

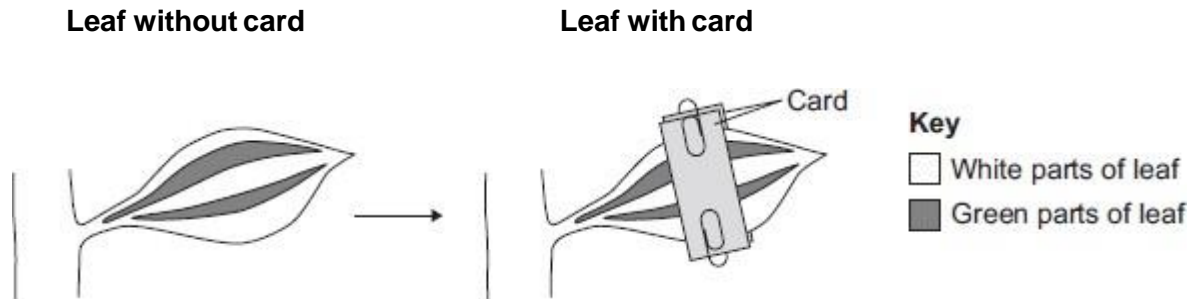
- 1 (a) A student carried out the following investigation using a plant with variegated leaves. A variegated leaf has green and white stripes.

The student:

- left the plant in the dark for 3 days to remove the starch
- fixed two pieces of card to a leaf on the plant
- left the plant in the light for 2 days
- removed the leaf from the plant
- tested the leaf for starch.

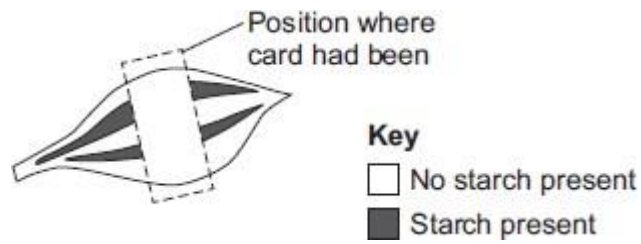
**Figure 1** shows how the two pieces of card were attached to the leaf.

**Figure 1**



**Figure 2** shows the same leaf after 2 days in the light. The leaf has been tested for starch.

**Figure 2**



Give **two** conclusions from this investigation.

Tick (✓) **two** boxes.

Carbon dioxide is needed for photosynthesis.

Chlorophyll is needed for photosynthesis.

Light is needed for photosynthesis.

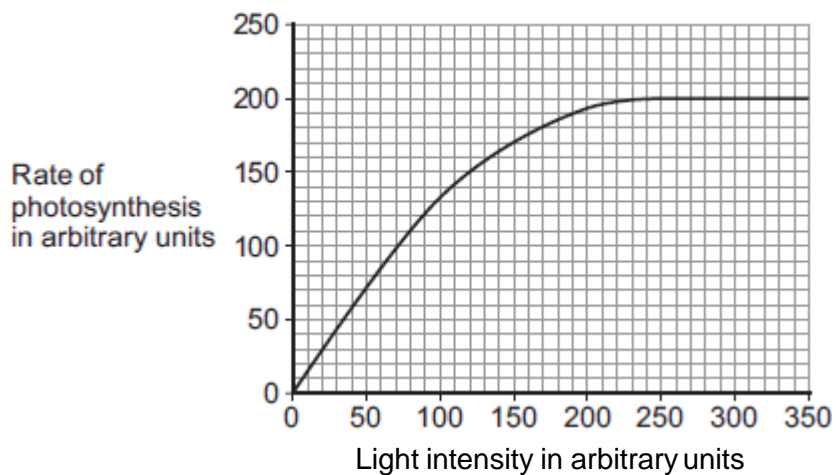
Water is needed for photosynthesis.

(2)

(b) Scientists investigated the effect of light intensity on the rate of photosynthesis.

**Figure 3** shows the scientists' results.

**Figure 3**



Describe the effect of increasing light intensity on the rate of photosynthesis.  
You should include numbers from **Figure 3** in your description.

