Photosynthesis

These practice questions can be used by students and teachers and is suitable for GCSE AQA Biology topic Questions 8641

Level: GCSE AQA Biology 8641

Subject: Biology

Exam board: GCSE AQA

Topic: Photosynthesis

Q1.

Plants are made up of cells, tissues and organs.

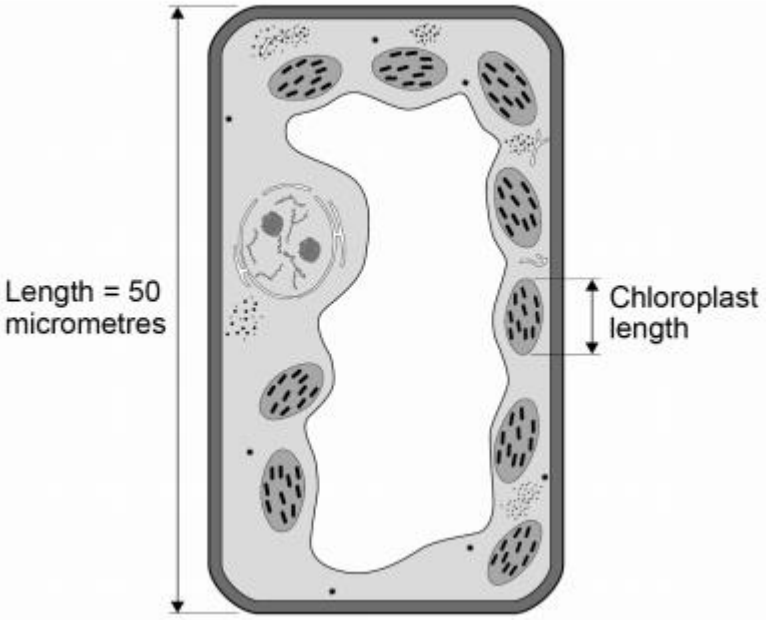
(a) Draw **one** line from each level of organisation to the correct plant part.

Level of organisation	Plant part
	Leaf
Organ	Root hair
	Spongy mesophyll
Tissue	Vacuole
	Xylem

(2)

Figure 1 shows a plant cell drawn to scale.

Figure 1



(b) Where in a plant would the cell in **Figure 1** be found?

Tick **one** box.

Epidermis ☐

Palisade mesophyll ☐

Phloem ☐

Xylem ☐

(1)

(c) Calculate the length of the chloroplast labelled in **Figure 1**.

_____

_____

_____

_____

_____

_____

_____

_____

Length = _____ micrometres

(2)

(d) Cells in plant roots do **not** photosynthesise.

Give **one** reason why.

_____

_____

_____

_____

(1)

(e) As a plant grows, new root hair cells are formed from unspecialised cells.

How does an unspecialised cell become a new root hair cell?

Tick **one** box.

Differentiation ☐

Metabolism ☐

Transpiration ☐

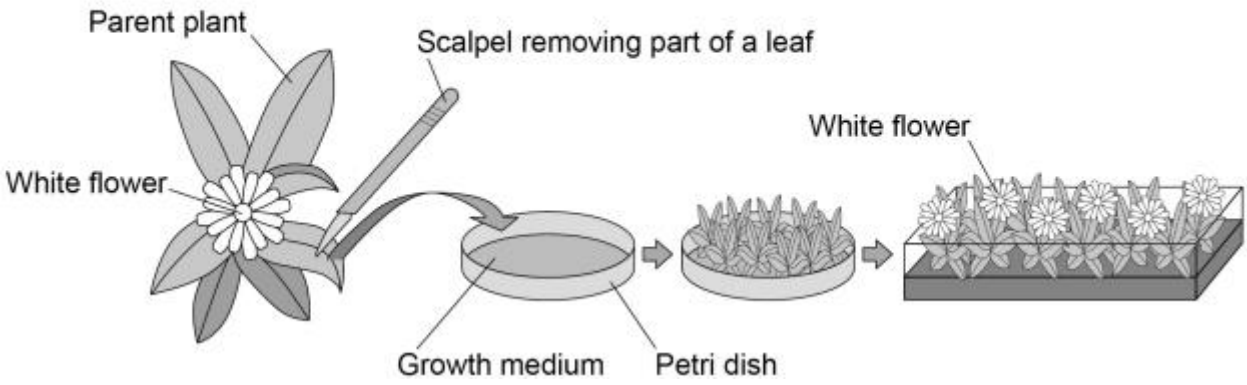
Transport ☐

(1)

Scientists can clone plants using tissue culture.

Figure 2 shows the process of tissue culture.

Figure 2



(f) Why might scientists want to clone plants?

Tick **one** box.

To create new species of plants. ☐

To introduce variation into plants. ☐

To protect endangered plants from extinction. ☐

To reduce disease resistance in plants. ☐

(1)

(g) What is the advantage of cloning plants using tissue culture?

Tick **one** box.

No special equipment is needed.	☐
Plants can be produced quickly.	☐
The flowers are all different colours.	☐
The offspring are all genetically different.	☐

(1)

(h) The growth medium in **Figure 2** helps the plants to grow.

Name **one** substance in the growth medium.

_____

_____

_____

_____

(1)

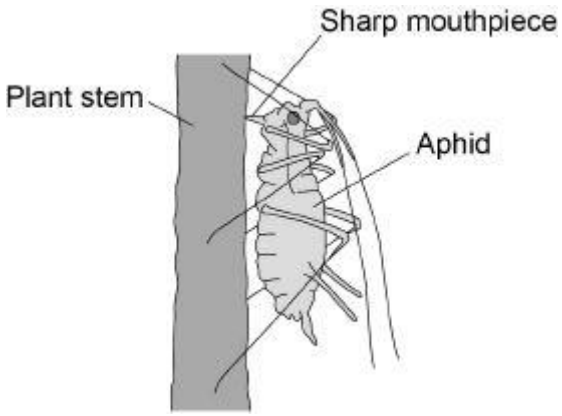
(Total 10 marks)

Q2.

Aphids are small insects that carry pathogens.

Figure 1 shows an aphid feeding from a plant stem.

Figure 1



(a) An aphid feeds by inserting its sharp mouthpiece into the stem of a plant.

After feeding, the mouthpiece of an aphid contains a high concentration of dissolved sugars.

Which part of the plant was the aphid feeding from?

Tick **one** box.

- Palisade layer ☐
- Phloem ☐
- Stomata ☐
- Xylem ☐

(1)

(b) What is the process that transports dissolved sugars around a plant?

Tick **one** box.

- Filtration ☐
- Respiration ☐
- Translocation ☐
- Transpiration ☐

(1)

(c) Plants infected with aphids have stunted growth.

Explain **one** way the removal of dissolved sugars from the stem of the plant causes stunted growth.

_____

_____

_____

_____

(2)

(d) Most aphids do not have wings when they hatch. After several generations, some aphids hatch which have wings and can fly.

Explain the advantage to the aphid of being able to fly.

(2)

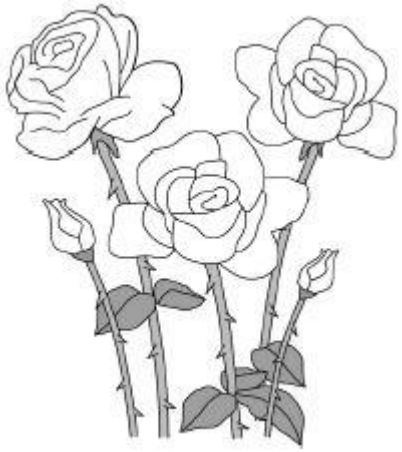
(e) The leaves of some plants release oils onto their surface.

Suggest how the production of oil on the surface of a leaf may protect the plant from aphids.

(1)

Figure 2 shows part of a rose plant.

Figure 2



(f) Give **one** adaptation shown in **Figure 2** that helps the rose plant defend itself.

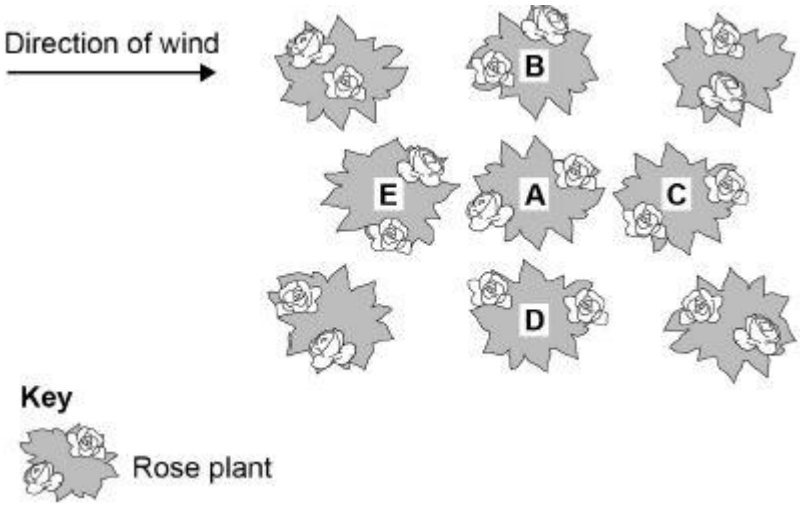
_____

_____

(1)

Figure 3 shows a plan of a garden containing rose plants.

Figure 3



(g) Plant **A** has the fungal disease rose black spot.

Which plant in **Figure 3** is the fungus likely to spread to first?

Give a reason for your answer.

Plant _____

Reason

_____

_____

_____

_____

_____

_____

(2)

(h) Suggest **one** way the gardener could reduce the spread of rose black spot to the other plants in the garden.

_____

_____

_____

_____

(1)

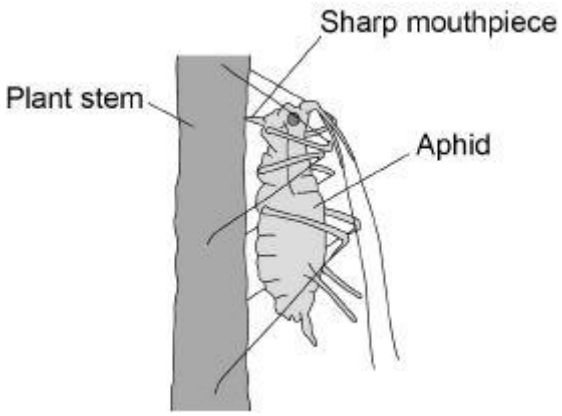
(Total 11 marks)

Q3.

Plants can be infected by fungi, viruses and insects.

Aphids are small insects that carry pathogens.

The diagram below shows an aphid feeding from a plant stem.



(a) An aphid feeds by inserting its sharp mouthpiece into the stem of a plant.

Give the reason why the mouthpiece of an aphid contains a high concentration of dissolved sugars after feeding.

(1)

(b) Plants infected with aphids may show symptoms of magnesium deficiency.

Magnesium deficiency symptoms include:

- yellow leaves
- stunted growth.

Explain how a deficiency of magnesium could cause these symptoms.

(5)

(c) A farmer thinks a potato crop is infected with potato virus Y (PVY).

The farmer obtains a monoclonal antibody test kit for PVY.

To make the monoclonal antibodies a scientist first isolates the PVY protein from the virus.

Describe how the scientist would use the protein to produce the PVY monoclonal antibody.

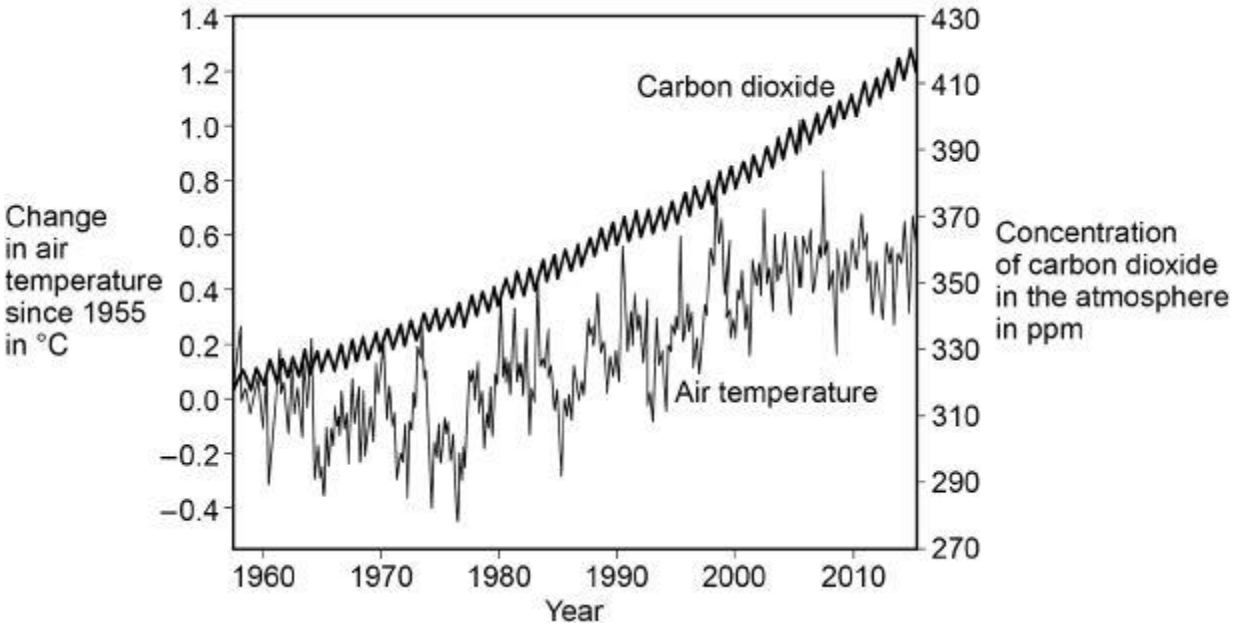
(4)

(Total 10 marks)

Q4.

Many scientists think that global air temperature is related to the concentration of carbon dioxide in the atmosphere.

The graph below shows changes in global air temperature and changes in the concentration of carbon dioxide in the atmosphere.



(a) Complete the table below.

Use information from the graph above.

Choose answers from the box.

You may use each answer once, more than once or not at all.

constant	decreasing	increasing

	1960 − 1977	1977 − 2003	2003 − 2015
Trend in carbon dioxide concentration	Increasing		
Trend in air temperature			

(2)

Many scientists think that an increase in carbon dioxide concentration in the atmosphere causes an increase in air temperature.

(b) How would an increase in the concentration of carbon dioxide in the atmosphere cause an increase in air temperature?

_____

_____

(1)

(c) Evaluate evidence for and against the theory that an increase in the concentration of carbon dioxide in the atmosphere causes an increase in air temperature.

Use data from the graph above and your own knowledge.

_____

_____

_____

_____

(4)

In each year, the concentration of carbon dioxide in the atmosphere is higher in the winter than in the summer.

(d) Give **one** human activity that could cause the higher concentration of carbon dioxide in the winter.

_____

_____

_____

_____

(1)

(e) Give **one** biological process that could cause the lower concentration of carbon dioxide in the summer.

_____

_____

_____

_____

(1)

(f) Give **two** possible effects of an increase in global air temperature on living organisms.

1.

_____

_____

_____

_____

2.

_____

_____

_____

_____

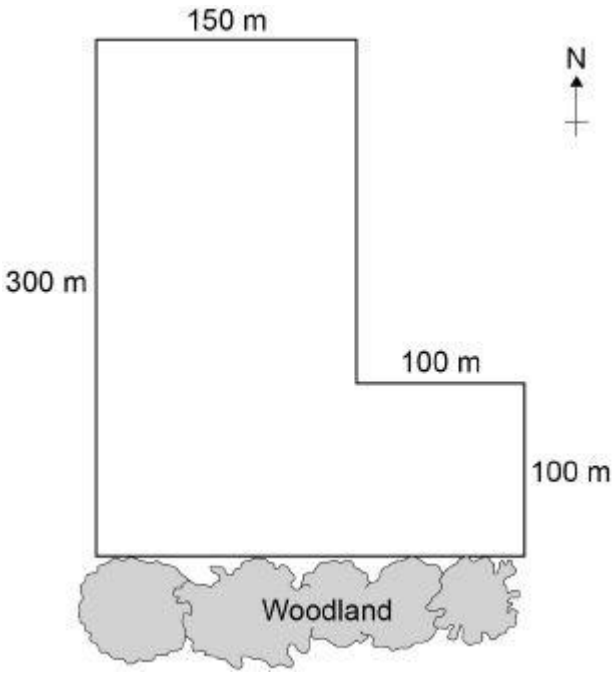
(2)

(Total 11 marks)

Q5.

Some students investigated the size of a population of dandelion plants in a field.

The diagram below shows the field.



The students:

- placed a 1 m × 1 m square quadrat at 10 random positions in the field
- counted the number of dandelion plants in each quadrat.

The table below shows the students' results.

Quadrat number	Number of dandelion plants
1	6
2	9
3	5
4	8
5	0
6	10
7	2
8	1
9	8

10	11

(a) Why did the students place the quadrats at random positions?

_____

_____

_____

_____

(1)

(b) Estimate the total number of dandelion plants in the field.

Calculate your answer using information from the diagram and the table above.

Give your answer in standard form.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Total number of dandelion plants = _____

(5)

Quadrats **5**, **7** and **8** were each placed less than 10 metres from the woodland.

These quadrats contained low numbers of dandelion plants.

The students made the hypothesis:

‘Light intensity affects the number of dandelion plants that grow in an area.’

(c) Plan an investigation to test this hypothesis.

(6)

(d) Light is an environmental factor that affects the growth of dandelion plants.

Give **two** other environmental factors that affect the growth of dandelion plants.

1.

2.

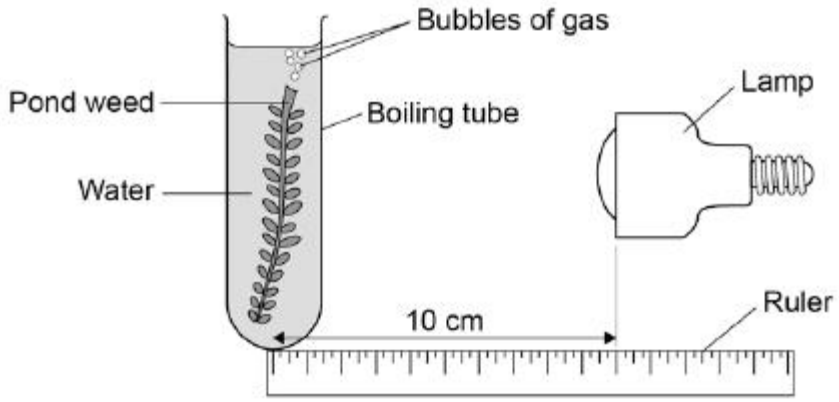
(2)

(Total 14 marks)

Q6.

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.

_____

_____

_____

_____

(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	**X**
40	30	32	31	31
50	13	15	15	14

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

_____

_____

_____

_____

X = _____ bubbles per minute

(1)

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

_____

_____

_____

_____

(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.

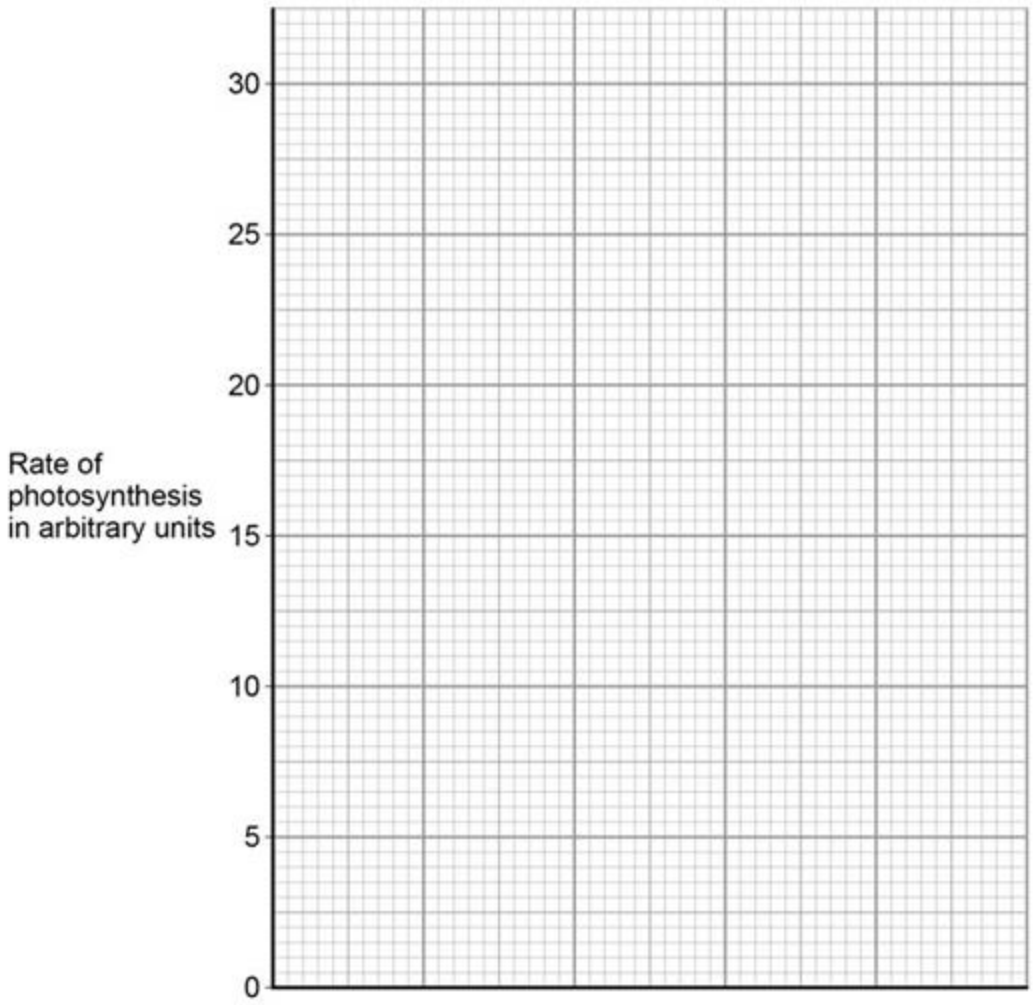
The results are shown in **Table 2**.

Table 2

Colour of light	**Rate of photosynthesis in arbitrary units**
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 _____ .

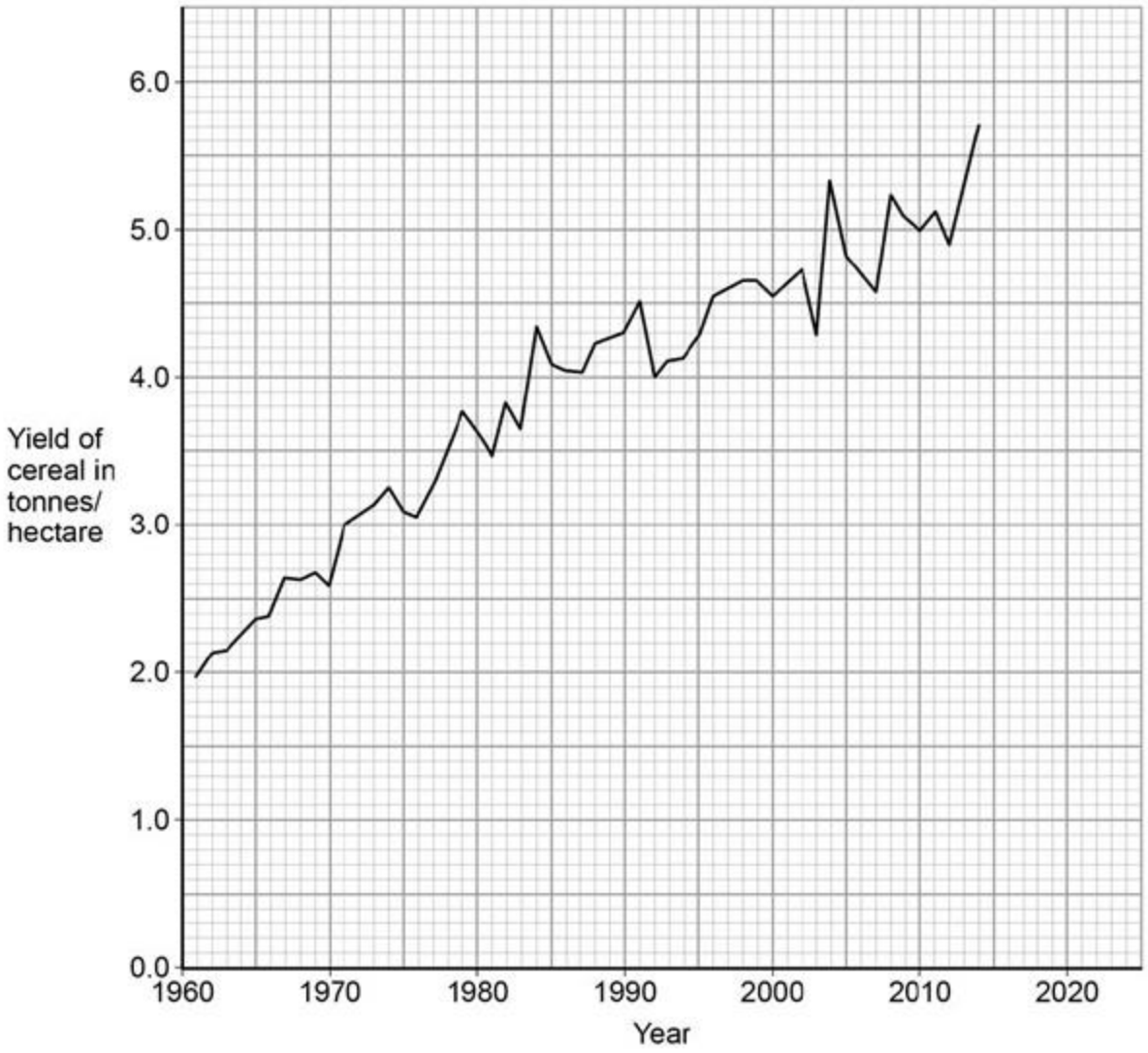
Glucose can be stored as _____ .

(3)

(Total 14 marks)

Q7.

The graph shows information about the yield of cereal crops grown in the European Union.



(a) Calculate the increase in the yield of cereal between 1970 and 2010.

_____

_____

_____

Increase in yield = _____ tonnes/hectare

(2)

(b) Estimate by what fraction the yield of cereal increased between 1971 and 1992.

Tick **one** box.

$\frac{1}{10}$ ☐ $\frac{1}{3}$ ☐ $\frac{1}{2}$ ☐ $\frac{3}{4}$ ☐

(1)

(c) The increase in yield is partly due to increased use of nitrate fertilisers.

Which substance do plants make using nitrate ions?

Tick **one** box.

Cellulose ☐

Fat ☐

Protein ☐

Starch ☐

(1)

(d) The yield of cereal in 2004 was much greater than the yield in 2003.

Suggest **three** possible reasons for the increased yield in 2004.

Tick **three** boxes.

A genetically-modified variety of seed was sown in 2004. ☐

A pathogenic fungus grew on the cereal in 2004. ☐

Farmers added more nitrate to the soil in 2003. ☐

More cereal seeds were sown in 2003. ☐

More rain fell in spring and early summer in 2004. ☐

The mean summer temperature was lower in 2003. ☐

(3)

Humans eat cereals.

Humans also eat the animals that feed on cereals.

Figure 1 and **Figure 2** show two food chains.

