no light and so do not grow.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance								
18	a	i	<table><tr><td></td><td>?</td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table> (1)		?							1	more than 1 tick = 0 ignore crosses <u>?Examiner's Comments??</u> Both parts to this quest were well answered.
	?												
		ii	<table><tr><td></td><td>?</td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table> (1)		?							1	more than 1 tick = 0 ignore crosses <u>?Examiner's Comments??</u> Both parts to this quest were well answered.
	?												
	b	i	as the temperature increases, the rate of photosynthesis increases and decreases (1) but as the temperature increases, the rate of photosynthesis increases, levels off, and then decreases (2) plus correct uses of data, e.g.: rises to max rate of 20 (arbitrary units) / rises to max rate at 30 (°C) / decreases after 40 (°C) / rate is zero at 55 (°C) / constant / optimum 28?40 (°C)	3	(it) increases and goes down = 0 (it) increases, levels off, then decreases (1) allow answer in range 28?30 (°C) allow answer in range 28?40 (°C) <u>?Examiner's Comments??</u> Many candidates were quoting figures in their answers from the graph which was rewarded but there were a number of candidates who tried to explain the changes rather than describe them.								

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	answer in range 28-30 (°C) (1) idea that max rate of photosynthesis and heating any more would be wasteful (1)	2	allow value less than 28 (°C) if explains that reduced rate of photosynthesis / yield is balanced by reduced heating costs <u>?Examiner's Comments??</u> This was a challenging question and few candidates at this level appreciated that a temperature of about 30 degrees would be the best balance between cost and increased rate.
		iii	cost of heaters / cost of heating / payback time for heaters (1) idea of pollution / environmental damage / carbon footprint (1)	2	ignore simply 'cost' allow idea that gas / oil heaters also release carbon dioxide for photosynthesis (1) allow idea that transpiration might increase / may need more water (1) <u>?Examiner's Comments??</u> A small number of answers indicated that increased temperature might mean more watering is needed but most candidates listed other possible limiting factors.
			Total	9	
19			any two from contain chlorophyll / chloroplasts (1) to absorb light (1) for photosynthesis / to make sugar (1)	2	<u>?Examiner's Comments??</u> Many candidates simply assumed that the traps were green for camouflage reasons.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
20		i	sun(light) / light (1)	1	not green plants
		ii	any two from: can be a herbivore and a carnivore / is an omnivore / feeds on both plants and animals / feeds on both green plant and caterpillar (1) when it feeds on green plants it is a primary consumer (1) when it feeds on caterpillar it is a secondary consumer (1)	2	
		iii	numbers increase (1) less are eaten (1)	2	allow its predator has gone
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
21		i	as the temperature increases, the rate of photosynthesis increases and decreases (1) but as the temperature increases, the rate of photosynthesis increases, levels off, and then decreases (2) plus correct uses of data, e.g.: rises to max rate of 20 (arbitrary units) / rises to max rate at 30 (°C) / decreases after 40 (°C) / rate is zero at 55 (°C) / constant / optimum 28 – 40 (°C)	3	(it) increases and goes down = 0 (it) increases, levels off, then decreases (1) allow answer in range 28–30 (°C) allow answer in range 28–40 (°C) <u>?Examiner's Comments??</u> Many candidates gained three marks for fully describing the graph. Candidates who didn't gain full marks usually omitted to include the section of the graph where the rate of photosynthesis was constant. Some described the rate falling but not rising initially, and others didn't make the variables explicit. Most correctly included data in their description.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	(as the temperature increases, the rate of photosynthesis) increases because particles / enzymes have more (kinetic) energy / collide more (frequently) / ORA (1) levels off because of some other limiting factor / not enough CO₂ / not enough light / temperature is not a limiting factor (1) decreases because enzymes denature (1)	3	ignore optimum temperature allow at start, temperature is the limiting factor (1) <u>Examiner's Comments</u> Most candidates attempted to describe the shape of the graph in more detail than in part (i) but only a minority did as the question asked, and explained the shape of the graph. Those who did, usually gained one mark for explaining the fall in rate being due to enzymes denaturing, although some did also explain the rise in rate being due to particles having more energy. Very few used the idea of limiting factors to explain the constant part of the graph; of those that did, many incorrectly thought that temperature was the limiting factor at this point.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	answer in range 28–30 (°C) (1) idea that max rate of photosynthesis and heating any more would be wasteful (1)	2	if give temperature above 30 (°C) then no marks at all allow value less than 28 (°C) if explains that reduced rate of photosynthesis / yield is balanced by reduced heating costs = 2 answer below 28 (°C) with no justification = 0 <u>?Examiner's Comments??</u> Less than half the candidates correctly chose a temperature in the range of 28-30°C, although those who did, usually went on to correctly explain why. A common error was to choose a temperature around 35 °C, the reason being given that it was in the middle of the range of temperatures giving the maximum rate of photosynthesis.