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(3)

(c) At a light intensity of 250 arbitrary units, light is **not** a limiting factor of photosynthesis.

(i) What is the evidence for this in **Figure 3**?

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(1)

(ii) Give **two** factors that could be limiting the rate of photosynthesis at a light intensity of 250 arbitrary units.

1. \_\_\_\_\_
2. \_\_\_\_\_

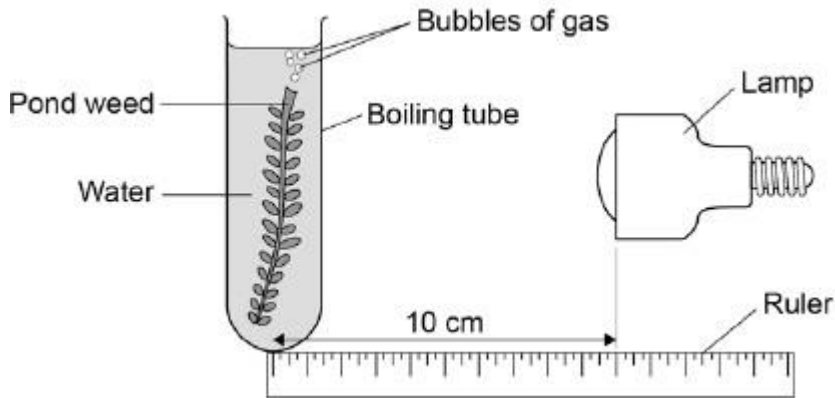
(2)

(Total 8 marks)

2

A student investigated the effect of light intensity on the rate of photosynthesis.

The diagram shows the apparatus the student used.



This is the method used.

1. Set up the apparatus as shown in the diagram above.
2. Place the lamp 10 cm from the pondweed.
3. Turn the lamp on and count the number of bubbles produced in one minute.
4. Repeat with the lamp at different distances from the pondweed.

(a) Complete the hypothesis for the student's investigation.

'As light intensity increases, \_\_\_\_\_  
\_\_\_\_\_.'

(1)

(b) What was the independent variable in this investigation?

Tick **one** box.

Light intensity

Number of bubbles produced

Temperature

Time

(1)

- (c) The teacher suggests putting the boiling tube into a beaker of water during the investigation.

Suggest why this would make the results more valid.

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(1)

**Table 1** shows the student's results.

**Table 1**

Distance of lamp from pondweed in cm	Number of bubbles produced per minute			
	Trial 1	Trial 2	Trial 3	Mean
10	67	66	69	67
20	61	64	62	62.3
30	53	51	52	<b>X</b>
40	30	32	31	31
50	13	15	15	14

- (d) Calculate value **X** in **Table 1**.

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**X** = \_\_\_\_\_ bubbles per minute

(1)

- (e) State **one** error the student has made when completing the results at 20 cm.

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(1)

(f) What evidence in **Table 1** shows that the data is repeatable?

Tick **one** box.

The number of bubbles decreases as distance decreases.

The numbers of bubbles at each distance are similar.

The student calculated a mean for each distance.

The student did the experiment three times.

(1)

Another student investigated the effect of the colour of light on the rate of photosynthesis.