Figure 1

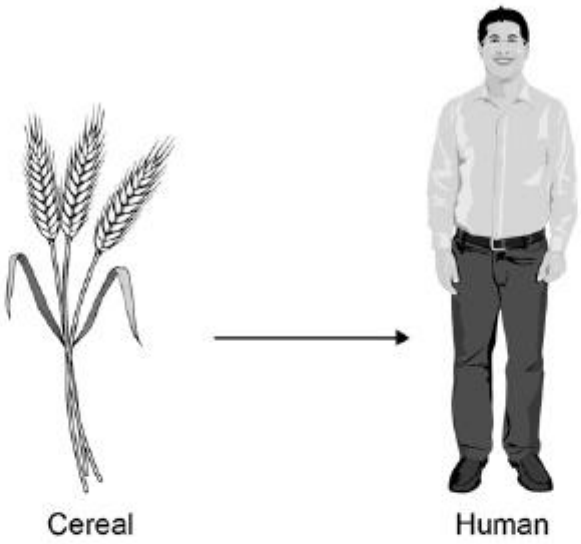
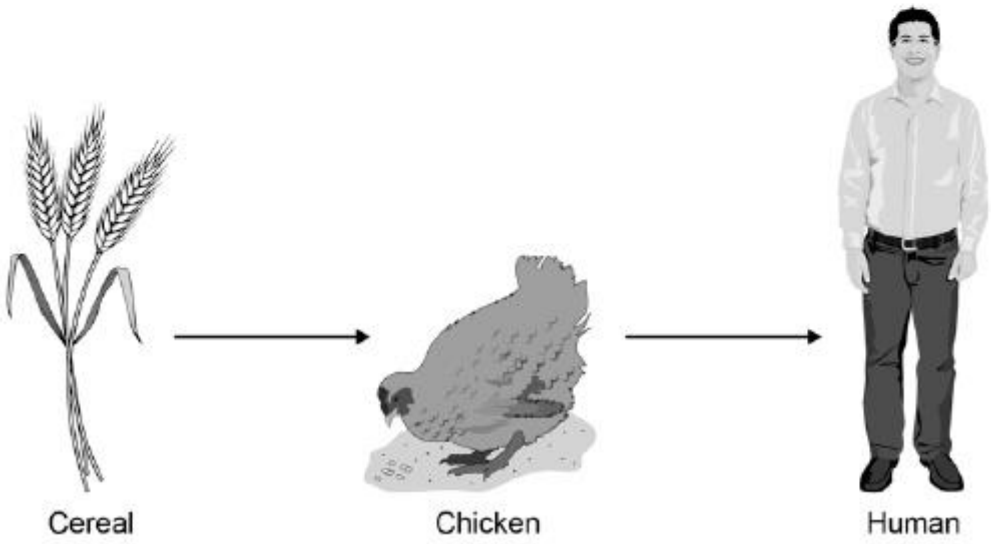
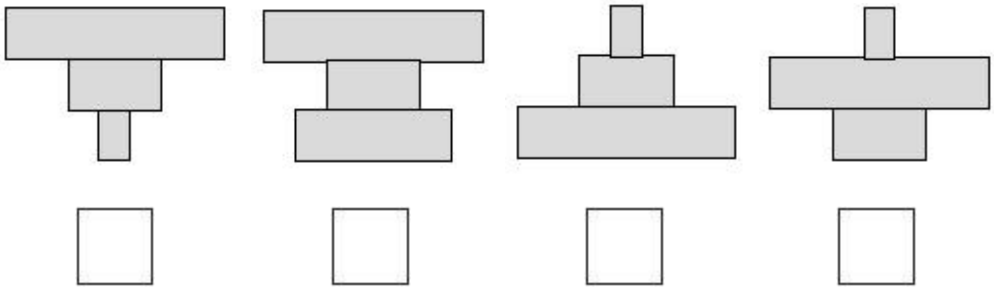


Figure 2



(e) Which pyramid of biomass is correct for the food chain shown in **Figure 2**?

Tick **one** box.



In **Figure 1**, 1 hectare of cereal crop would provide enough energy for 8 people for a year.

In **Figure 2**, 10 hectares of cereal crop would be needed to provide enough energy for only 1 person for a year.

(f) It is much more efficient for humans to get energy by eating cereals than by eating chickens.

Calculate how many times more efficient.

_____

_____

_____

_____

Answer = _____ times

(1)

(g) Why is it more efficient for humans to get energy by eating cereals than by eating chickens?

Tick **two** boxes.

Cereals gain extra energy from mineral ions in the soil. ☐

Chickens contain more protein per gram than cereals. ☐

Chickens use energy for movement and for keeping warm. ☐

Much of the food eaten by chickens is wasted as faeces. ☐

Not all parts of the cereal plants are edible. ☐

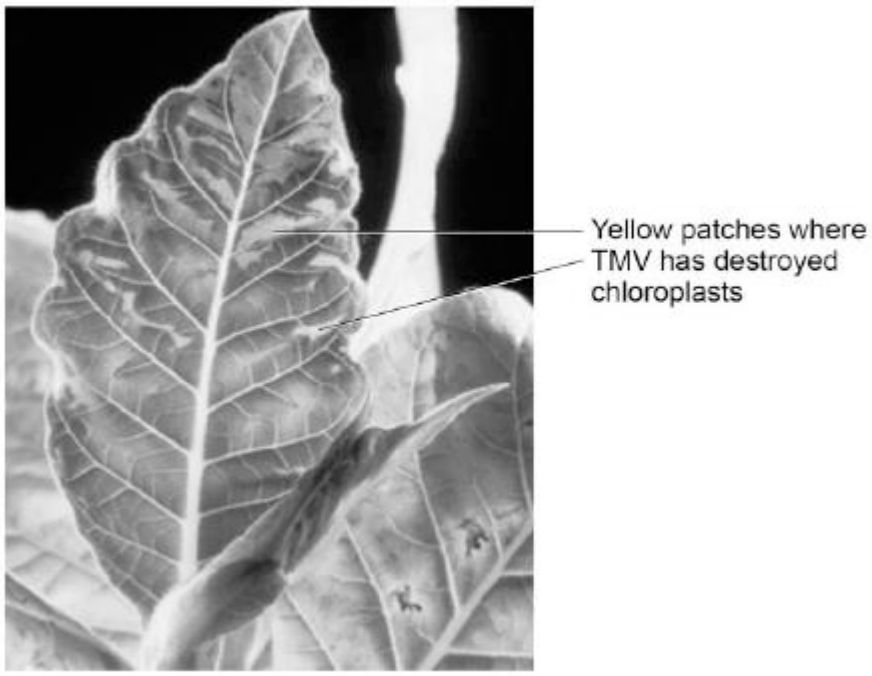
(2)

(Total 11 marks)

Q8.

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

The diagram below shows a leaf infected with TMV.



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

Suggest why.

_____

_____

_____

_____

(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.

(1)

(c) Some plants produce fruits which contain glucose.

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

(2)

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

This causes leaf discoloration.

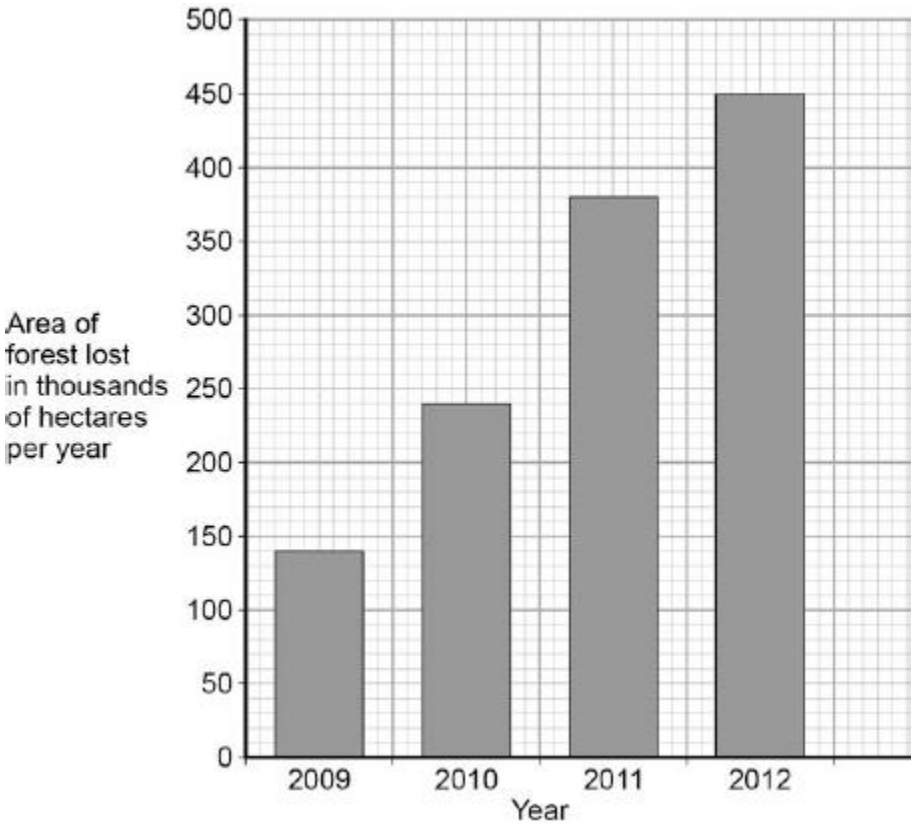
Explain why plants with TMV have stunted growth.

(4)

(Total 8 marks)

Q9.

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.

_____

_____

_____

_____

(1)

(Total 8 marks)

Q10.

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.

_____

_____

_____

_____

_____

_____

_____

_____

(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.

_____

_____

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.

_____

_____

_____

_____

(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.

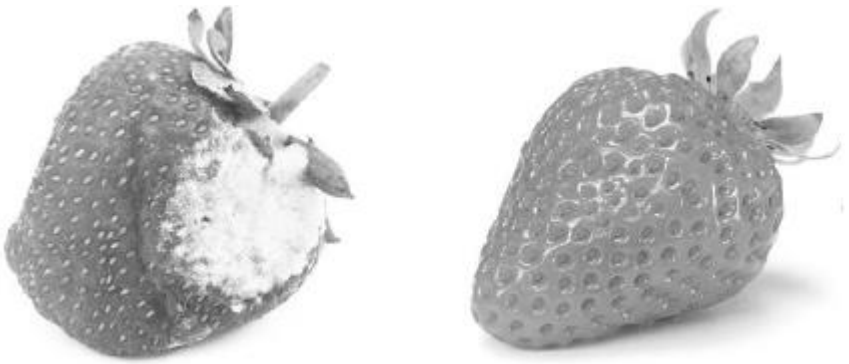
Explain how the carbon is recycled into the growth of new leaves.

(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. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

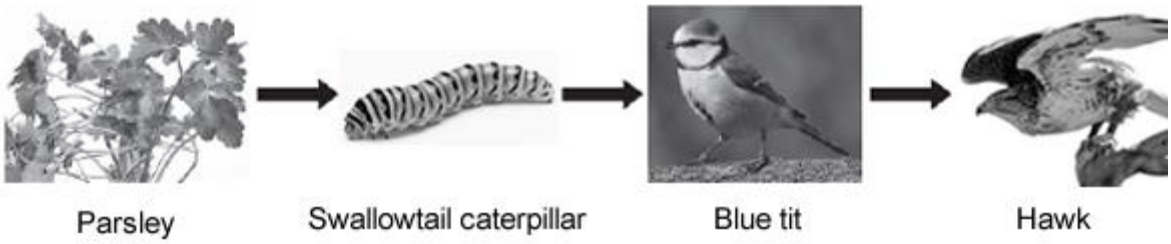
(3)

(Total 13 marks)

Q11.

Figure 1 shows how energy and biomass pass along a food chain.

Figure 1



(a) The parsley shown in **Figure 1** carries out photosynthesis.

_____

_____

_____

_____

_____

_____

_____

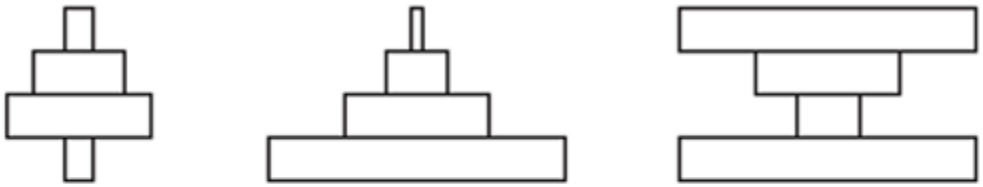
_____

(2)

(b) Which diagram shows the pyramid of biomass for the food chain in **Figure 1**?

Why is photosynthesis important in the food chain?

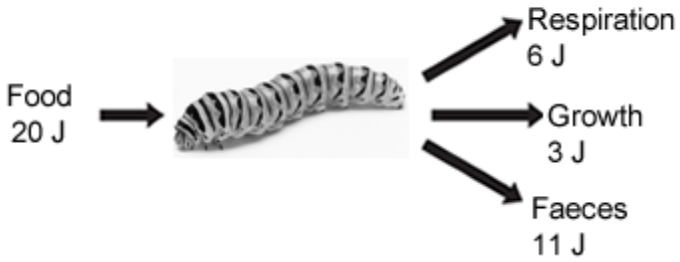
Tick (✓) **one** box.



(1)

(c) **Figure 2** shows the ways a swallowtail caterpillar transfers 20 J of energy from food.

Figure 2



What percentage of the energy in the caterpillar's food is used for growth?

_____

_____

_____

_____

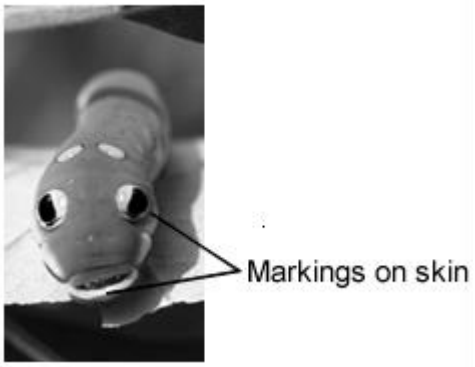
Percentage = _____

(2)

(d) The organisms in the food chain are adapted for survival.

(i) **Figure 3** shows a swallowtail caterpillar seen from the back.

Figure 3



Suggest how the swallowtail caterpillar shown in **Figure 3** is adapted to reduce the chance of being eaten by blue tits.

_____

_____

_____

_____

_____

_____

_____

(2)

(ii) **Figure 4** shows a hawk.

Figure 4

Suggest **two** ways that the hawk is adapted to catch and kill blue tits.

1. _____

2. _____

(2)

(Total 9 marks)

Q12.

Over millions of years:

- new groups of organisms have evolved

- other groups of organisms have become extinct.

(a) If an asteroid collided with the Earth, large amounts of dust and water vapour would be thrown up into the air. This would mean less light and heat would reach the Earth's surface from the Sun.

(i) A reduced amount of light and heat could have caused the extinction of plants.

Suggest how.

_____

_____

_____

_____

(1)

(ii) How could the extinction of plants have caused the extinction of some animals?

_____

_____

_____

_____

(1)

(iii) Give **two** reasons, other than collision with an asteroid, why groups of animals may become extinct.

1.

_____

_____

_____

_____

2.

_____

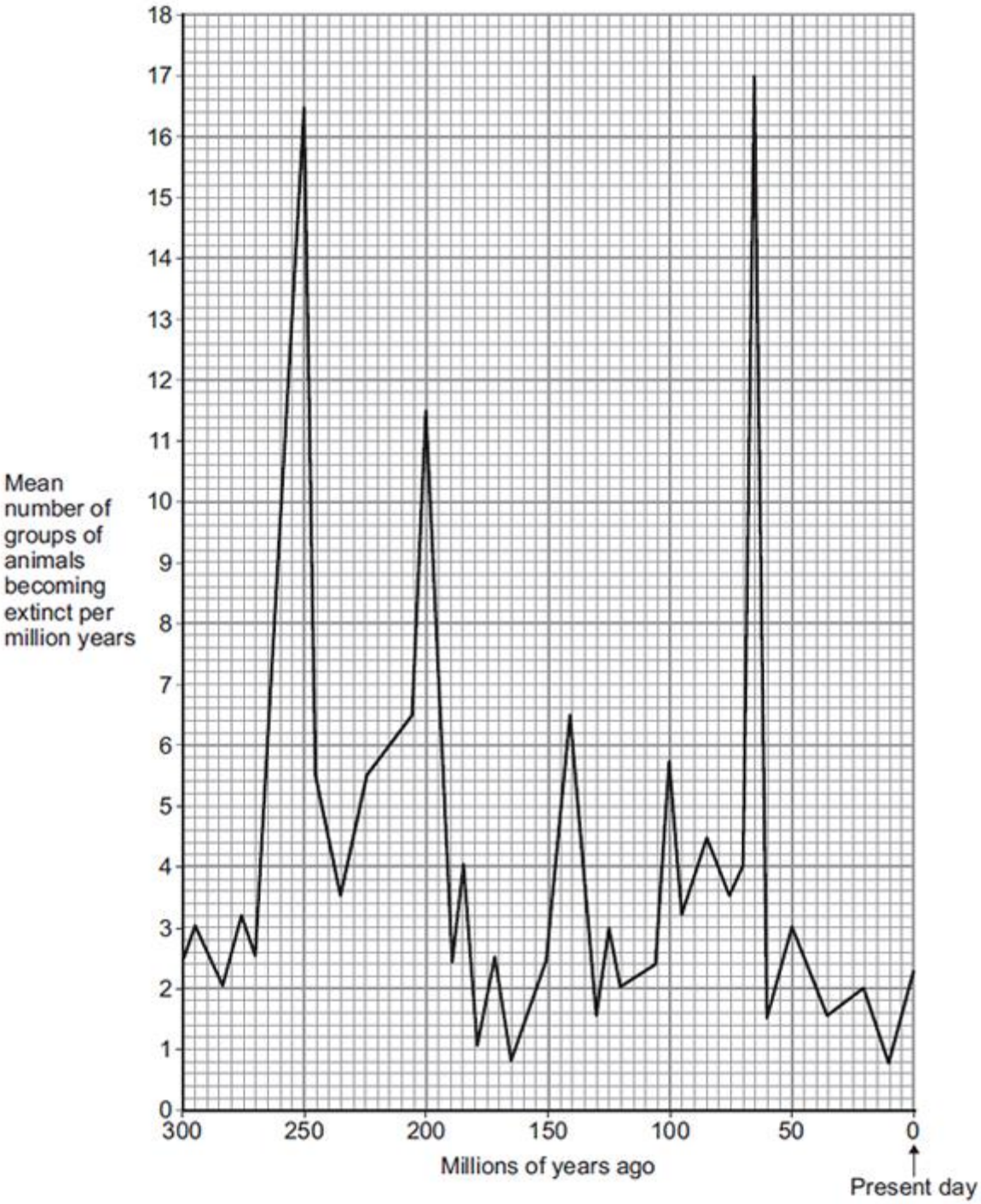
_____

_____

_____

(2)

(b) The graph shows how the rate of extinction of groups of animals has varied over the past 300 million years.



(i) If more than 10 groups of animals become extinct in a 1 million year period, scientists call this a 'mass extinction'.

How many mass extinctions occurred over the past 300 million years?

_____

(1)

(ii) How do we know what types of animals lived hundreds of millions of years ago?

_____

_____

(1)

(c) Use information from the graph to answer part (i) and (ii).

(i) How many years ago did the most recent mass extinction of animals occur?

Tick (✓) **one** box.

50 million years ago ☐

65 million years ago ☐

250 million years ago ☐

(1)

(ii) What was the mean number of groups of animals becoming extinct per million years in the most recent mass extinction?

_____ groups per million years

(1)

(iii) Why are scientists not sure how many groups of animals became extinct in the most recent mass extinction?

_____

_____

(1)

(Total 9 marks)

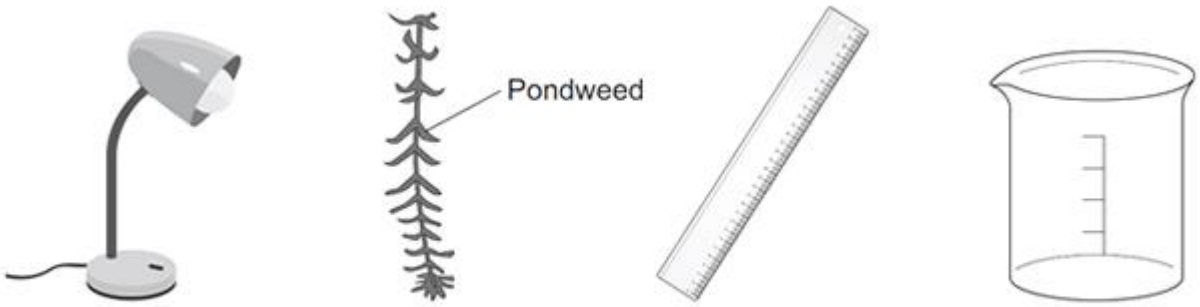
Q13.

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

Light intensity, carbon dioxide concentration and temperature are three factors that affect the rate of photosynthesis.

How would you investigate the effect of **light intensity** on the rate of photosynthesis?

The image below shows some of the apparatus you might use.



Not to scale

You should include details of:

- how you would set up the apparatus and the materials you would use
- the measurements you would make
- how you could make this a fair test.

(Total 6 marks)

Q14.

Photosynthesis needs light.

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

$$6CO_2 + \underline{\qquad\qquad} \xrightarrow{\text{light}} \underline{\qquad\qquad} + 6O_2$$

(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**?

_____

_____

(1)

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

_____

_____

_____

_____

_____

(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

_____

_____

_____

Explanation

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q15.

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?

_____

_____

(1)

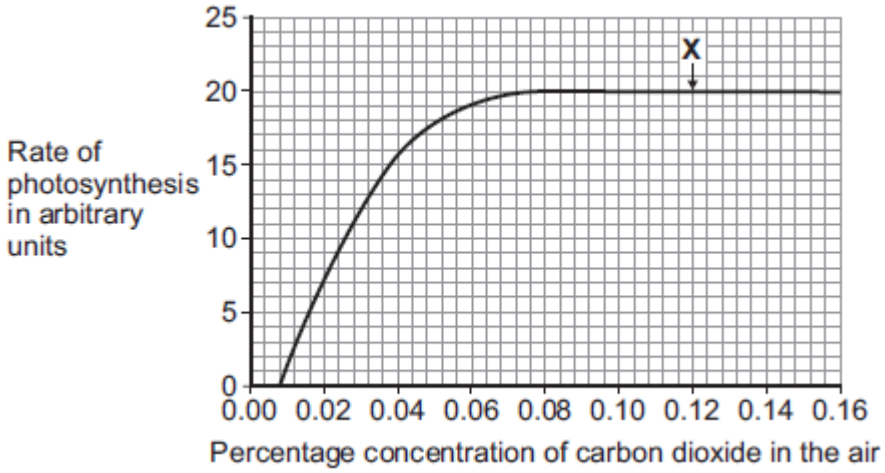
(iii) Which part of a plant cell absorbs the energy needed for photosynthesis?

_____

_____

(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)

Q16.

Green plants can make glucose.

(a) Plants need energy to make glucose.

How do plants get this energy?

_____

_____

_____

_____

_____

_____

(2)

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

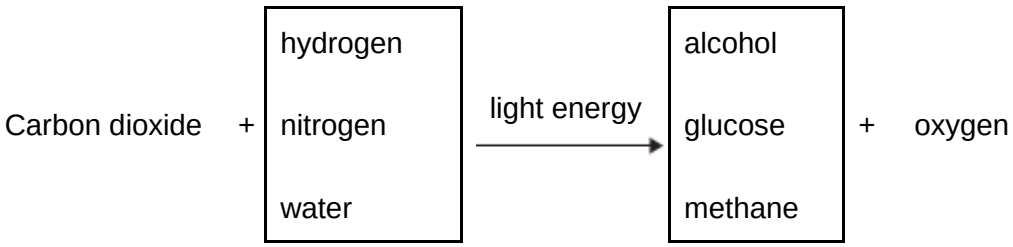
Give **four** other ways in which plants use the glucose they have made.

(4)

(Total 6 marks)

Q17.

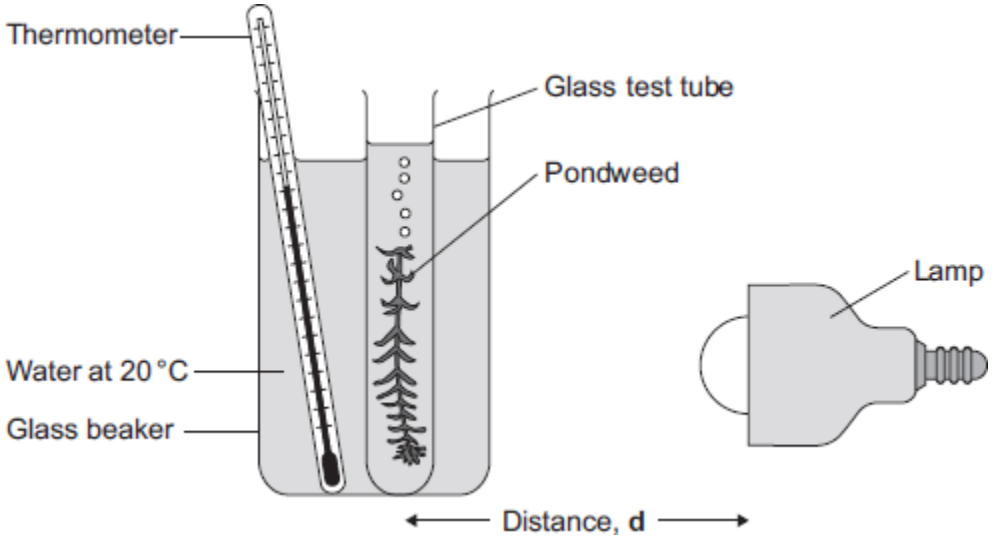
(a) Complete the equation for photosynthesis. Draw a ring around each correct answer.



(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?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(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.

_____

_____

_____

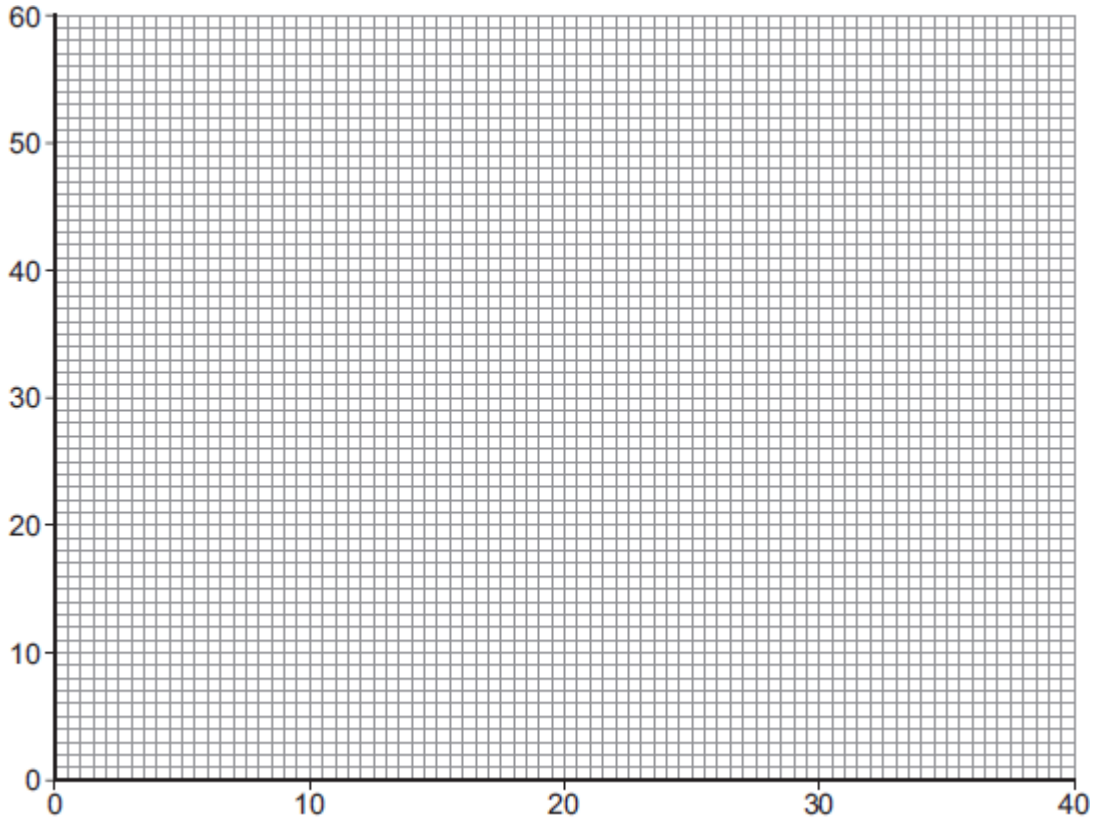
_____

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.



Distance **d** in cm

(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?

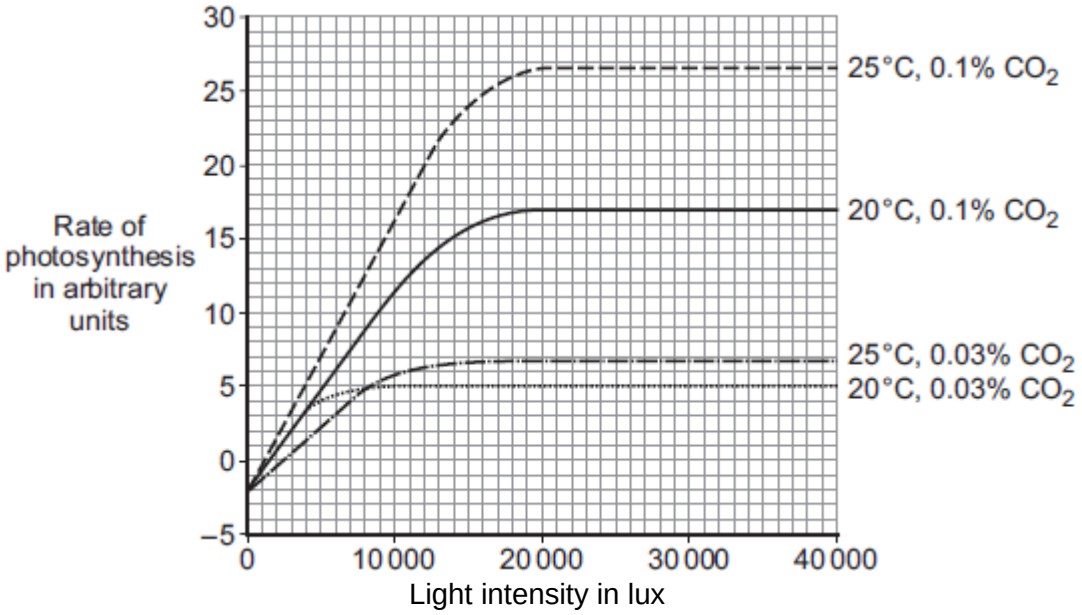
Explain your answer.

