

1

Tobacco mosaic virus (TMV) is a disease affecting plants.

The diagram below shows a leaf infected with TMV.



Yellow patches where
TMV has destroyed
chloroplasts

© Nigel Cattlin/Visuals Unlimited/Getty Images

- (a) All tools should be washed in disinfectant after using them on plants infected with TMV.

Suggest why.

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(1)

- (b) Scientists produced a single plant that contained a TMV-resistant gene.

Suggest how scientists can use this plant to produce **many** plants with the TMV-resistant gene.

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(1)

- (c) Some plants produce fruits which contain glucose.

Describe how you would test for the presence of glucose in fruit.

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(2)

- (d) TMV can cause plants to produce less chlorophyll.

This causes leaf discoloration.

Explain why plants with TMV have stunted growth.

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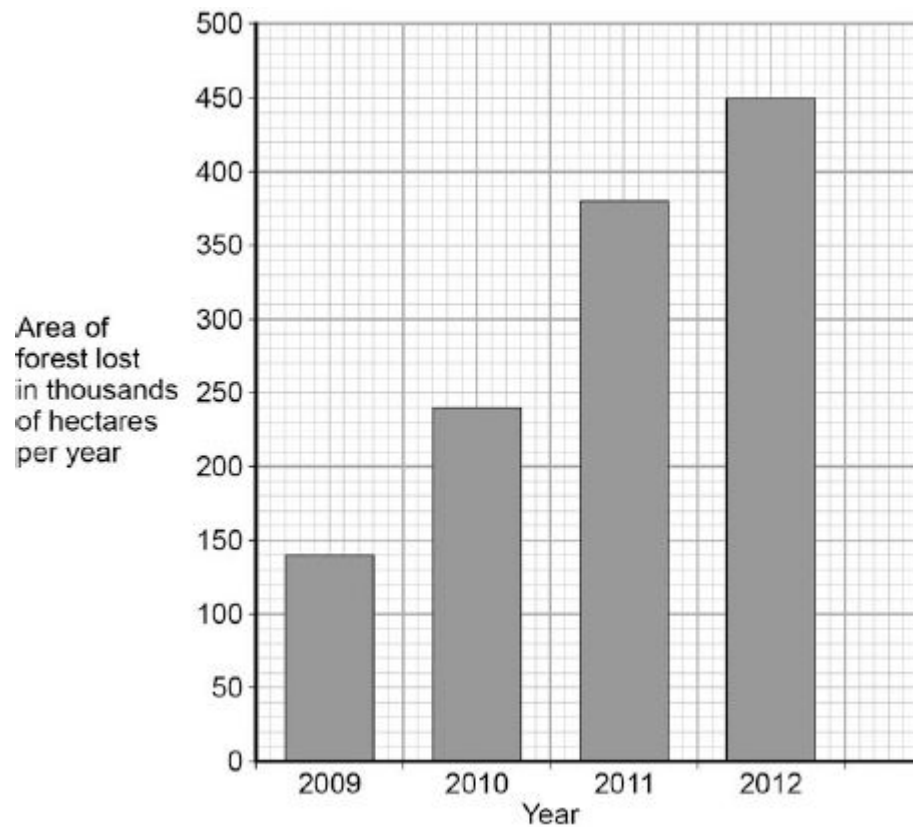
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(4)

(Total 8 marks)

2

The graph below shows the area of forest lost in Madagascar from 2009 to 2012.



- (a) The area of forest lost each year in Madagascar increased between 2009 and 2012.

Determine the total area of forest lost from the start of 2009 to the end of 2012.

.....
.....

Total area of forest lost = thousand hectares

(1)

- (b) What are the possible reasons for the change in the area of forest lost per year between 2009 and 2012?

Tick **two** boxes.

The local people stop growing rice

☐

Fewer new houses are needed for the population

☐

The local people decided to farm cattle

☐

More trees have been planted

☐

A company starts growing plants for biofuels

☐

(2)

- (c) More forest was lost in 2012 than in 2009.

Use words from the box to complete the sentences.

carbon dioxide	excretion	nitrogen
oxygen	photosynthesis	respiration

The increase in the area of forest lost has caused an increase in the gas

The increase of this gas has been caused because less of the gas is being absorbed by plants for the process of

(2)

- (d) Deforestation can have negative effects on our ecosystems.

What are the negative effects of deforestation?

Tick **two** boxes.

Animals and birds migrate because there is less food

☐

More habitats are destroyed

☐

There is less acid rain

☐

There is more biodiversity

☐

The global temperature decreases

☐

(2)

- (e) Scientists try to reduce the negative effects of human activity on our ecosystems.

One way is to protect rare habitats.

Give **one other** way of reducing the negative effects of human activity on our ecosystems.

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(1)

(Total 8 marks)

3

A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

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(2)

(b) The gardener finds this research on the Internet:

‘A carbon to nitrogen ratio of 25:1 will produce fertile compost.’

Look at the table below.

Type of material to compost	Mass of carbon in sample in g	Mass of nitrogen in sample in g	Carbon:nitrogen ratio
Chicken manure	8.75	1.25	7:1
Horse manure	10.00	0.50	20:1
Peat moss	9.80	0.20	X

Determine the ratio **X** in the table above.

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Ratio

(1)

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

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(1)

- (d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

Explain how the carbon is recycled into the growth of new leaves.

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(6)

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

Strawberry A



Strawberry B



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

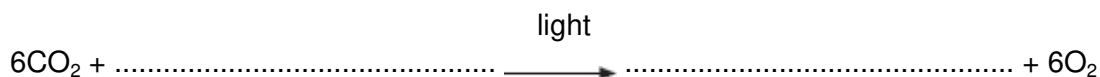
- 1
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- 2
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- 3
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(3)
(Total 13 marks)

4

Photosynthesis needs light.

(a) Complete the **balanced symbol** equation for photosynthesis.



(2)

- (b) A green chemical indicator shows changes in the concentration of carbon dioxide (CO_2) in a solution.

The indicator solution is **green** when the concentration of CO_2 is normal.

The indicator solution turns **yellow** when the concentration of CO_2 is high.





The indicator solution turns **blue** when the concentration of CO_2 is very low or when there is no CO_2 .

The indicator solution does not harm aquatic organisms.

Students investigated the balance of respiration and photosynthesis using an aquatic snail and some pondweed.

The students set up four tubes, **A**, **B**, **C** and **D**, as shown in the table below.

The colour change in each tube, after 24 hours in the light, is recorded.

Tube A	Tube B	Tube C	Tube D
			
Indicator solution only	Indicator solution + pondweed	Indicator solution + snail	Indicator solution + pondweed + snail
Stays green	Turns blue	Turns yellow	Stays green

- (i) What is the purpose of **Tube A**?

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(1)

- (ii) Explain why the indicator solution in **Tube C** turns yellow.

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(2)

- (iii) Predict the result for **Tube D** if it had been placed in the dark for 24 hours and **not** in the light.

Explain your prediction.

Prediction.....

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Explanation.....

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(3)

(Total 8 marks)

5

Photosynthesis uses carbon dioxide to make glucose.

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

carbon dioxide + $\xrightarrow{\text{energy}}$ glucose +

(2)

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

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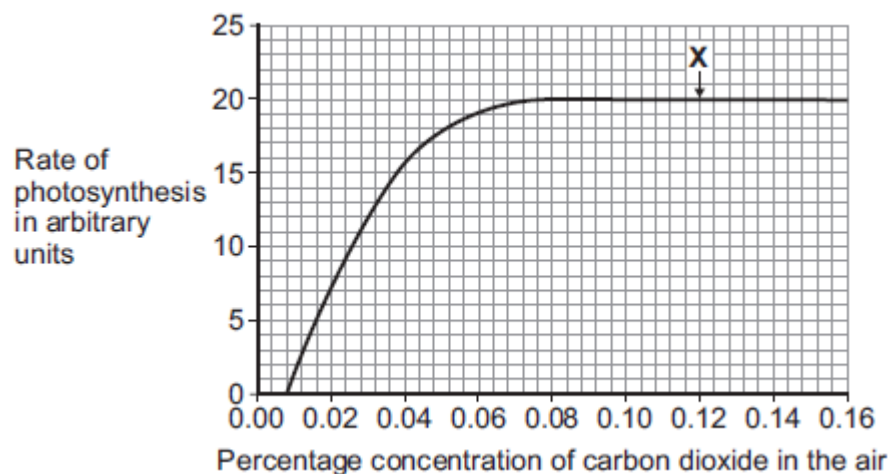
(1)

- (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)

6

Green plants can make glucose.

- (a) Plants need energy to make glucose.

How do plants get this energy?

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(2)

- (b) Plants can use the glucose they have made to supply them with energy.

Give **four** other ways in which plants use the glucose they have made.

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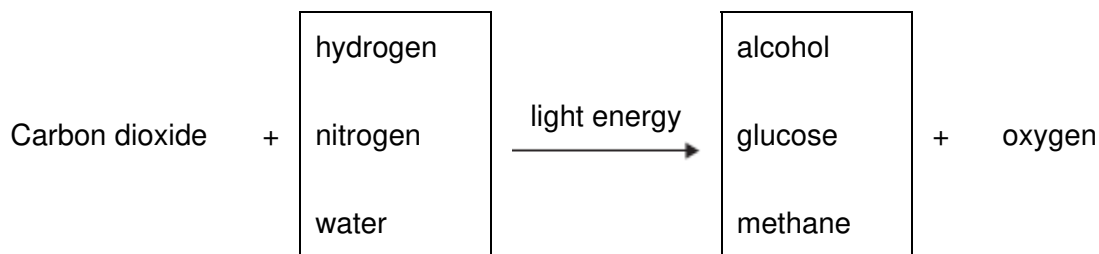
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(4)
(Total 6 marks)

7

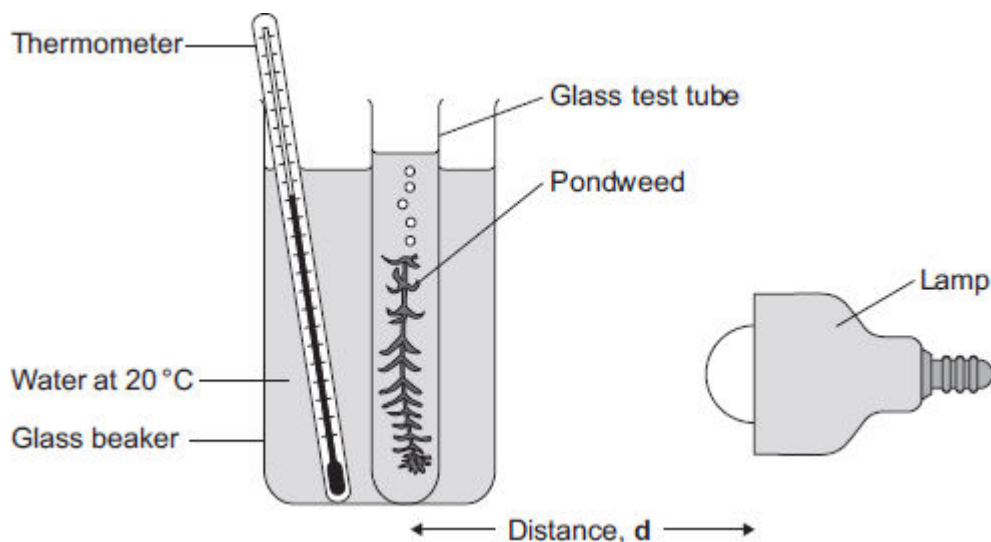
- (a) Complete the equation for photosynthesis. Draw a ring around each correct answer.



(2)

Some students investigated the effect of light intensity on the rate of photosynthesis in pondweed.

The diagram shows the apparatus the students used.



The closer the lamp is to the pondweed, the more light the pondweed receives.

The students placed the lamp at different distances, **d**, from the pondweed.

They counted the number of bubbles of gas released from the pondweed in 1 minute for each distance.

- (b) A thermometer was placed in the glass beaker.

Why was it important to use a thermometer in this investigation?

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(3)

- (c) The students counted the bubbles four times at each distance and calculated the correct mean value of their results.

The table shows the students' results.

Distance d in cm	Number of bubbles per minute				
	1	2	3	4	Mean
10	52	52	54	54	53
20	49	51	48	52	50
30	32	30	27	31	30
40	30	10	9	11	

- (i) Calculate the mean number of bubbles released per minute when the lamp was 40 cm from the pondweed.

