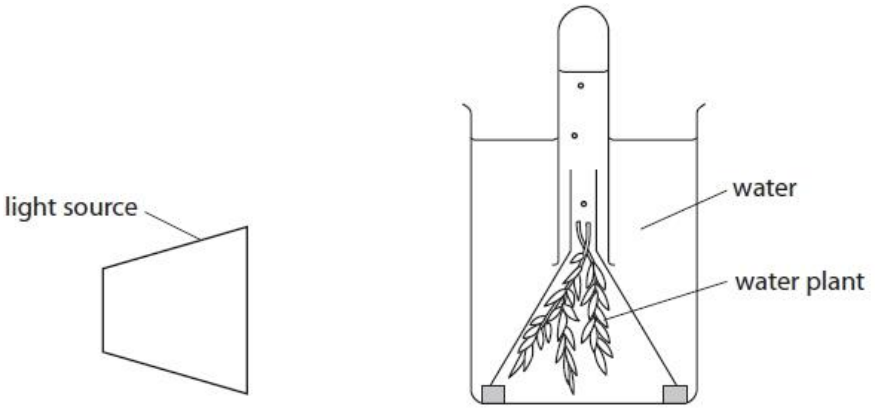
Questions

Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Figure 6 shows a method of investigating the rate of photosynthesis in a water plant.



(Source: © ghrzuzudu/Shutterstock)

Figure 6

(i) What are the products of photosynthesis?

(1)

- ☒ **A** carbon dioxide and water
- ☒ **B** water and glucose
- ☒ **C** glucose and oxygen
- ☒ **D** oxygen and carbon dioxide

(ii) The rate of photosynthesis can be measured by counting the number of bubbles of gas produced in one minute.

Figure 7 shows some results from this investigation in different light intensities.
Light intensity was changed by moving the lamp towards or away from the water plant.

light intensity in arbitrary units	rate of photosynthesis in bubbles per minute
25	19
31	43
39	46
50	95
69	125
100	222

Figure 7

Describe the effect of light intensity on the rate of photosynthesis. Use information from Figure 7 to help you.

(2)

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(iii) The bubbles are different sizes and can be difficult to count.

Describe how the quality of the results from this investigation could be improved.

(2)

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(iv) Describe how this investigation could be changed to find the effect of temperature on the rate of photosynthesis.

(3)

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(Total for question = 8 marks)

Q2.

Figure 16 shows an area of woodland with some small plants growing in the ground between the trees.

(Source: © Maksym Holovinov/Shutterstock)

Figure 16

The leaves of the small plants are green.

Describe how these plants make glucose.

(2)

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(Total for question = 2 marks)

Q3.

Figure 16 shows the effect of light intensity and temperature on the rate of photosynthesis.

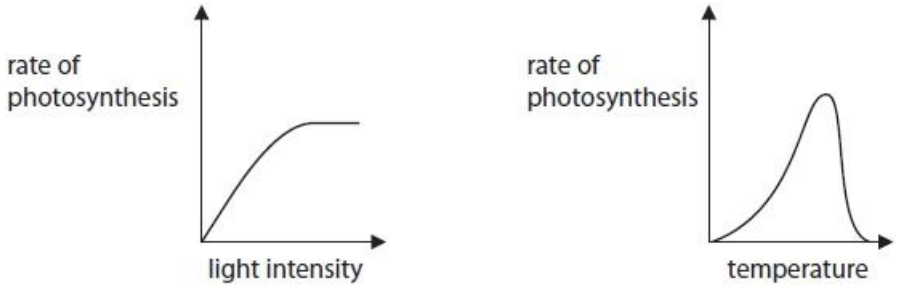

Figure 16

(i) Describe the effect of light intensity on the rate of photosynthesis.

(2)

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(ii) Explain the effect of temperature on the rate of photosynthesis.

(2)

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(Total for question = 4 marks)

Q4.

*Figure 23 shows a diagram of some equipment that can be used to investigate the rate of photosynthesis.