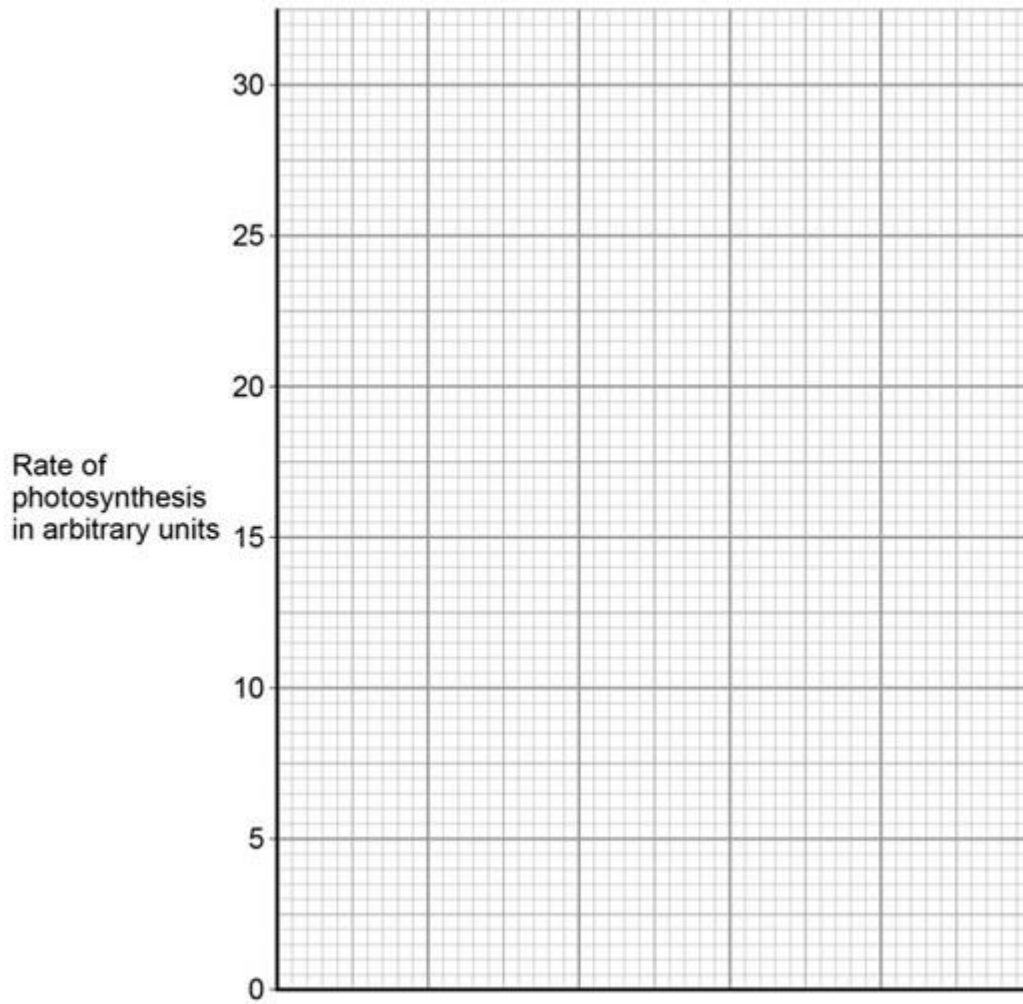
The results are shown in **Table 2**.

**Table 2**

<b>Colour of light</b>	<b>Rate of photosynthesis in arbitrary units</b>
Blue	24
Green	4
Red	17
Yellow	8

(g) Plot the data from **Table 2** on the graph.

You should label the x-axis.



(3)

(h) Give **two** conclusions from the graph above.

1. \_\_\_\_\_  
\_\_\_\_\_

2. \_\_\_\_\_  
\_\_\_\_\_

(2)

- (i) The glucose produced in photosynthesis can be converted into amino acids to make new proteins for the plant.

Complete the sentences.

The glucose produced in photosynthesis can also be used in other ways.

Glucose can be used in respiration to release \_\_\_\_\_.

Glucose can be converted to cellulose to strengthen the \_\_\_\_\_.

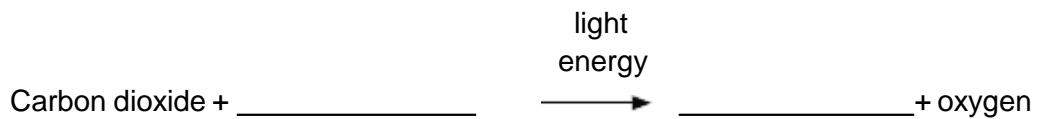
Glucose can be stored as \_\_\_\_\_.