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
22	a		photosynthesis (1)	1	
	b		(oxygen levels) rises during the day as / more (Sun) light / more photosynthesis (1) (oxygen levels) decreases over night as no or less /(Sun) light / no or less photosynthesis (1)	2	allow (oxygen levels) rises early evening / more (Sun) light / more photosynthesis (1) allow (oxygen levels) decreases early morning as no or less /(Sun) light / no or less photosynthesis (1) allow (oxygen levels) decreases as it gets darker (1) ignore rate of photosynthesis is highest in early evening ignore references to water and carbon dioxide ignore references to respiration if both changes are explained but with no direct link to time then = 1 e.g. (oxygen levels) rises as more photosynthesis then decreases as no photosynthesis (1)
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
23	a		photosynthesis (1)	1	allow phonetic spelling
	b		(oxygen levels) rises during the day as more (Sun) light / more photosynthesis (1) (oxygen levels) decreases over night as no or less (Sun) light / no or less photosynthesis (1)	2	allow more oxygen in early evening as more (Sun) light / more photosynthesis (during the day) (1) allow less oxygen in early morning as no or less (Sun) light / no or less photosynthesis (during the night) (1) allow (oxygen levels) decreases as it gets darker (1) ignore rate of photosynthesis is highest in early evening ignore references to water and carbon dioxide ignore references to respiration if both changes are explained but with no direct link to time then = 1 e.g. (oxygen levels) rises as more photosynthesis then decreases as no photosynthesis (1)
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
24			B ✓	1 (AO 2.2)	<u>Examiner's Comments</u> This question tested AO2.2, with candidates' awareness of the role of chlorophyll in photosynthesis and practical skills of interpreting results from a starch test are needed to successfully answer the question. Candidates frequently made the choice between B and C and occasionally D was seen. Higher ability candidates were able to select the correct response, clearly distinguishing between the area that contains chlorophyll being the area that can photosynthesise in a variegated leaf.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
25	a	i	6H ₂ O ✓ 6O ₂ ✓	2 (AO 2 x 1.1)	must be on correct side of equation ALLOW unbalanced/incorrectly balanced H₂O O₂ for one mark <u>Examiner's Comments</u> This question assesses AO1.1 recall of knowledge. However, many candidates seemed to lack any recall and tried to separate out combinations from the formulae given in the question, in many cases these were unrecognisable formulae. Only a few higher ability candidates scored both marks. Common mistakes were to get the correct balanced formula but, unfortunately, put them on the wrong side of the equation. Numbers within molecules were sometimes written as a superscript rather than subscript, or even the same size as the letter.
		ii	<u>endothermic</u> ✓	1 (AO 1.1)	<u>Examiner's Comments</u> Here, many candidates were able to identify this as an endothermic reaction in this AO1.1 question. Only a few incorrectly opted for exothermic but a significant number mistakenly interpreted the question as what would provide the energy and gave respiration as their response.