(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% CO_2
- no extra lighting.

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

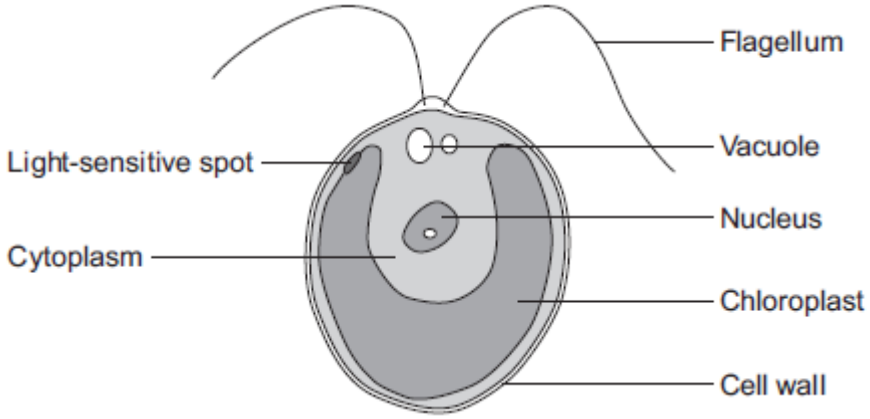
You should use information from the scientists' graph in your answer.

(4)

(Total 17 marks)

Q18.

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

_____

(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.

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

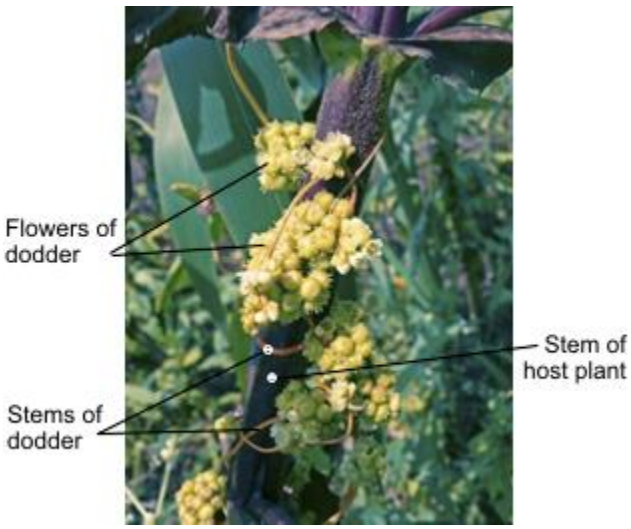
Q19.

(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.



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

What is the function of chlorophyll in most plants?

_____

_____

_____

_____

_____

_____

_____

_____

(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.

_____

_____

(1)

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

_____

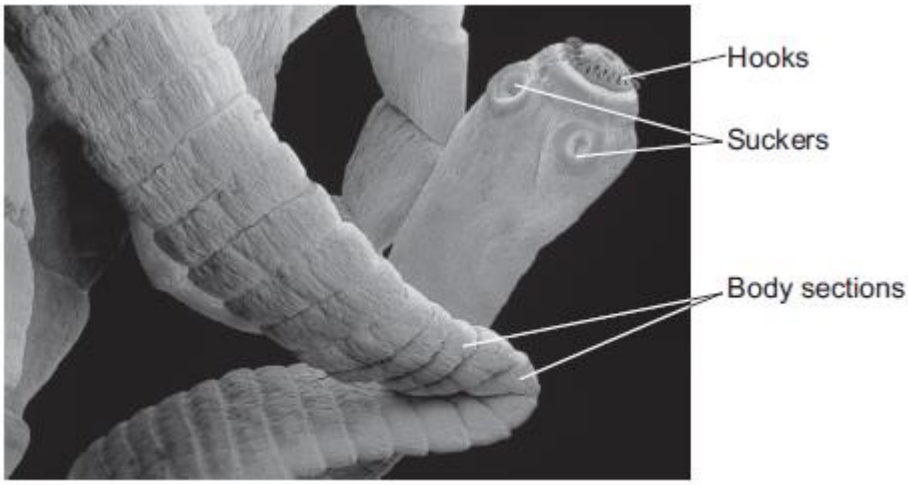
_____

(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.



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.

_____

_____

Extra space

(6)
(Total 10 marks)

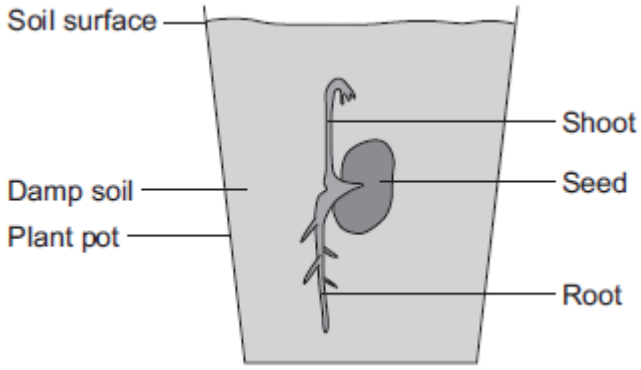
Q20.

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)

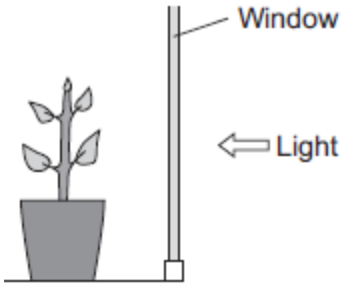
(ii) After the 5 days, the shoot had grown

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

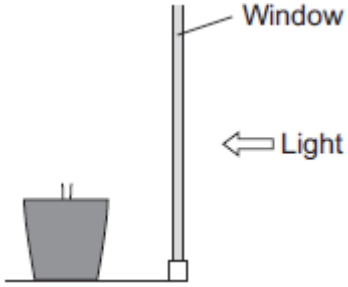
(1)

(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).

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q21.

(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

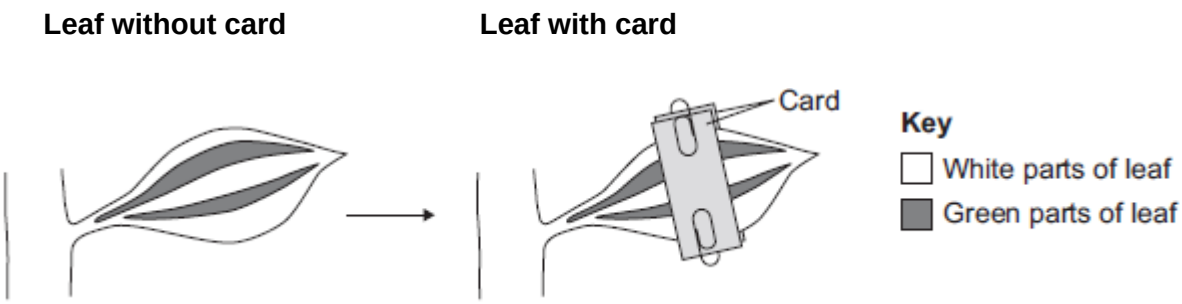
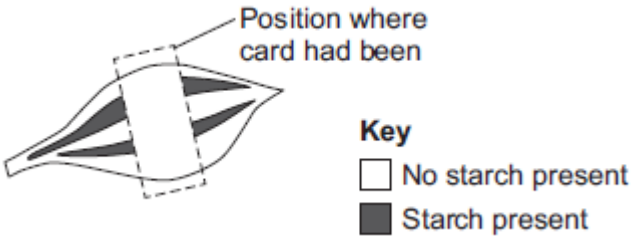


Figure 2 shows the same leaf after 2 days in the light.
The leaf has been tested for starch.

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. ☐

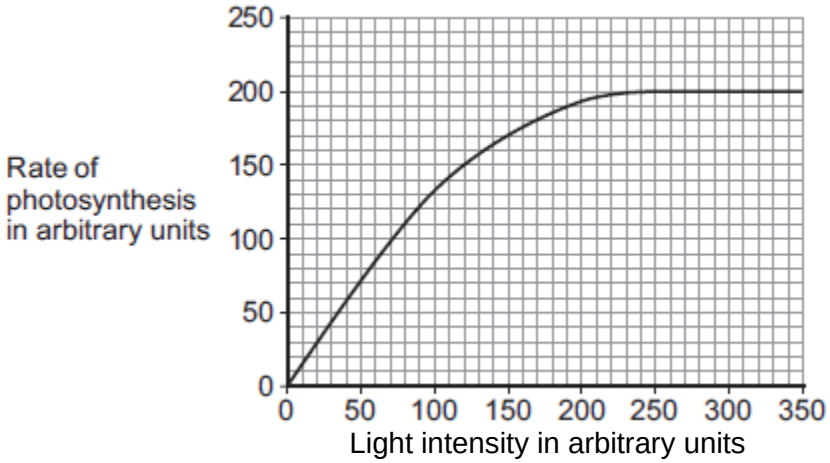
Water is needed for photosynthesis. ☐

(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.

(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**?

_____

_____

_____

_____

(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)

Q22.

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.

Extra space

_____

_____

_____

_____

_____

_____

_____

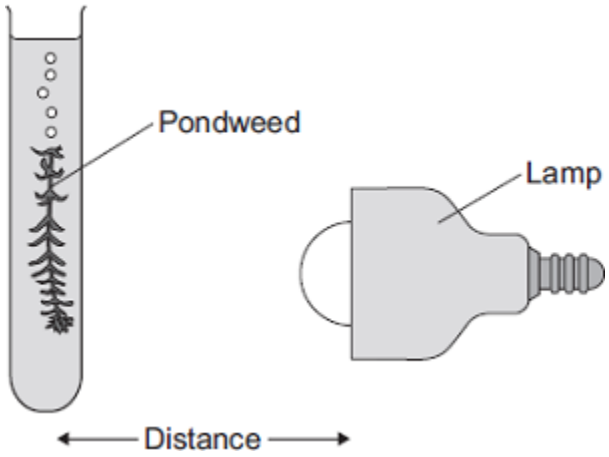
(Total 6 marks)

Q23.

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?

_____

_____

_____

_____

(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?

_____

_____

_____

_____

(1)

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

_____

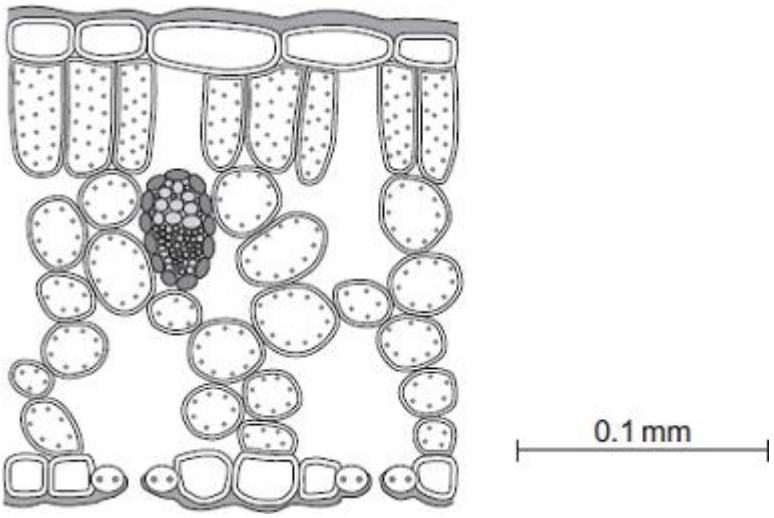
_____

(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.

_____

_____

_____

(6)

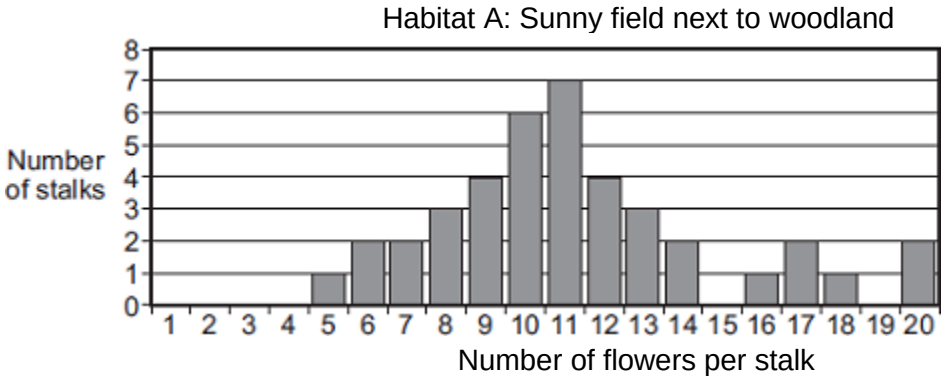
(Total 9 marks)

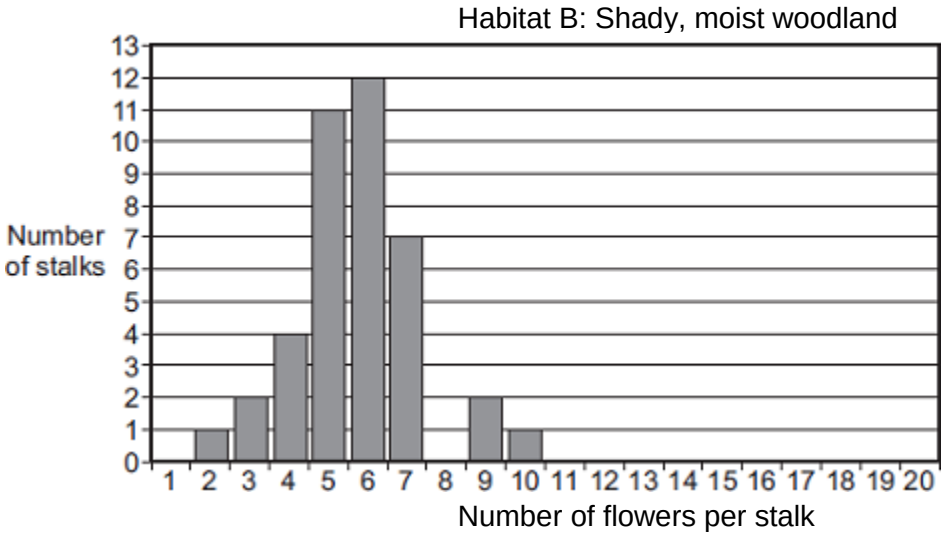
Q24.

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.

_____

_____

_____

_____

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

_____

_____

_____

_____

_____

_____

(2)

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

_____

_____

_____

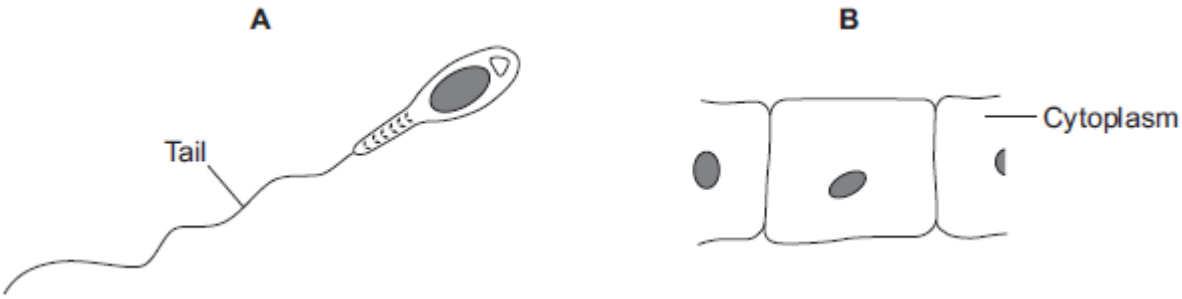
_____

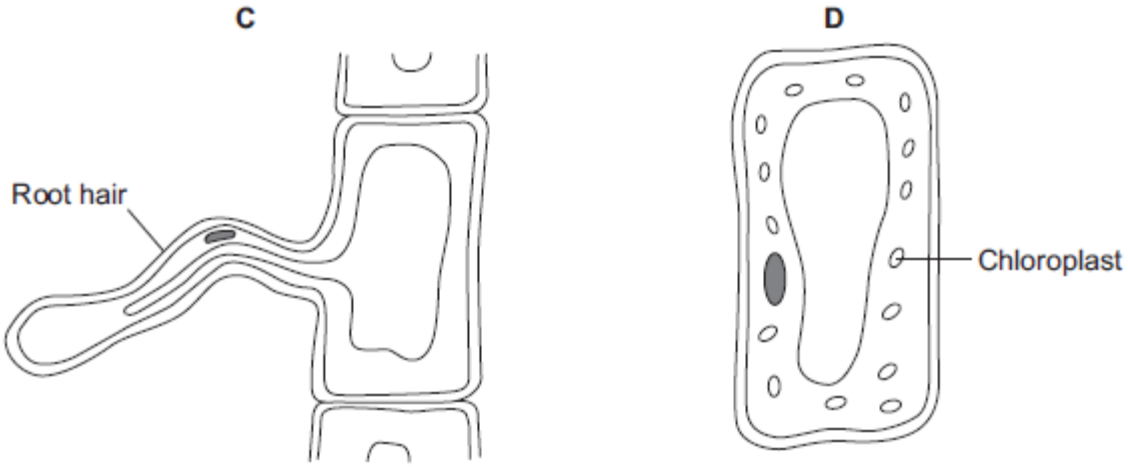
(2)

(Total 9 marks)

Q25.

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)

Q26.

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. ☐

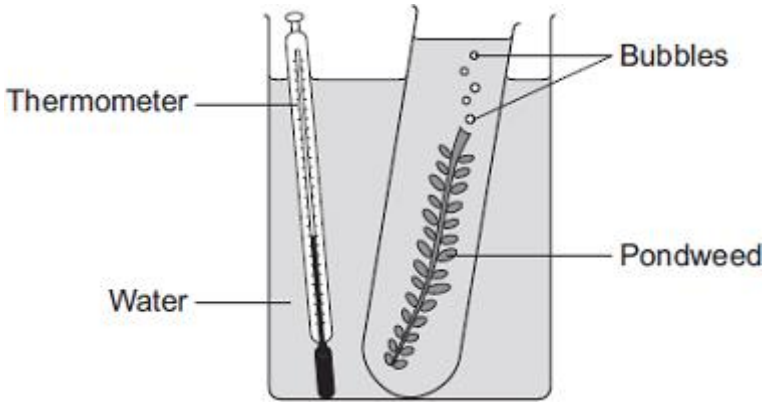
The starch is stored for use later. ☐

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.

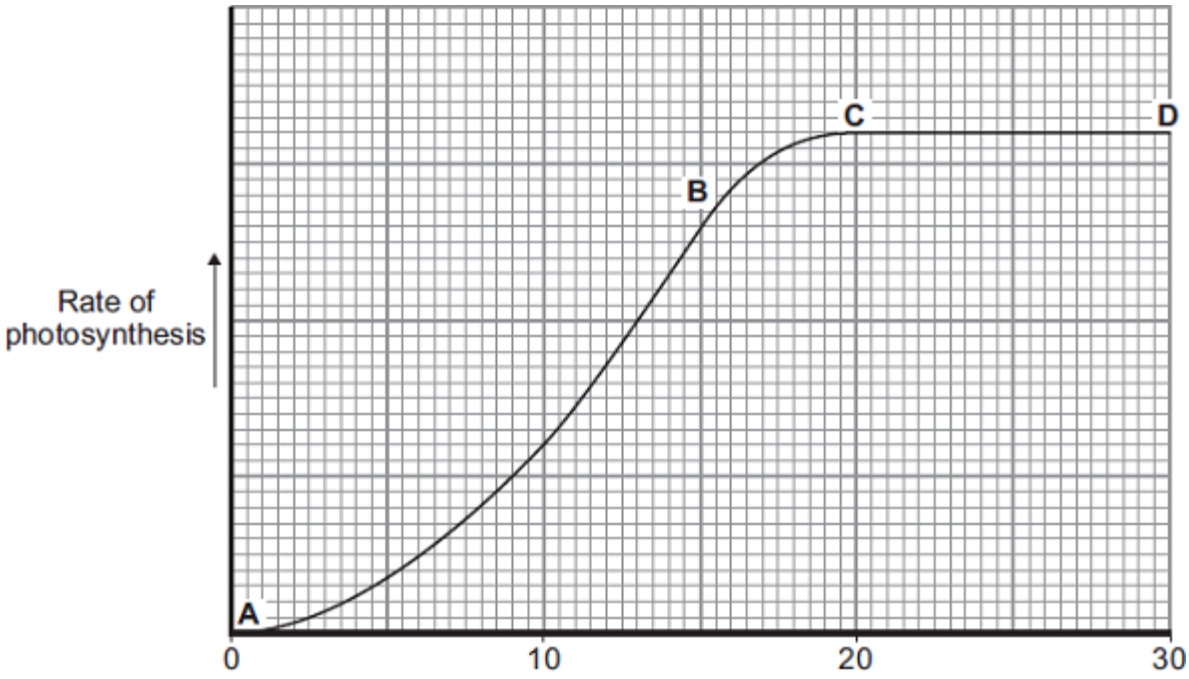
What **two** measurements would the student make to calculate the rate of photosynthesis?

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.

_____

(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)

Q27.

(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. _____

_____

2. _____

_____

3. _____

_____

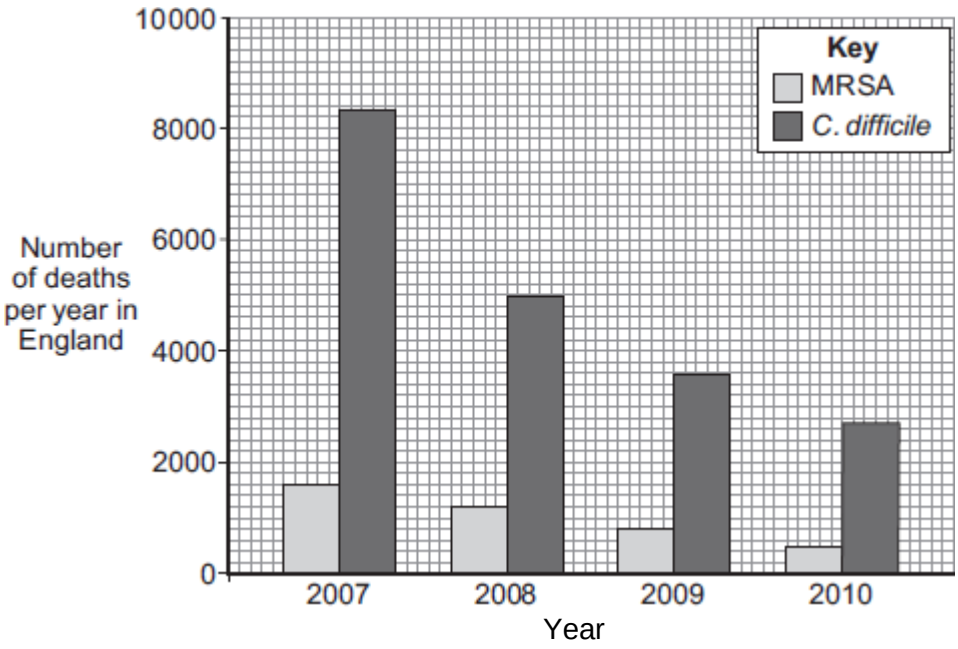
(3)

(Total 7 marks)

Q28.

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*.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

Explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

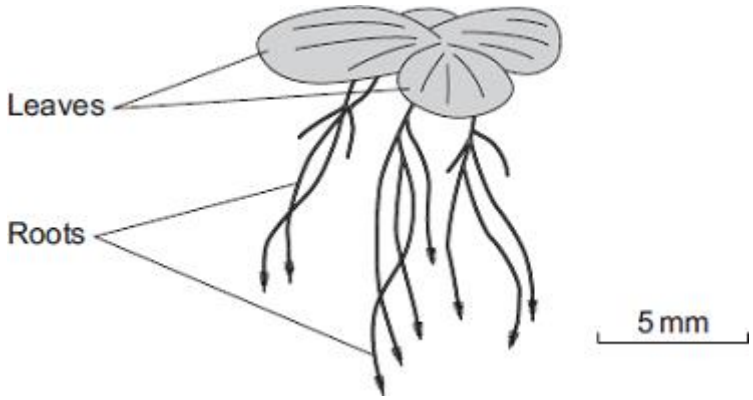
(3)

(Total 10 marks)

Q29.

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

	Concentration of mineral ions in mg

Mineral ion	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.

_____

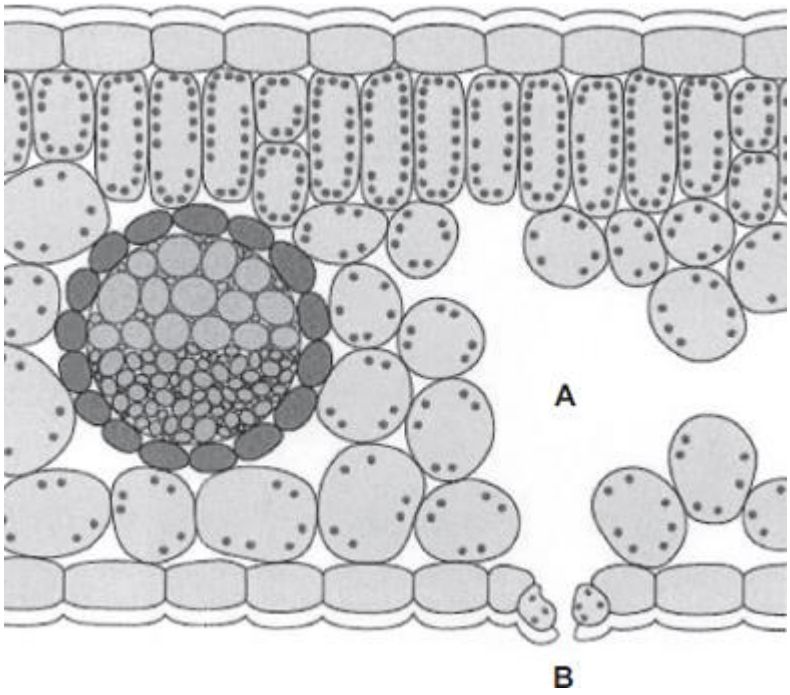
_____

(1)

(Total 5 marks)

Q30.

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)

Q31.

(a) Complete the equation for photosynthesis.

_____ + water $\xrightarrow{\text{light energy}}$ _____ + _____

(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.

(5)

(Total 8 marks)

Q32.

(a) Complete the word equation for photosynthesis.

Use words from the box.

chlorophyll	**minerals**	**oxygen**	**water**

carbon dioxide + _____ → glucose + _____

(2)

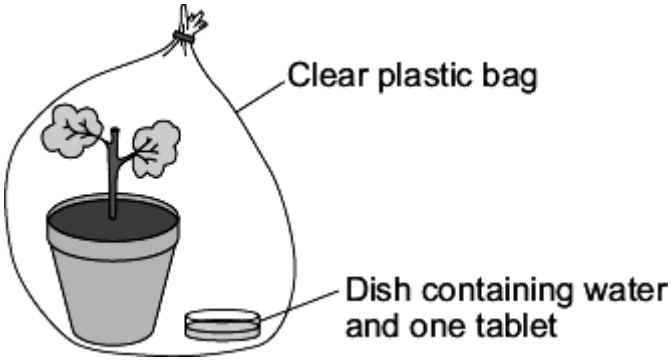
(b) Plants may grow faster if they have more carbon dioxide.

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.

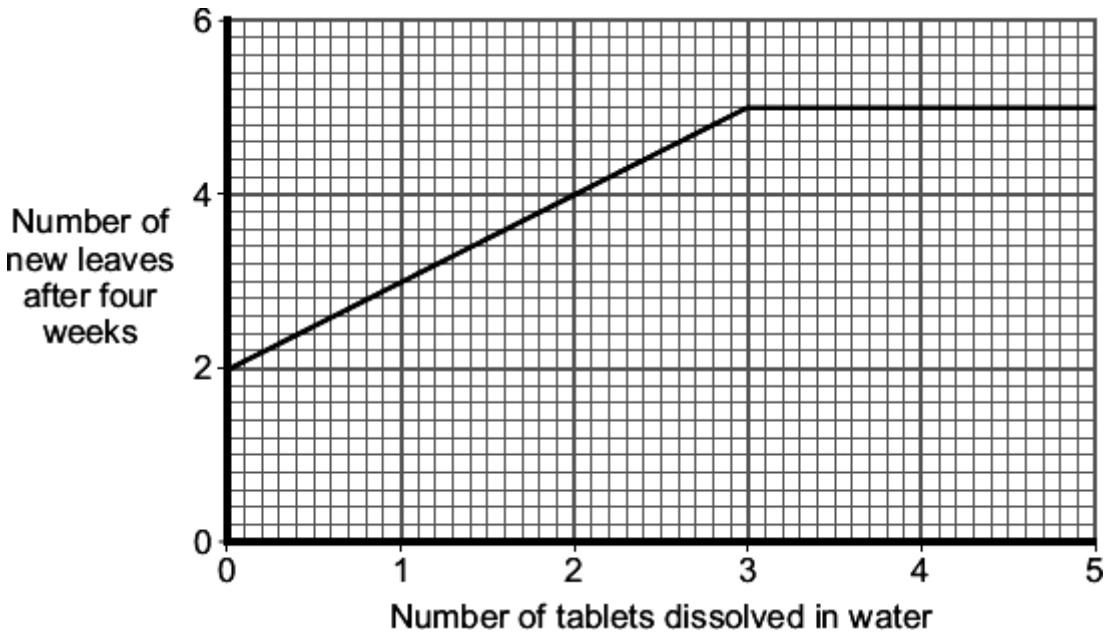
Explain why.