(3)

(Total 14 marks)

3

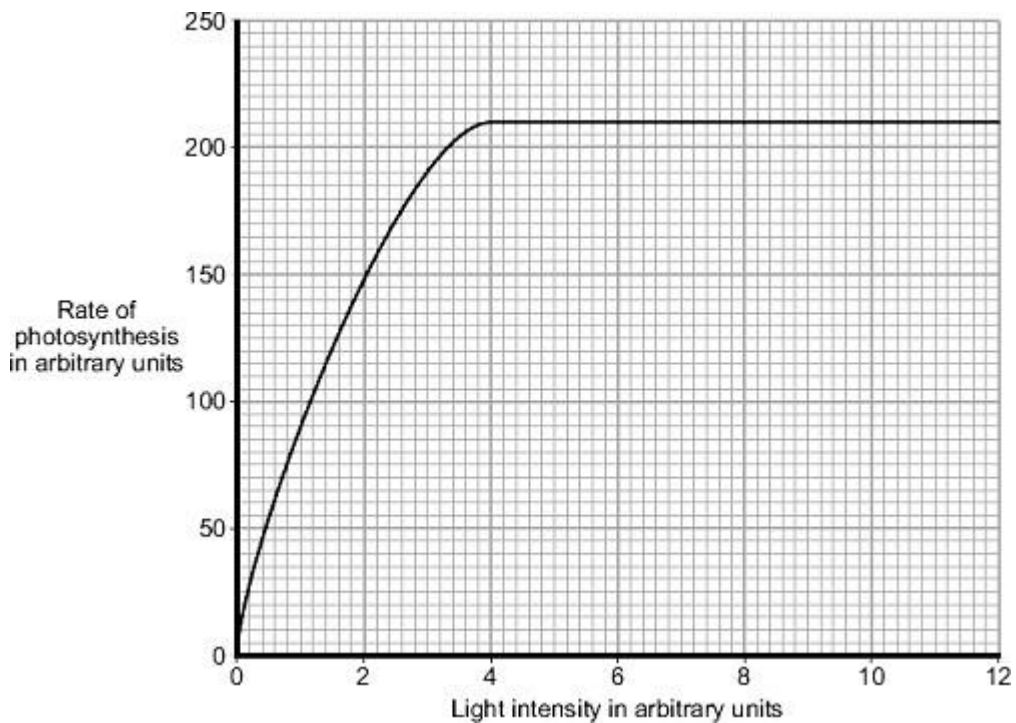
- (a) Complete the equation for photosynthesis.



(2)

- (b) A farmer grew tomato plants in a greenhouse.

The graph shows the effect of light intensity on the rate of photosynthesis in the tomato plants growing in the greenhouse.





(i) At which light intensity was light a limiting factor for photosynthesis?

Tick (✓) **one** box.

1 arbitrary unit

4 arbitrary units

10 arbitrary units

(1)

(ii) What was the highest rate of photosynthesis?

\_\_\_\_\_ arbitrary units

(1)

(iii) The farmer wants to increase the rate of photosynthesis in his tomato plants.

Apart from light intensity, name **one** factor that the farmer could change to increase the rate of photosynthesis in his tomato plants.

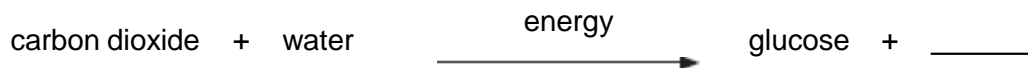
\_\_\_\_\_

(1)

(Total 5 marks)

**4**

(a) Complete the word equation for photosynthesis.



(1)

(b) Draw a ring around the correct answer to complete each sentence.

(i) The energy needed for photosynthesis comes from

light.  
osmosis.  
respiration.

(1)

(ii) Energy is absorbed by a green pigment called

chloride.  
chloroplast.  
chlorophyll.

(1)

(iii) If the temperature is decreased the rate of photosynthesis will

decrease.  
increase.  
stay the same.