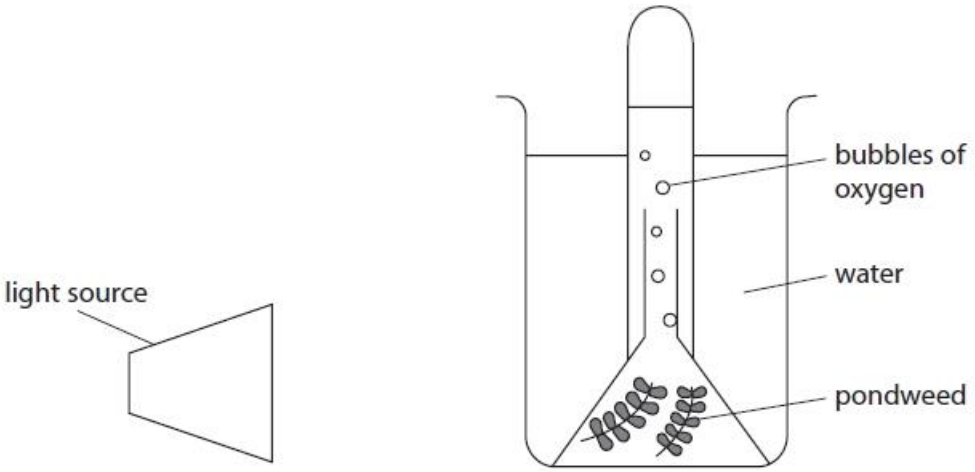

Figure 23

Devise a plan to investigate the effect of light intensity on the rate of photosynthesis.

Include variables you would need to control.

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(Total for question = 6 marks)

Q5.

Algae are green plants.

Figure 10 shows the number of algae in a lake in the United Kingdom during one year.

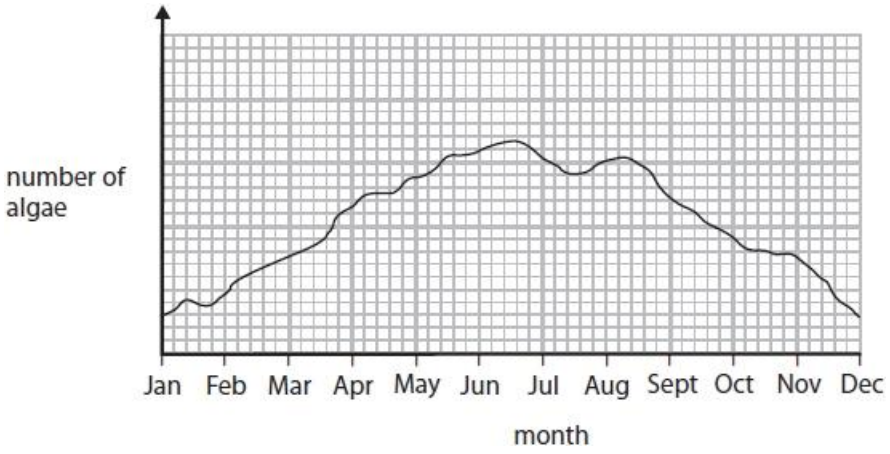

Figure 10

Explain the changes in the number of algae in the lake from February to June.

(3)

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(Total for question = 3 marks)

Q6.

Figure 14 shows how light intensity changed during one day.

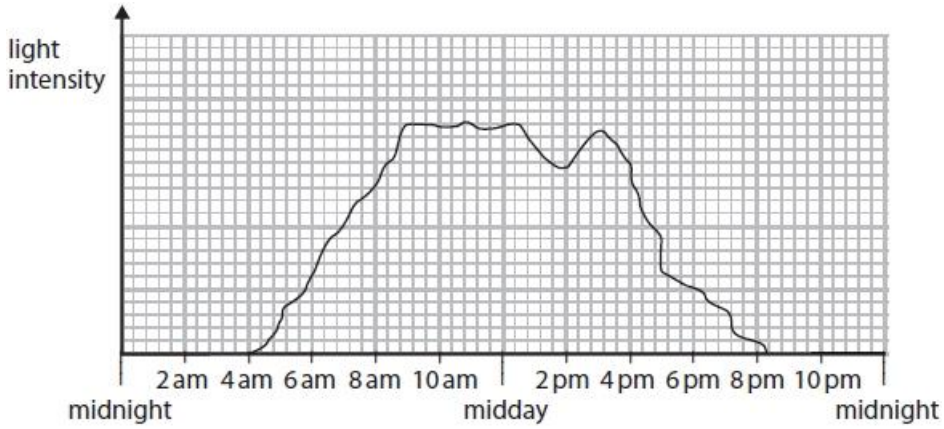

Figure 14

Use information in Figure 14 to explain why oxygen moved out of the leaf between 9 am and midday.

(2)

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(Total for question = 2 marks)

Q7.

Photosynthesis occurs in leaves.

(i) Which substance is needed for photosynthesis?