_____

(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.

_____

_____

_____

_____

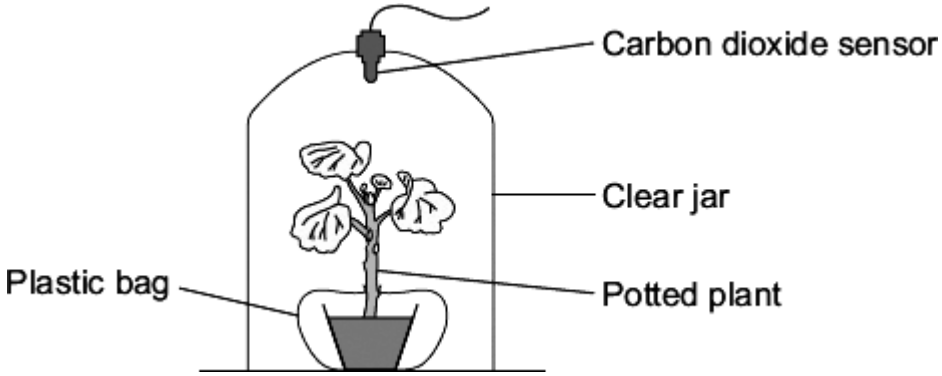
(3)

(Total 7 marks)

Q33.

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

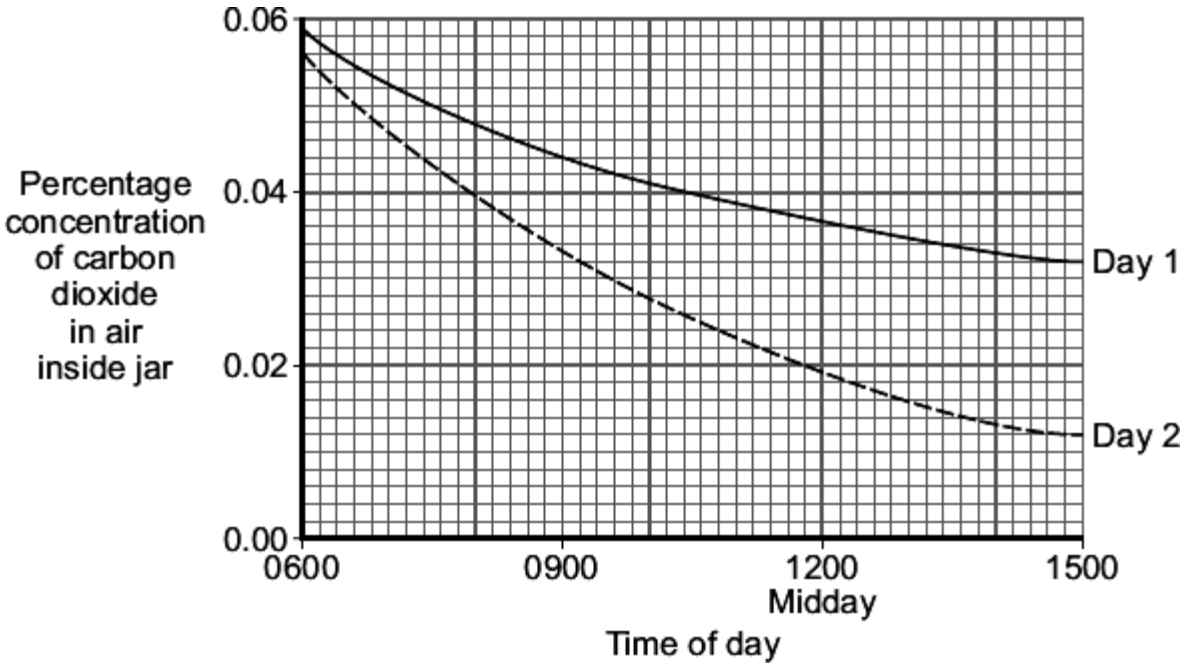
The diagram shows the student's apparatus.



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)

Q34.

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 → **caterpillar** → **blue-tit** → **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)

Q35.

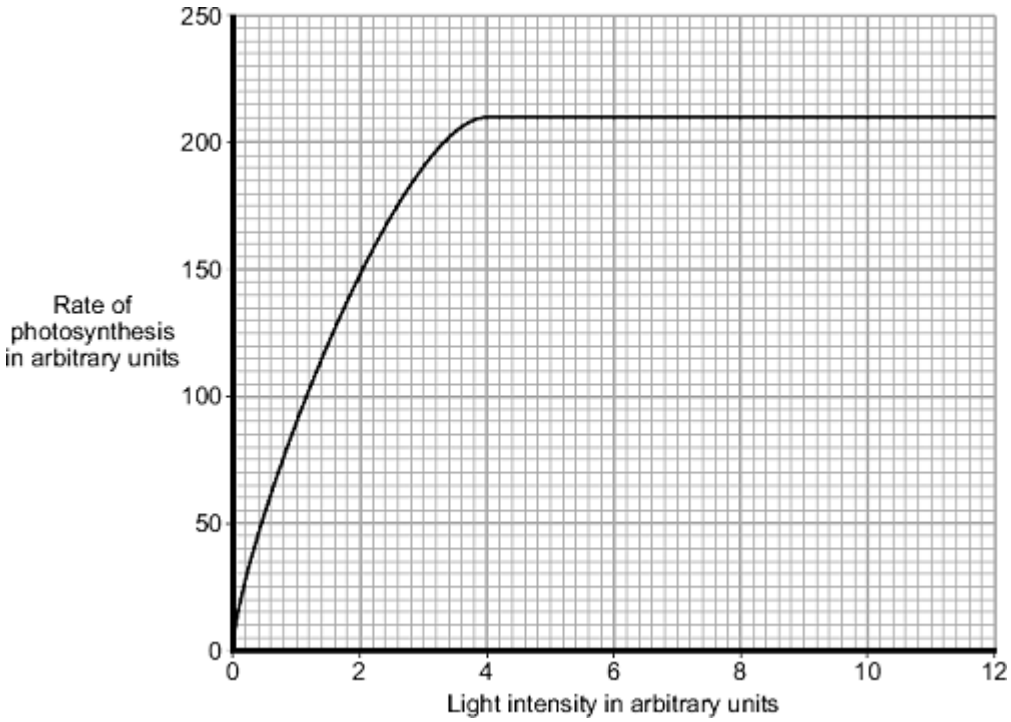
(a) Complete the equation for photosynthesis.

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.

_____

_____

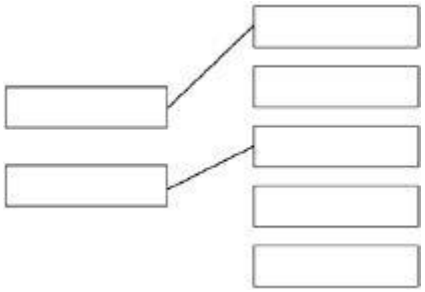
(1)

(Total 5 marks)

Mark schemes

Q1.

(a)



additional line from a level of organisation negates the mark for that level of organisation

2

(b) palisade mesophyll

1

(c) $\frac{50}{8}$

1

6 / 6.25 / 6.3 (micrometres)

1

*an answer of 6 / 6.25 / 6.3 scores **2** marks*

(d) they have no chloroplasts / chlorophyll

allow they are underground
allow they don't get (access to) light
allow (because) photosynthesis needs light
allow they can't absorb light
ignore 'sun'
ignore 'it is dark'

1

(e) differentiation

1

(f) to protect endangered plants from extinction

1

(g) plants can be produced quickly

1

(h) any **one** from:

- glucose / sugars / starch
- amino acids / protein
- hormones

  allow named hormones e.g. auxin
- ions / minerals

  allow magnesium / nitrate

- vitamins
  allow named vitamins e.g. vitamin B
- water
  allow H_2O / H2O
  ignore oxygen / carbon dioxide / agar / nutrients / fertiliser

1

[10]

Q2.

(a) phloem

1

(b) translocation

1

(c) either:

less (sugars for) respiration

1

(so) less energy released

1

or

less amino acids made (1)

(so) less protein produced **or** less protein synthesis (1)

or

less cellulose made (1)

(so) weaker cell walls (1)

(d) (aphids) can fly to another plant **or** part of the plant
ignore to fly unqualified

1

to get (more) food
allow to find a mate
allow idea of less competition for food
allow to escape predators
*do **not** accept escape prey*

1

(e) (oil) prevents aphids from attaching to leaf **or** causes aphids to slide off leaf
ignore 'the leaf is slippery'

or
idea that oil may harm / kill the aphid
allow oil may be unpleasant to the aphid

1

(f) (plant / stem has) thorns

allow spines / spikes / prickles
ignore stings
*do **not** accept thorns protect (the plant) from predators*

1

(g) C

if any other letter given then no marks for the question

1

(fungi / spores) blown by / in direction of the wind

allow black spot / disease is blown by / in direction of the wind

or
it's the closest plant (to A)

*do **not** accept reference to bacteria / viruses / pollen being blown*

1

(h) any **one** from:

- spread rose bushes out more

allow isolate the infected plant
allow idea of barrier around infected plant
ignore separate unless qualified

- remove any infected parts of the plant

allow remove infected plant / A

- use a fungicide

ignore pesticide
*do **not** accept insecticides / herbicide*

1

[11]

Q3.

(a) (mouthpiece) has pierced / entered the phloem
or
(the aphid) has been feeding from the phloem

1

(b) yellow leaves due to lack of chlorophyll

ignore 'chloroplasts'
ignore magnesium is needed to make chlorophyll

1

(therefore) less / no light absorbed (by chlorophyll)

1

(therefore) lower rate of / no photosynthesis

*do **not** allow 'energy is produced by*

photosynthesis'

1

(therefore) plant makes less / no sugar / glucose

1

(therefore) plant converts less / no sugar / glucose into protein (for growth, so growth is stunted)

allow less glucose / sugar converted into cellulose (cell wall)
allow less energy for protein synthesis

1

(c) inject the protein / it into a mouse

1

combine lymphocytes with tumour / cancer cells to make hybridoma (cells)

ignore white blood cells
allow T or B lymphocytes
ignore tumour unqualified

1

find a hybridoma which makes a monoclonal antibody specific to PVY

1

(the scientist) clones (the hybridoma) to produce many cells (to make the antibody)

*do **not** allow cloning of original stem cells*
allow many rounds of cloning / mitosis

1

[10]

Q4.

(a)

	1960 − 1977	**1977 − 2003**	**2003 − 2015**
trend in carbon dioxide concentration		increasing	increasing
trend in air temperature	decreasing	increasing	constant / decreasing

1

1

allow synonyms e.g. level / goes up / goes down

(b) traps heat / energy or (long-wavelength / IR) radiation

*do **not** accept light / UV*

or

less loss of heat

allow stops (some) heat escaping
*do **not** accept stops all heat escaping*

or

insulates

ignore greenhouse effect
ignore reference to ozone layer

1

(c) **Level 2:** Some logically linked reasons are given. There may also be a simple judgement.

3–4

Level 1: Relevant points are made. They are not logically linked.

1–2

No relevant content

0

Indicative content

for the theory:
- (overall increased CO_2 parallels) overall increased temperature (e.g. by 0.4 (°C))
- CO_2 traps (long-wave) radiation / IR / heat

against the theory:
- in some years (e.g. 1960–1977) temperature falls (while CO_2 is rising)
- many (large and small) erratic rises and falls in temperature
- overall correlation does not necessarily mean a causal link
- other (unknown) factors may be involved in temperature change

to access level 2 there must be evidence both for and against the theory **and** use of data from the graph

(d) burning of (fossil) fuels

allow e.g. coal / oil / gas
allow driving cars
allow any activity which leads to burning fuels – e.g. using central heating

ignore power stations unqualified
ignore burning / fires unqualified
ignore deforestation

1

(e) photosynthesis

allow full description or full equation
allow a symbol equation which is not balanced

1

(f) any **two** from:
- (some) plants grow faster / higher yield
- loss of habitat
- migration **or** change in distribution*
- extinction*

if neither is given allow alters biodiversity for **1 mark*

allow (in terms of extinction) death due to e.g. lack of water / food or increased disease

ignore death unqualified

2

allow points made using examples

[11]

Q5.

(a) there is an uneven distribution of dandelions
or
(more) representative / valid
or
avoid bias
or
more accurate / precise mean

ignore accurate / precise unqualified
ignore repeatability / reproducibility / reliability / fair test

1

(b) (correct mean per m^2 =) 6 or 6.0

1

(correct field area =) 55 000 (m^2)

1

mean × area − e.g. 6(.0) × 55 000

allow incorrect calculated values for mean and / or field area

1

330 000

allow correct calculation from previous calculation

1

3.3×10^5

allow calculated value in standard form

1

*an answer of 3.3×10^5 scores **5** marks*
*an answer of 330 000 scores **4** marks*

(c) **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- placing of quadrat
- large number of quadrats used
- how randomness achieved − e.g. table of random numbers **or** random number button on calculator **or** along transect
- quadrats placed at coordinates **or** regular intervals along transect
- in each of two areas of different light intensities **or** transect running through areas of different light intensity
- for each quadrat count number of dandelions
- for each quadrat measure light intensity
- compare data from different light intensity

to access **level 3** the key ideas of using a large number of quadrats randomly, or along a transect, and counting the number of dandelions in areas of differing light intensity need to be given to produce a valid outcome

(d) any **two** from:

- temperature

  allow heat

- water

  allow moisture / rain

- (soil) pH

  allow acidity

- minerals / ions

  *allow e.g. magnesium ions **or** nitrate*
  allow salts / nutrients

- winds
- herbivores

  allow trampling
  ignore carbon dioxide
  ignore space
  ignore competition unqualified
  *do **not** accept oxygen*

2

[14]

Q6.

(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

(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

[14]

Q7.

(a) correct figures from graph: 5.0 / 5 and 2.60 / 2.6

2.40 / 2.4

*an answer of 2.40 / 2.4 scores **2** marks*

1

*allow correct answer from candidate's figures from graph for **1** mark*

1

(b) $\frac{1}{3}$

1

(c) protein

1

(d) a genetically-modified variety of seed was sown in 2004

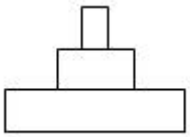
1

more rain fell in spring and early summer in 2004

1

the mean summer temperature was lower in 2003

1

(e) 

1

(f) 80

1

(g) chickens use energy for movement and for keeping warm

1

much of the food eaten by chickens is wasted as faeces

1

[11]

Q8.

(a) to kill virus
or
to prevent virus spreading

1

(b) take (stem) cells from meristem
or
tissue culture

allow take cuttings

1

(c) use Benedict's solution

1

glucoses turns solution blue to orange

1

(d) **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The student makes logical links between clearly identified, relevant points that explain why plants with TMV have stunted growth.

Level 1 (1–2 marks):
Simple statements are made, but not precisely. The logic is unclear.

0 marks:
No relevant content.

Indicative content
- less photosynthesis because of lack of chlorophyll
- therefore less glucose made
  so
- less energy released for growth
- because glucose is needed for respiration
  and / or
- therefore less amino acids / proteins / cellulose for growth
- because glucose is needed for making amino acids / proteins / cellulose

4

[8]

Q9.

(a) (140 + 240 + 380 + 450 =) 1210

1

(b) the local people decided to farm cattle

1

a company starts growing plants for biofuels

1

(c) carbon dioxide
in this order only

1

photosynthesis

1

(d) animals and birds migrate because there is less food

1

more habitats are destroyed

1

(e) any **one** from:
- breeding programmes (for endangered species)
- regeneration (programmes)
- reintroduction of field margins / hedgerows
- awareness raising with politicians / public
- recycling

1

[8]

Q10.

(a) methane is produced
ignore bad smell

1

which is a greenhouse gas / causes global warming

1

(b) (9.80 / 0.20 = 49 therefore) 49:1

1

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

Level 2 (3–4 marks):
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

Level 1 (1–2 marks):
Simple statements are made, but no attempt to link to explanations.

0 marks:
No relevant content.

Indicative content

statements:
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

explanations:
- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

use of carbon in growth:
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

6

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

allow reference to bacteria / fungi / mould

3

[13]

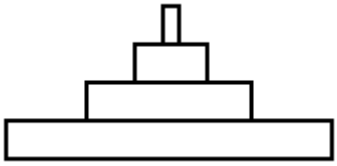
Q11.

(a) any **two** from:

- *idea of* absorption of light / energy
- transfer to chemical energy

  allow produce sugars / glucose / starch / carbohydrate / food / biomass
- provides food / energy for animals / caterpillar
- releases oxygen

2

(b) 

1

(c) 15(%)

*allow **1** mark for* $\frac{3 \times 100}{20}$ *with no answer or incorrect answer*

or

*allow **1** mark for 0.15*

2

(d) (i) any **two** from:

- markings look like eyes / face / mouth of much larger animal
- looks fierce / scary / dangerous

  allow it looks like a snake
- to frighten blue tit / bird

max 1 if reference to camouflage

2

(ii) any **two** from:

- sharp / long / big claws

  ignore strong
- sharp / hooked beak

  ignore strong / big
- large wings **or** flies quickly

  allow streamlined / aerodynamic

  ignore powerful wings
- good eyesight

2

[9]

Q12.

(a) (i) reduced photosynthesis

ignore growth

*do **not** allow need light for respiration*

1

(ii) less food (for animals) **or** less oxygen (for animals)

allow loss of habitat

1

(iii) any **two** from:

accept 2 physical factors or 2 biological factors or one of each for full marks

examples of physical factors, eg
- flooding
- drought
- ice age / temperature change
  ignore pollution
- volcanic activity

examples of biological factors, eg
- (new) predators (allow hunters / poachers)
- (new) disease / named pathogen
- competition for food
- competition for mates
- cyclical nature of speciation
- isolation
- lack of habitat or habitat change

*If no other answers given allow natural disaster / climate change / weather change / catastrophic event / environmental change for **1** mark*

2

(b) (i) 3

1

(ii) fossils

ignore bones, remains, fossil fuels

1

(c) (i) 65 million years ago

1

(ii) 17

allow ecf

1

(iii) fossil record incomplete
or
some fossils destroyed

accept not enough evidence

or

cannot perform experiment to test

1

[9]

Q13.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

Level 3 (5–6 marks):
A description of how the apparatus is used to measure the **rate** of photosynthesis at different light **intensities** is given.

For full marks reference must be made to a control variable
or
repeats

Level 2 (3–4 marks):
A description of how the apparatus is set up
and
a description of how photosynthesis can be measured.
or
a description of how light intensity is varied
or
a control variable **or** any other relevant point

Level 1 (1–2 marks):
A partial description of how the apparatus is set up
or
a description of how light is supplied
or
a simple description of how photosynthesis can be measured.
or
a control variable

0 marks:
No relevant content.

examples of the points made in the response:
- apparatus set up:
  – weed in water in beaker
  – light shining on beaker
- method of varying the light intensity–eg changing distance of lamp from plant
- method of controlling other variables
  – use same pond weed **or** same length of pond weed
  – temperature: water bath or heat screen
  – CO_2
- leave sufficient time at each new light intensity before measurements taken
- method of measuring photosynthesis – eg counting bubbles of gas released or collecting gas and measuring volume in a syringe
- measuring **rate of photosynthesis** by counting bubbles for set period of time
- repetitions

extra information:
allow information in the form of a diagram

[6]

Q14.

(a) $6H_2O$

in the correct order

1

$C_6H_{12}O_6$

1

(b) (i) control

do not accept *'control variable'*

allow:

to show the effect of the organisms

or

to allow comparison

or

to show the indicator doesn't change on its own

1

(ii) snail respires

1

releases CO_2

1

(iii) turns yellow

1

plant can't photosynthesise so CO_2 not used up

1

but the snail (and plant) still respires so CO_2 produced

1

[8]

Q15.

(a) (i) LHS = water

accept H_2O

*do **not** accept H^2O / H2O*

1

RHS = oxygen

accept O_2

*do **not** accept O / O^2 / O2*

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]

Q16.

(a) <u>light</u> is trapped / absorbed / used

extra answers cancel mark

ignore solar / sunshine

1

by chlorophyll / chloroplasts

if no other marks awarded, allow 1 mark for photosynthesis / equation for photosynthesis

1

(b) (to make) starch (for storage)

ignore 'for growth' unqualified

ignore respiration

1

(to make) fat / oil (for storage)

1

(to make) amino acids / proteins / enzymes

1

(to make) cellulose / cell walls

allow for active transport

allow any other correct, named organic substance<u>s</u> (eg DNA / ATP / chlorophyll / hormone)

*if no named examples, allow 'to make **named** cell structures' for max. 1 mark*

1

[6]

Q17.

(a) LHS = water

1

RHS = glucose

1

(b) any **three** from:

- (measure) temperature

  ignore reference to fair test
- to check that the temperature isn't changing
- rate of reaction changes with temperature
- temperature is a variable that needs to be controlled

  allow lamp gives out heat

3

(c) (i) 10

*correct answer = **2** marks*

*allow **1** mark for:* $\frac{(10+9+11)}{3}$

*allow **1** mark for correct calculation without removal of anomalous result ie 15*

2

(ii) graph:

*allow ecf from **(c)(i)***

label on y-axis as 'number of bubbles per minute'

1

three points correct = **1** mark

allow ± 1 mm

four points correct = **2** marks

2

line of best fit = smooth curve

1

(iii) as distance increases, rate decreases – pro

allow yes between 20 – 40

1

but should be a straight line / but line curves – con / not quite pro

allow not between 10 – 20

if line of best fit is straight line, allow idea of poor fit

1

(d) any **four** from:

- make more profit / cost effective
- raising temp. to 25 °C makes very little difference at 0.03% CO_2
- (at 20 °C) with CO_2 at 0.1%, raises rate
- (at 20 °C with CO_2 at 0.1%) → >3x rate / rises from 5 to 17
- although 25 °C → higher rate, cost of heating not economical
- extra light does not increase rate / already max. rate with daylight

  accept ref to profits c.f. costs must be favourable

4

[17]

Q18.

(a) (i) chloroplast

1

(ii) cell wall

1

(b) (i) osmosis

accept diffusion

1

(ii) cell wall (prevents bursting)

1

(c) (i) carbon dioxide

allow correct formula

1

glucose

allow sugar / starch

1

(ii) any **two** from:

- light sensitive spot detects light
- tells flagellum to move towards light
- more light = more photosynthesis

2

(d) (cell has) larger SA:volume ratio

1

short (diffusion) distance

allow correct description

1

(diffusion) via cell membrane is sufficient / good enough

or

flow of water maintains concentration gradient

1

[11]

Q19.

(a) (i) traps light (energy)

allow uses light / converts light energy to chemical energy

1

for photosynthesis / for making sugar / starch / carbohydrates

ignore food

allow organic molecules

1

(ii) dodder takes sugar / glucose / sucrose from phloem / dodder cannot make its own glucose / carbohydrate

or

phloem has sugar / glucose / sucrose

accept amino acids / fatty acids / other small organic molecule

ignore takes food / minerals / water / nutrients

1

(iii) any **one** from:

- not enough sugar / nutrients to grow / respire

  accept not enough food to grow / respire
- might strangle / restrict growth by squeezing stem tightly
- may damage stem tissues by growing into it
- may smother leaves / block light **so** less photosynthesis / less growth

1

(b) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1 – 2 marks)
Description and explanation of an adaptation which only involves hooks **and / or** suckers.

Level 2 (3 – 4 marks)
Description and explanation of adaptations including hooks **and / or** suckers with any other adaptation **or** explanation.

Level 3 (5 – 6 marks)
Description of most correct adaptations **and** explanations.

Examples of biology points made in the response:

- hooks – for holding on / not being detached
- suckers – for holding on / not being detached
- flattened / large surface area – absorption of (large amounts of) food
- no gut – not needed as host digests food
- thick cuticle – protection from host's enzymes / so not digested
- large number of eggs – increased chance of infecting new host

  allow hermaphrodite and self-fertilising – likely to be just one worm per host

  internal fertilisation – gametes not digested

6

[10]

Q20.

(a) (i) in the direction of the force of gravity

1

(ii) against the force of gravity

1

(b) (i) diagram completed to show stem bending / leaning towards the window

the bend / lean can be at / from any point above pot level

ignore any leaves

1

(ii) more light (for leaves)

ignore heat

1

more photosynthesis / biomass / glucose

ref to 'more' needed once only, eg 'more light for photosynthesis' = 2 marks

if no other marks given allow 1 mark for 'to get light for photosynthesis'

1

[5]

Q21.

(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

[8]

Q22.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
There is at least one reason for deforestation
or
an attempt at a description of at least one way deforestation is affecting the atmosphere.

Level 2 (3 – 4 marks)
There is at least one reason for deforestation
and
a description of the way deforestation is affecting one gas in the atmosphere
or
the process that causes an effect.

Level 3 (5 – 6 marks)
There are reasons for deforestation
and
a clear description of the way deforestation is affecting one gas in the atmosphere
and
the process that causes this.

examples of the points made in the response

Reasons for deforestation

- timber for construction / furniture / boat building / paper production
- growing plants for biofuels for motor fuel / aviation / lawnmowers
- use of wood as a fuel
- land for building or agriculture to provide food, such as rice fields and cattle ranching

Effects of deforestation

- increase in carbon dioxide in atmosphere
  due to burning
  due to activities of microbes
  less carbon dioxide taken in / locked up (by trees)
  less photosynthesis

- increase in methane in atmosphere
  due to rice production / cattle

extra information
ignore references to oxygen
accept explanations of the effect of water (vapour)

[6]

Q23.

(a) any **one** from:

ignore 'check temperature'

- add a water bath
- heat screen
- use LED
- low energy bulb / described

1

(b) (i) rate / number of bubbles decreases

*accept converse with reference to increasing light **or** shorter distance*

or

less oxygen / gas released

ignore reference to rate of photosynthesis

1

(ii) temperature / CO_2 (concentration)

*accept 'it was too cool' **or** not enough CO_2*
accept number of chloroplasts / amount of chlorophyll
allow heat
allow CO2
*do **not** allow CO^2*

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a brief description of at least 1 tissue **or** at least 1 function of an indicated part of the leaf.

The account lacks clarity or detail.

Level 2 (3-4 marks)
There is a clear description which includes at least 1 named tissue and at

least 1 correct function described for an indicated part of the leaf.

Level 3 (5-6 marks)
There is a detailed description of most of the structures and their functions.

Examples of responses:

- epidermis
- cover the plant
- mesophyll / palisade
- photosynthesises
- phloem
- xylem
- transport.

The following points are all acceptable but beyond the scope of the specification:

- (waxy) cuticle – reduce water loss
- epidermis – no chloroplasts so allows light to penetrate
- stomata / guard cells – allow CO_2 in (and O_2 out) **or** controls water loss
- palisade (mesophyll) – <u>many</u> chloroplasts to trap light

  – near top of leaf for receiving more light
- spongy (mesophyll) – air spaces for rapid movement of gases

6

[9]

Q24.

(a) use of quadrat / point frame

allow description

1

<u>randomly</u> placed / <u>random</u> sampling

ignore reference to transects

1

(b) (i) 6

1

(ii) more <u>light</u> in A / in field / where sunny

ignore sun

1

more / better / faster photosynthesis in A / with more light

allow converse

1

(iii) use light meter / measure light <u>intensity</u> in both habitats

1

take many measurements at same time of the day

1

or

laboratory / field investigation with 2 batches high light and low light (1)

count or number of flowers in each (1)

counting point is dependent on investigation point

(c) more glucose / energy available

allow other named product eg protein

allow if more energy produced

1

for growth

dependent on 1st mark

1

[9]

Q25.

(a) (i) **C** and **D**

no mark if more than one box is ticked

1

(ii) any **one** from:

*do **not** allow if other cell parts are given in a list*

- (have) cell wall(s)
- (have) vacuole(s)

1

(b) (i) **A**

apply list principle

1

(ii) **D**

apply list principle

1

(c) respiration

apply list principle

1

[5]

Q26.

(a) The starch is stored for use later

no mark if more than one box is ticked

1

(b) (i) any **two** from:

*do **not** accept temperature*
apply list principle
ignore reference to time

- carbon dioxide (concentration)
- light intensity
- light colour / wavelength

*allow **1** mark for light if neither intensity or colour are awarded*

- pH
- size / amount of pondweed / plant
- same / species / type pondweed
- amount of water <u>in the tube</u>

ignore amount of water alone

2

(ii) number / amount of bubbles **or** amount of gas / oxygen

allow volume of bubbles (together)
ignore 'the bubbles' unqualified

1

(relevant reference to) time / named time interval

allow how long it bubbles for
*do **not** accept time bubbles start / stop*
ignore speed / rate of bubbling
ignore instruments
*do **not** accept other factors eg temperature*
*accept how many bubbles per minute for **2** marks*

1

(c) (i) temperature

allow heat / cold / °C

1

(ii) carbon dioxide / CO_2

allow CO2
*do **not** accept CO^2*

1

[7]

Q27.