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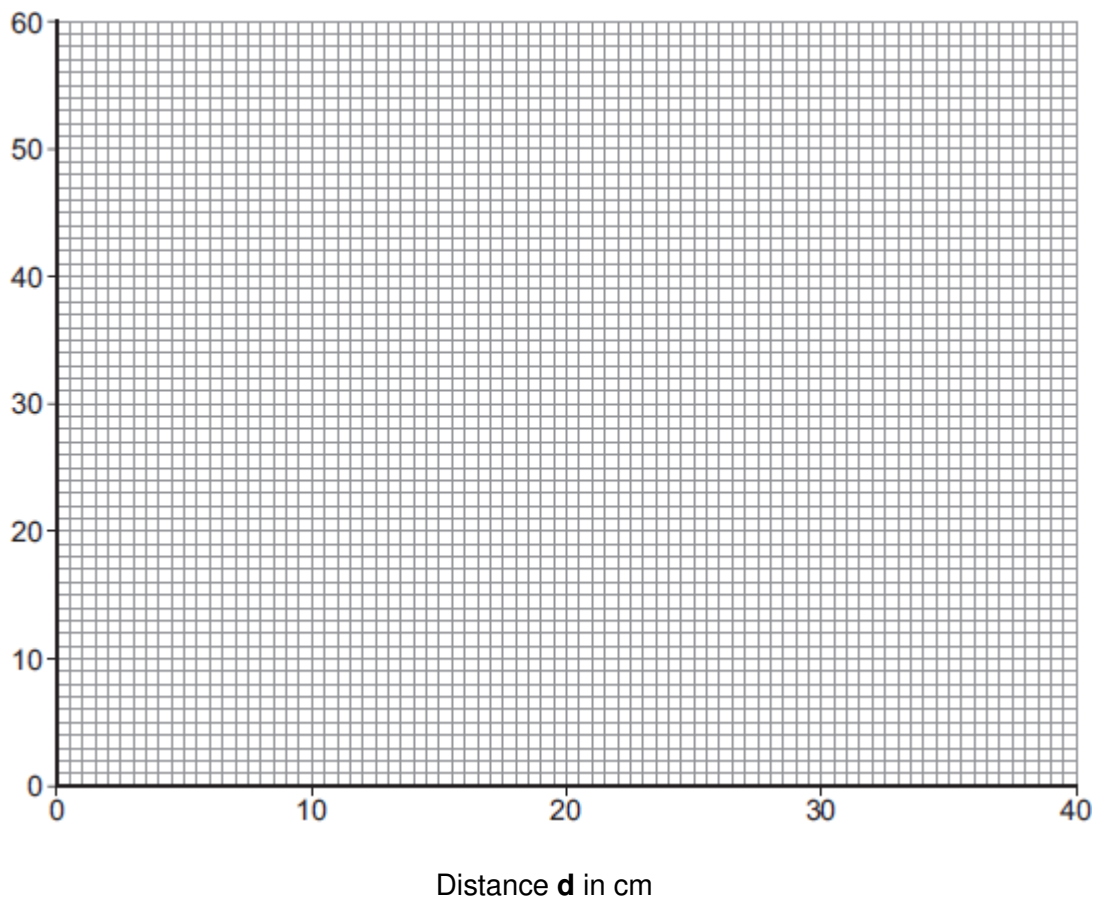
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Mean number of bubbles at 40 cm =

(2)

(ii) On the graph paper below, draw a graph to show the students' results:

- add a label to the vertical axis
- plot the **mean values** of the number of bubbles
- draw a line of best fit.



(4)

(iii) One student concluded that the rate of photosynthesis was inversely proportional to the distance of the lamp from the plant.

Does the data support this conclusion?

Explain your answer.

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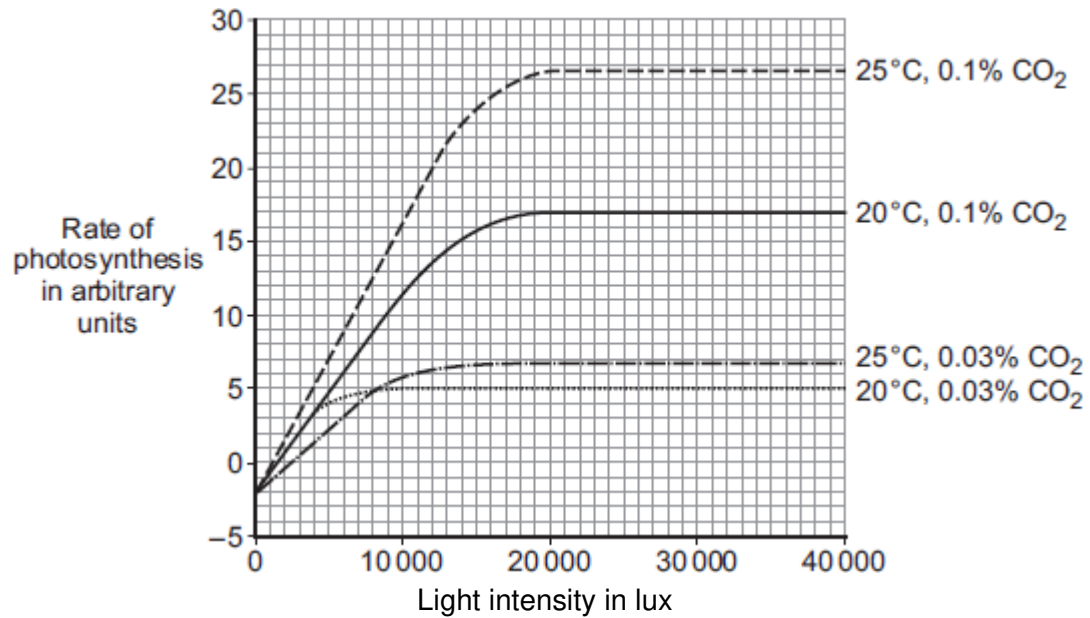
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(2)

- (d) Light intensity, temperature and concentration of carbon dioxide are factors that affect the rate of photosynthesis.

Scientists investigated the effects of these three factors on the rate of photosynthesis in tomato plants growing in a greenhouse.

The graph below shows the scientists' results.



A farmer in the UK wants to grow tomatoes commercially in a greenhouse.

The farmer read about the scientists' investigation.

During the growing season for tomatoes in the UK, natural daylight has an intensity higher than 30 000 lux.

The farmer therefore decided to use the following conditions in his greenhouse during the day:

- 20°C
- 0.1% CO₂
- no extra lighting.

Suggest why the farmer decided to use these conditions for growing the tomatoes.

You should use information from the scientists' graph in your answer.

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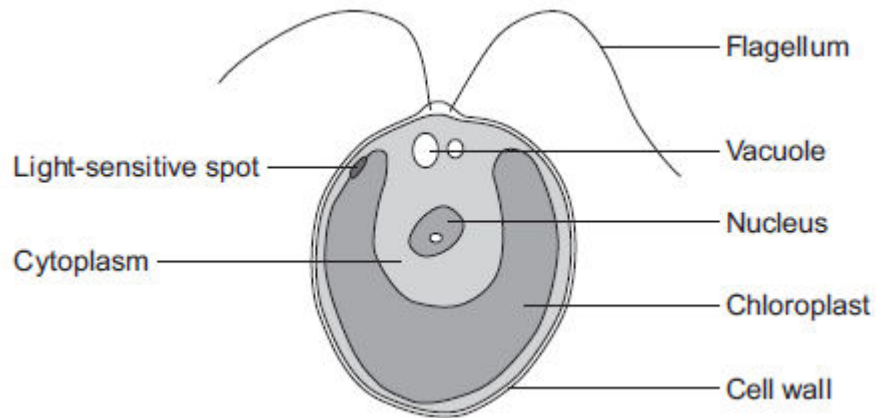
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(4)
(Total 17 marks)

8

The diagram below shows a single-celled alga which lives in fresh water.



(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

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(1)

(ii) is made of cellulose?

.....

(1)

(b) In the freshwater environment water enters the algal cell.

(i) What is the name of the process by which water moves into cells?

.....

(1)

(ii) Give the reason why the algal cell does not burst.

.....

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(1)

(c) (i) The alga can photosynthesise.

Complete the **word** equation for photosynthesis.

water + $\xrightarrow{\text{Light energy}}$ + oxygen

(2)

- (ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

Suggest how this might happen.

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(2)

- (d) Multicellular organisms often have complex structures, such as lungs, for gas exchange.

Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

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(3)

(Total 11 marks)

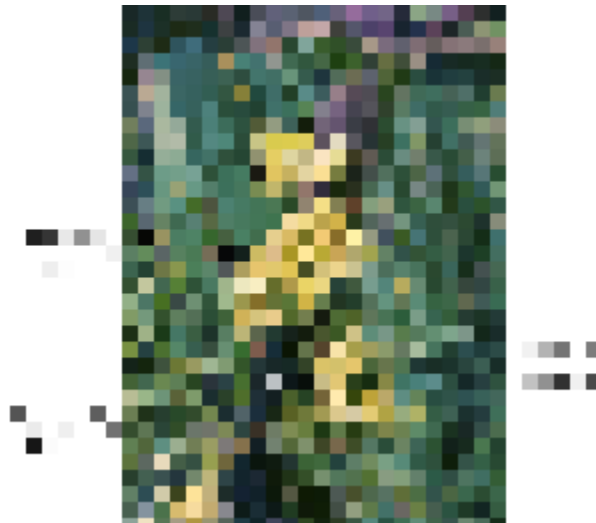
9

- (a) Dodder is an unusual flowering plant. It is a parasite.

The dodder plant:

- has no chlorophyll
- has no roots
- has no leaves
- grows attached to the stem of a host plant.

The image below shows dodder attached to its host plant.



© yogesh_more/iStock/Thinkstock

- (i) Dodder has no chlorophyll. Most plants have leaves containing chlorophyll.

What is the function of chlorophyll in most plants?

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(2)

- (ii) Parts of the dodder stem grow into the host stem and attach to the host's phloem tissue.

Suggest why it is helpful to the dodder plant to be attached to the host's phloem tissue.

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(1)

- (iii) Suggest why the dodder will have a harmful effect on the host plant.

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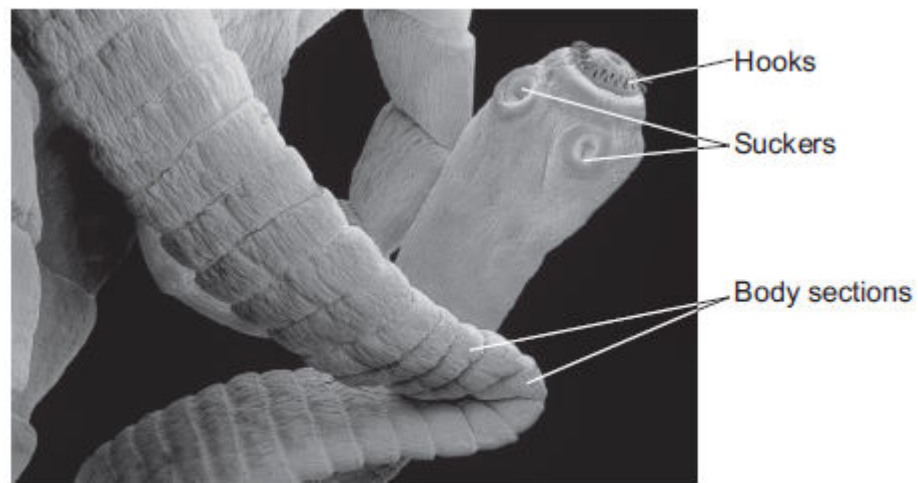
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(1)

- (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The tapeworm is another parasite.

The image below shows part of a tapeworm.



© Science Photo Library

The tapeworm lives inside the small intestine of a mammal.

Describe and explain how the tapeworm is adapted for living inside the small intestine of its host.

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(Total 10 marks)

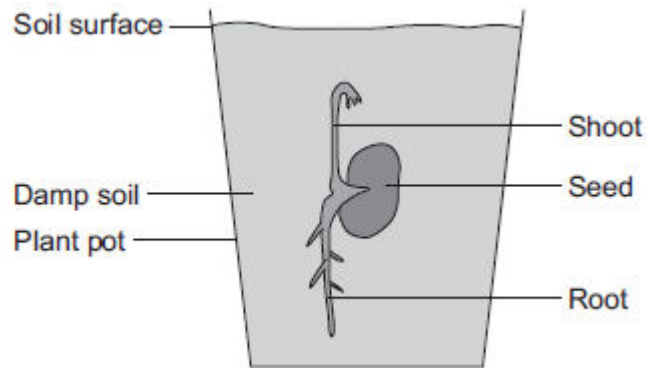
10

A student investigated growth in plants.