	b	i	30(°C)✓	1 (AO 2.2)	<u>Examiner's Comments</u> Nearly all candidates gained marks here, showing good application of scientific techniques AO2.2. Occasionally candidates put 3.9 as their answer, showing they had misinterpreted the graph.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	record at narrower temperature intervals✓ narrower intervals around the 30⁰C value✓	2 (AO 2 x 3.3b)	ALLOW any temperature increment less than 5⁰C ALLOW narrower intervals around the optimum ALLOW narrower interval range between 25–35⁰C but must include 30⁰C <u>Examiner's Comments</u> This question assesses AO3 to analyse information to improve experimental procedures. Many candidates identified the need for narrower temperature intervals, often stating the actual interval they would use, but very few targeted these to around the optimum temperature.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
26		i	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Provides a detailed explanation drawing conclusions why GM plants would make more biomass available to humans. Links photosynthesis to agricultural food chains and function of insecticides. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Provides an explanation why GM plants would make more biomass available to humans. Links photosynthesis or function of insecticides to agricultural food chains. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Provides a basic explanation why GM plants would make more biomass available to humans. This could include ideas about photosynthesis or function of insecticide or agricultural food chains. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.	6 (AO 3 × 1.1) (AO 2 × 2.1) (AO 1 × 3.2b)	AO1.1 Demonstrates knowledge of insecticides and photosynthesis. • Insecticides will kill insect pests • Less leaves will be eaten/pests eat less leaves • Leaves are the site of photosynthesis • Less pests of the GM plant AO2.1 Apply knowledge and understanding of photosynthesis to the production of biomass • More photosynthesis • More light absorption for photosynthesis • More chlorophyll / chloroplasts for photosynthesis • More food/glucose/biomass made by photosynthesis AO3.2b Draw conclusions linking photosynthesis to food chains • More plant growth/food/biomass for cattle • More biomass passes through the agricultural food chain • Cattle receive more energy for growth • Then cattle will grow more, therefore more food for humans <u>Examiner's Comments</u> In this Level of Response question, examiners were looking for a detailed conclusion linking photosynthesis to food chains. This should link both photosynthesis and function of pesticides to agricultural food chains. This differentiated well over the whole ability range of the candidates. Exemplar 7 shows a Level 3 answer which gained 6 marks. Exemplar 7

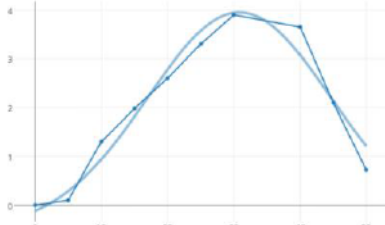
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					13 Genetically modified plants that make insecticide are resistant to insects and repel them. This prevents biomass being lost this way and results in more biomass being available for cattle consumption which means more food for them which means more cattle are reared resulting in more food being available for humans in the form of meat or dairy. If less leaves are eaten by insects then there are more leaves available for photosynthesis as there is more surface area. A greater rate in photosynthesis means that the plants will grow stronger and faster which is more efficient for the farmer which means more food for the cattle at a lower cost.
		ii	any two from: concern that they may be harmful to humans if eaten ✓ plants may escape into the wild ✓ useful /pollinating insects might be harmed ✓ disrupt food chains ✓ ethically wrong ✓	2 (AO 2 × 2.1)	ALLOW harmful effects not discovered to humans IGNORE dangerous ALLOW resistance / resistance gene could get into other plants IGNORE harmful to insects/pests ALLOW harm the environment /reduce biodiversity ALLOW morally / religiously wrong IGNORE playing God / not natural / disrupt nature IGNORE may not taste good IGNORE reduced gene pool / genetic variation / susceptible to the same disease <u>Examiner's Comments</u> The most common credited mark was that it was ethically wrong. A lot of responses focused on it not being natural, which was a non-credit worthy answer.