(a) oxygen

allow O_2 / O2

*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]

Q28.

(a) (i) decrease

1

rate of decrease slows

1

(ii) any **one** from:

- more use of disinfectant

  allow any reasonable increase in hygiene or sterilisation precautions
- more use of hand washing
- more careful / more often cleaning of patient facilities
- raised awareness / education about hygiene

1

Explanation:
stops / reduces the bacteria being transferred / spreading

1

(iii) 800 – 500 / 800 × 100 =

1

37.5 (%)

*correct answer with or without working gains **2** marks*

1

(iv) any **one** from:

- numbers quite low now so hard to reduce further
- was a big campaign / much publicity (in 2009) so more people already doing it
- hygiene / cleaning now good so hard to improve
- hospitals short of money so less staff to clean

1

(b) mutation occurred giving resistance (to methicillin)

*do **not** accept overuse caused mutation*

1

resistant bacteria not able to be treated / not killed

1

these bacteria multiplied / reproduced / spread quickly

1

[10]

Q29.

(a) protein

1

(b) (i) (more) magnesium gives more growth / more leaves / more duckweed

if converse must be clear that less magnesium gives less growth

1

(ii) **A** gave highest number of leaves / plants **or** more than others

*it equals **'A'***

*use of numbers must compare **A** with at least one other*

or

A gave most growth / most duckweed **or** more than others

allow faster / fastest / better / best growth

allow more growth with nitrate / less growth without nitrate

do not allow 'no' growth without nitrate

(c) (i) mark (c) as a whole

sensible method:

e.g. mass / weighing

ignore dry or fresh

allow other sensible method involving measuring eg length of roots – ignore 'size' of roots or measure roots unqualified

1

(ii) corresponding explanation:

ignore accuracy

e.g. includes roots / includes <u>whole</u> plant
or
leaves vary in size
or
(length / mass / surface area given in c(i)) is a continuous variable

1

[5]

Q30.

(a) xylem **and** phloem

either order
allow words ringed in box
allow mis-spelling if unambiguous

1

(b) (i) movement / spreading out of particles / molecules / ions / atoms

ignore names of substances / 'gases'

1

from high to low concentration

accept down concentration gradient
ignore 'along' / 'across' gradient
ignore 'with' gradient

1

(ii) oxygen / water (vapour)

allow O_2 / O2
ignore O^2/ O
allow H_2O / H2O
ignore H^2O

1

[4]

Q31.

(a) LHS – carbon dioxide / CO_2

allow CO2
ignore CO^2

1

RHS

in either order

glucose / carbohydrate / sugar

allow starch
allow $C_6H_{12}O_6$ / C6H12O6
ignore $C^6H^{12}O^6$

1

oxygen

allow O_2 / O2

ignore O^2 / O

1

(b) any **five** from:

- factor 1: CO^2 (concentration)
- effect - as CO_2 increases so does rate and then it levels off or shown in a graph
- explanation:
(graph increases) because CO_2 is the raw material or <u>used</u> in photosynthesis / converted to organic substance / named eg
or
(graph levels off) when another factor limits the rate.

accept points made via an annotated / labelled graph

- factor 2: temperature

allow warmth / heat

- effect – as temperature increases, so does the rate and then it decreases or shown in a graph

allow 'it peaks' for description of both phases

- explanation:
(rise in temp) increases rate of chemical reactions / more kinetic energy

allow molecules move faster / more collisions

or
(decreases) because the enzyme is denatured.

context must be clear = high temperature

allow other factor plus effect plus explanation:
eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves
2nd or 3rd mark can be gained from correct description and explanation

5

[8]

Q32.

(a) water

1

oxygen

in this order only
accept correct chemical symbols
allow H_2O / OH_2

1

(b) allow light (in / through) / need light

*do **not** accept attracts light*

ignore heat / moisture / carbon dioxide

ignore so the plants can be seen

accept the converse, ie the black plastic bag would not let light in (1)

1

for photosynthesis / make sugar / glucose

so there would be no photosynthesis (1)

*do **not** allow make food unqualified*

1

(c) Increase (in leaves / new leaves)

ignore growth unqualified

1

(then) level off **or** number of (new) leaves (then) stays the same

1

numerical statement eg max at 3 tablets / 5 (new) leaves

should refer to one of the first two marking points

*for every extra tablet get 1 extra leaf = **2** marks*

*for every extra tablet get 1 extra leaf then it levels off = **3** marks*

1

[7]

Q33.

(a) less carbon dioxide used
or higher carbon dioxide (concentration) in jar

*do **not** allow no carbon dioxide used or no change in carbon dioxide*

1

because less photosynthesis **or** light was a limiting factor

*do **not** allow no photosynthesis*

1

(b) magnesium / Mg

*do **not** allow manganese / Mn*

allow iron / Fe

ignore nitrates

1

[3]

Q34.

(a) (i) sun

ignore light

apply list principle

1

(ii) photosynthesis

apply list principle
allow approximate spelling
*do **not** accept phototropism*

1

(b) (i) chemical

1

(ii) carbon dioxide

1

(iii) carbohydrates

1

(c) As carbon dioxide from the caterpillar

if more than 2 boxes ticked deduct one mark for each additional incorrect box

1

As faeces (droppings) from the blue-tit

1

[7]

Q35.

(a) (LHS) water / H_2O

allow H2O
*do **not** accept H^2O*

1

(RHS) glucose / sugar / $C_6H_{12}O_6$

allow starch / carbohydrate
allow C6H12O6
*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 / CO2
or
temperature / heat / warmth

*do **not** accept CO^2*
ignore mineral ions
ignore water

1

[5]

Q1.

(a) Complete the equation for photosynthesis.

_____ + _____ $\xrightarrow{\text{light energy}}$ _____ + oxygen

(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.

_____

_____

_____

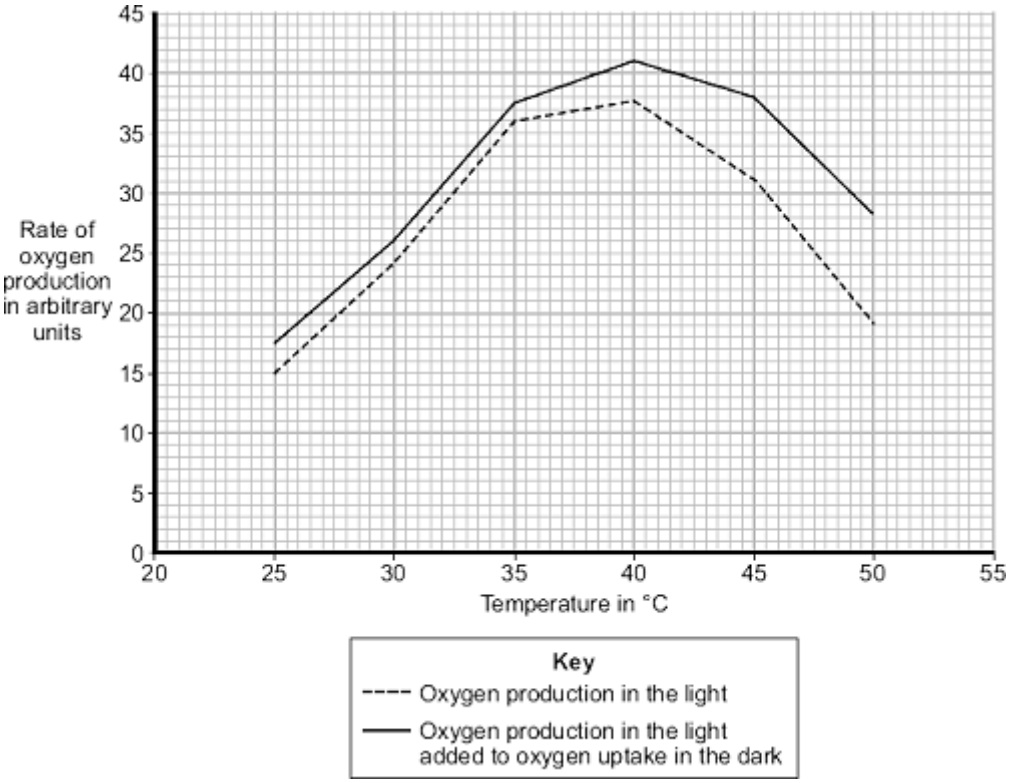
_____

(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)

Q2.

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

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

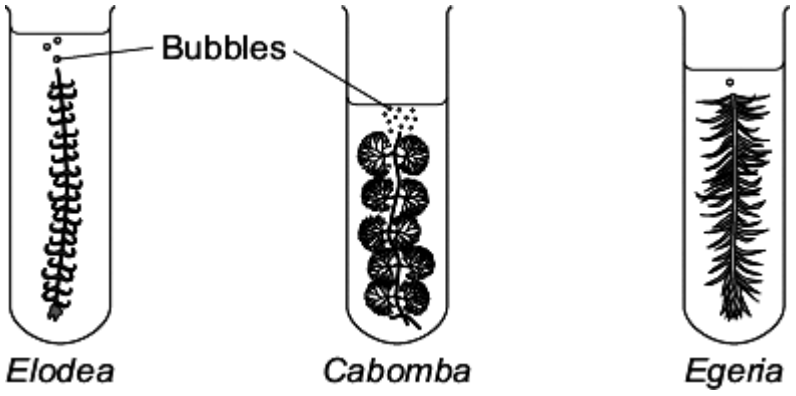
(1)

(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
Elodea	17
Cabomba	28
Egeria	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?

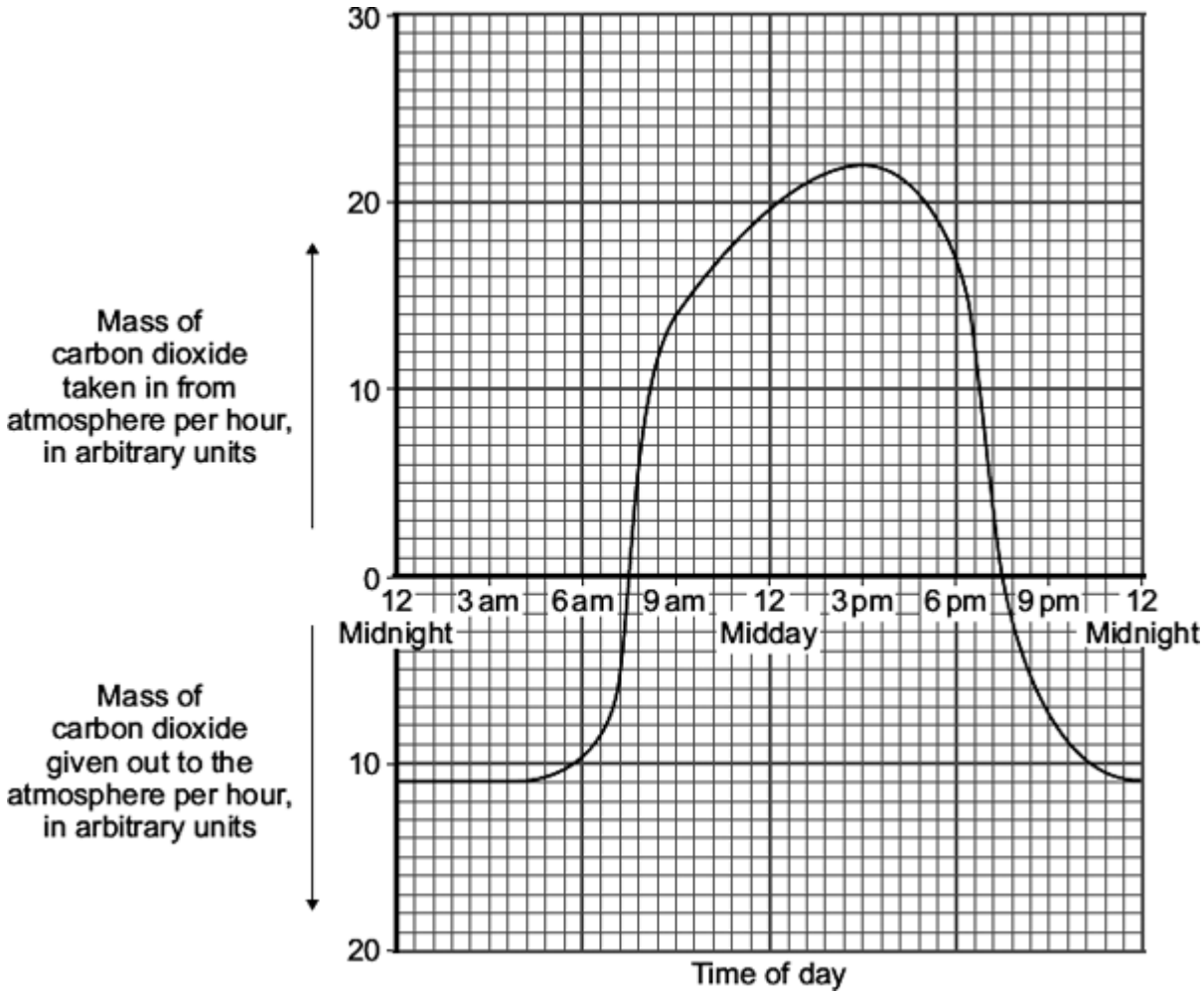
_____

(1)

(Total 6 marks)

Q3.

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 respires 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.

_____

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q4.

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)

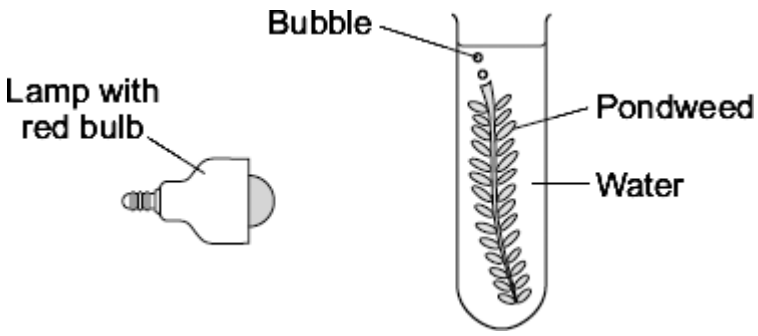
Q5.

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)

Q6.

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	☐

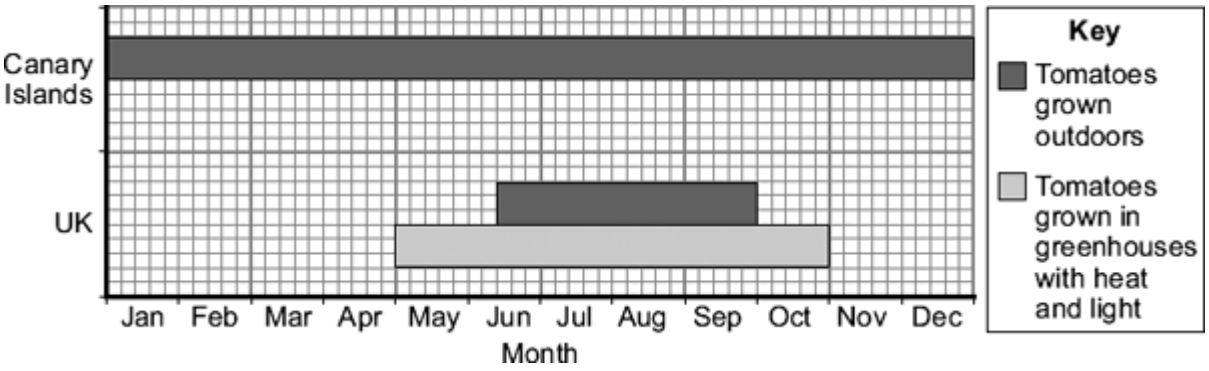
(2)

(Total 3 marks)

Q7.

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

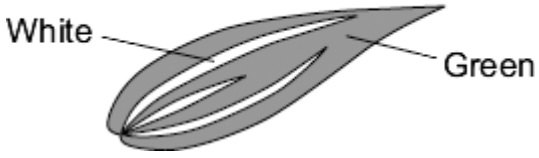
(Total 3 marks)

Q8.

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.

Diagram 1

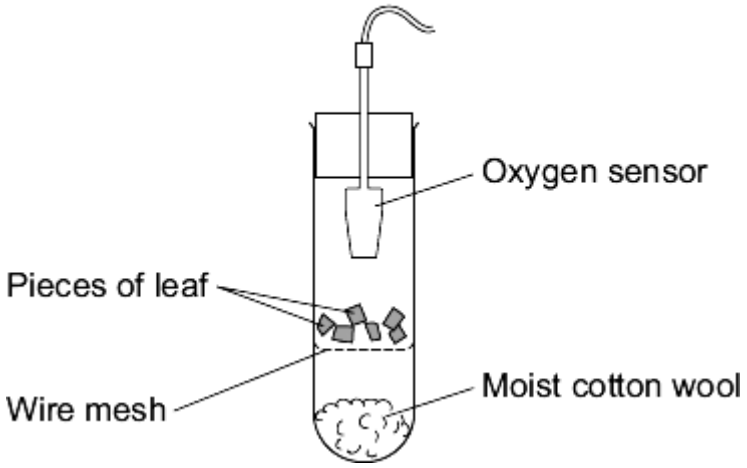


The students:

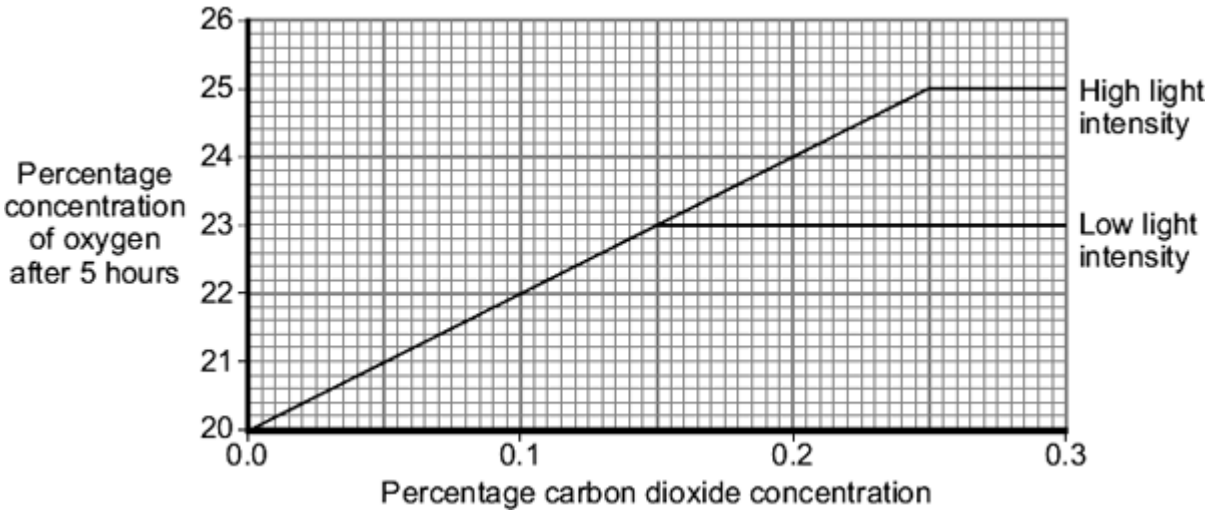
- cut pieces of leaf from the green region
- put the pieces into tubes
- added different concentrations of carbon dioxide to each tube
- shone lights on the tubes with either high or low light intensity
- recorded the concentration of oxygen in the tubes after 5 hours.

Diagram 2 shows how each experiment was set up.

Diagram 2



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)

Q9.

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
Nitrate	Stunted growth

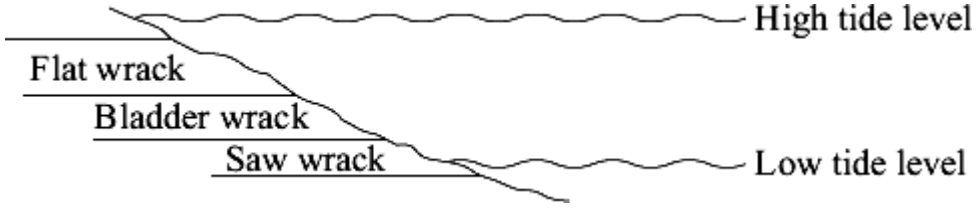
White flowers

(2)

(Total 6 marks)

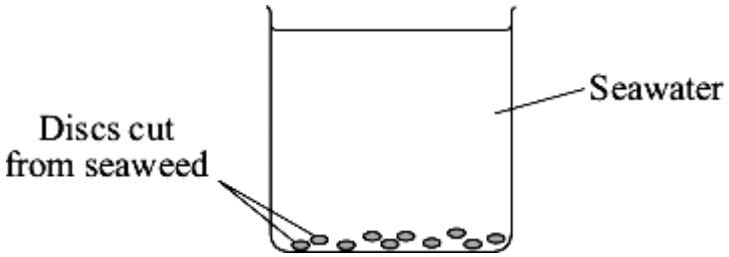
Q10.

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)

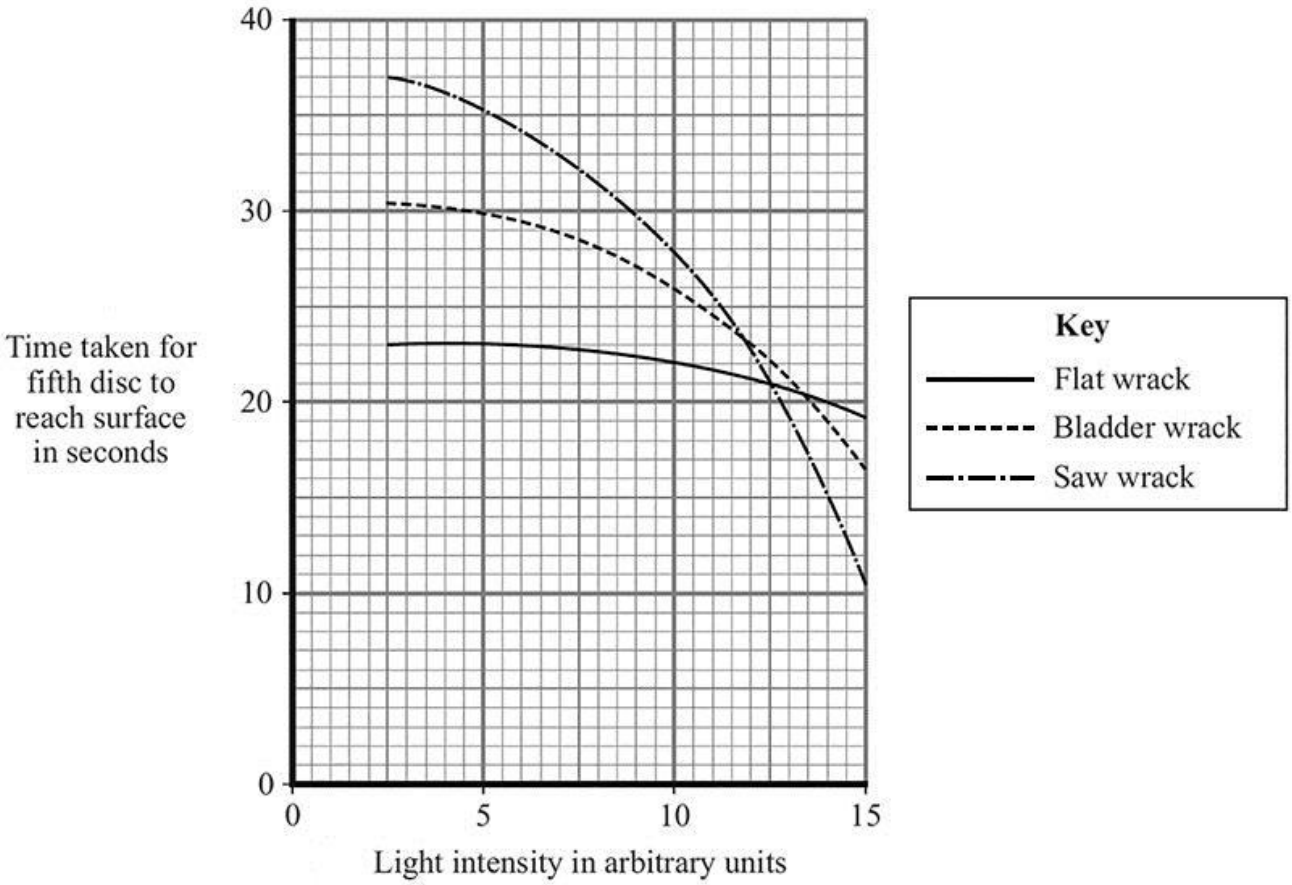
(ii) Suggest the advantage of recording the time taken for the fifth disc to reach the surface, rather than for the tenth disc.

_____

_____

(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)

Q11.

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?

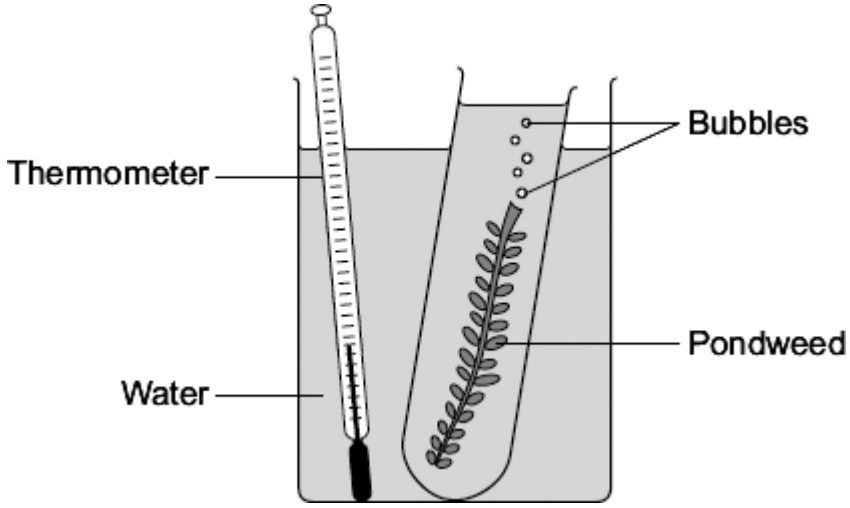
Tick (✓) **one** box.

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.

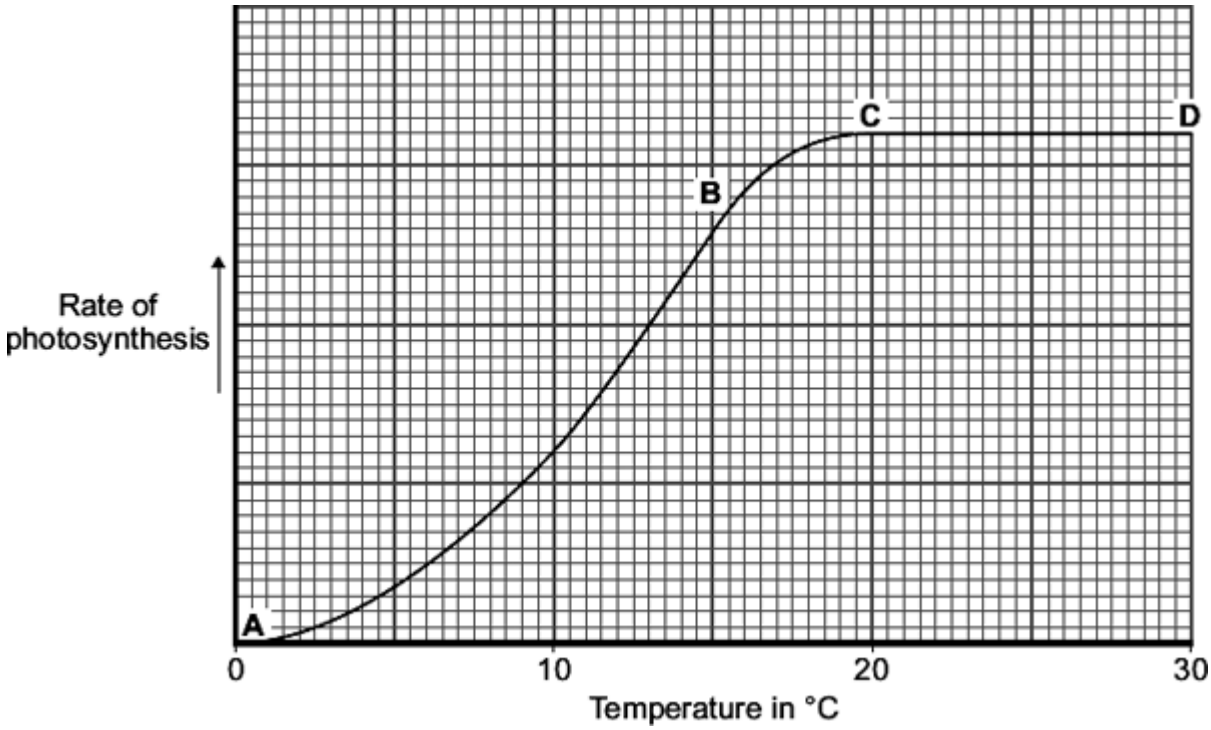
What **two** measurements would the student make to calculate the rate of photosynthesis?