The student:

- planted a seed in damp soil in a plant pot
- put the plant pot in a dark cupboard.

The image below shows the result after 5 days.



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

(i) After the 5 days, the root had grown

away from water.
in the direction of the force of gravity.
towards light.

(1)

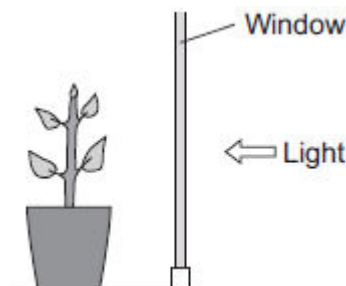
(ii) After the 5 days, the shoot had grown

against the force of gravity.
away from light.
towards water.

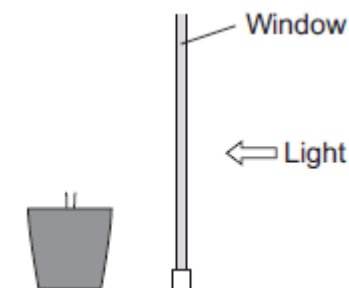
(1)

(b) After the plant had grown, the student put the plant pot by a window with lots of light.

The illustration below shows this.



- (i) Complete the diagram below to show the appearance of the student's plant after 20 days by the window.



(1)

- (ii) Explain the advantage to the plant of growing in the way that you have drawn in part (b)(i).

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(2)

(Total 5 marks)

11

- (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.

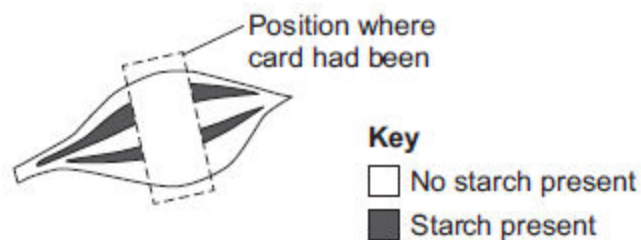
Figure 1

Leaf without card

Leaf with card

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.

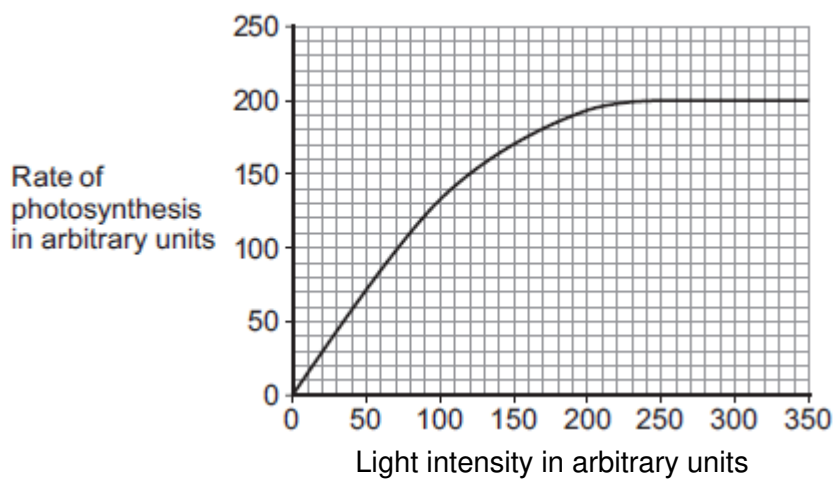
☐

(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)

12

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Deforestation affects the environment.

Deforestation is causing a change in the amounts of different gases in the atmosphere. This change causes global warming and climate change.

The image below shows an area of deforestation.



Give the reasons why deforestation is taking place.

Describe how deforestation is causing the change in the amounts of different gases in the atmosphere.

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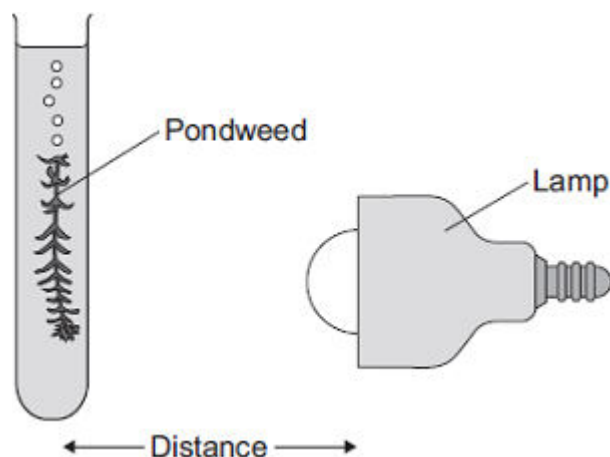
(Total 6 marks)

13

Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1



The students:

- placed the lamp 10 cm from the pondweed
- counted the number of bubbles of gas released from the pondweed in 1 minute
- repeated this for different distances between the lamp and the pondweed.

(a) The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

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.....

(1)

- (b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

- (i) At distances between 15 cm and 50 cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

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(1)

- (ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10 cm and 15 cm.

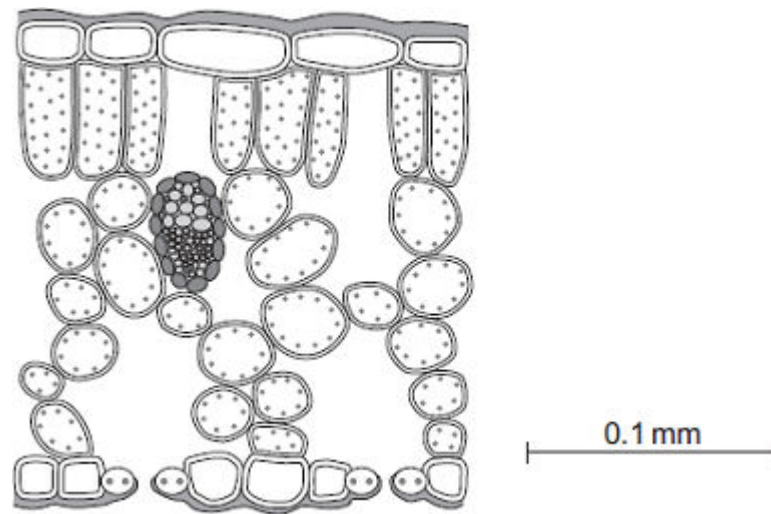
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(1)

- (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Diagram 2 shows a section through a plant leaf.

Diagram 2



Describe the structure of the leaf and the functions of the tissues in the leaf.

You should use the names of the tissues in your answer.

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(6)
(Total 9 marks)

14

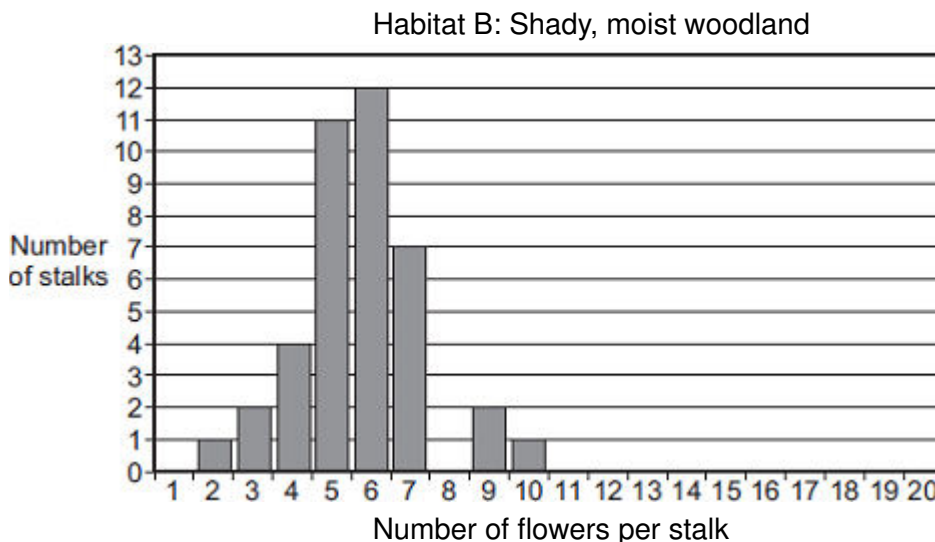
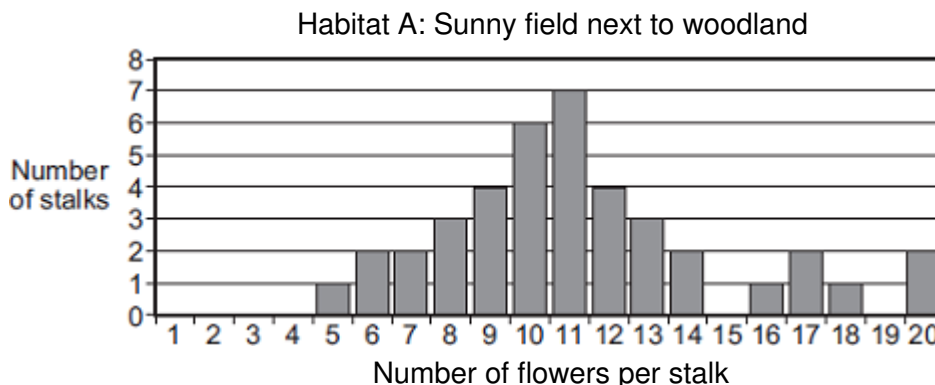
Some students studied bluebell plants growing in two different habitats.

Habitat **A** was a sunny field next to woodland.

Habitat **B** was a shady, moist woodland.

A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat.

The bar charts show the results.



- (a) The students wanted to collect valid data.
Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

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(2)

- (b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode =

(1)

- (ii) The students suggested the following hypothesis:

‘The difference in the modes is due to the plants receiving different amounts of sunlight.’

Suggest why.

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(2)

- (iii) Suggest how the students could test their hypothesis for the two habitats.

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(2)

- (c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

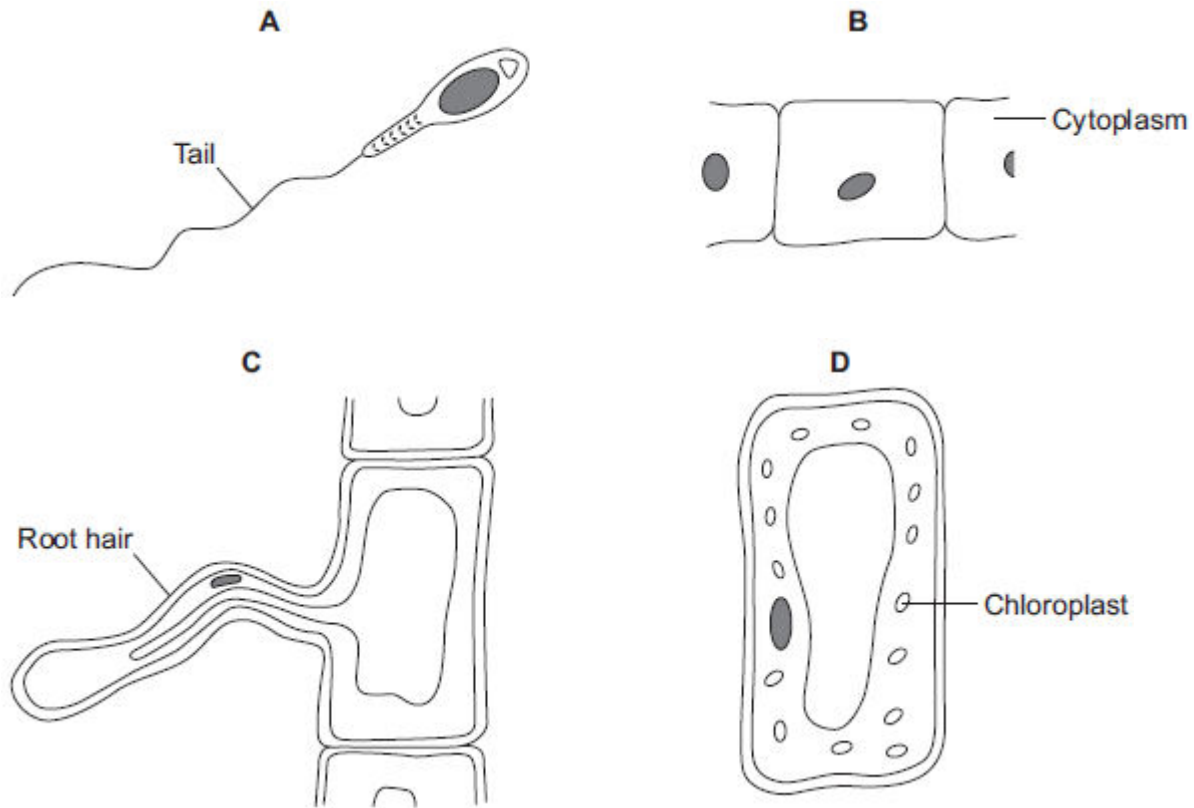
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(2)

(Total 9 marks)

15

The diagrams show four types of cell, **A**, **B**, **C** and **D**.
Two of the cells are plant cells and two are animal cells.