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
27			idea of less plants/percentage of plants/% cover in shade/closer to the tree ✓ less light (in shade/closer to the tree)✓ less photosynthesis (in shade/closer to the tree)✓ less food/raw materials produced for growth (in shade/closer to the tree)✓	4 (AO 1.2) (AO 2.1) (AO 3.1b) (AO 3.2b)	ORA for all marking points ALLOW shows negative correlation IGNORE less sun IGNORE in shade no photosynthesis / no light ALLOW less light for photosynthesis (closer to the tree) 2 marks ALLOW photosynthesis less effective (closer to the tree) <u>Examiner's Comments</u> A number of candidates achieved 1 mark on this question for the idea of less plants/% cover closer to the tree/shade or the reverse argument. Most candidates didn't link this to less light for photosynthesis. Less food for growth was the least credited marking point.
			Total	4	
28			C ✓	1 (AO 2.2)	<u>Examiner's Comments</u> This question proved to be the most challenging question in section A. Many candidates did not apply the inverse square law and chose the answer D rather than C.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
29	a		energy/heat is taken from surroundings/into the reaction ✓	1 (AO 1.1)	ALLOW energy absorbed is more than the energy released <u>Examiner's Comments</u> Very few candidates confused endothermic with exothermic in this question.
	b		suitable smooth line of best fit is drawn ✓	1 (AO 2.2)	 dot to dot line = 0 <u>Examiner's Comments</u> The construction of a smooth curve seemed very challenging for candidates. Many candidates attempted to draw a straight line for part of the curve. Others just joined the points. Double lines were often seen.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		at point A light is limiting as increasing light intensity increases the rate / as it has sufficient temperature and carbon dioxide ✓ at point B temperature is limiting as increasing temperature increases rate / as it has sufficient light and carbon dioxide ✓ at point C carbon dioxide is limiting as increasing carbon dioxide increases rate / it has sufficient temperature and light ✓	3 (AO 3×2.1)	if no other mark scored allow one mark for correct identification of the three limiting factors with no explanations Examiner's Comments This question challenged many of the candidates and was a good discriminator for high ability candidates. Whilst some candidates could identify the limiting factors at the three points, few backed this up with explanations using evidence from the graph. An example of a candidate lacking full explanations and therefore only scoring 1 mark is shown in exemplar 8. Exemplar 8 At A, the light intensity is very low and is the limiting factor. At point B, the temperature prevents the rate of photosynthesis from increasing and at point C, the CO₂ levels are the limiting factor and is stopping the photosynthesis rate from increasing ✓ [3]
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
30			idea of less plants/percentage of plants/% cover in shade/closer to the tree ✓	(AO 1.2)	ORA for all marking points ALLOW shows negative correlation
			less light (in shade/closer to the tree) ✓	(AO 2.1)	IGNORE less sun IGNORE in shade no photosynthesis / no light
			less photosynthesis (in shade/closer to the tree) ✓	(AO 3.1b)	ALLOW less light for photosynthesis (closer to the tree) 2 marks ALLOW photosynthesis less effective (closer to the tree)
			less food/raw materials produced for growth (in shade/closer to the tree) ✓	(AO 3.2b)	<u>Examiner's Comments</u> This question assessed four different assessment objectives. Candidates had to identify the trend from the graph and apply their knowledge and understanding to give a reason for the trend. They also had to interpret reasons for the trend and draw conclusions about how the shade was affecting the plants. Most candidates identified the trend. Higher ability candidates linked this to less light closer to the tree so reduced rate of photosynthesis. However, only the highest ability candidates concluded that this would result in less glucose/food production. Most candidates just referred to reduced growth, which on its own did not score a mark. Exemplar 2 <i>The results show that the further away from the base of the tree (where the shade is strongest) more plants are growing. For example, 2m away only 10% of the ground is covered by plants whereas 8m away a greater percentage of 64% of ground is covered. This means that the higher the light intensity (away from shade), the higher rate of photosynthesis showing it is a limiting factor and helps more plants to grow. Whereas the shade limits the light intensity and limits growth.</i> This candidate has been credited with 3 marks. A mark is gained for identifying the trend as a reverse argument. They have gained a second mark for recognising that

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					this is due to a higher light intensity further from the tree. A third mark was gained for linking the increase light intensity to an increased rate of photosynthesis. The candidate has not gained the final conclusion mark as they have only referenced the plant growth and not the food/raw materials produced to enable the growth to occur.