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)

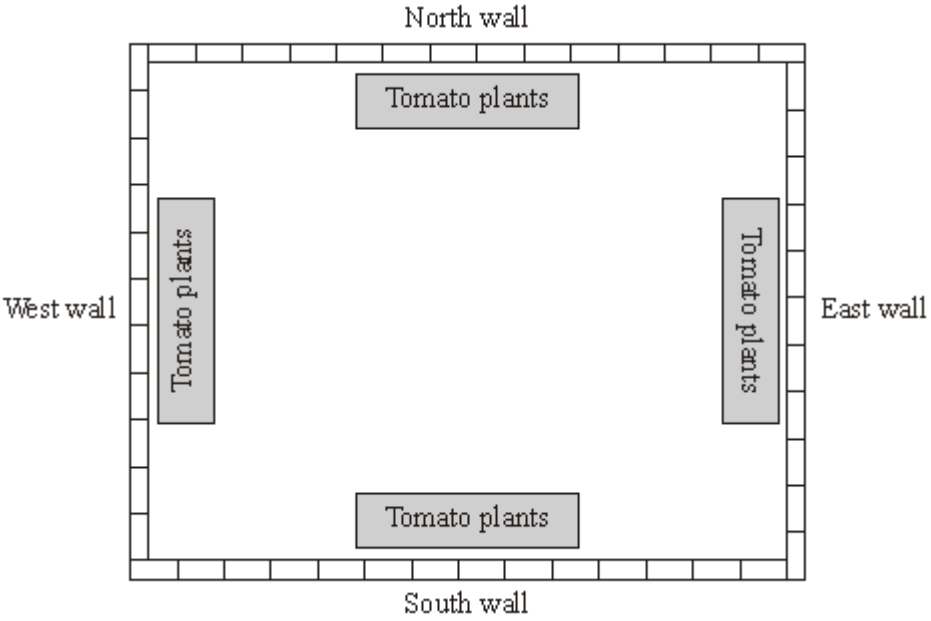
(Total 7 marks)

Q12.

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)

Q13.

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

carbon dioxide + _____ (+ light energy) → glucose + _____

(2)

(ii) Most of the carbon dioxide that a plant uses during photosynthesis is absorbed from the air.

Give **one** other source of carbon dioxide for a plant.

Draw a ring around your answer.

the soil **respiration in the plant** **osmosis in the plant** **water**

(1)

A student investigated the conditions that plants need for photosynthesis.
The leaves of the plant he used had green and white parts.

Diagram 1 shows how part of one leaf was covered in black (opaque) card.
The plant was placed in a warm, sunny area and was watered well.
Eight hours later the leaf was removed from the plant and was tested for starch.

The results of the test are shown in **Diagram 2**, the shaded parts show where starch was present.

Diagram 1

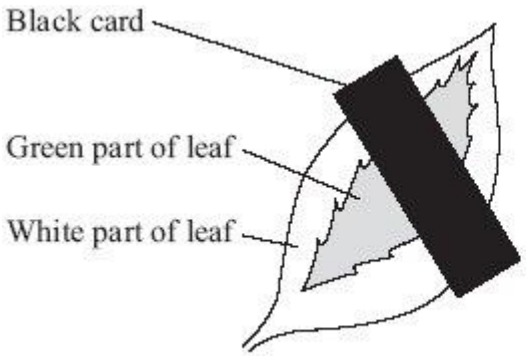
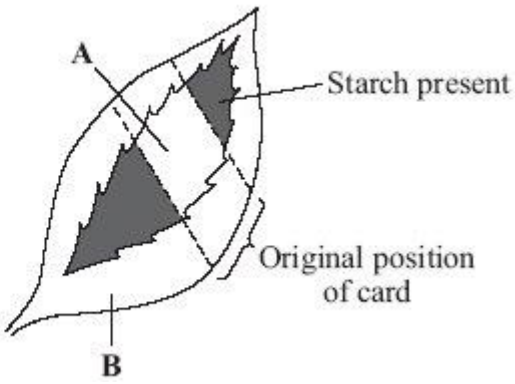


Diagram 2



(b) Name the **two** independent variables in this investigation.

1. _____

_____

2. _____

_____

(2)

(c) Why was no starch found in:

(i) the part of the leaf labelled **A**

_____

_____

(1)

(ii) the part of the leaf labelled **B**?

_____

_____

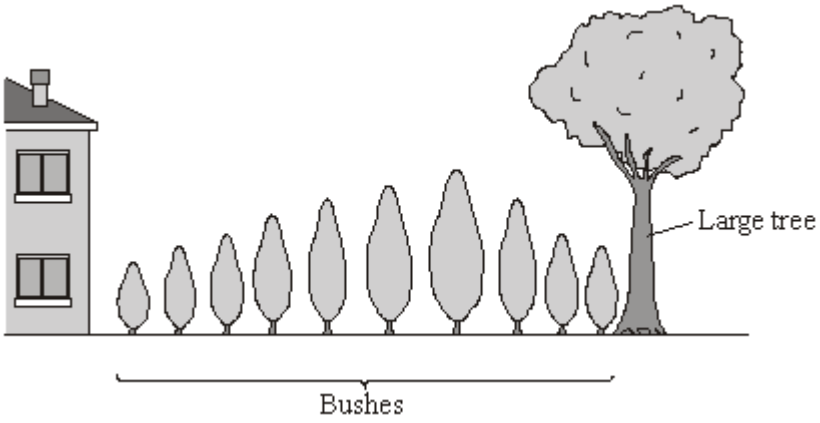
(1)

(Total 7 marks)

Q14.

The diagram shows bushes in a hedge growing near to a house.

The bushes were the same species and the same age.



(a) (i) The student said, “I have noticed that the short bushes grow next to the house. I think that the more light the bushes get, the faster they will grow.”

Draw lines to match each of the student’s statements to the correct term.

Draw only two lines.

Statement	Term
The short bushes grow next to the house.	A conclusion
Plants will grow faster if they get more light.	A prediction
	An observation

(2)

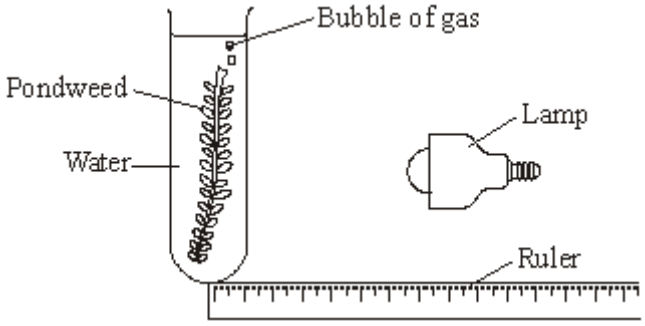
(ii) Complete the word equation for photosynthesis.

_____ + water (+ light energy) → _____ + oxygen

(2)

(b) The student decided to investigate the effect of light intensity on the rate of photosynthesis.

She used the apparatus shown in the diagram.



She measured the rate of photosynthesis by counting the number of gas bubbles given off each minute.

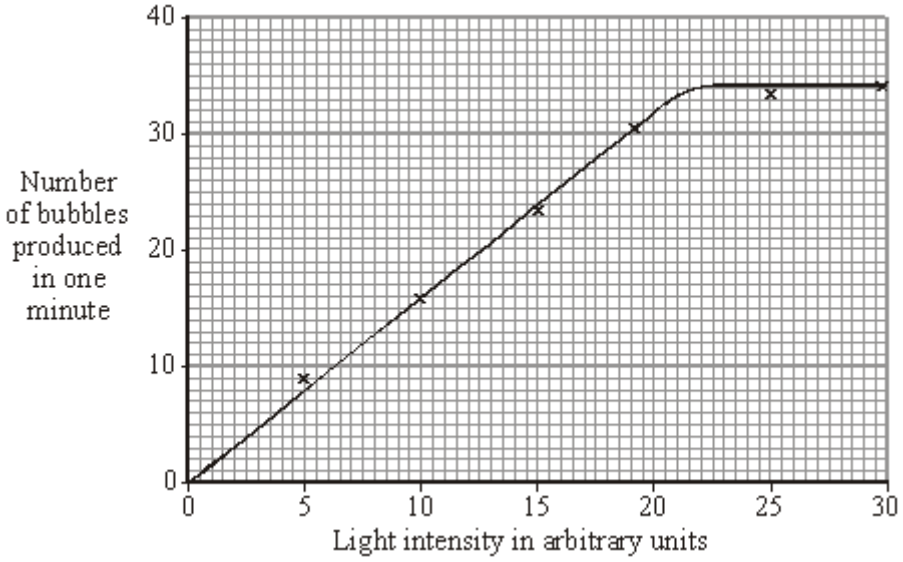
(i) Suggest how the student varied the intensity of the light received by the pondweed.

_____

_____

(1)

(ii) The student's results are shown on the graph.



Describe the pattern shown on the graph.

_____

_____

_____

_____

(2)

(iii) This is what the student wrote for her conclusion.

"Increasing the light intensity increases the rate of photosynthesis of the

pondweed."

Why was her conclusion incomplete?

_____

_____

(1)

(Total 8 marks)

Q15.

Green plants are able to make their own food.

Complete each sentence by drawing a ring around the correct answer in the box.

(a) Green plants make their own food during the process of

diffusion
photosynthesis
respiration

(1)

(b) This process can be summarised by the equation:

carbon dioxide + water → glucose +

mineral salts
light
oxygen

(1)

(c) The energy needed for this process is trapped for the plant by

chlorophyll
glucose
light

(1)

(d) Some of the food made by plants is stored as insoluble

chlorophyll
glucose
starch

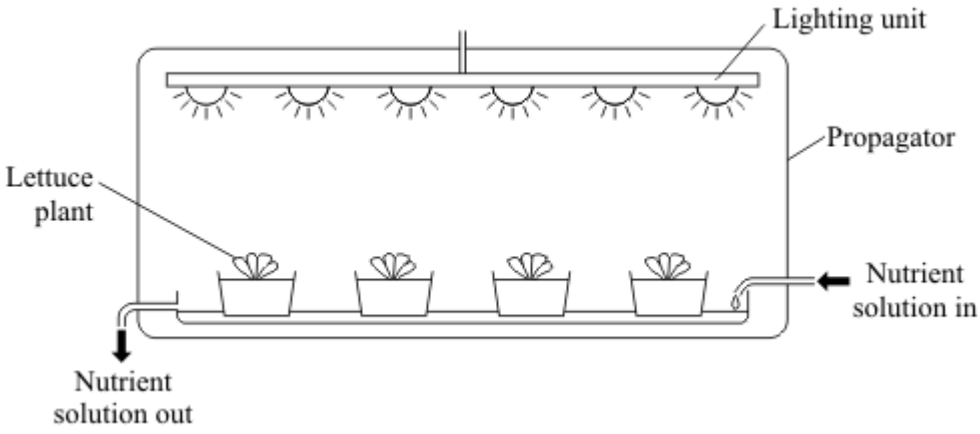
(1)

(Total 4 marks)

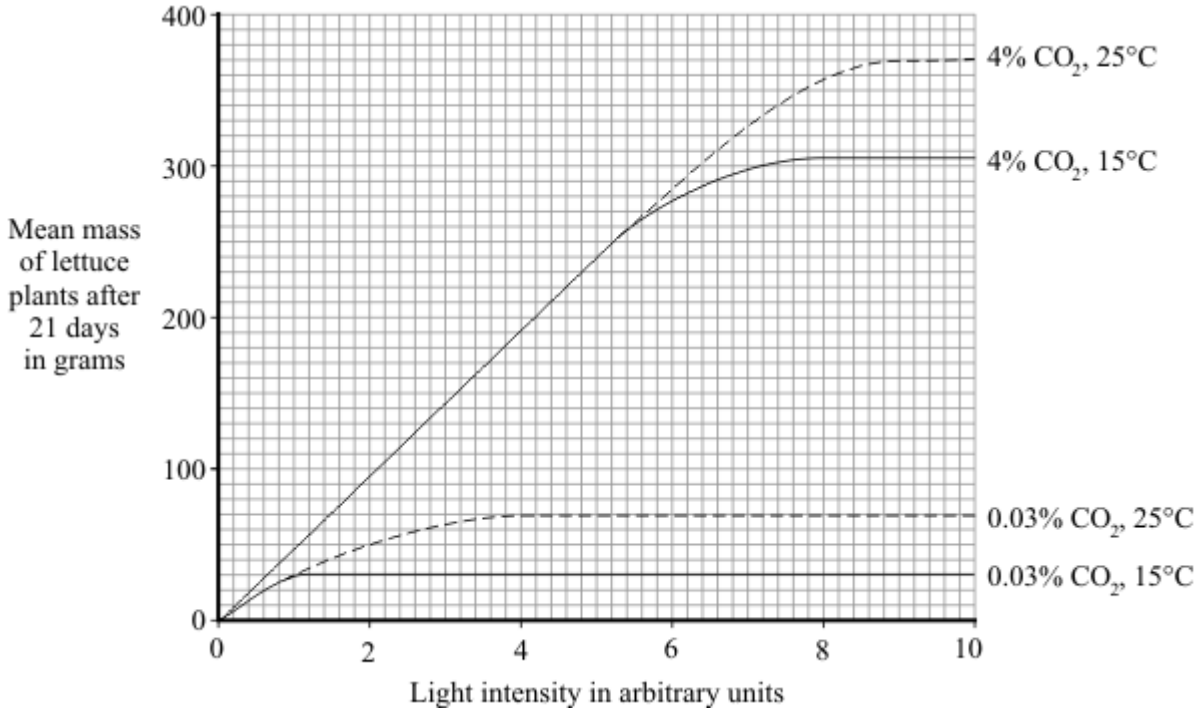
Q16.

Changing the conditions in which plants grow affects how fast they grow.

The diagram shows a propagator in which scientists can control temperature, light intensity and carbon dioxide concentration.



The graph shows the effects of changing the temperature, light intensity and carbon dioxide concentration on the growth of lettuce plants.



(a) Describe and explain the effect of increasing light intensity on the mean mass of lettuce plants at 4% carbon dioxide and 15 °C.

(3)

(b) Growers wish to make maximum profits from their lettuces.

What do they need to consider before making decisions about the growing conditions for their lettuces?

_____

_____

_____

_____

(2)

(c) The nutrient solution contains nitrate ions and magnesium ions.

Complete the table to show the functions of these ions in plants and their deficiency symptoms.

Ion	Function in plants	Deficiency symptoms
Nitrate	_____ _____ _____	_____ _____ _____
Magnesium	_____ _____ _____	_____ _____ _____

(4)

(Total 9 marks)

Q17.

(a) The equation describes the process of photosynthesis.

carbon dioxide + _____ + light energy ⟶ glucose + _____

(i) Write in the names of the **two** missing substances.

(2)

(ii) Name the green substance which absorbs the light energy.

_____

(1)

(b) (i) In bright sunlight, the concentration of carbon dioxide in the air can limit the rate of photosynthesis. Explain what this means.

_____

_____

_____

(2)

(ii) Give **one** environmental factor, other than light intensity and carbon dioxide concentration, which can limit the rate of photosynthesis.

_____

(1)

(Total 6 marks)

Q18.

The table shows the effects that two different concentrations of sulphur dioxide in the air had on the growth of rye grass plants.

Sulphur dioxide concentration in the air in micrograms per m^3	**9.0**	**191.0**
Number of leaves per plant	85.6	47.3
Total leaf area in cm^2	417.2	203.6
Dry mass of stubble in grams	0.48	0.22

(a) What human activity releases sulphur dioxide into the air?

_____

(1)

(b) (i) What effect does sulphur dioxide have on rainwater?

_____

_____

(1)

(ii) Use information from the table to describe **one** effect of sulphur dioxide on the leaves of the grass plants.

_____

_____

(1)

(c) The stubble consists of the bases of the stems of the plants and the roots left in the soil after harvesting.

Use your answer to part (b) to explain why the dry mass of the stubble was less at the higher concentration of sulphur dioxide.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q19.

Photosynthesis takes place in green plants.

(a) Name the substance that combines with water in photosynthesis.

_____

(1)

(b) Where does water enter the plant?

_____

(1)

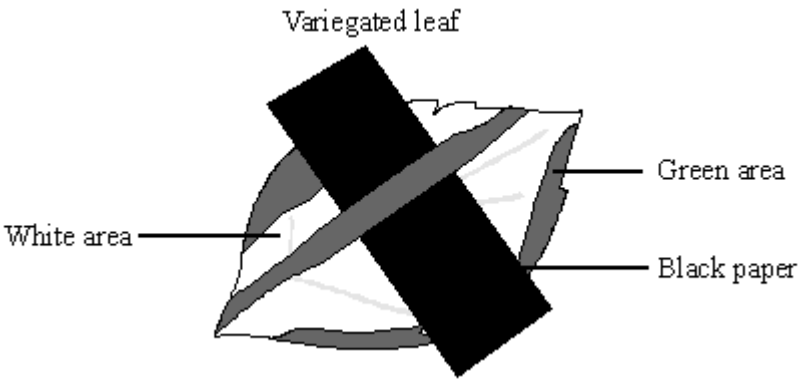
(c) Name **two** products of photosynthesis.

_____

(2)

(d) Variegated leaves have areas that are green and areas that are white. Some students used variegated leaves to investigate photosynthesis.

- They covered a variegated leaf with a black paper shape.
- The leaf was left in a sunny place.
- They tested the leaf for starch.
- The results were compared with a leaf that was not covered.



Area of the leaf	Start present after test

tested	covered	uncovered
Green area	no	yes
White area	no	no

Explain why starch was present in only one of the tests.

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q20.

(a) Complete the following sentences.

Green plants produce their own food by a process called photosynthesis. In this process the raw materials are _____ and carbon dioxide. Glucose and _____ are produced. _____ energy is absorbed by the green substance called _____ .

(4)

(b) Name **two** things that can happen in the plant to the glucose produced in photosynthesis.

1. _____

2. _____

(2)

(c) Plants need mineral salts.

(i) Through which part do mineral salts get into the plant?

_____

(1)

(ii) Explain why water is important in this process.

_____

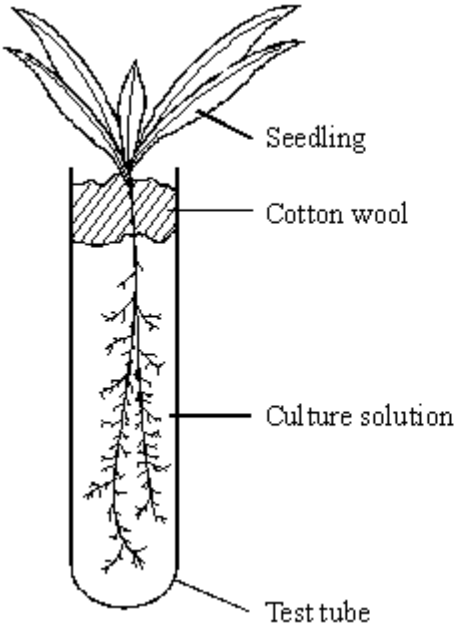
_____

_____

_____

(2)

Some students set up water cultures to find out how plants use nitrates.
They had two sets of nutrient solutions.
A full solution provided the plant with all the required nutrients.
The results table shows the average mass of the seedlings after 28 days of growth.



Culture solution	Average mass of seedling in g
distilled water	0.14
full solution with no nitrates	0.29
full solution	0.43

(d) (i) Give a conclusion you could make from these results.

_____

_____

(1)

(ii) Calculate the difference in average mass caused by the addition of nitrates to the culture solution.

_____

(1)

(iii) What are nitrates used for in the seedling?

_____

(1)

(iv) Some factors need to be controlled to keep this test fair. Name **two** of them.

1. _____

2. _____

(2)

(v) Suggest **one** way you could improve the experiment.

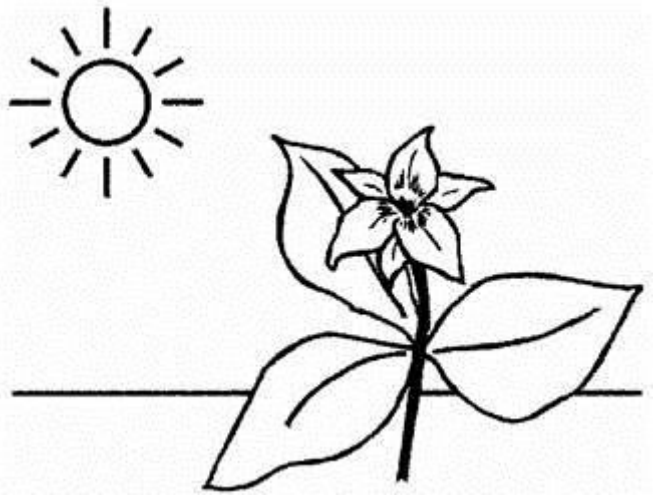
_____

(1)

(Total 15 marks)

Q21.

(a) Plants make their own food by photosynthesis.



Use the following words to fill in the gaps. You can use each word once or not at all.

carbon	chlorophyll	cytoplasm	light	nitrogen
oxygen	sound	starch	water	

During photosynthesis _____ dioxide and _____ are converted into glucose and _____ . The energy needed to do this is _____ energy which is trapped by a green pigment called _____ .

The plant can change the glucose into _____ which is insoluble so it can be stored.

(6)

(b) Which part of a plant is adapted for photosynthesis?

_____

(1)

(c) How do the **two** raw materials for photosynthesis get into the plant?

1. _____

_____

2. _____

_____

(2)

(d) Describe **one** way you could speed up photosynthesis.

_____

_____

(1)

(Total 10 marks)

Q22.

(a) Photosynthesis is a process that takes place in green plants.

(i) What type of energy is needed for this process?

_____

(1)

(ii) What substance in the plant absorbs this energy?

_____

(1)

(iii) In which part of the plant cell does photosynthesis take place?

_____

(1)

(iv) Write a balanced chemical equation for photosynthesis.

_____ → _____

(3)

(b) Describe **two** ways you could speed up photosynthesis.

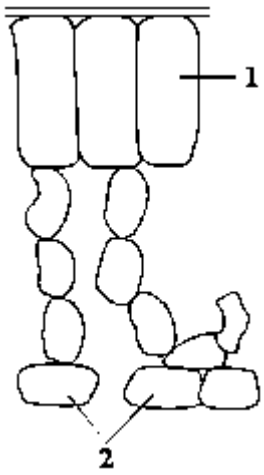
_____

_____

_____

(2)

(c) The diagram shows the outline of a cross-section of a leaf. Name cells **1** and **2** and describe how they are involved in photosynthesis.



(4)

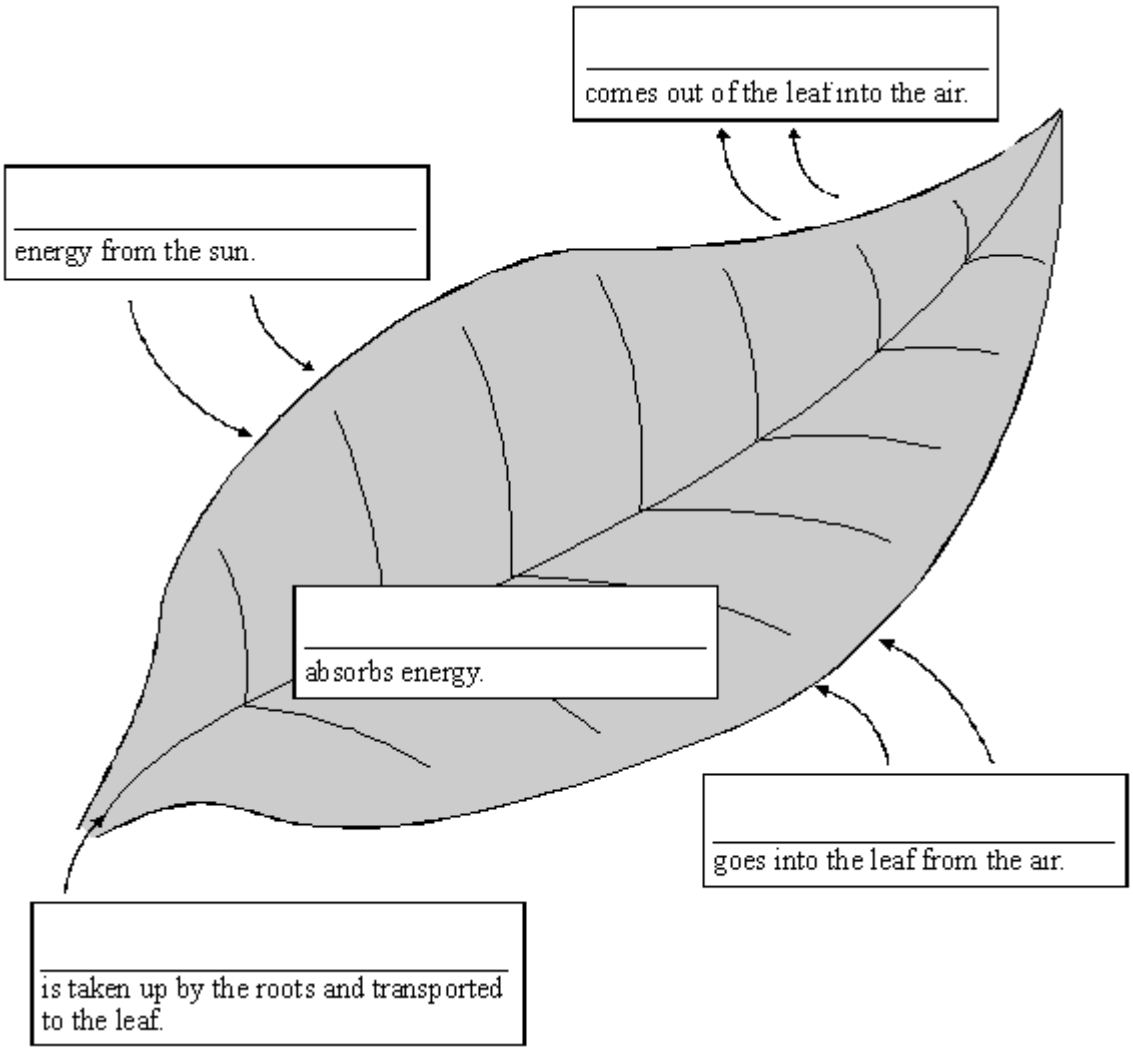
(Total 12 marks)

Q23.

The diagram shows how a leaf of a green plant makes glucose.

(a) Use words from the box to complete the labels on the diagram. You may use each word once or not at all.

carbon dioxide	chlorophyll	glucose	heat
light	oxygen	water	



(5)

(b) (i) Compete the following sentence.

Glucose in food is a type of _____ . When we eat it, it gives us energy.

(1)

(ii) The plant turns some of the glucose into starch. Why is starch useful to the plant?

_____

_____

(1)

(iii) What does the plant do with the rest of the glucose?

_____

(1)

(c) (i) What is the name of the process outlined in the diagram?

_____

(1)

(ii) Give **one** way that leaves are adapted to do this process.

_____

(1)

(Total 10 marks)

Q24.

Photosynthesis takes place the leaves of green plants.

(a) Write a balanced chemical equation for the formation of glucose by photosynthesis.

_____

(3)

(b) Describe **two** ways that the rate of photosynthesis can be decreased without lowering the temperature.

_____

_____

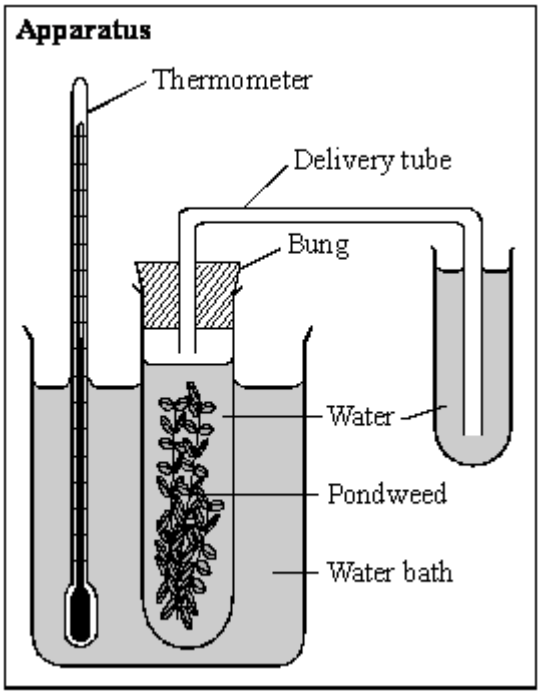
_____

_____

_____

(2)

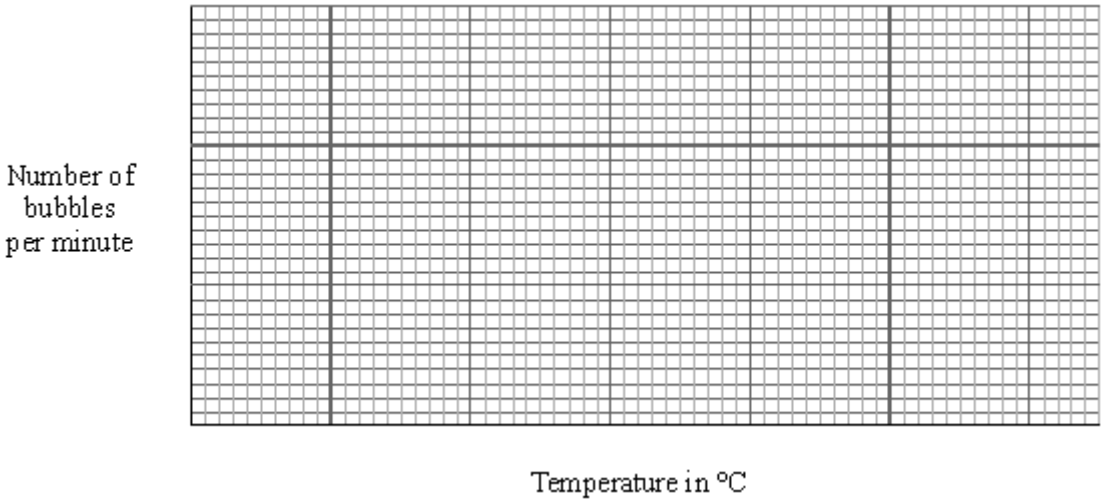
(c) Some students decided to investigate the effect of temperature on the rate of photosynthesis in pond weed. They set up the apparatus and altered the temperature using ice and hot water. The counted the number of bubbles given off in a minute at different temperatures. They obtained the following results.