(1)

(c) Give **three** ways in which plants use the glucose made in photosynthesis.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

(3)

(Total 7 marks)

**5**

(a) Complete the word equation for photosynthesis.

Use words from the box.

<b>chlorophyll</b>	<b>minerals</b>	<b>oxygen</b>	<b>water</b>
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carbon dioxide + \_\_\_\_\_ → glucose + \_\_\_\_\_

(2)

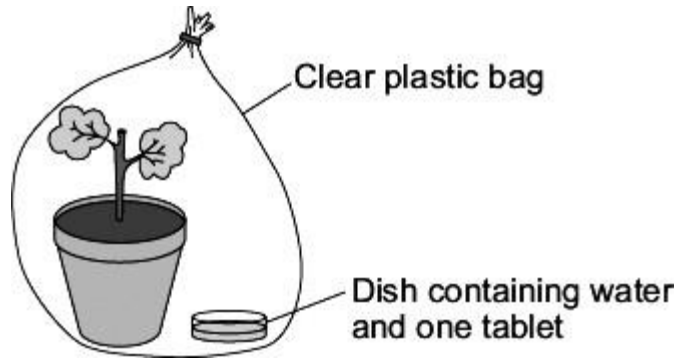
(b) Plants may grow faster if they have more carbon dioxide.

Indigestion tablets dissolve in water to form a solution.  
This solution slowly gives off carbon dioxide.

A student set up an investigation to see what concentration of carbon dioxide is best for increasing the growth of geranium plants.

The student:

- put a geranium plant in a clear plastic bag
- put a dish containing water and one tablet in the bag
- sealed the top of the bag.



The student:

- set up 5 more experiments each with water and a different number of tablets
- left all the plants in a well-lit place for four weeks.

The student used a clear plastic bag, not a black plastic bag.

Explain why.

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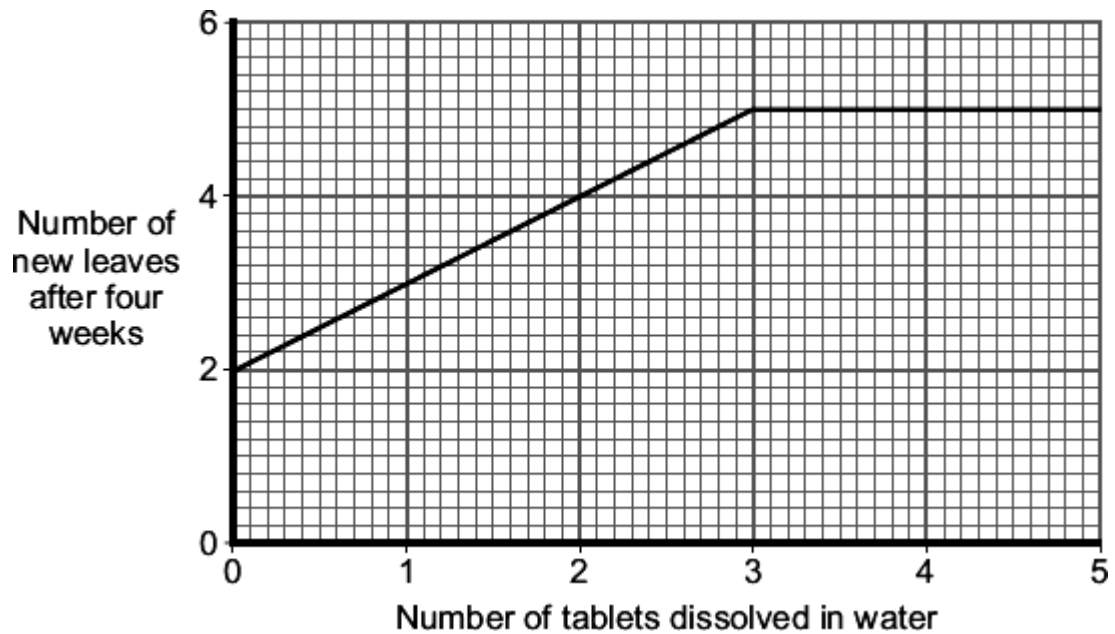
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(2)

(c) After four weeks, the student counted the number of new leaves on each plant.