- (a) (i) Which **two** of the cells are plant cells?

Tick (✓) **one** box.

A and B

☐

A and D

☐

C and D

☐

(1)

- (ii) Give **one** reason for your answer.

.....

.....

(1)

- (b) (i) Which cell, **A**, **B**, **C** or **D**, is adapted for swimming?

☐

(1)

(ii) Which cell, **A**, **B**, **C** or **D**, can produce glucose by photosynthesis?

(1)

(c) Cells **A**, **B**, **C** and **D** all use oxygen.

For what process do cells use oxygen?

Draw a ring around **one** answer.

osmosis

photosynthesis

respiration

(1)

(Total 5 marks)

16

This question is about photosynthesis.

(a) Plants make glucose during photosynthesis. Some of the glucose is changed into insoluble starch.

What happens to this starch?

Tick (✓) **one** box.

The starch is converted into oxygen.

☐

The starch is stored for use later.

☐

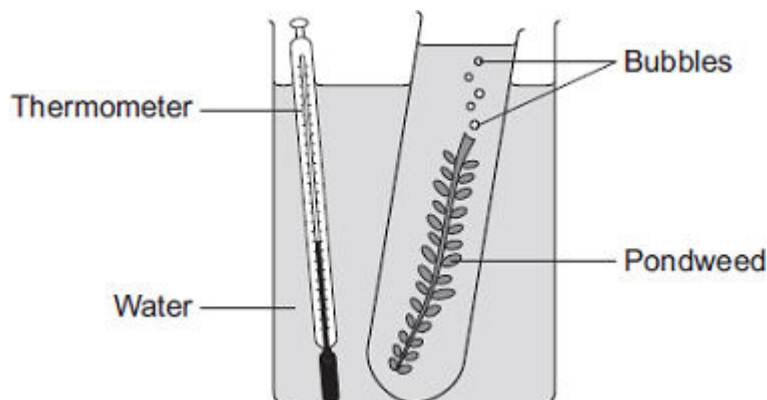
The starch is used to make the leaf green.

☐

(1)

- (b) A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The diagram shows the way the experiment was set up.



- (i) The student needed to control some variables to make the investigation fair.

State **two** variables the student needed to control in this investigation.

1.....

2.....

(2)

- (ii) The bubbles of gas are only produced while photosynthesis is taking place.

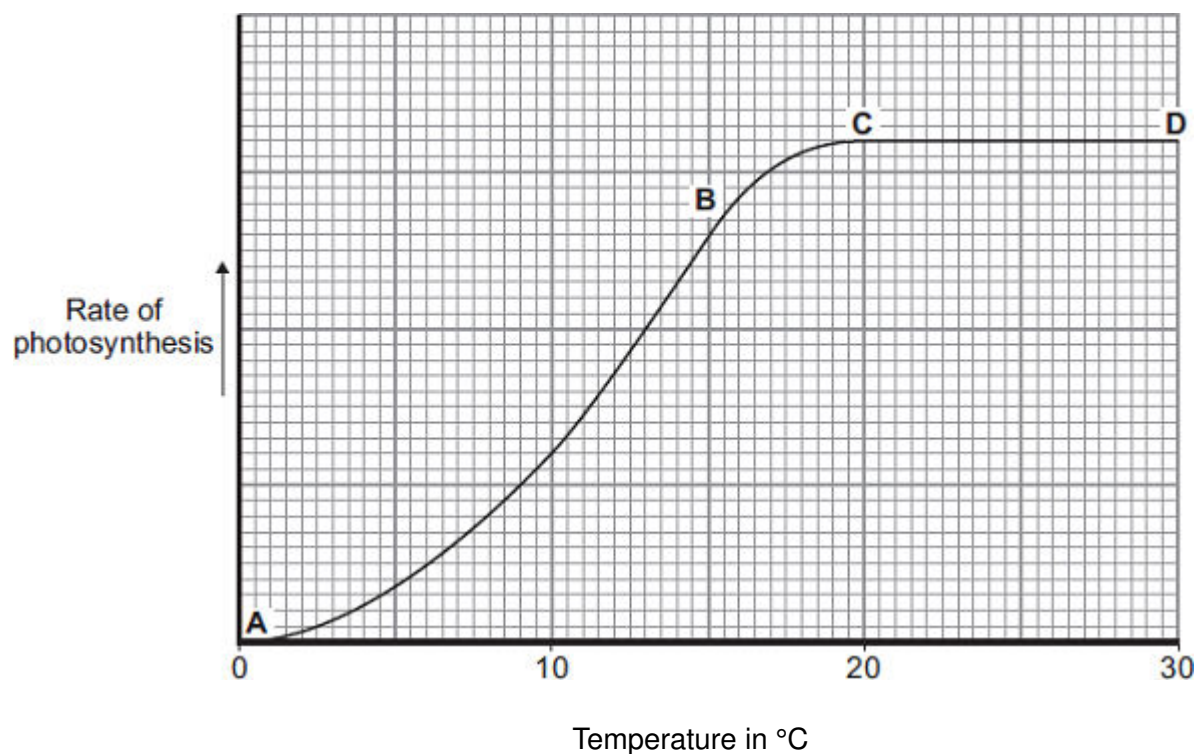
What **two** measurements would the student make to calculate the rate of photosynthesis?

1.....

2.....

(2)

- (c) The graph shows the effect of temperature on the rate of photosynthesis in the pondweed.



- (i) Name the factor that limits the rate of photosynthesis between the points labelled **A** and **B** on the graph.

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(1)

- (ii) Suggest which factor, carbon dioxide, oxygen or water, might limit the rate of photosynthesis between the points labelled **C** and **D** on the graph.

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(1)

(Total 7 marks)

17

- (a) Complete the word equation for photosynthesis.

carbon dioxide + water $\xrightarrow{\text{energy}}$ glucose +

(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

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2

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3

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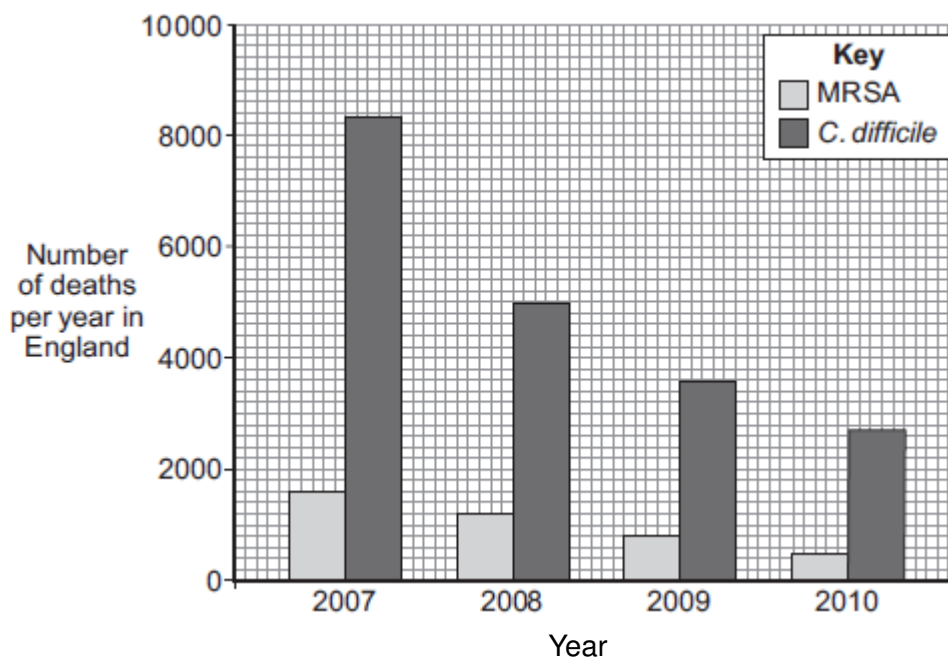
(3)

(Total 7 marks)

18

Infections by antibiotic resistant bacteria cause many deaths.

The bar chart below shows information about the number of deaths per year in England from *Methicillin-resistant Staphylococcus aureus* (MRSA) and from *Clostridium difficile* (*C.difficile*) over 4 years.



- (a) (i) Describe the trend for deaths caused by *C.difficile*.

.....

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.....

(2)

- (ii) Suggest a reason for the trend you have described in part (a)(i).

Explain your answer.

.....

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.....

.....

(2)

- (iii) Calculate the percentage change in deaths caused by MRSA from 2009 to 2010.

.....

.....

.....

Percentage change in deaths caused by MRSA = %

(2)

- (iv) Numbers have not yet been published for 2011.

When the numbers are published, scientists do **not** expect to see such a large percentage change from 2010 to 2011 as the one you have calculated for 2009 to 2010.

Suggest **one** reason why.

.....

.....

(1)

- (b) Before 2007 there was a rapid increase in the number of deaths caused by MRSA.

Describe how the overuse of the antibiotic methicillin led to this increase.

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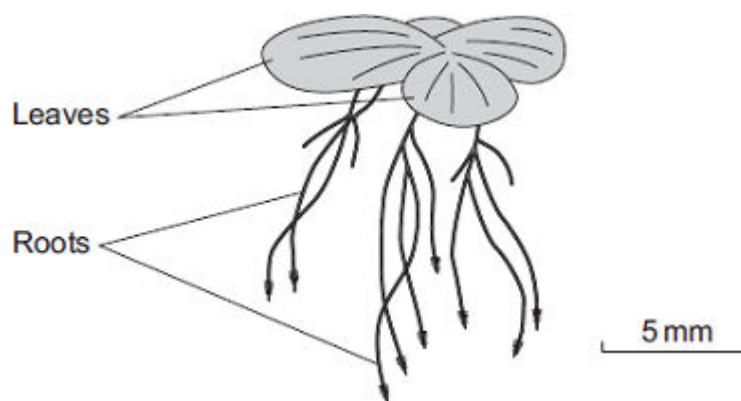
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(3)
(Total 10 marks)

19

Duckweed is a plant. Duckweed grows in ponds. The leaves of duckweed float on the surface of the water and its roots hang down in the water.

The drawing shows a duckweed plant.



- (a) Duckweed roots absorb nitrate ions from the water.
The nitrate ions help the duckweed to grow.

Draw a ring around the correct answer to complete the sentence.

Duckweed needs nitrate ions to make

carbohydrate.
fat.
protein.

(1)

- (b) Some students grew duckweed plants in three different solutions of mineral ions, **A**, **B** and **C**, and in distilled water (**D**).

Table 1 shows the concentrations of mineral ions in each of **A**, **B**, **C** and **D** at the start of the investigation.

Table 1

Mineral ion	Concentration of mineral ions in mg per dm ³ at the start of the investigation			
	A	B	C	D
Nitrate	1000	4	4	0
Phosphate	300	0	0	0
Magnesium	200	84	24	0

The students counted the number of duckweed leaves in **A**, **B**, **C** and **D** at the start of the investigation and after 28 days.

Table 2 shows their results.

Table 2

	A	B	C	D
Number of leaves at start	4	4	4	4
Number of leaves after 28 days	50	27	14	6

- (i) Using **Table 1** and **Table 2**, describe the effect of magnesium ions on the growth of duckweed.

.....

(1)

- (ii) Solution **A** contained the highest concentration of nitrate ions.

One student said, 'The results show that nitrate ions are needed for the growth of duckweed.'

What evidence in **Table 2** supports what the student said?