(1)

☒ **A** carbon dioxide

☒ **B** glucose

☒ **C** oxygen

☒ **D** nitrogen

(ii) A leaf cell is 0.08 mm long.

Calculate the length of the image of this cell after it has been magnified 50 times using a microscope.

(2)

..... mm

(Total for question = 3 marks)

Q8.

Plants need light for photosynthesis.

Part of the photosynthesis equation is shown below.

..... + carbon dioxide → glucose + ...

(a) Which of the following would complete the photosynthesis equation?

(1)

	reactant	product
☒ **A**	water	chlorophyll
☒ **B**	chlorophyll	oxygen
☒ **C**	water	oxygen
☒ **D**	oxygen	water

A scientist investigates the effect of light intensity on photosynthesis.

He sets up the equipment shown in Figure 1.

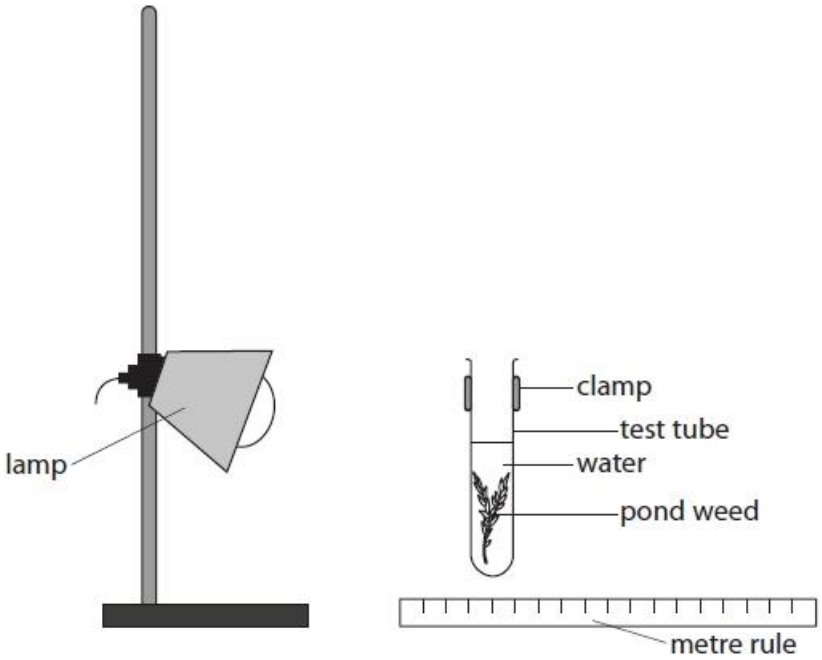

Figure 1

He places the lamp 10cm from the test tube and records the number of bubbles produced in five minutes.

He repeats the procedure with the lamp at a distance of 20cm and 30cm away from the test tube.

The scientist wants to repeat his investigation at each distance.

(b) (i) State **three** variables that should be kept constant to improve the results.

(3)

1 .....

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2 .....

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3 .....

.....

The scientist noticed that the temperature of water near the light increased.
(ii) Give **one** improvement the scientist could make to reduce the effect of this increase in temperature.

(1)

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.....

(c) Figure 2 shows the results of the investigation.

distance (cm)	number of bubbles counted			
	test 1	test 2	test 3	mean
10	42	37	44	41
20	23	24	22	
30	10	11	12	11

Figure 2

(i) Calculate the mean result for a distance of 20cm.

(1)

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The number of bubbles counted for test 2 at 10cm was anomalous.

(ii) State how the scientist could deal with this anomaly.

(1)

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(iii) Give a conclusion about the effect of light intensity on photosynthesis.

(1)

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(Total for question = 8 marks)

Q9.

A scientist investigated the effect of light intensity on the rate of photosynthesis of the aquatic *Cabomba* plant.

A lamp was used as a source of light. The lamp was placed at different distances (*d*) from the *Cabomba* plant, and the number of bubbles produced in 60 seconds was counted.

The number of bubbles produced in 60 seconds was used to calculate the rate of photosynthesis.

The light intensity was then calculated using the inverse square law $\left(\frac{1}{d^2}\right)$.

Figure 10 shows the scientist's results.

distance (*d*) of lamp from *Cabomba* (cm)	light intensity (arbitrary units)	bubbles produced in 60 seconds
5	0.0400	79
10	0.0100	21
15	0.0044	12
20	0.0025	7
25		5
30	0.0011	4

Figure 10

(a) (i) Calculate the light intensity when the lamp is 25 cm from the *Cabomba* plant.