The graph shows his results.



Describe the effect of increasing the number of tablets dissolved in water on the number of new leaves that grew in four weeks.

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(3)

(Total 7 marks)

6

Anaerobic respiration happens in muscle cells and yeast cells.

The equation describes anaerobic respiration in muscle cells.



(a) How can you tell from the equation that this process is anaerobic?

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(1)

(b) Exercise **cannot** be sustained when anaerobic respiration takes place in muscle cells.

Explain why.

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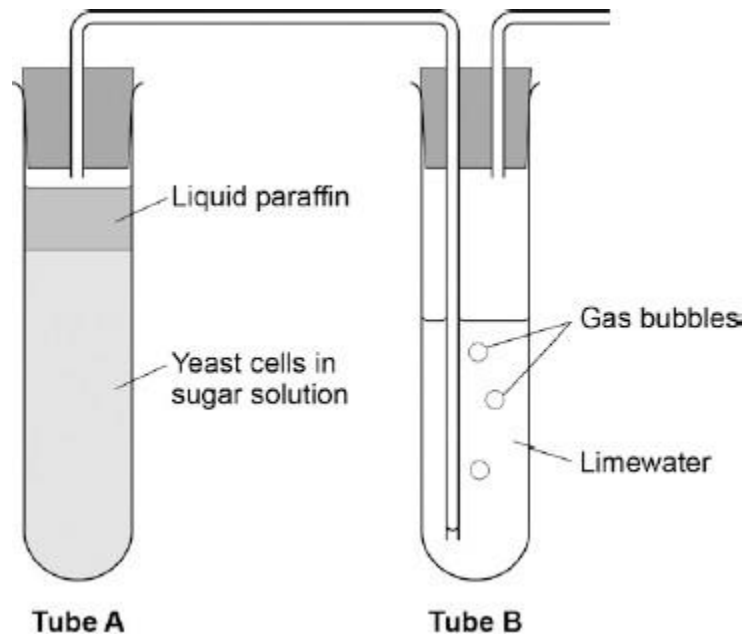
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(2)

(c) The diagram below shows an experiment to investigate **anaerobic** respiration in yeast cells.



What gas will bubble into Tube **B**?

Tick **one** box.

Carbon dioxide

Nitrogen

Oxygen

Water vapour

(1)

(d) Describe how you could use tube **B** to measure the rate of the reaction in tube **A**.

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(2)

(e) Anaerobic respiration in yeast is also called fermentation.

Fermentation produces ethanol.

Give **one** use of fermentation in the food industry.

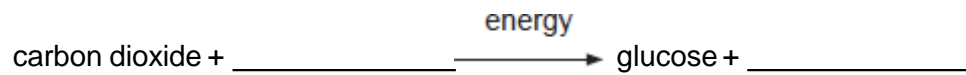
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(1)

(Total 7 marks)

**7** Photosynthesis uses carbon dioxide to make glucose.

(a) (i) Complete the equation for photosynthesis.



(2)

(ii) What type of energy does a plant use in photosynthesis?

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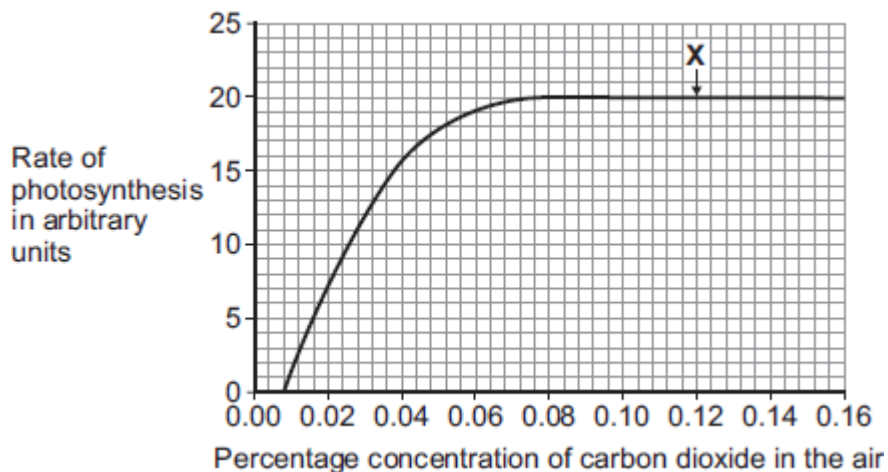
(1)

