

EXAM INSIGHTS

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mistakes

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GCSE Biology

Emma Dougan

Suitable for: AQA, OCR, WJEC, CCEA,
Pearson Edexcel (UK & International)

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Plant processes

Overview

Knowledge recap

- * Photosynthesis is an *endothermic* reaction, which is a reaction that requires energy to be absorbed to work.
- * The word equation for photosynthesis is:
carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen
- * The balanced symbol equation for photosynthesis is:
 $6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- * A *limiting factor* reduces the rate of a reaction. In photosynthesis low temperature, shortage of carbon dioxide, shortage of light and shortage of chlorophyll are limiting factors.
- * Farmers and growers of crop plants often maximise crop growth (the yield) by monitoring and controlling limiting factors. They may increase heat, carbon dioxide and/or light. There is a balance, however, between the cost of maintaining optimum conditions for maximum crop growth and profit.
- * *Transpiration* is the gradual release of water vapour from leaves to continue the 'pull' of water up to the leaves from the soil (known as the *transpiration stream*). Water *evaporates* out of the leaf cells and enters the leaf air spaces as water vapour. This water vapour *diffuses* out of the leaf through air spaces and *stomata*.
- * Transpiration rate is affected by wind speed, temperature, humidity and light intensity.

Practice questions

- 1 In the process of photosynthesis, energy is absorbed. What name is given to this type of reaction? Tick one box. (1)

- ☐ endothermic
☐ combustion
☐ decomposition
☐ exothermic

Insight

Examiner reports warn that students often fail to write chemical equations correctly. To ensure marks, subscript numbers should be used, for example CO_2 .

- 2 Write the balanced symbol equation for photosynthesis. (2)

- 3 Give the source of energy for photosynthesis. (1)

- 4 Plants are producers. Describe the role of a producer in a food web. (2)

Insight

Examiners warn that students incorrectly refer to energy being 'produced', 'created' or 'made' during photosynthesis. Ensure you use the correct biological term in your answer.

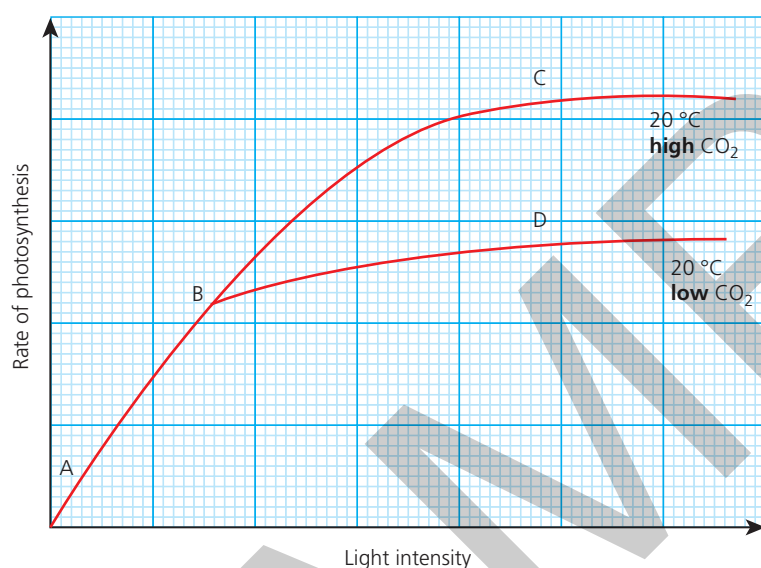
5 Define the term *limiting factor*. (1)

6 Which two of the following are examples of limiting factors in photosynthesis? Tick two boxes. (2)

- ☐ glucose ☐ light
☐ oxygen ☐ starch
☐ carbon dioxide

7 The graph below shows the effect of different light intensities on the rate of photosynthesis at:

- 20 °C with **low** carbon dioxide (CO₂) levels
- 20 °C with **high** carbon dioxide (CO₂) levels.



Insight

Examiners warn that students fail to follow the instructions in graph questions, often describing or explaining the shape of the whole graph. Take care to read the question so you refer to the appropriate part of the graph.