.....

(1)

- (c) The students measured the growth of the duckweed by counting the number of leaves.

- (i) Suggest a better method of measuring the growth of the duckweed.

.....

(1)

- (ii) Suggest why your method is better than the students' method.

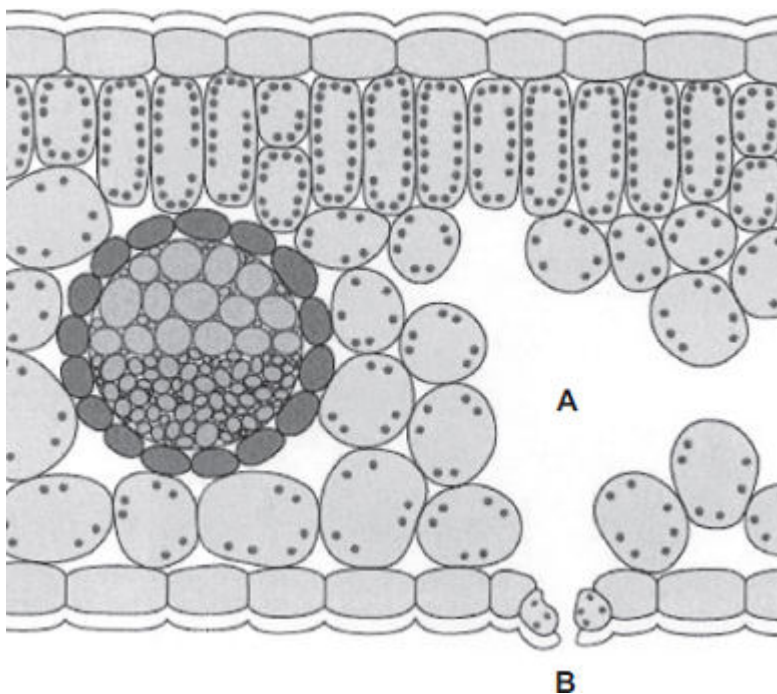
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(1)

(Total 5 marks)

20

The diagram shows a section through a plant leaf.



- (a) Use words from the box to name **two** tissues in the leaf that transport substances around the plant.

epidermis

mesophyll

phloem

xylem

..... and

(1)

(b) Gases *diffuse* between the leaf and the surrounding air.

(i) What is *diffusion*?

.....

.....

.....

.....

(2)

(ii) Name **one** gas that will diffuse from point **A** to point **B** on the diagram on a sunny day.

.....

(1)

(Total 4 marks)

21

(a) Complete the equation for photosynthesis.



(3)

- (b) The rate of photosynthesis in a plant depends on several factors in the environment. These factors include light intensity and the availability of water.

Describe and explain the effects of **two other** factors that affect the rate of photosynthesis.

You may include one or more sketch graphs in your answer.

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(5)
(Total 8 marks)

22

- (a) Complete the word equation for photosynthesis.

Use words from the box.

chlorophyll	minerals	oxygen	water
-------------	----------	--------	-------

carbon dioxide + → glucose +

(2)

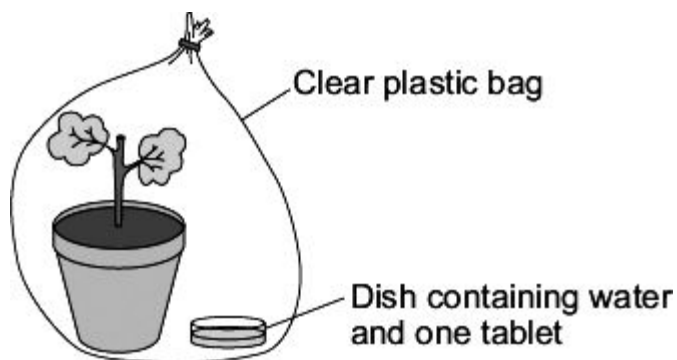
- (b) Plants may grow faster if they have more carbon dioxide.

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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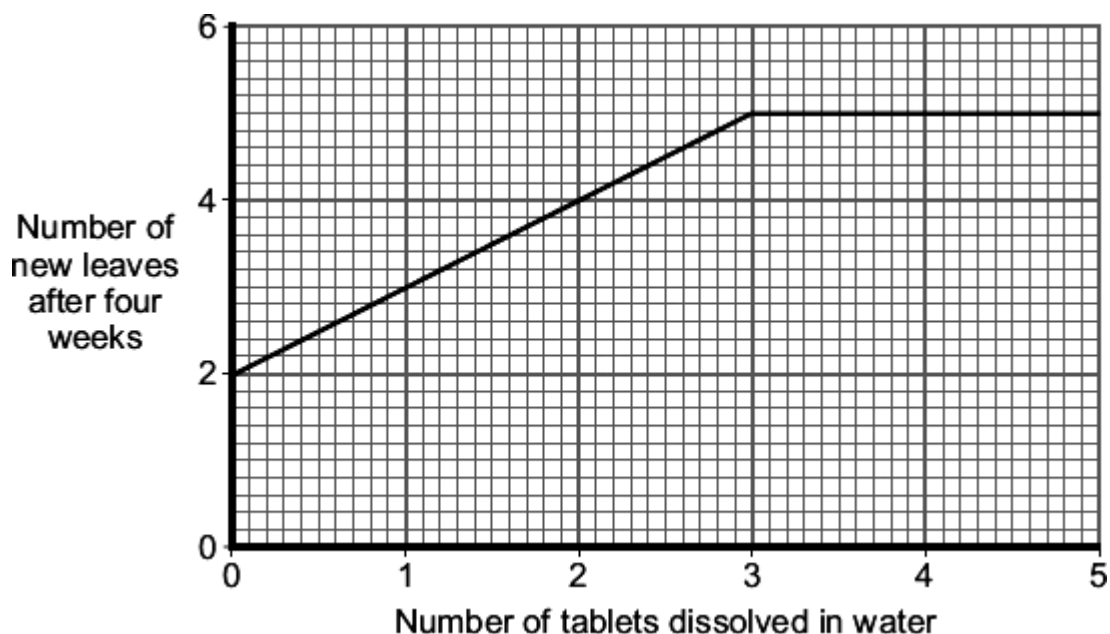
.....

.....

(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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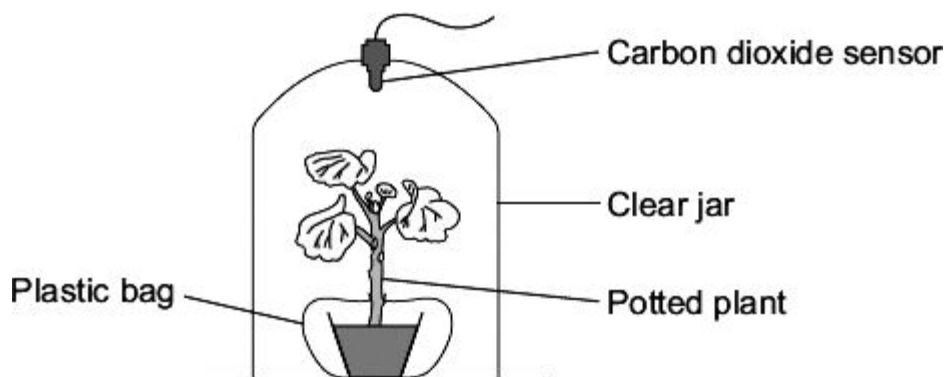
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(3)
(Total 7 marks)

23

A student measured the concentration of carbon dioxide in the air around a potted plant on two different days.

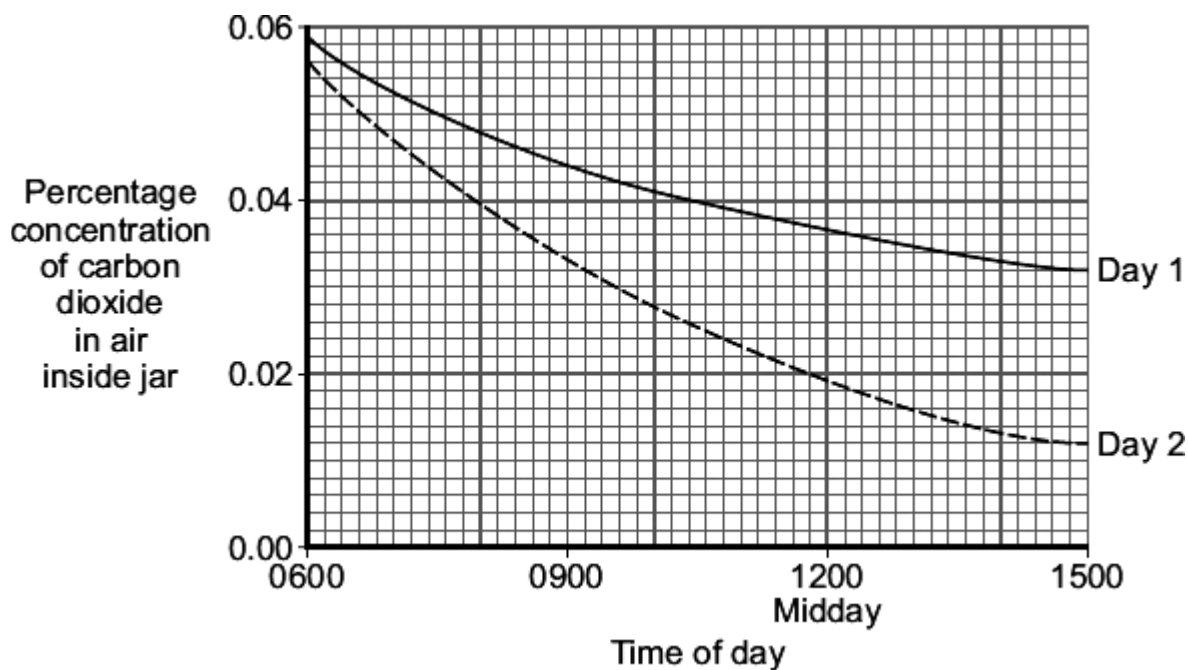
The diagram shows the student's apparatus.



There was a plastic bag round the plant pot to stop microorganisms in the soil affecting the concentration of gases in the air inside the jar.

The apparatus was put near a window.

The graph shows the results.



- (a) **Day 1** was cloudier than **Day 2**.

What evidence from the graph shows that **Day 1** was cloudier?

Explain your answer.

.....

.....

.....

(2)

- (b) A potted plant sometimes develops yellow leaves.

The development of yellow leaves could be due to the lack of a mineral ion.

Suggest the mineral ion that could be lacking.

(1)

(Total 3 marks)

24

Green plants are found at the start of all food chains.

- (a) Complete the sentences.

(i) The source of energy for green plants is radiation from the

(1)

(ii) Green plants absorb some of the light energy that reaches them for a process called

(1)

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

(i) This process transfers light energy into

chemical
sound
electrical

energy.

(1)

(ii) The process uses the gas

carbon dioxide.
oxygen.
water.

(1)

(iii) The process produces carbon-containing compounds called

carbohydrates.
minerals.
salts.

(1)

- (c) The amount of living material (biomass) at each stage in a food chain is less than at the previous stage.

The diagram shows a food chain.

oak tree \longrightarrow **caterpillar** \longrightarrow **blue-tit** \longrightarrow **hawk**

Give **two** ways in which biomass is lost in this food chain.

Tick (✓) **two** boxes.