(iii) Which part of a plant cell absorbs the energy needed for photosynthesis?

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(1)

- (b) The graph shows the effect of the concentration of carbon dioxide on the rate of photosynthesis in tomato plants at 20 °C.



- (i) What is the maximum rate of photosynthesis of the tomato plants shown in the graph?

\_\_\_\_\_ arbitrary units

(1)

- (ii) At point **X**, carbon dioxide is **not** a limiting factor of photosynthesis.

Suggest **one** factor that is limiting the rate of photosynthesis at point **X**.

\_\_\_\_\_

(1)

- (c) A farmer plans to grow tomatoes in a large greenhouse.

The concentration of carbon dioxide in the atmosphere is 0.04%.

The farmer adds carbon dioxide to the greenhouse so that its concentration is 0.08%.

- (i) Why does the farmer use 0.08% carbon dioxide?

Tick (✓) **one** box.

To increase the rate of growth of the tomato plants

To increase the rate of respiration of the tomato plants

To increase water uptake by the tomato plants

(1)

(ii) Why does the farmer **not** use a concentration of carbon dioxide higher than 0.08%?

Tick (✓) **two** boxes.

Because it would cost more money than using 0.08%

Because it would decrease the temperature of the greenhouse

Because it would not increase the rate of photosynthesis of the tomato plants any further

Because it would increase water loss from the tomato plants

(2)

(Total 9 marks)



## Mark schemes

- 1** (a) chlorophyll is needed for photosynthesis 1
- light is needed for photosynthesis 1
- (b) increases 1
- levels off / reaches a maximum / remains constant / stays the same / plateaus  
*do not allow stops / stationary / peaks*  
*allow stops increasing* 1
- goes up to / reaches a maximum / levels off at (a rate of) 200 (arbitrary units)  
**or**  
levels off at 225 – 240 (light units)  
*ignore references to other numerical values* 1
- (c) (i) higher light intensity does not increase rate of photosynthesis  
*accept the graph stays level (above this value)*  
*allow stops increasing*  
*allow the rate of photosynthesis stays the same (above this value)* 1
- (ii) any **two** from:
- carbon dioxide (concentration)
  - temperature / heat
  - (amount of) chlorophyll / chloroplasts  
*allow water*  
*allow ions / nutrients*  
*ignore ref to surface area of the leaf* 2
- 2** (a) rate of photosynthesis increases  
**or**  
number of bubbles produced (in one minute) increases  
**or**  
volume of gas / oxygen produced (in one minute) increases  
*allow decreases / stays the same throughout* 1
- (b) light intensity 1

**[8]**

- (c) reduces the effect of heat from the lamp  
**or**  
prevents temperature affecting photosynthesis 1
- (d) 52 1
- (e) should be 62  
**or**  
is to 3 s.f. / not rounded  
*allow inconsistent number of significant figures / decimal places* 1
- (f) the numbers of bubbles at each distance are similar 1
- (g) x-axis correctly labelled (colour of light) **and** bars identified as correct colour  
*bars can be identified by labels beneath the x-axis or with a key* 1
- bars plotted correctly  
*all 4 correct = 2 marks 3 correct = 1 mark*  
*if wrong type of graph drawn, max 2 marks* 2
- (h) blue light gives highest (rate of) photosynthesis  
*allow ecf from candidate's graph allow blue light is best* 1
- green light gives the lowest (rate of) photosynthesis  
*allow green light is worst* 1
- (i) energy  
*in this order only* 1
- cell wall(s)  
*allow cell*  
do **not** accept (cell) membrane 1
- starch / fat / oil / lipid 1
- 3** (a) (LHS) water / H<sub>2</sub>O  
*allow H<sub>2</sub>O*  
do **not** accept H<sup>2</sup>O 1