7-1 Describe and explain the increase in the rate of photosynthesis between A and B. (2)

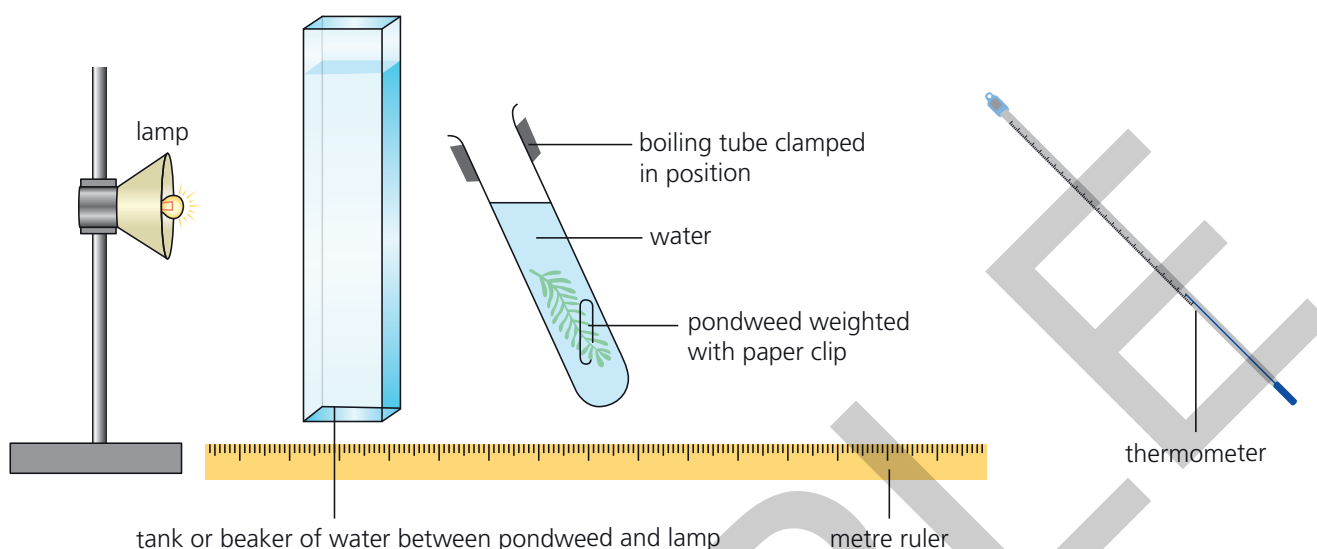
7-2 Give one factor that limits the rate of photosynthesis at point D. (1)

7-3 Draw a line on the graph to show the effect of an increase in light intensity on the rate of photosynthesis when the temperature is 10 °C and the carbon dioxide level is low. (2)

Extended responses

Worked example

1 You have been provided with the apparatus shown in the image below.



Outline a plan to investigate how light intensity affects the rate of photosynthesis.

(6)

Plan your answer to this question on a separate piece of paper. Start by circling the command word and then highlight or underline any useful information. When writing your plan, consider numbering your points in the order you would write them.

Here is a sample answer with expert commentary:

This is good because it starts to describe how to set up the apparatus. The student needs to include more detail referencing the other apparatus shown.

I would take the pondweed and cut it under water at a 45-degree angle. When it is under the water put the pondweed into a boiling tube. Then set up the light in front of the boiling tube and count the number of bubbles it produced in 1 minute.

The student has correctly stated that the number of bubbles should be counted over a set period of time.

Upgrade

To help structure your answer, you should refer to all of the apparatus provided, describe how you would set the apparatus up and detail the measurements you would take.

This answer would get 2/6 because the student has partially described how to set up the investigation and the measurements they would take. To gain full marks, they need to further describe how they would set up the experiment by making reference to the ruler, changing the distance of the pondweed from the light source and repeating the measurements taken at each distance to calculate an average.

Be the examiner

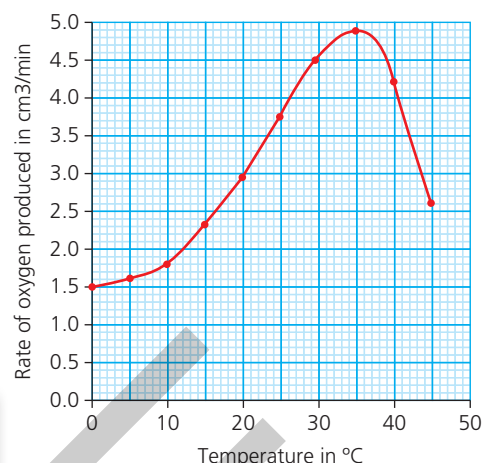
- 2 The image to the right shows the effect of temperature on the rate of photosynthesis.