			Total	4	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
31	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Detailed explanation including conclusions about how the mechanism affects photosynthesis and links this to less biomass available to humans in the food chain. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Explanation of how the mechanism affects photosynthesis or affects the biomass available to humans. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Demonstrates some knowledge of how the mechanism affects photosynthesis or affects the biomass available to humans. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>	6 (AO 3. × 1.1) (AO 2. × 2.1) (AO 1. × 3.2b)	AO1.1 Demonstrate knowledge of photosynthesis and biomass. • Photosynthesis requires light energy • Mechanism reduces photosynthesis • Trapped by the leaves and used to produce food molecules • Photosynthesis required for plant growth • Plant biomass is a food source for animals including humans AO2.1 Apply knowledge and understanding of photosynthesis to the production of biomass • More light energy converted to heat, then less energy for photosynthesis • Less photosynthesis then plants can make less food / plants can grow less • Less plant biomass leads to less available food AO3.2b Draw conclusions linking photosynthesis to biomass in food chains • In low light intensities, light availability is the limiting factor • Less plant growth/crops therefore less food for cattle/less food for humans / in the food chain <u>Examiner's Comments</u> This Level of Response question assessed all three main assessment objectives. It was common to be limited to a low level mark due to repeating the stem of question regarding less biomass all through their response instead of linking the protection mechanism's impact to less light, less photosynthesis so less glucose/food made and consequently less food for cattle and humans. Candidates that did not appreciate that a reduction in light resulted in a reduction in photosynthesis, which also limited their answer to a low level.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					There was little evidence of candidates planning their response. Taking time to consider how to answer a LoR, might encourage them to make notes and think through key areas. A common low level answer was to refer to the loss of energy due to the energy needed to switch on the mechanism. It was noted how many candidates did not link biomass to growth or production of food. However, those candidates that realised that the key to the answer was essentially linked to factors influencing photosynthesis, produced excellent responses. Exemplar 5 High light intensity levels cause the plant to absorb less light, reducing the amount of photosynthesis that takes place. This means the plant will not grow as much/as quickly so there is less crop ~~that grow~~ ^{that grow}. As a result yield decreases so the mass of crop decreases. This means there is less food available for humans to consume. When the protection mechanism switches off slowly, there is a gradual increase in the amount of glucose the plant makes which slowly increases biomass available. However if it slowly increases the level of photosynthesis there is still less energy available for human consumption. This answer has less light/less photosynthesis and less crop and links this to the impact on the food chain so all Level 3, 6 marks This candidate has been credited Level 3 maximum 6 marks. They have structured their answer in a concise manner but included all the relevant marking points. The candidate describes the protection mechanism's impact in reducing light and photosynthesis. The candidate states that the decrease in mass of crops and food made means there is consequently less food for the humans to consume. They continue to give a reason why there will still be less energy available even when the plants resume photosynthesis due to the mechanism switching off slowly.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
32		i	(no) microorganisms (in the soil) ✓ no decay (takes place) ✓	2 (AO 1.1) (AO 2.1)	AW microbes, decomposers, saprophytes, detritivores, bacteria, fungi AW decomposition, rotting, break down ALLOW not enough nitrifying bacteria to replace nitrates / no nitrates released by nitrifying bacteria = 2 IGNORE no organisms to recycle the minerals <u>Examiner's Comments</u> Very few candidates were able to apply their knowledge of microbes and decay to this question, and found it challenging to answer. Many candidates misinterpreted the question and talked about lack of oxygen for life or that Mars is too dry for life. This is demonstrated with Exemplar 4 which was given 0 marks. Exemplar 4 The conditions are different. ~~It~~ it is really hot on mars so the soil would dry out. [2]