Results

Temperature in °C	Number of bubbles per minute
10	6
20	15
30	21
40	23
50	19

(i) Plot the points on the graph.



(3)

(ii) Use your graph to predict the number of bubbles per minute at 25 °C.

_____

(1)

(iii) Suggest a reason why the rate of photosynthesis seems to decrease in this pondweed after 40 °C.

_____

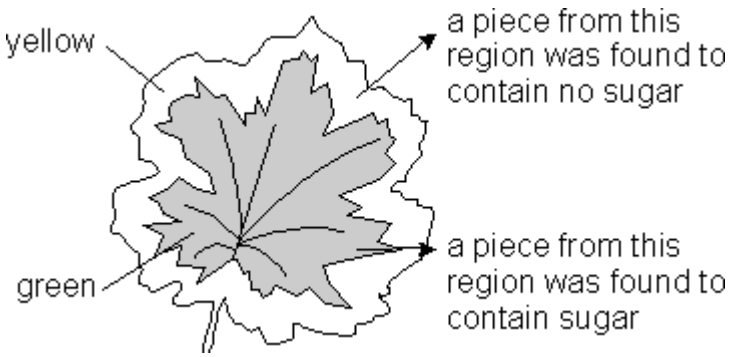
_____

(1)

(Total 10 marks)

Q25.

A plant with variegated (two-coloured) leaves was left in sunlight for several hours. Pieces of one of its leaves were then detached (removed) and tested for sugar. The diagram below shows the results.



Explain, as fully as you can, why the yellow region of the leaf had not produced sugar.

_____

_____

_____

_____

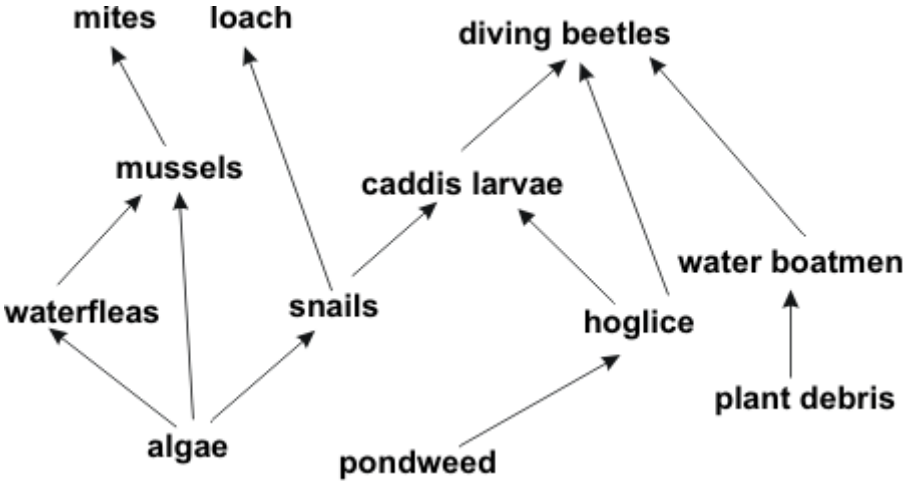
_____

_____

(Total 2 marks)

Q26.

The diagram below shows a food web for some of the organisms which live in a pond.



(a) (i) Name **one** secondary consumer in this food web.

_____

(1)

(ii) The algae are small green plants.

Give **three** conditions needed by green plants to produce sugars.

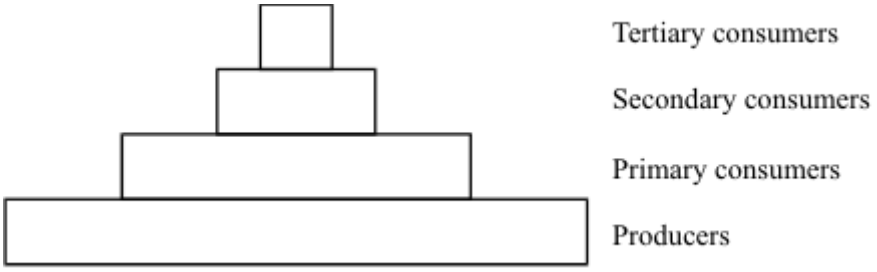
1. _____

2. _____

3. _____

(3)

(b) This is a pyramid of biomass for the organisms in the aquarium.



Some of the biomass of the producers is **not** transferred to the tertiary consumers.

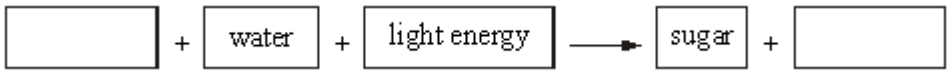
Explain, as fully as you can, what happens to this biomass.

(6)

(Total 10 marks)

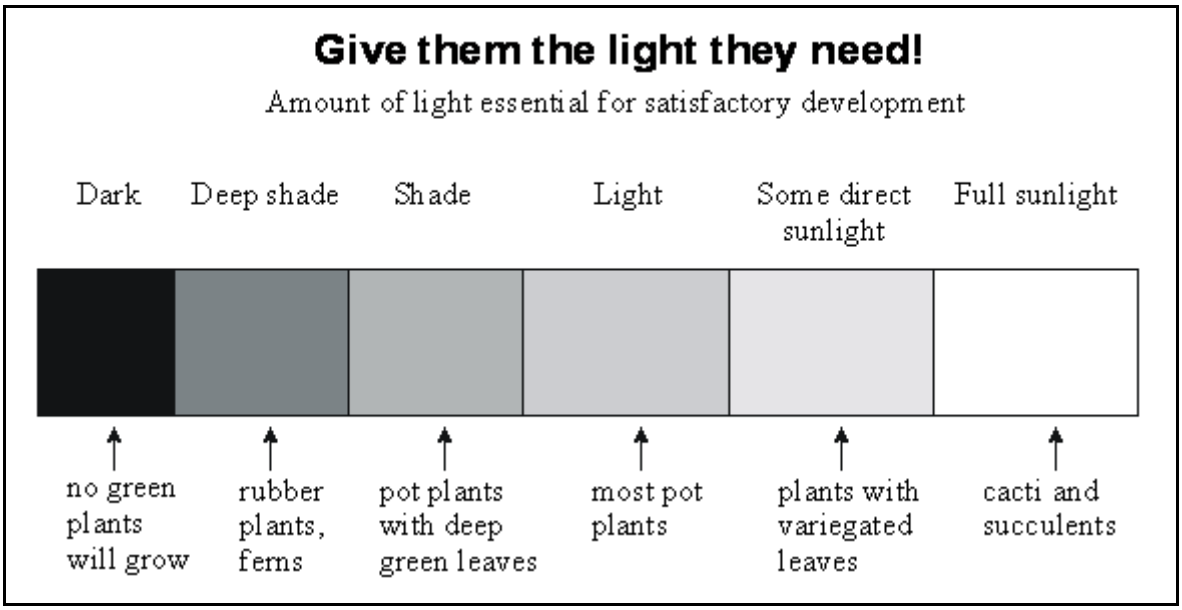
Q27.

(a) Complete the equation for photosynthesis.



(2)

(b) The diagram below is printed in a plant care manual.



Use information from the diagram to answer the following questions.

(i) Name **one** type of plant which could live on the floor of a dense forest in the middle of summer.

_____

(1)

(ii) Explain the reason for your answer to (i) above.

(1)

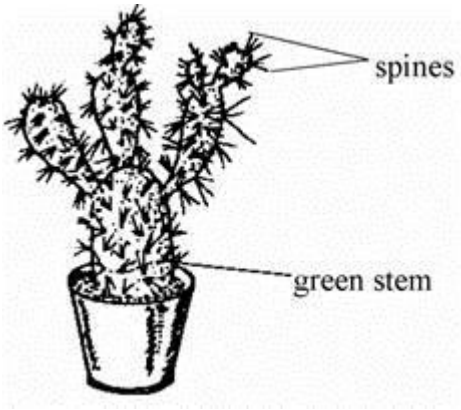
(iii) The drawing shows one type of plant with variegated leaves.

The manual says that these plants need direct sunlight.

Suggest and explain why this plant needs 'some direct sunlight' in order to develop satisfactorily.

(2)

(iv) The drawing shows a cactus.



Suggest and explain why cacti can only develop satisfactorily if they receive full sunlight.

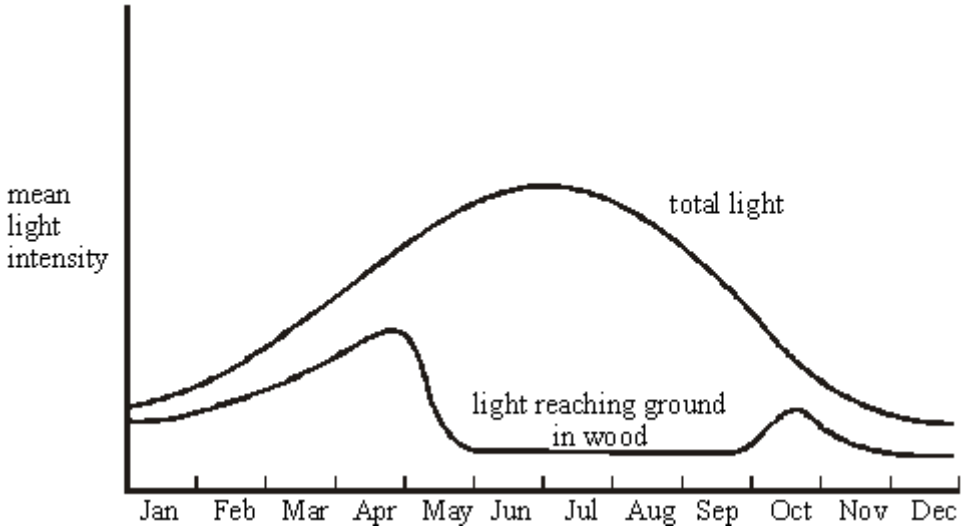
_____

(2)

(Total 8 marks)

Q28.

The graph shows the mean light intensity at different times of the year in an oak wood.



(a) (i) In which month would you expect the rate of photosynthesis in the oak trees to be greatest?

_____

(1)

(ii) There are plants living on the ground in the wood. In which month would you expect their rate of growth to be fastest?

_____

Explain your answer.

_____

_____

_____

_____

(3)

(b) Name **two** factors, other than light intensity, that would affect the rate of photosynthesis in the oak trees.

1. _____

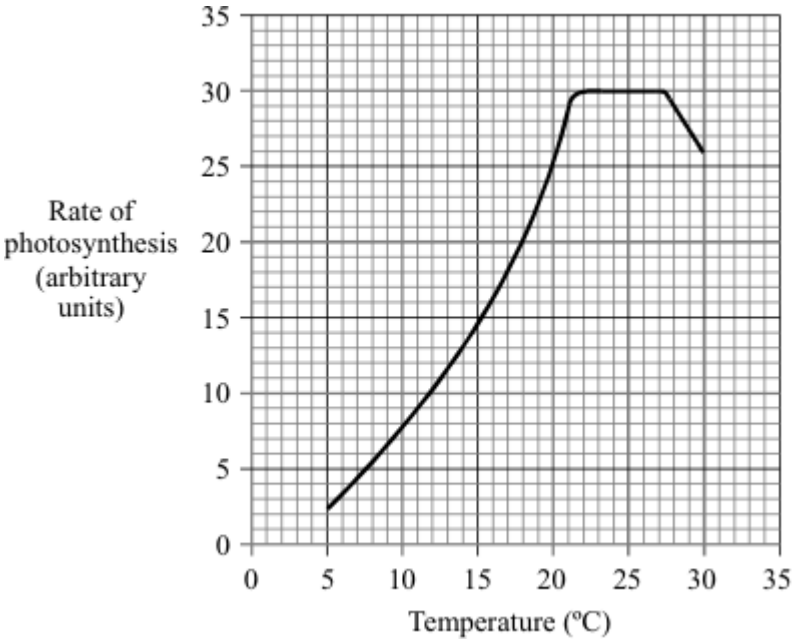
2. _____

(2)

(Total 6 marks)

Q29.

The graph shows the effect of temperature on photosynthesis.



(a) Between which temperatures is the rate of photosynthesis fastest?

_____ and _____ °C

(1)

(b) Suggest why the rate of photosynthesis stays the same between these two temperatures.

_____

_____

_____

_____

(2)

(c) A greenhouse owner wants to grow lettuces as quickly and cheaply as possible in winter.

At what temperature should he keep his greenhouse in order to grow the lettuces as quickly and cheaply as possible?

_____ °C

Explain your answer.

_____

_____

_____

_____

(3)

(Total 6 marks)

Q30.

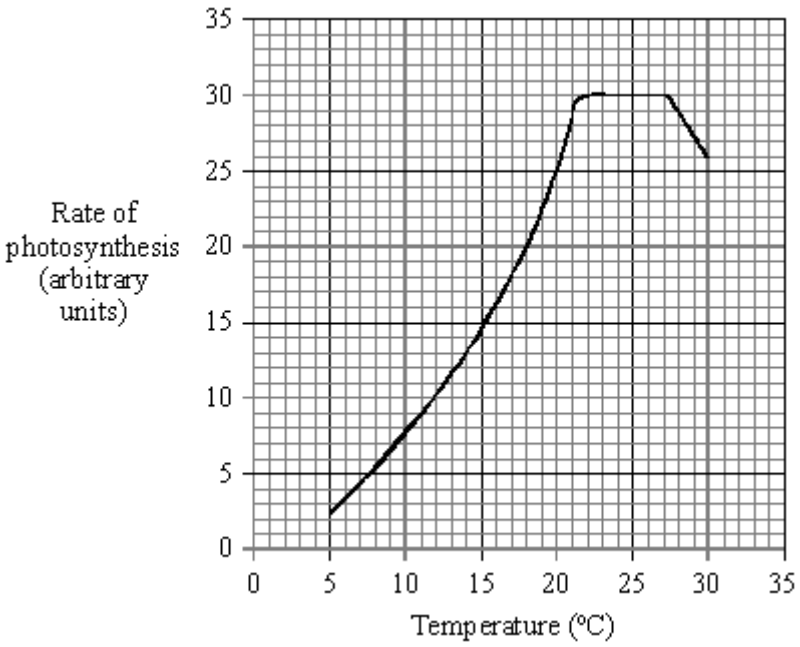
Green plants make food in their leaves.

(a) From where do the leaves get the energy that they need to make food?

_____

(1)

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



(i) Between which temperatures is the rate of photosynthesis fastest?

_____ and _____ °C

(1)

(ii) Suggest why the rate of photosynthesis stays the same between these two temperatures.

_____

_____

_____

_____

(2)

(iii) A greenhouse owner wants to grow lettuces as quickly and cheaply as possible in winter.

At what temperature should he keep his greenhouse in order to grow the lettuces as quickly and cheaply as possible?

_____ °C

Explain your answer.

_____

_____

_____

_____

(3)

(Total 7 marks)

Q31.

Busy lizzie plants produce flowers with many different colours.

A gardener wants to produce busy lizzie plants to fill a flower bed in her garden.
She decides to grow them from cuttings rather than seeds.

(a) Give **one** condition that she should supply to the new cuttings so that they grow well.

_____

(1)

Busy Lizzie plants can produce flowers which are white, pink or red.
A gardener wants to grow a display containing all three colours of flowers.

(b) Give **one** advantage and **one** disadvantage to the gardener of growing Busy Lizzie plants from cuttings rather than seeds.

Advantage _____

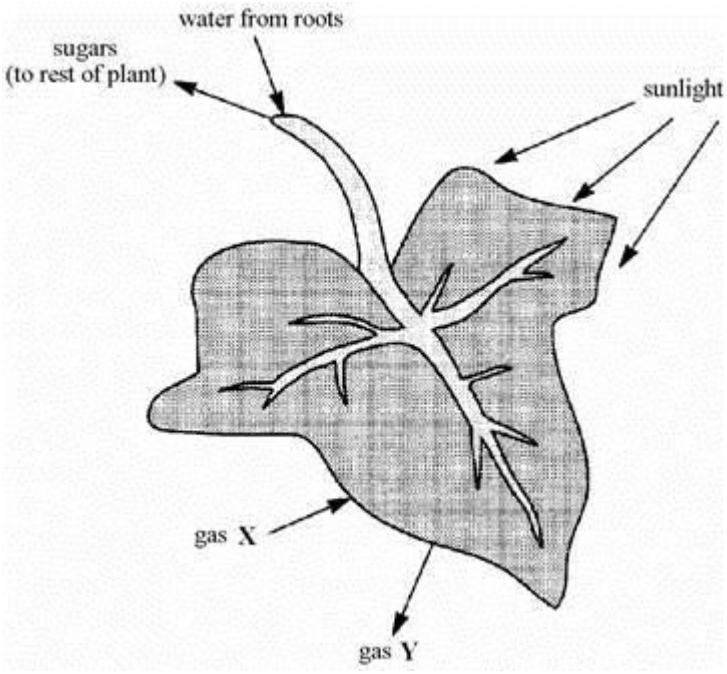
Disadvantage _____

(2)

(Total 3 marks)

Q32.

The diagram shows a plant leaf during photosynthesis.



(a) Name:

(i) gas **X**; _____

(ii) gas **Y**. _____

(2)

(b) Why is sunlight necessary for photosynthesis?

_____

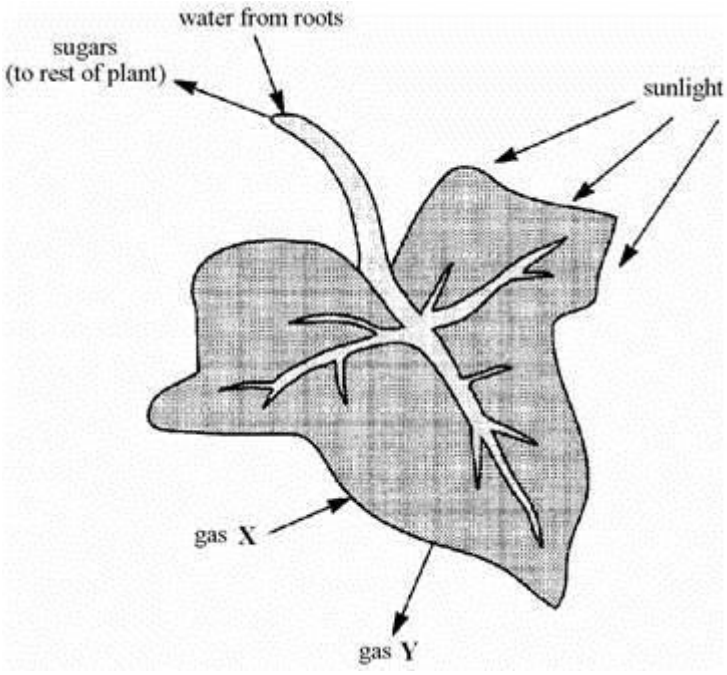
_____

(1)

(Total 3 marks)

Q33.

The diagram shows a plant leaf during photosynthesis.



(a) Name:

(i) gas **X**; _____

(ii) gas **Y**. _____

(2)

(b) Why is sunlight necessary for photosynthesis?

_____

_____

(1)

(c) Some of the sugars produced by photosynthesis are stored as starch in the roots. Explain, as fully as you can, why it is an advantage to the plant to store carbohydrate as starch rather than as sugar.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q34.

Low light intensity is one factor that limits the yield of a crop.

In Britain, many tomato growers use artificial lights to increase the yield of tomato crops.

The table shows the amount of natural daylight and artificial lamplight received by a tomato crop grown in a greenhouse.

Month	Natural daylight received by tomato plant		Artificial lamplight given to tomato plant		Total light energy received by plant per day in J/cm^2	Percentage increase in growth resulting from artificial light
	Day length in hours	Light energy received by plant per day in J/cm^2	Hours of light given per day	Light energy received by plant per day in J/cm^2		
January	8.1	239	18	492	731	206
February	9.9	492	18	492	984	100
March	11.9	848	12	328	1176	39
April	13.9	1401	2	55	1456	4
May	15.5	1786	0	0	1786	0
June	16.6	1960	0	0	1960	0
July	16.2	1849	0	0	1849	0
August	14.7	1561	0	0	1561	0
September	12.8	1064	2	55	1119	5
October	10.6	614	11	301	915	49
November	8.8	288	18	492	780	171
December	7.6	183	18	492	675	269

(a) Describe the pattern for the amount of light energy received from natural daylight by a tomato plant during the day.

_____

(3)

(b) A tomato plant needs 600 J of light energy per cm^2 each day to grow and produce tomatoes.

Use this information and data from the table to suggest an explanation for the pattern of the artificial light given to the tomato plants.

_____

_____

_____

_____

_____

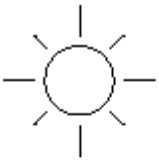
_____

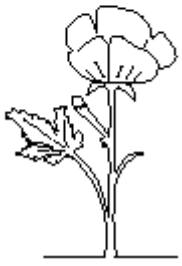
(2)

(Total 5 marks)

Q35.

Energy for living organisms comes from the Sun.





Complete the sentences by using the correct words from the box.

animals	**carbohydrates**	**carbon dioxide**	**oxygen**	**plants**	**water**

Light energy is captured by green _____ .

They use this energy to make _____ .

To do this, they also use _____ .

(Total 3 marks)

Mark schemes

Q1.

(a) LHS: carbon dioxide **AND** water

in either order

*accept CO_2 **and** H_2O*
allow CO2 and H2O
if names given ignore symbols
*do **not** accept CO^2 / H^2O / Co / CO*
ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept $C_6H_{12}O_6$
allow C6H12O6
*do **not** accept $C^6H^{12}O^6$*

1

(b) (i) light is needed for photosynthesis

or

no photosynthesis occurred (so no oxygen produced)

1

(ii) oxygen is needed / used for (aerobic) respiration

full statement

*respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark*

2

(c) (i) (with increasing temperature) rise then fall in rate

1

use of figures, ie

max. production at 40 °C
or maximum rate of 37.5 to 38

1

(ii) <u>25 – 35 °C</u>

either faster movement of particles / molecules / more collisions
or particles have more energy / enzymes have more energy

1

or temperature is a limiting factor over this range

<u>40 – 50 °C</u>

denaturation of proteins / enzymes

ignore denaturation of cells
ignore stomata

1

(d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate

1

so waste of money **or** less profit / expensive

1

because respiration rate is higher at > 35 °C
or
respiration reduces the effect of photosynthesis

1

[12]

Q2.

(a) photosynthesis

*do **not** accept other additional processes*

1

(b) (i) any **three** from, eg:

ignore time / apparatus

- mass of pondweed
  *type of pondweed = max **2***
  accept amount / volume / length / size
  ignore number / surface area of leaves / pondweed unqualified
- volume of water
  accept amount
- other reasonable features of the water
- light intensity
  accept distance between light source and tube / pondweed
- light colour
  accept light if neither colour nor intensity is given
- carbon dioxide
- temperature
- pH

3

(ii) any **one** idea from, eg:

ignore reference to cost

- how much oxygen they give off
- is pondweed poisonous to fish
- will fish eat pondweed

- is pondweed harmful to environment
- how long the pondweed lives
- growth rate / size of pondweed
- reference to appearance / aesthetics
- availability

1

(c) magnesium / Mg

accept iron / Fe
ignore ion and $^{+}$ or $^{-}$
ignore nitrate

1

[6]

Q3.

(a) 7.15 to 7.45 <u>am</u> **and** 7.15 to 7.45 <u>pm</u>

***both** required, either order*
accept in 24 hr clock mode

1

(b) (i) 11

1

(ii) 32.5 to 33

allow answer to (b)(i) + 21.5 to 22

1

(c) any **two** from:

- more photosynthesis than respiration
- more biomass / carbohydrate made than used
  allow more food made than used
- so plant able to grow / flower
  accept plant able to store food

2

[5]

Q4.

(a) (i) 70

*award **2** marks for correct answer irrespective of working*
*allow **1** mark for 30 + 10 + 24 + 6 (with wrong answer or no answer), do **not** award this sum if other figure(s) are included in the addition*

2

(ii) 6

*award **2** marks for correct answer irrespective of working*
*award **2** marks for correct answer to (a)(i) – 64 (ecf)*
*award **1** mark either for 70 – 64 or answer to (a)(i) – 64 with no answer or incorrect answer*

2

(b) photosynthesis.

1

[5]

Q5.

(a) (i) colour of light / bulb / lamp
allow wavelength for colour
allow bulb alone
*do **not** accept light / colour unqualified*

1

(ii) any **one** from eg

- temperature
allow heat
- light intensity **or** distance between lamp and plant / tube
allow amount / brightness of light
ignore light unqualified
- carbon dioxide
allow symbols
- other light in room
allow use a dark room
- mass / size / amount / age / type of pondweed
allow same piece of pondweed
ignore pondweed unqualified
- volume / amount of water
ignore reference to time

1

(iii) improved reliability
*allow for reliability **or** less likely to lose count*

or

can spot anomalies / changes
allow reference to calculating a mean / average
ignore reference to accuracy / precision / fair

1

(b) (i) green

1

(ii) any **two** from:

ignore references to colour

- least / less bubbles / gas / oxygen / mean
  *reference to least / less needed only once, in context, for **2** marks*
- least / less photosynthesis
- least / less glucose / sugar / carbohydrate / food made
  only penalise no once, ie
  *no bubbles = **0** mark*
  *no bubbles so no photosynthesis = **1** mark*
  allow most / more green light reflected (by chloroplasts)

2

[6]

Q6.

(a) add mineral ions to the soil

extra box ticked cancels the mark

1

(b) increasing the temperature

*each extra box ticked cancels **1** mark*

1

turning lights on at night

1

[3]

Q7.

any **three** from:

*maximum **2** marks if only advantages **or** only disadvantages given*
ignore references to cost unqualified

advantages: (max 2)

ignore reference to fresher

- less transport / example of transport **or** less fuel used
  accept implication eg less food miles
  allow no transport / fuel costs
- less pollution / example
  accept eg less carbon dioxide / smaller carbon footprint
  allow no pollution / example
- support of local / UK economy / farmers

disadvantages: (max 2)

- not available all year
- may require use of heat / light
- (production of) heat / light causes pollution

[3]

Q8.

(a) (i) increase (and then level off) **and** max / up to at 0.15 (%) (carbon dioxide)

ignore references to oxygen concentration only
ignore mention of 23

1

(ii) $\underline{CO_2}$ is limiting at low CO_2 / at first

ignore specific numbers

1

light is limiting at high CO_2 / at end

1

(b) ***mark both parts together***

effect: (oxygen) falls

1

explanation: (oxygen) used for respiration

if no other marks *awarded allow (effect) no change* ***and*** *(explanation) no photosynthesis for* ***1*** *mark*

1

(c) more chlorophyll / chloroplasts

1

allows more photosynthesis / description

for both marks must refer to more at least once

1

[7]

Q9.

(a) root

1

(b) (i) chlorophyll

1

(ii) absorbs / traps / takes in light

do ***not*** *accept attracts / solar energy /sunshine / sun*

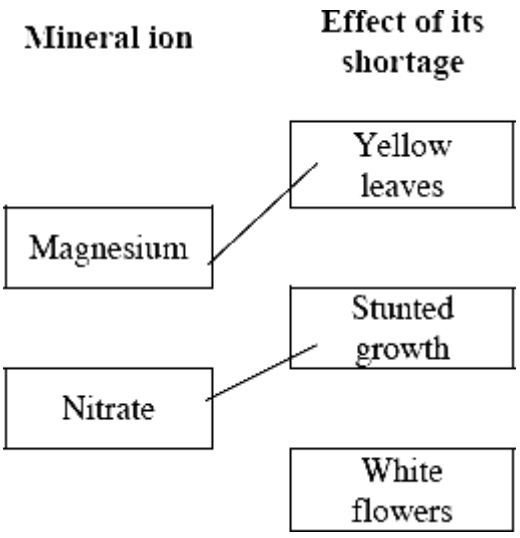
1

(for) photosynthesis

accept to make food / glucose / sugar/ biomass

1

(c)



1 *mark per correct line*

extra line from a mineral ion cancels the mark

2

[6]

Q10.