Describe and explain the effect of temperature on the rate of photosynthesis. Use data to support your answer.

(6)

Read through the sample answer below and comment on what is good and bad about it.

As temperature increased the rate of photosynthesis increased as the rate of oxygen produced increased from 1.5 at 0 °C to 4.9 at 35 °C. It increased by 3.4. The optimum temperature is 35 °C.



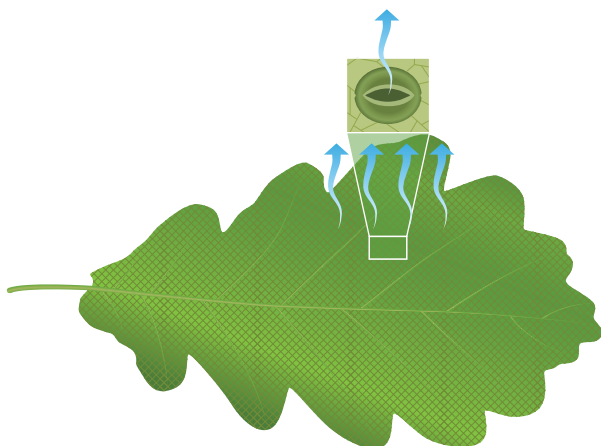
Use the mark scheme below to help identify how the student did. Use your comments and what you have checked off to give the answer a mark.

Level descriptors	Marks	
Indicative content <ul style="list-style-type: none"> As temperature increased, the rate of photosynthesis increased. The rate of oxygen produced increased from 1.5 at 0 °C to 4.9 at 35 °C/it increased by 3.4. The optimum temperature is 35 °C. The rate of photosynthesis was low at lower temperatures as the reactant molecules have less kinetic energy. As the temperature increases there is more kinetic energy, therefore more collisions and reactions. Above 35 °C there is another limiting factor. 		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Level 3: A detailed description using data describing the increase in the rate of photosynthesis as temperature increases. A clear explanation of the reason for the rate of reaction at low and higher temperatures. Correct terminology is used throughout. All parts of the graph are referred to.	5–6	<input type="checkbox"/>
Level 2: Descriptions are given to describe the increase in the rate of photosynthesis as temperature increases. A clear explanation is given for the rate of reaction at low or higher temperatures.	3–4	<input type="checkbox"/>
Level 1: A brief description describing the increase in the rate of photosynthesis as temperature increases.	1–2	<input type="checkbox"/>

I would give this _____/6 because ... _____

Practice question

- 3 The image below shows the loss of water from a leaf by transpiration.



Describe and explain how the process of transpiration results in the loss of water from a leaf. (6)

Read through the sample student answer below and make notes on how you would improve it.

Transpiration is the release of water vapour from leaves to continue the pull of water up through the roots of the plant, into the xylem and out of the leaves. Water enters the roots by osmosis and then moves through the xylem cells by osmosis to the leaves. The water leaves the leaf through open stomata by diffusion.

Write an improved response to this question that would get full marks.

Practical Biology

These questions involve an investigation into the effect of light intensity on the rate of photosynthesis using the aquatic plant pondweed and how plant crop yield can be maximised.

Practice questions

- 1 Students investigated the number of oxygen bubbles produced by pondweed at different light intensities. Their results are shown in the table below.

Distance of plant from light source / cm	Average number of bubbles of oxygen produced per minute
10	120
15	54
20	30
25	17
30	13

- 1-1 Describe and explain the results obtained by the students. (3)

- 1-2 Give the independent variable for this investigation. (1)

- 1-3 Describe how the students obtained the *average* number of bubbles of oxygen produced per minute. (2)

- 1-4 One factor the students controlled during the investigation was temperature. Describe how the students controlled the temperature. (1)

- 1-5 Explain why the results would not be valid if control variables were not kept constant. (1)

Insight

Examiner reports show that many students do not understand the term 'independent variable'. This is the variable that is *changed* in an investigation.