As carbon dioxide from the caterpillar

☐

As food eaten by the hawk

☐

As oxygen from the oak tree

☐

As faeces (droppings) from the blue-tit

☐

(2)
(Total 7 marks)

25

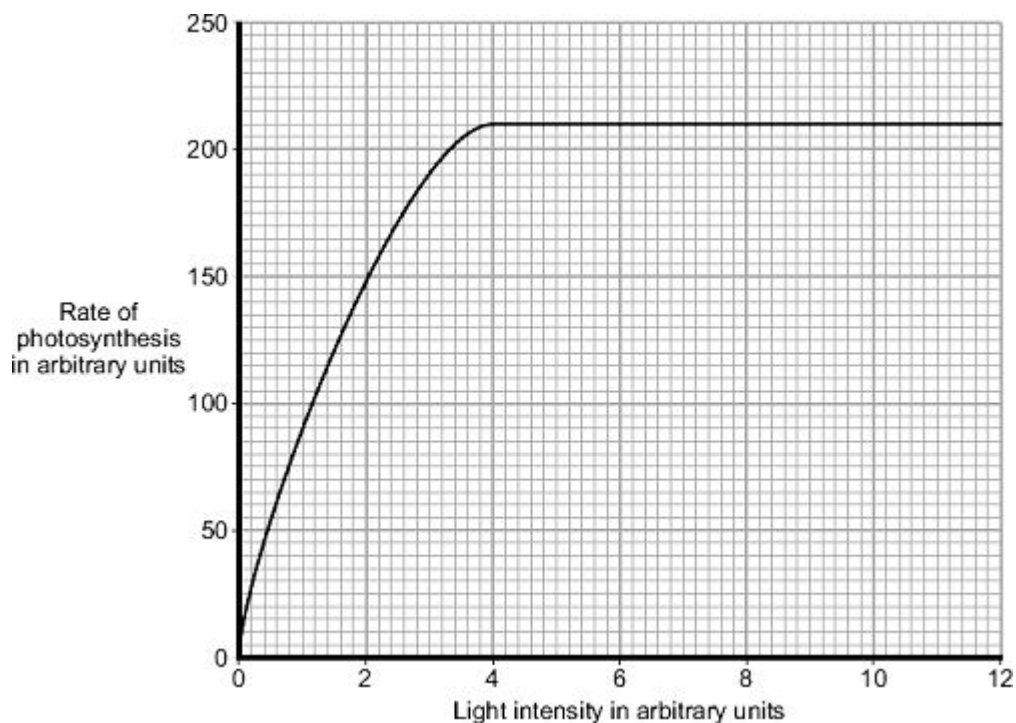
- (a) Complete the equation for photosynthesis.

Carbon dioxide + $\xrightarrow{\text{light energy}}$ + oxygen

(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.

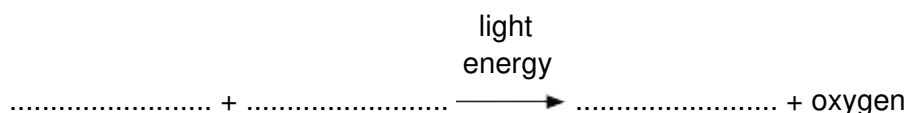
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(1)

(Total 5 marks)

26

- (a) Complete the equation for photosynthesis.



(2)

- (b) Scientists investigated how temperature affects the rate of photosynthesis. The scientists grew some orange trees in a greenhouse. They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

- (i) The leaf discs did not produce any oxygen in the dark.

Why?

.....

.....

(1)

- (ii) The leaf discs took in oxygen in the dark.

Explain why.

.....

.....

.....

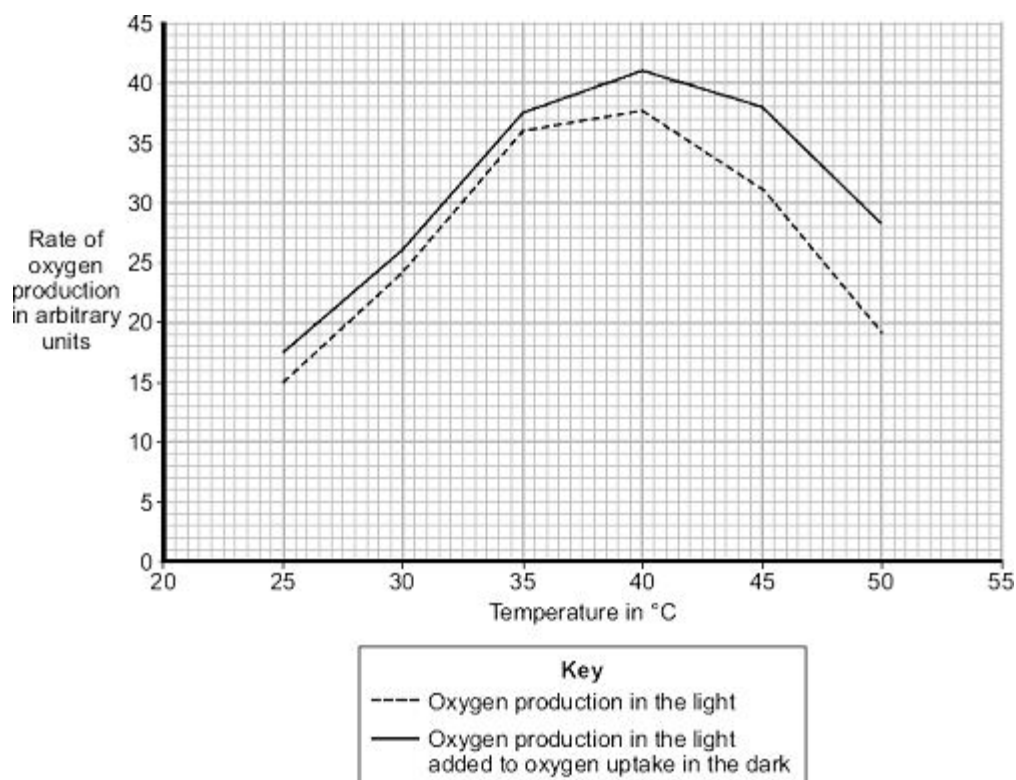
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(2)

- (c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

- (i) Describe the effect of temperature on oxygen production in the light.

.....

.....

.....

.....

(2)

- (ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

.....

.....

.....

from 40 °C to 50 °C.

.....

.....

.....

(2)

- (d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(Total 12 marks)

27

People often grow pondweed in fishponds to *oxygenate* the water.

- (a) Name the process that the pondweed uses to produce oxygen.

.....

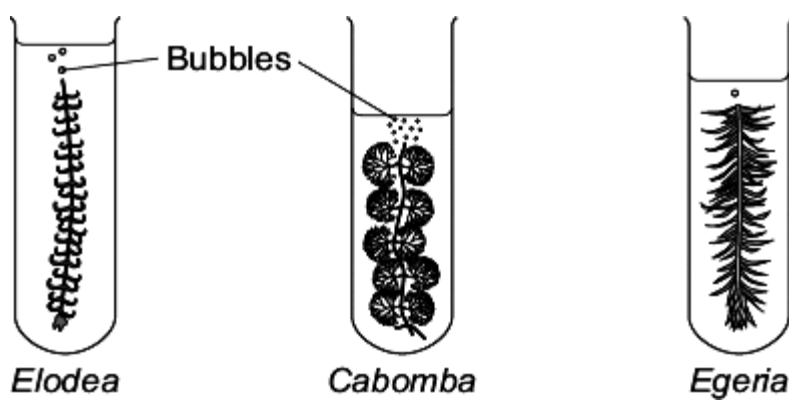
(1)

- (b) A student investigated oxygen production in three different pondweeds, *Elodea*, *Cabomba* and *Egeria*.

The student:

- cut a piece of pondweed from an *Elodea* plant
- put the pondweed into a tube of water
- counted the bubbles given off in one minute
- did the experiment again using a piece of pondweed from a *Cabomba* plant
- did the experiment a third time using a piece of pondweed from an *Egeria* plant.

The diagram shows the student's investigation.



The table shows the results.

Pondweed	Number of bubbles produced in 1 minute
<i>Elodea</i>	17
<i>Cabomba</i>	28
<i>Egeria</i>	8

- (i) The student said:

"I suggest that people grow *Cabomba* in garden ponds to oxygenate the water fastest."

Give **three** variables the student should have controlled to make sure his conclusion was valid.

Use information from the student's method and the diagram.

1

.....

2

.....

3

.....

(3)

- (ii) The three pondweeds all cost about the same.

Suggest **one** other factor that people with fishponds might think about before deciding which type of pondweed to use.

.....

(1)

- (c) A person grows *Cabomba* in his pond.

The *Cabomba* plants develop yellow leaves.

Which mineral ion would stop the leaves turning yellow?

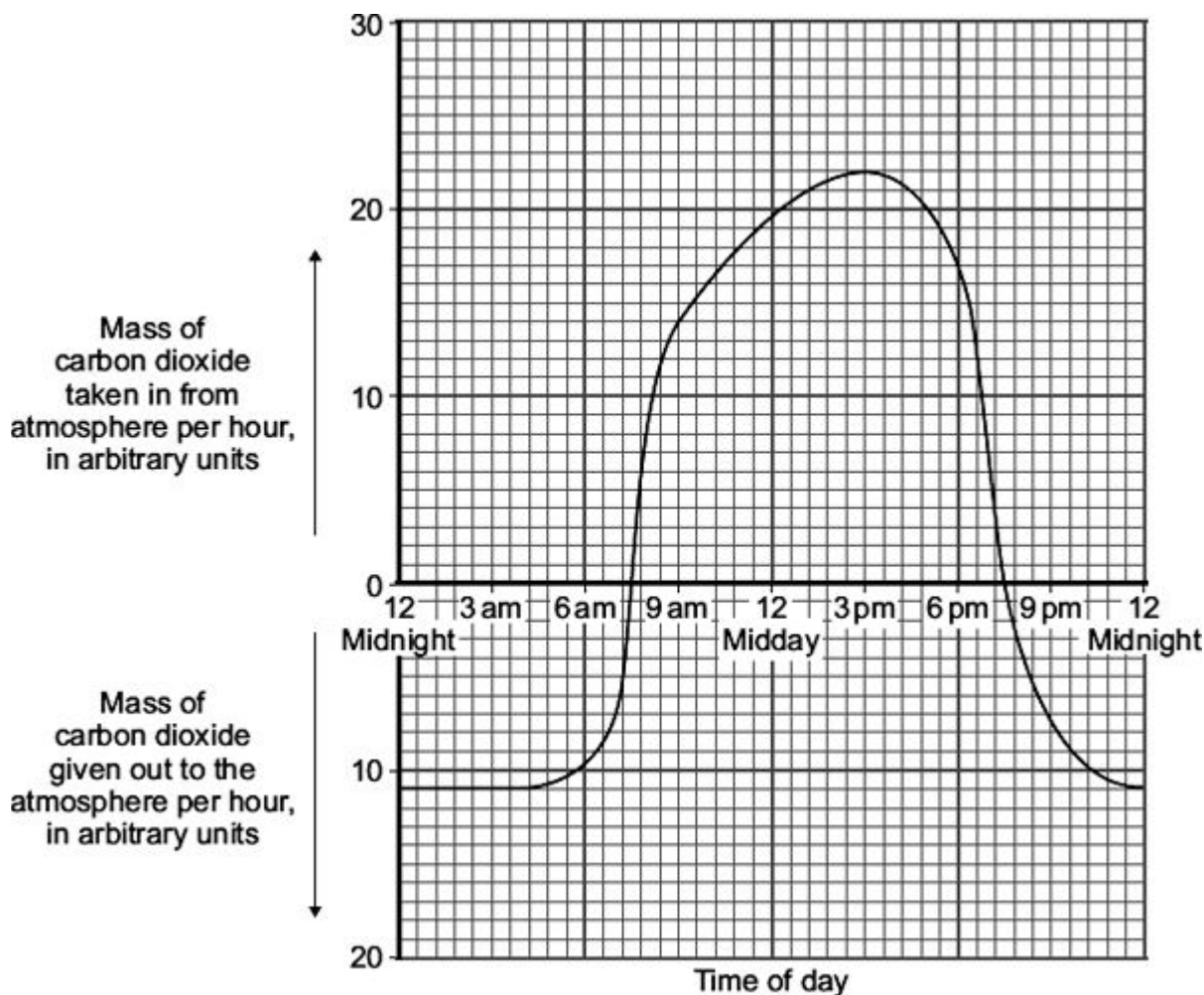
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(1)

(Total 6 marks)

28

The graph shows the uptake of carbon dioxide and the release of carbon dioxide by a bean plant on a hot summer's day.



- (a) At which **two** times in the day did the rate of photosynthesis exactly match the rate of respiration in the bean plant?

1 2

(1)

- (b) The bean plant respire at the same rate all through the 24 hour period.

- (i) How much carbon dioxide is released each hour during respiration?

..... arbitrary units

(1)

- (ii) How much carbon dioxide is used by photosynthesis in the hour beginning at 3 pm?

.....

.....

Answer = arbitrary units

(1)

- (c) Over the 24 hour period, the total amount of carbon dioxide taken in by the bean plant was greater than the total amount of carbon dioxide given out by the bean plant.

Explain, in detail, why this was important for the bean plant.

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.....

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.....

(2)
(Total 5 marks)

29

The amount of carbon dioxide in the atmosphere is increasing.