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	plants release oxygen by photosynthesis ✓ organisms in the soil / microbes / animals release carbon dioxide by respiration ✓	2 (AO 2.2)	ALLOW correct word (or symbol) equations for photosynthesis linked to plants and respiration linked to organisms in the soil / microbes / animals AW microbes, decomposers, saprophytes IGNORE breathe out carbon dioxide IGNORE plants will respire and give out carbon dioxide ALLOW 1 mark for plants release oxygen/photosynthesis and microbes give out carbon dioxide/respire if no other marks are awarded. <u>Examiner's Comments</u> Candidates had to apply their knowledge and understanding of gases given off by plants in photosynthesis and organisms in carrying out respiration to explain why air would no longer needed to be added after a while. Most non-scoring responses were too vague and just stated gases as in the stem of the question.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
33		i	(no) microorganisms (in the soil) ✓ no decay (takes place) ✓	2 (AO 1.1) (AO 2.1)	AW microbes, decomposers, saprophytes, detritivores, bacteria, fungi AW decomposition, rotting, break down ALLOW not enough nitrifying bacteria to replace nitrates / no nitrates released by nitrifying bacteria = 2 IGNORE no organisms to recycle the minerals <u>Examiner's Comments</u> Lower ability candidates didn't realise they needed to identify decomposer or a named type of decomposer and instead repeated the term living organisms from the question, thereby missing the AO1.1 aspect of the question. Higher ability candidates were able to name decomposers or types of decomposers. A significant number did not write about the AO2.1 aspect of the question about decomposition, using terms such as replenish or recycle minerals. Some candidates wrote about the minerals being used up but didn't go on to say why they would not be replaced.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	plants release oxygen by photosynthesis ✓ organisms in the soil / microbes / animals release carbon dioxide by respiration ✓	2 (AO 2.2)	ALLOW correct word (or symbol) equations for photosynthesis linked to plants and respiration linked to organisms in the soil / microbes / animals AW microbes, decomposers, saprophytes IGNORE breathe out carbon dioxide IGNORE plants will respire and give out carbon dioxide ALLOW 1 mark for plants release oxygen/photosynthesis and microbes give out carbon dioxide/respire if no other marks are awarded. <u>Examiner's Comments</u> In this AO2.1 question, many candidates referred to plants only, indicating the importance of careful reading of the question that asked about organisms other than plants. Another frequent response from candidates that did not score was reference to 'breathing' out carbon dioxide and not specifically to respiration.
			Total	4	
34			B	1 (AO 2.1)	
			Total	1	
35			A	1 (AO 1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
36	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
	c	i	axes correctly labelled, including units ✓ all points correctly plotted ✓ ✓ suitable line of best fit drawn ✓	4 (AO4 x 2.2)	ALLOW +/- half a square all points correctly plotted 0 to 1 correct point plotted = 0 mark 2 to 4 correct points plotted = 1 mark All 5 correct points plotted = 2 marks ALLOW line of best fit based on plotted points IGNORE dot to dot line

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	further lamp is from the plant photosynthesis reduced / ORA ✓ example of a decrease from data e.g. at 10cm 30 bubbles given off and at 40cm only 2 bubbles ✓ OR photosynthesis stops in very low light ✓ by 50 cm there are no bubbles ✓ OR idea that rate of photosynthesis decrease is a non-linear relationship ✓ e.g. nearly double the number of bubbles at 10cm compared to 20cm but not double elsewhere ✓	2 (AO3.2b)	IGNORE type of gas mentioned in bubbles ALLOW description of decrease in bubbles e.g. further lamp the less bubbles ALLOW there is a negative correlation
			Total	11	
37		i	Three/3 ✓	1 (AO2.2)	
		ii	(sun)light / the sun ✓	1 (AO1.1)	
		iii	Award one mark for: (an organism) that lives on/in on a (host) organism ✓ Idea parasite benefits at the expense to its <u>host</u> ✓ Award two marks for: An organism that feeds on a living organism / An organism that causes harm to a living organism ✓✓	2 (AO2 x 1.1)	IGNORE an organism that feeds on another organism unless qualified
			Total	4	