Upgrade

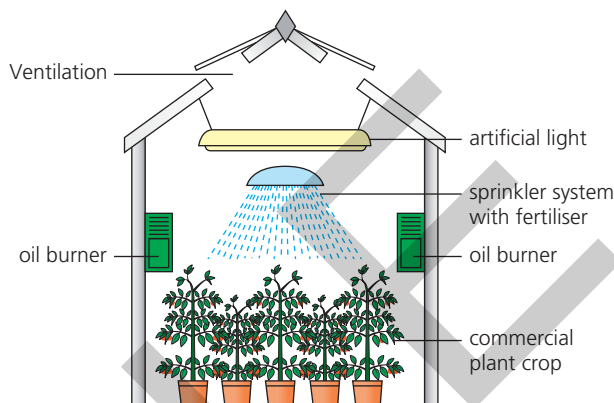
Don't confuse control variables and experimental controls. A control variable can affect the outcome and must be kept *constant*.



- 1-6** The students measured the rate of oxygen production by counting the number of bubbles produced in one minute. Suggest how the students could modify this investigation to obtain a more accurate measure of the rate of oxygen production. (1)

- 2** To maximise crop yield, crop growers maintain their plants in greenhouses. The figure to the right shows some of the features of a commercial greenhouse.

- 2-1** Use evidence from the diagram to describe how the crop growers can maximise their crop yield. (4)



- 2-2** Many crop growers install carbon dioxide sensors in their commercial greenhouses. Describe and explain how carbon dioxide sensors may help the crop grower to make more profit. (2)

- 3** Students investigated the rate of water uptake by a plant shoot using a weight potometer. They recorded the mass of the flask and plant shoot using a balance at the start and end of their investigation. In a separate investigation, the students used the same plant shoot and placed a clear polythene bag over it.

- 3-1** Describe and explain the effect of the clear polythene bag on the rate of water uptake by the plant shoot. (3)

Mathematics

The questions in this section involve inverse square law and light intensity in the context of photosynthesis including percentage change in mass.

Worked examples

- 1 The table below shows the effect of increasing light distance on the number of oxygen bubbles produced per minute and the inverse square law at each distance.

Distance (d) in cm of plant from the light source	Number of oxygen bubbles produced per minute	$\frac{1}{d^2}$
10	122	0.0100
20	32	
30	15	0.0011

- 1-1 Calculate the inverse square law at 20 cm to complete the table. (2)

Step 1 Write the formula for inverse square law: $\frac{1}{d^2}$

Step 2 Insert the value for d into the formula: $\frac{1}{20^2} = 0.0025$

The inverse square law states that as the distance between the plant and light is doubled, its rate of photosynthesis is quartered.

- 1-2 Use this information and your answer to 1-1 to give the number of oxygen bubbles you would expect to be produced at a distance of 40 cm. (2)

Step 1 Calculate the distance of 40 cm is double the distance of 20 cm: $40/2 = 20$

Step 2 Calculate the number of oxygen bubbles at 20 cm: 32

Step 3 The rate of photosynthesis is quartered: $32/4$: 8 bubbles

Be the examiner

- 2 Use the table on this page to calculate the inverse square law at 30 cm. (2)

Looking at the three answer below, work out which one is correct and why the two others are incorrect.

$1/102 = 0.0100$

A

$1/152 = 0.0044$

B

$1/302 = 0.0011$

C

Solution ____ is correct.

Solution ____ is incorrect because ...

Solution ____ is incorrect because ...

Practice questions

- 3 The table below shows the effect of increasing light distance on the number of oxygen bubbles produced per minute and the inverse square law at each distance.

Distance (d) in cm of plant from the light source	Number of oxygen bubbles produced per minute	$\frac{1}{d^2}$
5	79	0.0400
10	21	
15	12	0.0044

Upgrade

Make sure you remember to show your working out. You can be awarded marks for your working out even if your final answer is incorrect.



Calculate the inverse square law at 10 cm.

(2)

- 4 Students investigated the rate of water uptake by a plant shoot over 24 hours using a weight potometer. The students repeated their investigation three times. They recorded the mass of the flask and plant shoot at the start and end of each repeat.

The table below shows the students' results.

Repeat number	Mass of beaker and shoot / g		Change in mass / g	Percentage change in mass / %
	At start	After 24 hours		
1		107.79	7.44	6.46
2	116.75	108.49	8.26	7.07
3	114.89	107.52	7.37	

- 4-1 Calculate the mass of the beaker in repeat 1 at the start of the investigation. (1)

_____ g

- 4-2 Calculate the percentage change in mass for beaker 3. (2)

_____ %