(2)

light intensity = ... arbitrary units

(ii) Use information from Figure 10 to describe the effect of light intensity on the rate of photosynthesis.

(2)

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(iii) Give another method of measuring light intensity rather than calculating it.

(1)

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(iv) The scientist counted the number of bubbles produced by the *Cabomba* plant. Another scientist stated that this was not the best method of measuring the volume of gas produced.
Explain how you could improve the method to measure the volume of gas released more accurately.

(2)

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(b) Explain what would happen to the levels of gas produced if the light intensity decreased to 0.0001 arbitrary units.

(2)

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(Total for question = 9 marks)

Q10.

A student measured the rate of photosynthesis using algal balls in a laboratory. The tube of algal balls was kept at a temperature of 25 °C and was moved to different distances from a light source.

The results of this investigation showed that the rate of photosynthesis is

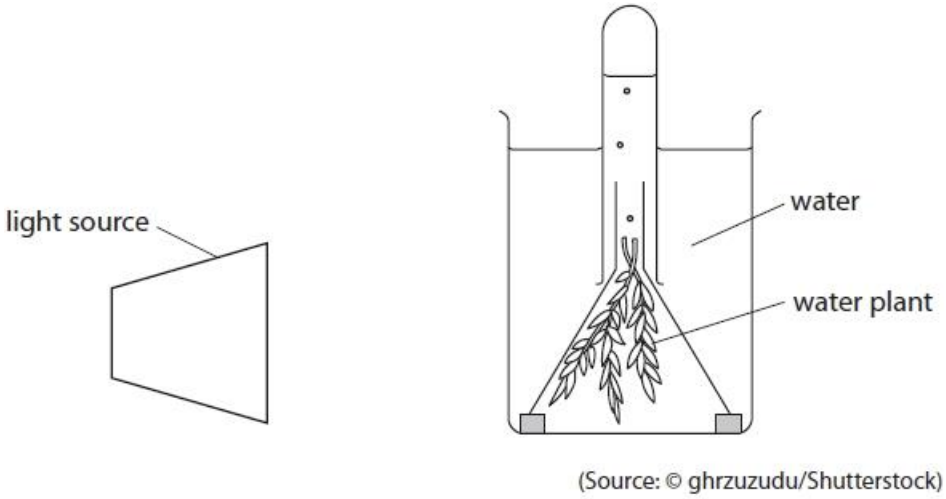
(1)

- ☒ **A** directly proportional to the distance from a light source
- ☒ **B** inversely proportional to light intensity
- ☒ **C** directly proportional to temperature
- ☒ **D** inversely proportional to the distance from a light source

(Total for question = 1 mark)

Q11.

Figure 10 shows a method of investigating the rate of photosynthesis in a water plant.



(Source: © ghrzuzudu/Shutterstock)

Figure 10

(i) What are the products of photosynthesis?

(1)

☒ **A** carbon dioxide and water

☒ **B** water and glucose

☒ **C** glucose and oxygen

☒ **D** oxygen and carbon dioxide

(ii) The rate of photosynthesis can be measured by counting the number of bubbles of gas produced in one minute.

Figure 11 shows some results from this investigation in different light intensities.
Light intensity was changed by moving the lamp towards or away from the water plant.

light intensity in arbitrary units	rate of photosynthesis in bubbles per minute
25	19
31	43
39	46
50	95
69	125
100	222

Figure 11

Describe the effect of light intensity on the rate of photosynthesis.
Use information from Figure 11 to help you.

(2)

.....

.....

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.....

(iii) The bubbles are different sizes and can be difficult to count.

Describe how the quality of the results from this investigation could be improved.

(2)

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(iv) Describe how this investigation could be changed to find the effect of temperature on the rate of photosynthesis.

(3)

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(Total for question = 8 marks)

Q12.

Plants release oxygen into the atmosphere.

What is the name of the process that releases oxygen into the atmosphere?

(1)

- ☒ **A** combustion
- ☒ **B** oxidation
- ☒ **C** photosynthesis
- ☒ **D** polymerisation

(Total for question = 1 mark)

Mark Scheme

Q1.