The table shows the estimated mass of carbon dioxide exchanged with the atmosphere in one year.

	Mass of carbon dioxide exchanged with the atmosphere in millions of tonnes	
	Passed out into the atmosphere	Taken in from the atmosphere
Plants	30	64
Animals	10	0
Microorganisms	24	0
Combustion	6	0

- (a) (i) Calculate the total mass of carbon dioxide passed out into the atmosphere in one year.

Show clearly how you work out your answer.

.....

Answer million tonnes

(2)

- (ii) Calculate the increase in the mass of carbon dioxide in the atmosphere in one year.

You should use your answer to part (a)(i) in your calculation.

Show clearly how you work out your answer.

.....

Answer million tonnes

(2)

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

Plants use carbon dioxide in the process of

decomposition.

photosynthesis.

respiration.

(1)

(Total 5 marks)

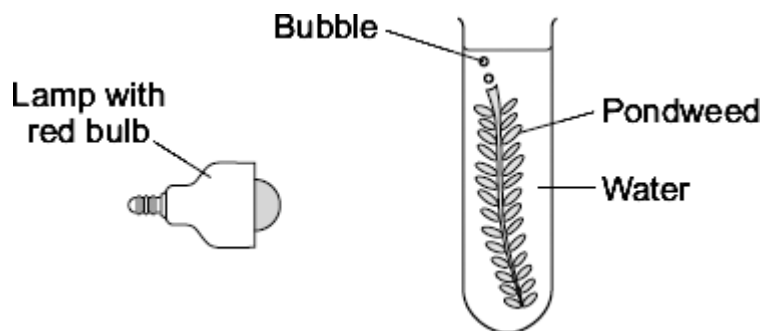
30

A group of pupils investigated the way in which the colour of light affects photosynthesis.

The pupils:

- put a piece of pondweed into a test tube of water
- shone light from a lamp with a red light bulb onto the pondweed
- counted the bubbles of gas produced by the pondweed every minute for three minutes.

The diagram shows the experiment.



The pupils repeated their experiment using a yellow light bulb, a green light bulb and a blue light bulb.

(a) (i) What was the independent variable in the investigation?

.....

(1)

(ii) To make the investigation fair the pupils needed to control some variables.

Suggest **one** variable that the pupils should have controlled during their investigation.

.....

(1)

- (iii) It is better to count the bubbles every minute for three minutes than to count all the bubbles in three minutes.

Why?

.....

.....

(1)

- (b) The table shows the pupils' results.

Colour of bulb	Number of bubbles produced in one minute			
	1st minute	2nd minute	3rd minute	Mean
Red	24	19	21	21
Yellow	18	14	15	16
Green	6	4	3	4
Blue	32	34	32	33

Algae are tiny organisms that photosynthesise.

In natural light algae grow very quickly on the sides of a fish tank.

The algae make it difficult to see the fish.

- (i) What would be the best colour of light bulb to illuminate the fish tank to reduce the growth of algae?

Use the results in the table to help you to decide.

Draw a ring around **one** answer.

red

yellow

green

blue

(1)

- (ii) Explain why the colour you have chosen is the best.

.....

.....

.....

.....

(2)

(Total 6 marks)

31

A gardener grows tomato plants.

The tomato plants develop yellow leaves.

(a) What would be the best way of improving the growth of these plants?

Tick (✓) **one** box.

Add mineral ions to the soil

☐

Water the plants more

☐

Add glucose to the soil

☐

(1)

- (b) Most tomatoes are grown in greenhouses.



By Giancarlo Dessì (Own work) [GFDL or CC-BY-SA-3.0-2.5-2.0-1.0], via Wikimedia Commons

Tomato growers alter the conditions in greenhouses to make tomato plants grow faster.

Which changes in conditions will make tomato plants grow faster?

Tick (✓) **two** boxes.

Increasing the temperature

☐

Increasing the oxygen concentration in the air

☐

Increasing the nitrogen concentration in the air

☐

Turning lights on at night

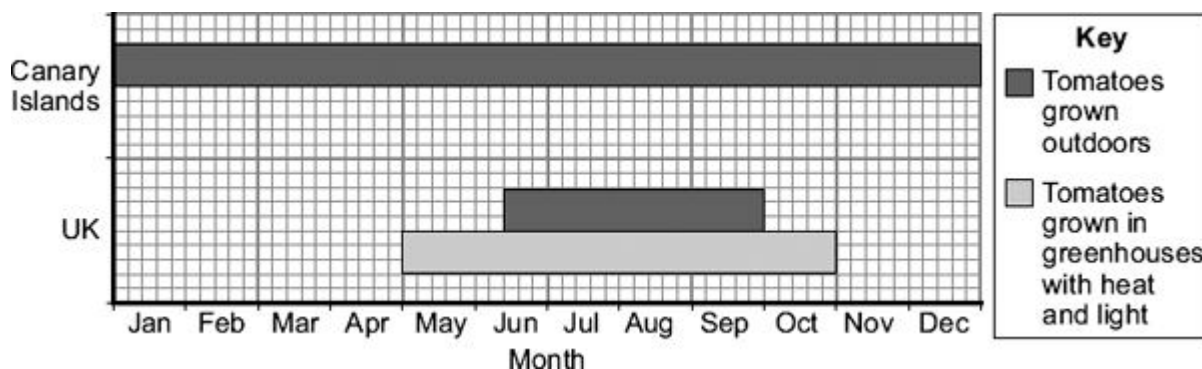
☐

(2)
(Total 3 marks)

32

Tomatoes are grown in greenhouses in the UK and outdoors in the UK and the Canary Islands.

The chart shows in which months these tomatoes can be bought in shops in the UK.



The Canary Islands are about 3000 km from the UK.

Some people prefer to buy tomatoes grown in the UK.

What are the **advantages** and **disadvantages** of buying tomatoes grown in the UK, instead of buying tomatoes grown in the Canary Islands?

Advantages of buying tomatoes grown in the UK

.....

.....

.....

.....

Disadvantages of buying tomatoes grown in the UK

.....

.....

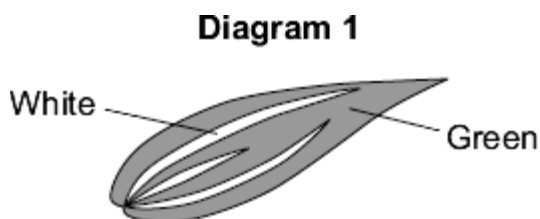
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(Total 3 marks)

Students investigated the effect of changing the carbon dioxide concentration on the rate of photosynthesis in pieces of leaf.

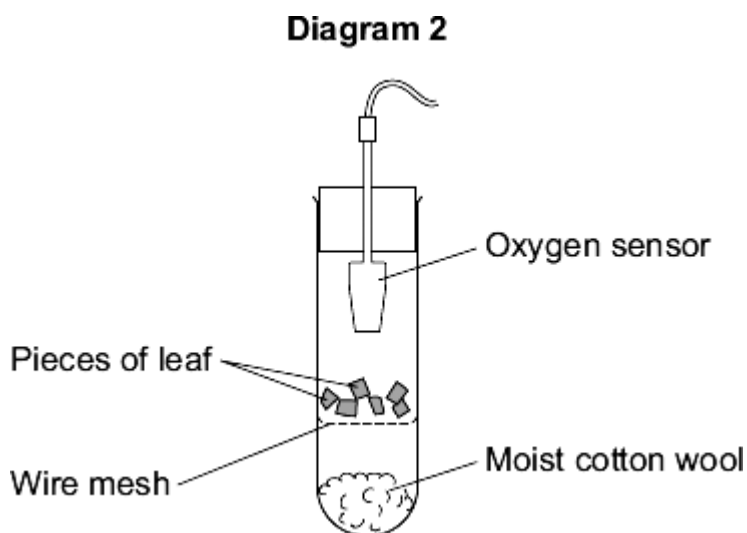
Diagram 1 shows the type of leaf used by the students.



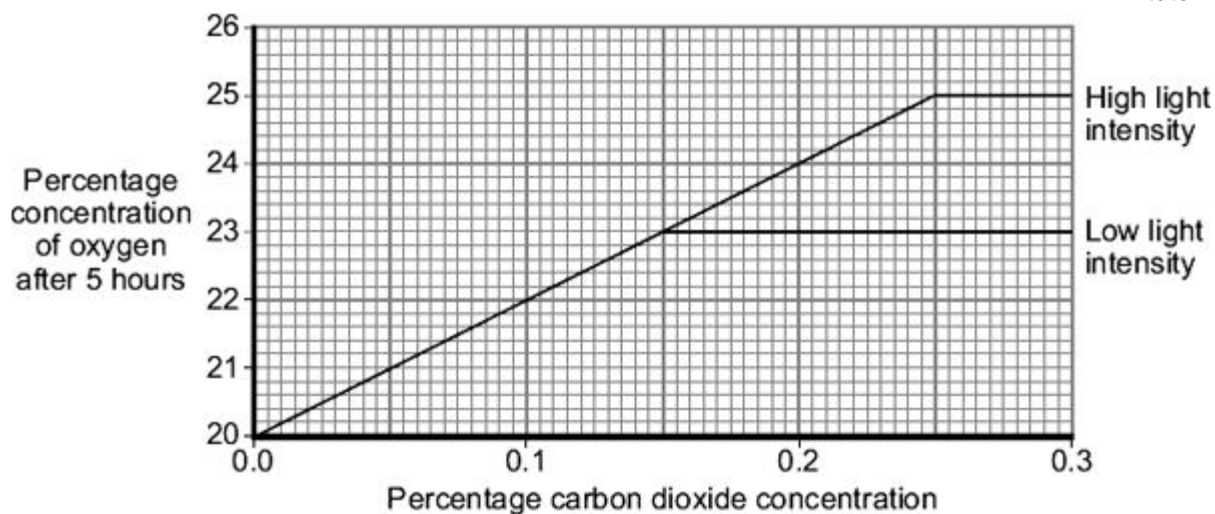
The students:

- cut pieces of leaf from the green region
- put the pieces into tubes
- added different concentrations of carbon dioxide to each tube
- shone lights on the tubes with either high or low light intensity
- recorded the concentration of oxygen in the tubes after 5 hours.

Diagram 2 shows how each experiment was set up.



The graph shows the results of the investigation.



- (a) (i) Describe the effect of increasing carbon dioxide concentration on the rate of photosynthesis at low light intensity.

.....

(1)

- (ii) Explain the effect that you have described.

In your answer you should refer to limiting factors.

.....

(2)

- (b) What would have been the effect on oxygen concentration over the five-hour period if a white region of the leaf had been used, instead of a green region?

Effect

Explain your answer.

Explanation

.....

(2)

- (c) Some people keep indoor plants which have variegated leaves (leaves with green and white regions).

If plants with variegated leaves are kept in dim light conditions the white areas of the leaves start to turn green.

This is an advantage to the plant.

Suggest why.

.....

.....

.....

.....

(2)
(Total 7 marks)

34

Plants need mineral ions for healthy growth.

- (a) Which part of a plant takes in mineral ions?

Tick (✓) **one** box.

Flower

☐

Leaf

☐

Root

☐

(1)

- (b) Leaves are usually green.

- (i) What is the green substance in leaves?

Draw a ring around your answer.

chlorophyll

glucose

starch

(1)

- (ii) The green substance in leaves is important to plants.

Explain why.

.....

.....

.....

.....

(2)

- (c) A shortage of mineral ions can affect a plant.

Draw **one** line from each mineral ion to the effect of its shortage.

Mineral ion

Effect of its shortage

Magnesium

Yellow leaves

Stunted growth

Nitrate

White flowers

(2)
(Total 6 marks)

35

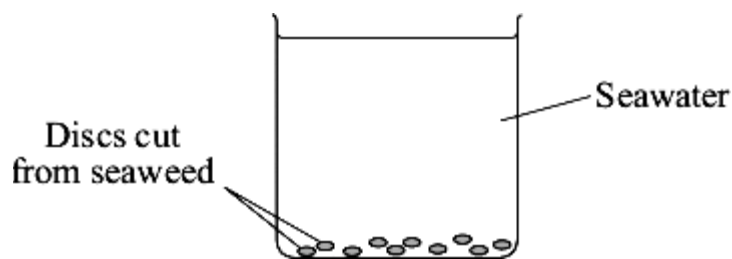
The diagram shows where three seaweeds live on a seashore.