[14]

(RHS) glucose / sugar /  $C_6H_{12}O_6$   
*allow starch / carbohydrate*  
*allow  $C_6H_{12}O_6$*   
*do not accept  $C^6H^{12}O^6$*

1

(b) (i) 1 arbitrary unit  
*extra box ticked – cancel*

1

(ii) 210

1

(iii) carbon dioxide /  $CO_2$  /  $CO_2$   
**or**  
temperature / heat / warmth  
*do not accept  $CO^2$*   
*ignore mineral ions*  
*ignore water*

1

[5]

4

(a) oxygen  
*allow  $O_2$  /  $O_2$*   
*do not accept  $O^2$  or  $O$*

1

(b) (i) light

1

(ii) chlorophyll

1

(iii) decrease

1

(c) any **three** from:

- for respiration / energy  
*do not accept use energy for photosynthesis*
- to make cellulose / starch  
*accept named carbohydrate other than glucose*
- to make lipid / fat / oil  
*accept fatty acid / glycerol*
- to make protein  
*accept named protein / amino acid / named amino acid*
- to build big molecules from small molecules / metabolism  
*if no other marks awarded for making molecules allow 1 mark for growth / repair / new cells*

3

[7]

<b>5</b>	(a) water	1	
	oxygen		
	<i>in this order only</i>		
	<i>accept correct chemical symbols</i>		
	<i>allow H<sub>2</sub>O / OH<sub>2</sub></i>	1	
	(b) allow light (in / through) / need light		
	<i>do <b>not</b> accept attracts light</i>		
	<i>ignore heat / moisture / carbon dioxide</i>		
	<i>ignore so the plants can be seen</i>		
	<i>accept the converse, ie the black plastic bag would not let light in</i>		
	<i>(1)</i>	1	
	for photosynthesis / make sugar / glucose		
	<i>so there would be no photosynthesis (1)</i>		
	<i>do <b>not</b> allow make food unqualified</i>	1	
	(c) Increase (in leaves / new leaves)		
	<i>ignore growth unqualified</i>	1	
	(then) level off <b>or</b> number of (new) leaves (then) stays the same	1	
	numerical statement eg max at 3 tablets / 5 (new) leaves		
	<i>should refer to one of the first two marking points</i>		
	<i>for every extra tablet get 1 extra leaf = <b>2</b> marks</i>		
	<i>for every extra tablet get 1 extra leaf then it levels off = <b>3</b> marks</i>	1	
			<b>[7]</b>
<b>6</b>	(a) no oxygen (is used)	1	
	(b) muscles become fatigued / stop contracting	1	
	because not enough energy is transferred	1	
	(c) carbon dioxide	1	
	(d) count the bubbles		
	<b>or</b>		
	measure volume of gas	1	

in a given time

1

(e) brewing / bread making

*allow other suitable use of fermentation in food industry*

1

[7]

7

(a) (i) LHS = water

*accept H<sub>2</sub>O*

*do not accept H<sup>2</sup>O / H<sub>2</sub>O*

1

RHS = oxygen

*accept O<sub>2</sub>*

*do not accept O / O<sup>2</sup> / O<sub>2</sub>*

1

(ii) light / sunlight

*ignore solar / sun / sunshine*

*do not allow thermal / heat*

1

(iii) chloroplasts

*allow chlorophyll*

1

(b) (i) 20

1

(ii) any **one** from:

- light (intensity)
- temperature.

1

(c) (i) To increase the rate of growth of the tomato plants

1

(ii) Because it would cost more money than using 0.08%

1

Because it would not increase the rate of photosynthesis of the tomato plants any further

1

[9]