Question Number	Answer	Mark
(i)	C glucose and oxygen **The only correct answer is C** ***A*** *is not correct because carbon dioxide and water are not products of photosynthesis* ***B*** *is not correct because water is not a product of photosynthesis* ***D*** *is not correct because carbon dioxide is not a product of photosynthesis*	**(1)** **AO1 1**

Question Number	Answer	Mark
(ii)	Any two from: • increasing light intensity increases rate of photosynthesis / number of bubbles per minute (1) • credit specific examples using manipulated data from the table (1)	**(2)** **AO3 1a 1b**

Question Number	Answer	Mark
(iii)	A description including two from: • video the investigation / plant (1) • play back (in slow motion) and count the bubbles (1) OR • collect bubbles / gas produced / use a (gas) syringe (1) • measure volume of gas (collected) (1) OR • repeat the investigation (at each light intensity) (1) • calculate a mean (1)	**(2)** **AO3 3b**

Question Number	Answer	Mark
(iv)	A description including three from: • change temperature of water (1) • use thermometer / temp probe (to monitor temperature of water) (1) • use a water bath (to keep each temperature constant) (1) • count the bubbles at each temperature (for set time) (1) • control a variable e.g., keep pond weed / light intensity / volume of water the same (1)	**(3)** **AO3 3a**

Q2.

Question Number	**Answer**	**Additional guidance**	**Mark**
	A description including **two** from: • have chlorophyll / chloroplasts (1) • (by) photosynthesis (1) • absorbing / using (sun)light (1) • (to react) water with carbon dioxide (1)	 accept symbol / word equations	**(2)** **AO2 1**

Q3.

Question number	Answer	Additional guidance	Mark
(i)	An answer linking the following: • as light intensity increases so does the rate of photosynthesis (1) • (it levels off) when light intensity ceases to be a limiting factor (1)	 accept idea of another factor limiting the rate of photosynthesis accept named factor	**(2)** AO 3 1a AO 3 1b

Question number	Answer		Mark
(ii)	An explanation linking **two** of the following: • as temperature increases so does the rate of photosynthesis {as enzymes can catalyse more reactions / more collisions occur} (1) • maximum rate of photosynthesis at the optimum temperature for **enzymes** (1) • {above the optimum/at high temperatures} **enzymes** become denatured (and photosynthesis decreases) (1)	 accept more enzyme-substrate complexes form accept active site changes shape for denatured	**(2)** AO 3 2a AO 3 2b

Q4.

Question number	Indicative content	Mark
	A03 3a and A02 2 (6 marks) **Plan for the investigation** • put a light (source) at a distance away from the pondweed • measure the volume of oxygen / count the number of bubbles • in a set time • repeat with the light at different distances **Variables and how to control them** **ambient light** • use darkened room / close curtains / turn lights out • use a light meter to measure light intensity • use the same light source at each distance **temperature (of water)** • use a heat shield • use a thermometer and add cold water as necessary **carbon dioxide concentration (in water)** • add sodium hydrogen carbonate to the water **bubbles contain different volumes of gas** • measure volume of oxygen in the test tube • replace the test tube with a measuring cylinder **acclimatisation period** • wait for the rate to settle down before you count the bubbles **amount of pondweed** • use the same pondweed each time.	**(6)**

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3-4	• The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5-6	• The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Level	**Mark**	**Additional Guidance**	**General additional guidance** The level is determined by the detail of the plan The mark within the level is determined by the number of variables and how to control them
	0	No rewardable material	
Level 1	1–2	• A simple answer stating at least one correct aspect of a plan • A reference to one variable that can be controlled	Possible candidate responses • Move the light to different distances. • You need to control the temperature of the water.
Level 2	3–4	• An answer that describes a workable plan • A detailed answer of how to control one variable OR a reference to more than one variable that need to be controlled	Possible candidate responses • Count the number of bubbles. Move the light further away and count again • Control the temperature of the water by using a water bath • Control the temperature of the water and close the blinds
Level 3	5-6	• A detailed workable plan • A detailed answer of how to control one variable AND at least one other reference to a different variable to be controlled	Possible candidate responses • Place the light at 10cm from the pondweed. Count the bubbles in one minute. Move the light to other distances and count the number of bubbles in one minute again. • Put a sheet of glass between the light and pondweed to stop it heating up. The amount of pondweed should be the same.

Q5.

Question number	Answer	Mark
	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (2 marks): Judgement: • the number of algae increase (1) Two reasons: • increased {temperature / light intensity} / longer daylight (1) • for (more) photosynthesis (for growth) (1) OR • increased minerals / nitrate ions / eutrophication in the lake (1) • (more) protein / chlorophyll (for growth) (1)	**(3)** AO 3 2a AO 3 2b

Q6.