As the tide moves in and out, these seaweeds are covered with seawater for different lengths of time.



Some students investigated the rate of photosynthesis in these seaweeds.

- They cut ten small discs from one seaweed.
- They dropped the discs into seawater in a beaker.
- They recorded the time taken for the fifth disc to float to the surface.
- They repeated this experiment with the other two seaweeds.



- (a) (i) Suggest why the discs floated to the surface.

.....

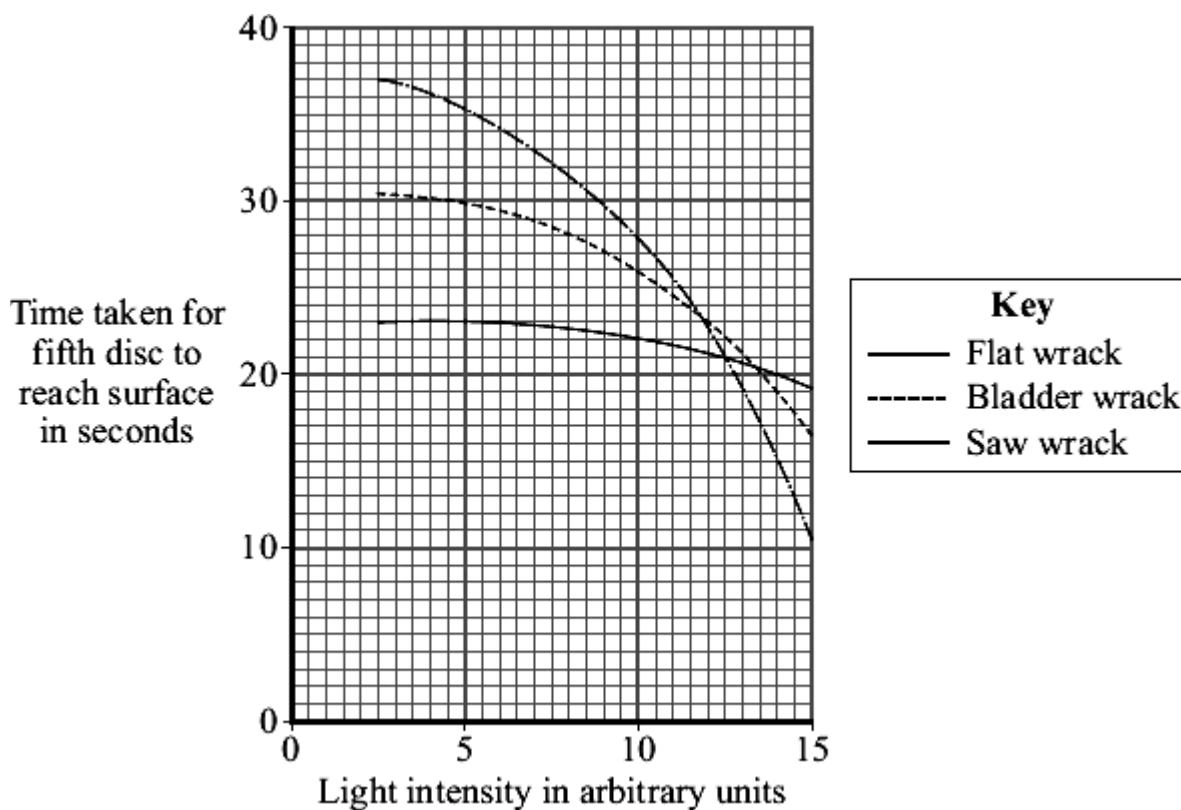
(1)

- (ii) Suggest the advantage of recording the time taken for the fifth disc to reach the surface, rather than for the tenth disc.

.....

(1)

- (b) The students carried out their experiments at different light intensities. The graph shows the results they collected.



- (i) Compare the rate of photosynthesis for flat wrack with the rate for saw wrack at different light intensities.

.....

.....

.....

.....

(2)

- (ii) Seawater absorbs light.

The growth rate of saw wrack is less than the growth rate of bladder wrack.

Suggest why.

.....

.....

.....

.....

(2)
(Total 6 marks)

36

This question is about photosynthesis.

- (a) Plants make glucose during photosynthesis. Some of the glucose is changed into insoluble starch.

What happens to this starch?

Tick (✓) **one** box.

The starch is converted into oxygen.

☐

The starch is stored for later use.

☐

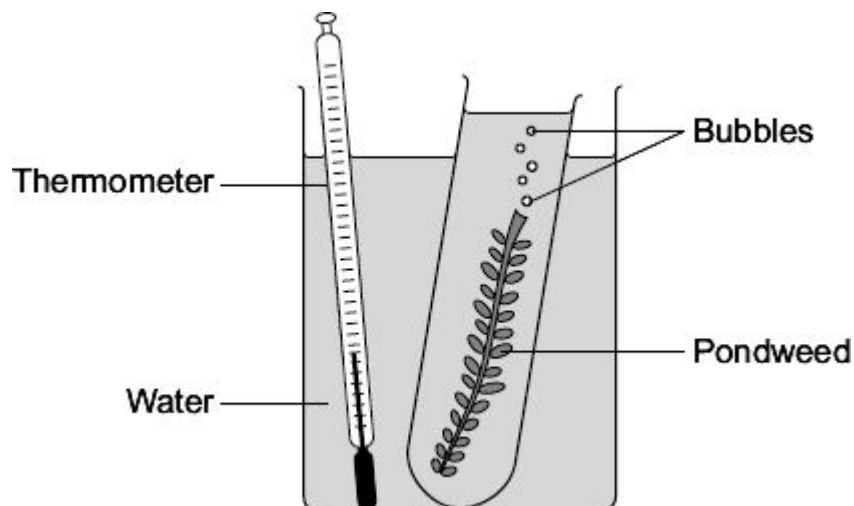
The starch is used to make the leaf green.

☐

(1)

- (b) A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The diagram shows the way the experiment was set up.



- (i) The student needed to control some variables to make the investigation fair.

State **two** of these variables.

1

2 (2)

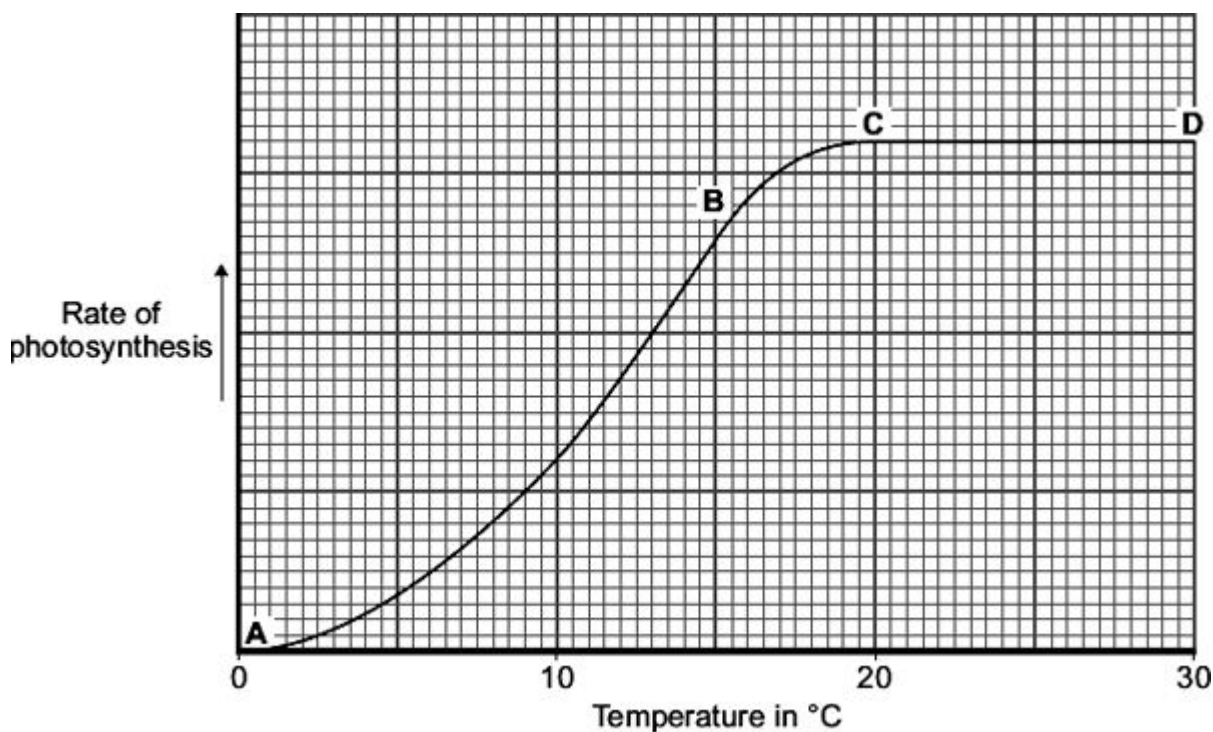
- (ii) The bubbles of gas are produced only while photosynthesis is taking place.

What **two** measurements would the student make to calculate the rate of photosynthesis?

1

2 (2)

- (c) The graph shows the effect of temperature on the rate of photosynthesis.



- (i) Name the factor that limits the rate of photosynthesis between the points labelled **A** and **B** on the graph.

.....

(1)

- (ii) Suggest which factor, carbon dioxide, oxygen or water, might limit the rate of photosynthesis between the points labelled **C** and **D** on the graph.

.....

(1)

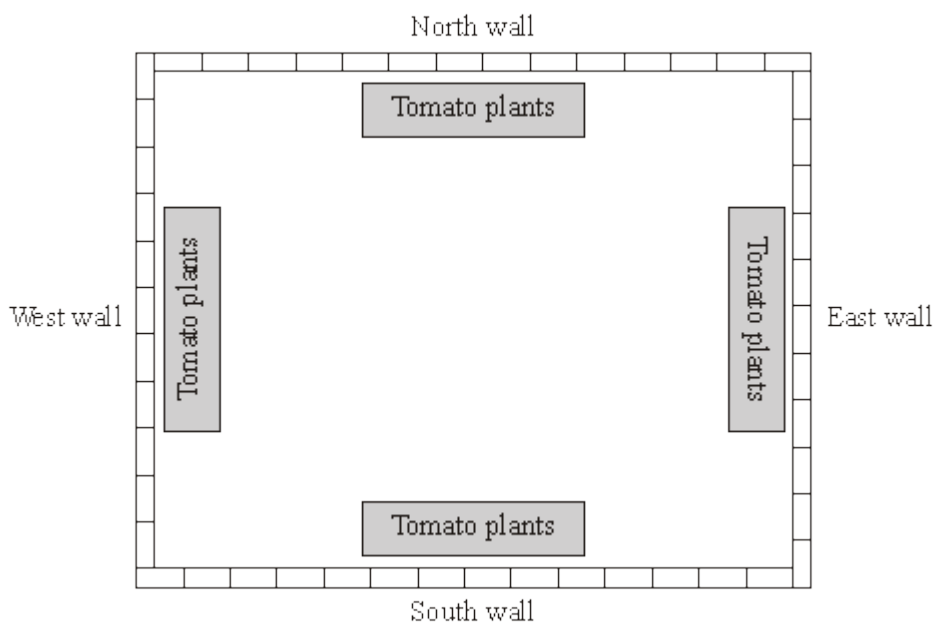
(Total 7 marks)

37

A gardener grows tomatoes.

He wants to find out how to get the biggest mass of tomatoes.

He plants different varieties of tomato against different walls in his garden.



Use these results to answer the questions.

- (a) The gardener wants his test to be fair.

Name **one** condition which he should keep the same for all his tomato plants.

.....

(1)

- (b) The table shows the gardener's results.

Variety of tomato plant	Sungold	Sungold	Sungold	Sungold	Nugget	Champion
Wall they were planted against	North	West	South	East	East	East
Mean mass of tomatoes produced in kilograms per plant	3.5	3.0	1.2	2.5	3.2	2.7

- (i) To obtain the biggest mass of tomatoes, against which wall is it best to grow the tomato plants?

Tick (✓) **one** box.

North wall

☐

South wall

☐

East wall

☐

West wall

☐

(1)

- (ii) To obtain the biggest mass of tomatoes, which variety of tomato plant would it be best to grow?

.....

(1)

- (c) From the information in the table, the gardener's test was **not** fair.

Give **one** way in which the test was **not** fair.

.....

.....

(1)

(Total 4 marks)