Question number	Answer	Mark
	An explanation which includes the following: • (between 9 and midday) light intensity is high / highest (1) • so more photosynthesis occurs (which produces oxygen) (1) OR • (more) photosynthesis is occurring (1) • so oxygen moves out of the leaf by diffusion / description of diffusion (1)	**(2)** AO 2 1

Q7.

Question number	Answer	Mark
(i)	**A** carbon dioxide (1) **The only correct answer is A** **B** *is not correct because glucose is not needed for photosynthesis.* **C** *is not correct because oxygen is not needed for photosynthesis.* **D** *is not correct because nitrogen is not needed for photosynthesis*	(1) AO1.1

Question number	Answer	Additional guidance	Mark
(ii)	Substitution 0.08 (mm) x 50 (1) evaluation = 4 (mm)	Full marks for correct answer with no working shown	(2) AO2.1

Q8.

Question number	Answer	Mark
(a)	C	(1)

Question number	Answer	Mark
(b) (i)	• temperature of water (1) • start each experiment with the same amount of carbon dioxide (1) • start each experiment with the same amount of water (1)	(3)

Question number	Answer	Mark
(b) (ii)	Any one improvement from: • use a heat shield (1) • use a water bath (1)	(1)

Question number	Answer	Additional guidance	Mark
(c) (i)	• $\frac{23+24+22}{3}$ (1) • 69 ÷ 3 = 23 (1)	award full marks for correct numerical answer without working	(1)

Question number	Answer	Mark
(c) (ii)	repeat the reading to get concordant results/calculate the mean without the anomalous result	(1)

Question number	Answer	Mark
(c) (iii)	{as light intensity decreases/distance from the lamp increases} the rate of photosynthesis decreases	(1)

Q9.

Question number	Answer	Additional guidance	Mark
(a) (i)	25 × 25 = 625 (1) 1 ÷ 625 = 0.0016 (1)	award full marks for correct numerical answer without working	(2)

Question number	Answer	Mark
(a) (ii)	An answer that combines points of interpretation/evaluation to provide a logical description: • as light intensity decreases the rate of photosynthesis also decreases (1) • after 20 cm away when light intensity appears to have little effect on the rate of photosynthesis (1)	(2)

Question number	Answer	Mark
(a) (iii)	use a light meter/lux meter	(1)

Question number	Answer	Additional guidance	Mark
(a) (iv)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • collect the gas/oxygen produced in a graduated gas syringe (1) • to reduce the errors generated when counting bubbles which maybe of different sizes (1)	accept alternative gas collection method with measuring cylinder and beehive shelf accept leave the apparatus for a longer amount of time	(2)

Question number	Answer	Mark
(b)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • the volume of gas produced would decrease to below four bubbles (1) • because light is needed for photosynthesis (1)	(2)

Q10.

Question number	Answer	Mark
	D inversely proportional to the distance from a light source **1. The only correct answer is D** ***A*** *is not correct because light intensity is not directly proportional to photosynthesis* ***B*** *is not correct because light intensity is not just inversely proportional to photosynthesis it is an inverse square.* ***C*** *is not correct because temperature is not directly proportional to photosynthesis*	**(1)** AO 1 1

Q11.

Question Number	Answer	Mark
(i)	C glucose and oxygen **The only correct answer is C** ***A*** *is not correct because carbon dioxide and water are not products of photosynthesis* ***B*** *is not correct because water is not a product of photosynthesis* ***D*** *is not correct because carbon dioxide is not a product of photosynthesis*	**(1)** **AO1 1**

Question Number	Answer	Mark
(ii)	Any two from: • increasing light intensity increases rate of photosynthesis / number of bubbles per minute (1) • credit specific examples using manipulated data from the table (1)	**(2)** **AO3 1a 1b**

Question Number	Answer	Mark
(iii)	A description including two from: • video the investigation / plant (1) • play back (in slow motion) and count the bubbles (1) OR • collect bubbles / gas produced / use a (gas) syringe (1) • measure volume of gas (collected) (1) OR • repeat the investigation (at each light intensity) (1) • calculate a mean (1)	**(2)** **AO3 3b**

Question Number	Answer	Mark
(iv)	A description including three from: • change temperature of water (1) • use thermometer / temp probe (to monitor temperature of water) (1) • use a water bath (to keep each temperature constant) (1) • count the bubbles at each temperature (for set time) (1) • control a variable, e.g. keep pond weed / light intensity / volume of water the same (1)	**(3)** **AO3 3a**

Q12.

Question number	Answer	Mark
	C photosynthesis is the only correct answer **A** and **B** are processes that required oxygen **D** is a process that does not involve oxygen	**1**