(a) (i) oxygen produced

1

(ii) any **one** from:

- average / mean / median
  ignore reliable / precise / accurate
- some may be anomalous
  allow some may not float

1

(b) (i) *do **not** allow answers in terms of time only*

*if candidate answers in terms of comparing rate of change then the rate of change of photosynthesis must be in the correct direction for **1** mark*

any **two** from:

- low intensity / below 12.5 / 2.5 - 12.5 (units of light) flat wrack /it, rate of photosynthesis faster **or** saw wrack rate of photosynthesis slower
  allow any value in range
- high intensity / above 12.5 / 12.5 - 15 (units of light) flat wrack / it,rate of photosynthesis slower **or** saw wrack rate of photosynthesis faster
  allow any value in range
- same (rate) at 12.5 units

2

(ii) any **two** from:

- saw wrack receives less light
  accept converse if clear reference to bladder wrack

- less photosynthesis
  if first and second responses, 'less' needed only once

  or
  less carbohydrate / sugar / starch production

- when tide is in **or** at high tide **or** any tide above low tide
  accept saw wrack covered by water / submerged longer / more
  reference to position on shore is insufficient

2

[6]

Q11.

(a) the starch is stored for later use.

1

(b) (i) any **two** from:
*do **not** accept temperature-apply list principle*
ignore reference to time

- carbon dioxide (concentration)

- light intensity
  *allow **one** mark for light if neither intensity or colour are awarded*

- light colour / wavelength

- pH

- size / amount plant

- same / species / type plant
  allow 'the plant'

- amount of water <u>in the tube</u>
  ignore amount of water alone

2

(ii) number / amount of bubbles **or** amount of gas / oxygen
allow volume of bubbles (together)
ignore 'the bubbles' unqualified

1

(relevant reference to) time / named time interval
allow how long it bubbles for
*do **not** accept time bubbles start / stop*
ignore speed / rate bubbles

ignore instruments
*do **not** accept other factors eg temperature*
*accept how many bubbles per minute for **2** marks*

1

(c) (i) temperature
allow heat / °C / cold

1

(ii) carbon dioxide / CO_2
CO2 / CO^2 / Co_2 / Co^2 / co_2 / co^2
*do **not** accept CO / 2CO*

1

[7]

Q12.

(a) any **one** from:

- (type of / amount of) soil / minerals / nutrients / pH
- amount of water / time of watering
- space between plants / plants and wall
- time for growth

list principle
ignore carbon dioxide / same number of plants / food
*do **not** allow temperature / light / exposure to wind*

1

(b) (i) North wall

1

(ii) nugget
list principle

1

(c) has not tested all varieties / nugget / champion against all walls
*do **not** allow repeat experiment*

1

[4]

Q13.

(a) (i) water / H_2O
allow hydrogen oxide

1

oxygen / O_2 / O
allow upper and lower case symbols and superscripts
answers must be in this order

1

(ii) respiration in the plant

allow clear indication of correct response

1

(b) light (no light) / light intensity

ignore references to the card / covered / uncovered

1

chlorophyll (no chlorophyll) / chloroplast

*allow leaf colour **or** both green **and** white given*

1

(c) (i) no light (received) **or** it's dark

allow no photosynthesis
*do **not** allow little light / photosynthesis*
ignore sun
apply list principle for other factors

1

(ii) no chlorophyll / chloroplasts (present)

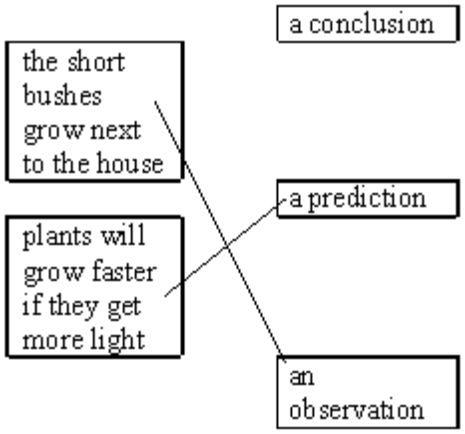
allow no / little photosynthesis
*allow white **or** not green **or** little chlorophyll / few chloroplasts*
apply list principle for other factors

1

[7]

Q14.

(a) (i)



*both correct = **2** marks*
*one correct = **1** mark*
extra line from a statement cancels the mark

2

(ii) 1st space: carbon dioxide

allow CO_2 (ignore superscript)

*do **not** allow CO alone*

1

2nd space: glucose / sugar / starch / carbohydrate

1

(b) (i) any **one** from:

- move lamp or change distance between lamp and plant
  ignore measure the distance
- change wattage / power of (light) bulb
  *do **not** accept just "change bulb"*
- change voltage / power supply to the (light) bulb
- change the number of lamps
- put translucent material between lamp and plant
  accept examples, eg tracing paper / filters
  *do **not** accept coloured filters*

1

(ii) rises

1

levels off
ignore numbers

1

(iii) idea that it levels off

or

does not increase at all light intensities

or

it only increases to a certain amount
*answers should relate to photosynthesis and **not** to bubbling*

1

[8]

Q15.

(a) photosynthesis

1

(b) oxygen

1

(c) chlorophyll

1

(d) starch

1

[4]

Q16.

(a) any **three** from:

- ((mean) mass) increases up to 7 / 8 units (of light) then levels off
- light limiting factor up to 7 / 8 units
- for photosynthesis
  must be in correct context
- other factor / temperature limiting above 7 / 8 units

3

(b) any **two** from:

- cost of providing conditions / heat / light / CO_2
- effect of treatment on profit
  allow too much of factor is wasteful
- relevant use of data from graph eg limiting factors
- named other factors eg fertiliser / pest control / weeds / density of planting
  allow taste / appearance

2

(c) **nitrate function**

produce amino acids / proteins / enzymes
ignore DNA
*do **not** allow chlorophyll*

1

nitrate deficiency

stunted growth
allow description
ignore plant dies

1

magnesium function

produce chlorophyll
ignore chloroplasts

1

magnesium deficiency

yellow leaves / plant

ignore plant dies

1

[9]

Q17.

(a) (i) L.H.S. – water / H_2O

1

R.H.S. – oxygen / O_2

accept H^2O

accept O^2 / O

1

(ii) chlorophyll

must make it clear that it is the chlorophyll
*do **not** credit chloroplast on its own*
*do **not** accept chloroplast / chlorophyll*
without indication that it is chlorophyll

1

(b) (i) light intensity / temperature is high enough for higher rate or light / temperature is not limiting

1

low CO_2 available or not enough CO_2 available **or** rate would be higher with more CO_2

1

(ii) temperature

allow water / rain
allow (too) cold / hot as a minimum
allow wave length / frequency / colour
ignore ions
ignore heat

1

[6]

Q18.

(a) burning fossil fuels / coal / gas / oil

accept driving <u>vehicles</u> / eg cars
accept coal-fired power station
accept car emissions
ignore combustion unqualified
*do **not** accept power station unqualified*
*do **not** accept <u>using</u> fossil fuels*

1

(b) (i) (SO_2) makes it acidic / makes acid rain / lowers pH

1

(ii) any **one** from:

(SO_2) kills leaves reduces number of leaves reduces leaf area

or smaller leaves causes fewer leaves to grow

ignore correct extras, eg
withered, yellow etc

1

(c) any **two** from:

(fewer leaves / less leaf S.A) so less photosynthesis

less food / less sugar / less starch supplied (to roots / to stems)

(SO_2) lowers pH of soil / makes soil acidic

ions (/minerals / salts / nutrients) less available (to plants)

accept don't get enough nutrients

2

[5]

Q19.

(a) carbon dioxide/CO_2

1

(b) through the roots/root hairs

*do **not** accept leaves*

1

(c) oxygen

1

sugar/glucose/other named sugar/starch/carbohydrate

1

(d) award one mark for each mark point

n.b. accept chloroplast for chlorophyll

*n.b. credit the candidate who answers **in** terms of the white areas of the leaf*

chlorophyll is green

e.g. green areas have chlorophyll

1

chlorophyll/green is needed for photosynthesis

e.g. it is only in green areas that photosynthesis can take place

after this point do not penalise a candidate if they do not refer to photosynthesis

1

light is needed

e.g. it does not happen in the dark
*do **not** accept sunshine/sun*

1

photosynthesis produces/makes starch

e.g. starch is made

so

e.g. 'you need light to make starch' scores 3rd and 4th marking points

'you need chlorophyll and light for photosynthesis' scores on the 2nd and 3rd marking points

'photosynthesis makes starch and you need green leaves and light for it to work' scores

on the 2nd, 3rd and 4th marking points

1

[8]

Q20.

(a) water [1]

oxygen [1]

(sun) light or solar [1]

*do **not** accept sun's*

chlorophyll [1]

*do **not** accept chloroplasts*

4

(b) any **two** from:

stored as fructose
stored as sucrose
stored as starch
stored as oil **or** lipid
moved or transported away <u>in the phloem</u>

*do **not** accept "stored" by itself*

respired or burnt up for energy or
fuel changed to protein
changed to cellulose
changed to fructose
changed to starch
changed to oil or lipid

*do **not** accept "food for plant"*
*do **not** accept "used up" by itself*

2

(c) (i) roots or root hair (cells)

1

(ii) the mineral salts are (dissolved) in water [1]

water transports salts throughout the plant
or water enables osmosis or diffusion to take place [1]

2

(d) (i) plants grow better with some nutrients than none

or
plants grow better with nitrates than without
comparison is needed
accept "faster" as equivalent to "better"
accept don't grow well with only water

1

(ii) 0.14(g)
*units **not** needed*

1

(iii) making protein **or** amino acids
*do **not** accept help them grow*
*accept named protein **or** DNA **or** chlorophyll*

1

any **two** from:

(iv) type **or** variety **or** starting weight **or**

2

(iii) size of seedlings
keep the environment the same
*only if light **or** temperature **or** day length not already credited*

light
temperature not heat
time of growth
*do **not** accept the same equipment*
*do **not** accept help them grow*

1

day length
amount of culture solution **or/**size of
accept named protein, DNA chlorophyll

boiling tube
number of seedlings per tube
pH
CO_2
humidity

[15]

Q21.

(a) carbon
water
oxygen

light

chlorophyll

starch

***1** mark each*

6

(b) leaf **(or** named part of leaf)
or
chloroplasts

accept anywhere green

do not credit chlorophyll unless qualified

1

(c) water through the roots
or
root hairs
or
by osmosis

*do **not** credit where the candidate is unclear about which is which*

1

CO_2 through the leaf
or
stomata
or
by diffusion

1

(d) any **one** point:

increased CO_2 concentration
increased water supply
increased temperature (up to a point)
increased light (intensity)

*accept altered light quality by less green **or** increasing other colours*

accept increased duration of exposure to light

*do **not** credit sun **or** sunshine*

accept CO_2 from respiration

1

[10]

Q22.

(a) (i) light **or** solar

*do **not** credit sun's energy*

*do **not** credit radiant*

1

(ii) chlorophyll

1

(iii) chloroplast

1

(iv) CO_2 **+** H_2O

reactants identified (accept words)

1

$C_6H_{12}O_6 + O_2$

products identified (accept words)

1

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

balanced equation

1

(b) any **two** from:

increased CO_2 concentration

increased water supply

increased temperature (up to a point)
increased light intensity

*do **not** accept heat or warmth*

altered light quality by less green **or** increasing other colours

2

(c) any **four** points

- palisade (mesophyll)
- lots of chloroplasts **or** chlorophyll **or** main site for photosynthesis **or** absorb maximum amount of light
- guard cells
- CO_2 in **or** O_2 out **or** water vapour out
- controls size of stoma **or** pores in leaf

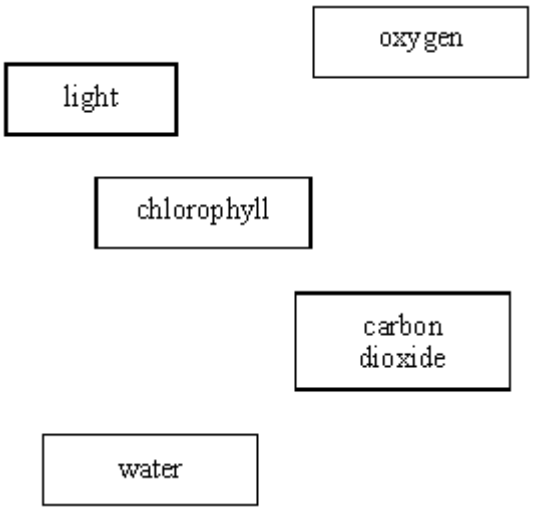
***allow** stomata*

4

[12]

Q23.

(a)



5

(b) (i) sugar **or** carbohydrate

1

(ii) it can be stored **or** it is insoluble

accept it has no osmotic effect

1

(iii) any **one** from:
respires it **or** releases **or** transfers energy
turns it **or** stores it as fructose **or** sucrose **or** lipid **or** protein **or** cellulose

1

(c) (i) photosynthesis

1

(ii) any **one** from:
flat surface
stomata
thin
chloroplasts
veins
large surface area
air spaces

*do **not** accept chlorophyll*

1

[10]

Q24.

(a) reactants: $CO_2 + H_2O$

1

products: $C_6H_{12}O_6 + O_2$

1

balance:

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

1

(b) **1** mark each for any of the following ideas:

lower CO_2 concentration

lower light intensity

decrease water availability

alter light wavelength **or** colour

accept more green light

2

(c) (i) scales correctly constructed

i.e. equal intervals along each axis

1

points plotted correctly

1

appropriate line correctly drawn

*accept dot to dot **or** line of best fit*

cancel if line extends through zero or beyond 50°C

1

(ii) 18 – 19 (bubbles per minute)

1

(iii) heat denatures enzymes **or** destroys membranes **or** ruptures cells **or** destroys cells

do not accept kills enzymes

1

[10]

Q25.

Does not contain chlorophyll which is needed to absorb light **or** energy

each for 1 mark

[2]

Q26.

(a) (i) e.g. mussels/caddis loach

for 1 mark

1

(ii) 3 of:
carbon dioxide
water
chlorophyll/chloroplasts
light

any 3 for 1 mark each

3

(b) 6 of e.g.
some plant/animal material not digested by consumers passes out with faeces
respiration releases energy used in movement lost as heat
some 'lower' organisms die energy transferred to decomposers/detritivores
thence to environment

any 6 for 1 mark each

6

[10]

Q27.

(a) carbon dioxide
oxygen

2

(b) (i) e.g. rubber plant/fern

1

(ii) because can tolerate low light levels

1

(iii) yellow parts of leaf do not contain chlorophyll therefore more light needed for photosynthesis

2

(iv) no leaves/only have stem only have small area which can photosynthesise

2

[8]

Q28.

(a) (i) June

for 1 mark

1

(ii) April
max. light
photosynthesis makes sugars/substances needed for growth

for 1 mark each

3

(b) 2 of:
temperature
carbon dioxide availability
water
chlorophyll

any 2 for 1 mark each

2

[6]

Q29.

(a) 21.5 – 22 ***and*** 27 – 27.5

for 1 mark

1

(b) *ideas of*
limiting factor / shortage of
e.g. light / carbon dioxide / water / chlorophyll

each for 1 mark
(allow 1 for 'maximum / optimum rate of enzyme activity if no reference to limiting factors) (ignore denaturation)

2

(c) 21.5 – 22° C

*(allow **first** figure from answer to (i) so that no 'double-penalty but only if this first answer is 20 or greater)*

maximum rate of photosynthesis / highest / fastest

but related to flat part of curve

most economical heating / cheapest related to heating

must relate to the temperature the candidate has given

each for 1 mark

3

[6]

Q30.

(a) Sun / sunlight / light

for 1 mark

1

(b) (i) 21.5 – 22 ***and*** 27 – 27.5

for 1 mark

1

(ii) ideas of limiting factor / shortage of
e.g. light / carbon dioxide / water /chlorophyll

each for 1 mark
(allow 1 for 'maximum' rate of enzyme activity if no reference to limiting factors)
(ignore reference to dematuring)

2

(iii) 21.5 – 22° C

(allow first figure from answer to (i) so that no 'double-penalty' <u>but</u> not below 20)

maximum rate of photosynthesis

(can relate to any number on 'flat')

most economical heating (must relate to left end of 'flat'

each for 1 mark

3

[7]

Q31.

(a) water / damp / wet
or
suitable temperature / warm / heat / hot
or
light / sun
(*accept* rooting powder / soil qualified e.g. fine / nutrients / fertiliser / minerals)
(*do NOT allow* oxygen / carbon dioxide / food)

for 1 mark

1

(b) *advantage*
quick / cheap / several from one plant / known outcome / same as parent
(*reject* all the same)
disadvantage
all the same / all get same disease

for 1 mark each

2

[3]

Q32.

(a) (i) carbon dioxide / CO_2 (*reject* CO)

(ii) oxygen / O_2 / O (*reject* water vapour)

for 1 mark each

2

(b) (provides) energy

for 1 mark

1

[3]

Q33.

(a) (i) carbon dioxide / CO_2 (*reject* CO)

(ii) oxygen / O_2 / O (water vapour neutral)

for 1 mark each

2

(b) (provides) energy

for one mark

1

(c) starch insoluble therefore water not taken in by osmosis
or
sugar is soluble / has small molecules may diffuse out therefore lost

*(*ignore *ref. to cells bursting)*

or

starch has large molecules
cannot diffuse therefore retained

for 1 mark each

3

[6]

Q34.

(a) low in winter / named months /when the days are short

accept increases in spring / Dec – June

1

high in summer / named month(s) / (when days are long

decreases in autumn / June – December

1

reasonable quantitative statement

accept any reasonable calculated / translated quantitative statement

higher in summer than in winter for 2 marks
comparative statements may be worth 2 marks
but
8/11 times higher in summer than in winter for 3 marks

1

(b) no artificial light given in summer / light only given in winter

since natural light greatly exceeds minimum / 600 J (required to produce tomatoes)

accept day length if linked to light energy

OR

light only given in winter

as natural light less than the minimum needed (to grow them) or 600 J

OR

for 2 marks:
percentage increase in growth from artificial] light only significant in winter

2

[5]

Q35.

plants

1

carbohydrates

accept oxygen

1

carbon dioxide

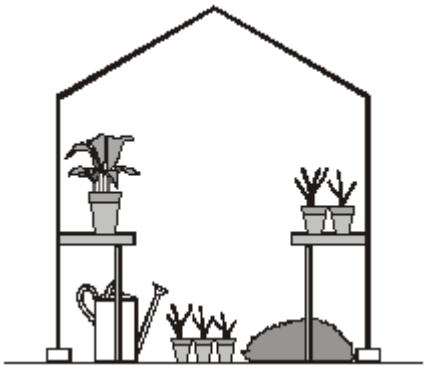
accept water
(these words must be in this order)

1

[3]

Q1.

The diagram shows some plants growing in a greenhouse on a hot summer's day.



Which **one** of the following factors is most likely to limit the rate of photosynthesis at this time?

- carbon dioxide concentration
- light intensity
- temperature

Factor _____

Explain the reason for your answer.

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q2.

Carnation plants have attractive flowers.

(a) Carnation plants are grown from cuttings.

Complete the sentences by using the correct words from the box.

asexual	clones	genes	mutation	sexual

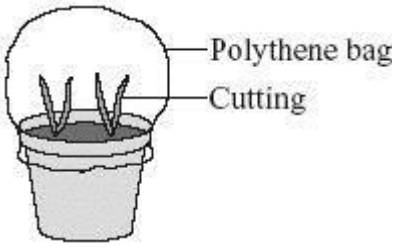
Carnations grown from cuttings have the same _____ as their parents.

This type of reproduction is _____ .

The new plants are known as _____ .

(3)

(b) Gardeners usually cover the cuttings with a polythene bag as shown in the diagram below.



Why do the cuttings grow better if gardeners do this?

_____

_____

(1)

(Total 4 marks)

Q3.

Nitrate fertilisers are important in agriculture. They help to increase crop yields and so make food cheaper to buy. Some of the nitrate fertilisers run off into rivers and get into drinking water. The problem is that the nitrates can react with iron in our blood. This reduces the blood's ability to carry oxygen. If the amount of nitrate in drinking water is too

high, it can cause ‘blue baby syndrome’, in which babies look blue due to lack of oxygen.

The table shows the amount of nitrate fertilisers used and the crop yield.

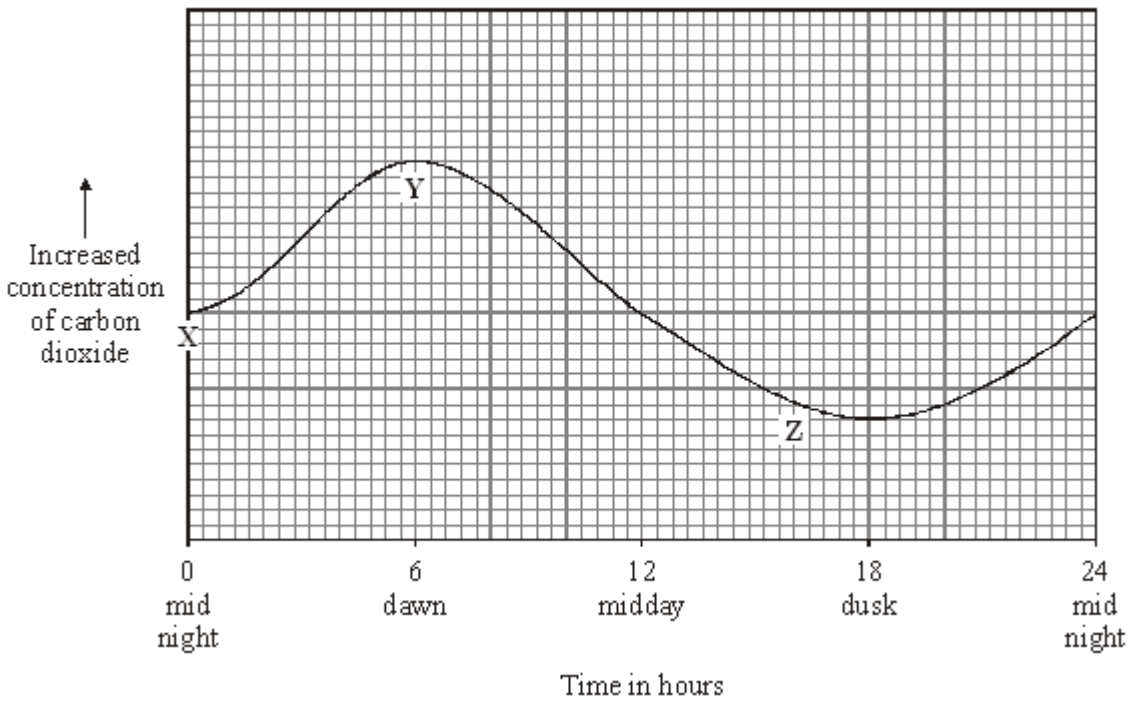
Nitrate fertilisers in kilograms per hectare of land	0	150	250
Crop yield in tonnes per hectare of land	5	8	7

Use the information above to suggest what should be done, by farmers and government, to prevent ‘blue baby syndrome’. Explain the reasons for your suggestions.

(Total 3 marks)

Q4.

The graph shows the concentration of carbon dioxide in the air in a greenhouse full of tomato plants, measured over a period of 24 hours.



(a) Explain why the concentration of carbon dioxide in the air in the greenhouse increased between **X** and **Y**.

(2)

(b) Explain why the concentration of carbon dioxide in the air in the greenhouse decreased between **Y** and **Z**.

(2)

(Total 4 marks)

Q5.

(a) Balance the following equation for photosynthesis.

_____ CO_2 + _____ H_2O → $C_6H_{12}O_6$ + _____ O_2

(1)

(b) Give **two** conditions necessary for photosynthesis apart from a suitable temperature

range and the availability of water and carbon dioxide.

1. _____

2. _____

(2)

(a) Plants have leaves which contain guard cells and palisade cells. Explain how **each** of these kinds of cell assists photosynthesis.

Guard cells _____

_____

_____

_____

(2)

Palisade cells _____

_____

_____

_____

(2)

(d) Glucose is a product of photosynthesis. Give **three** uses which green plants make of glucose.

1. _____

2. _____

3. _____

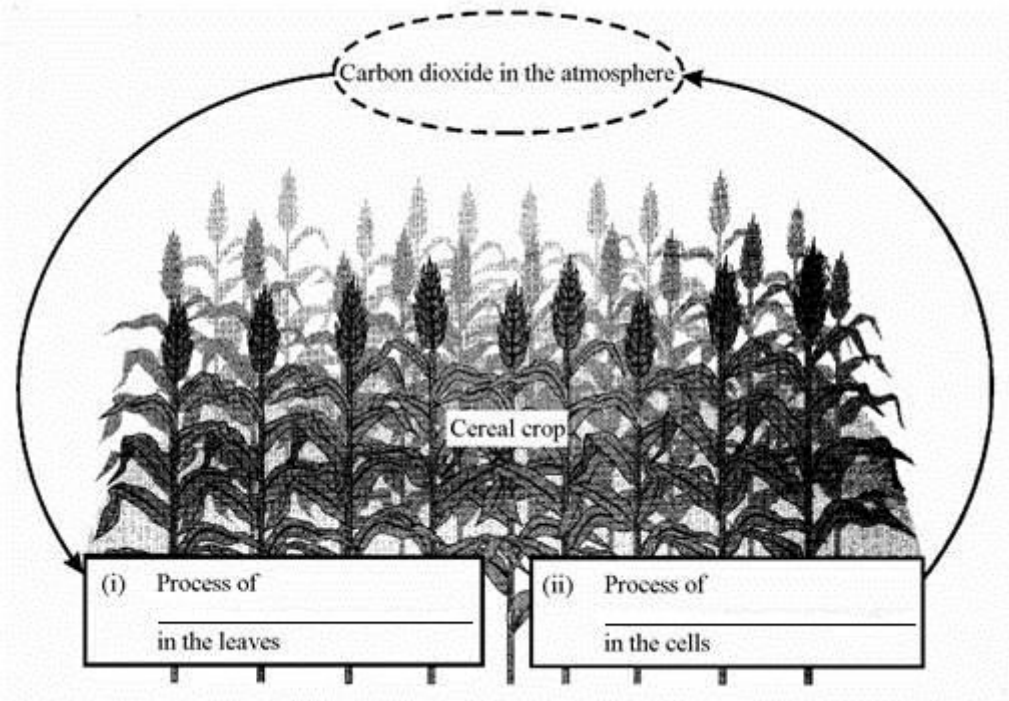
(3)

(Total 10 marks)

Q6.

(a) The diagram shows a cereal crop.

Complete spaces (i) and (ii).



(2)

(iii) What sort of weather may cause the cereal crop to wilt?

_____

(1)

(b) Describe the process of transpiration in plants.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q7.

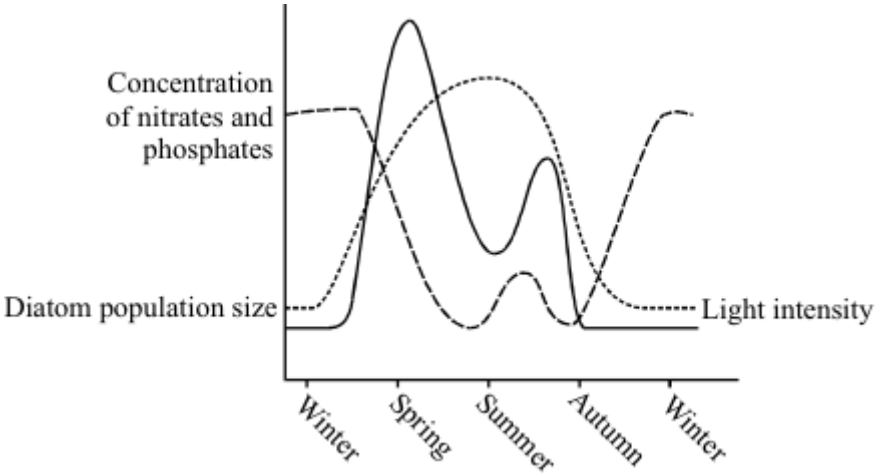
A food chain in the North Atlantic Ocean is:

diatoms → small fish → large fish

The graphs show how over a year:

- the population size of diatoms in the North Atlantic varies;
- the light intensity alters;

- the concentration of nitrate and phosphate minerals alters.



(a) Explain why the light intensity is a major factor in controlling the numbers of diatoms.

_____

_____

_____

(2)

(b) (i) Suggest **two** reasons why the population of diatoms decreases between spring and summer.

1. _____

_____

2. _____

_____

(2)

(ii) Give **two** reasons why the population of diatoms decreases in autumn.

1. _____

_____

2. _____

_____

(2)

(c) Use the information on the graph to suggest what change causes the number of diatoms to increase in the late summer. Give a reason for the change.

_____

_____

(2)

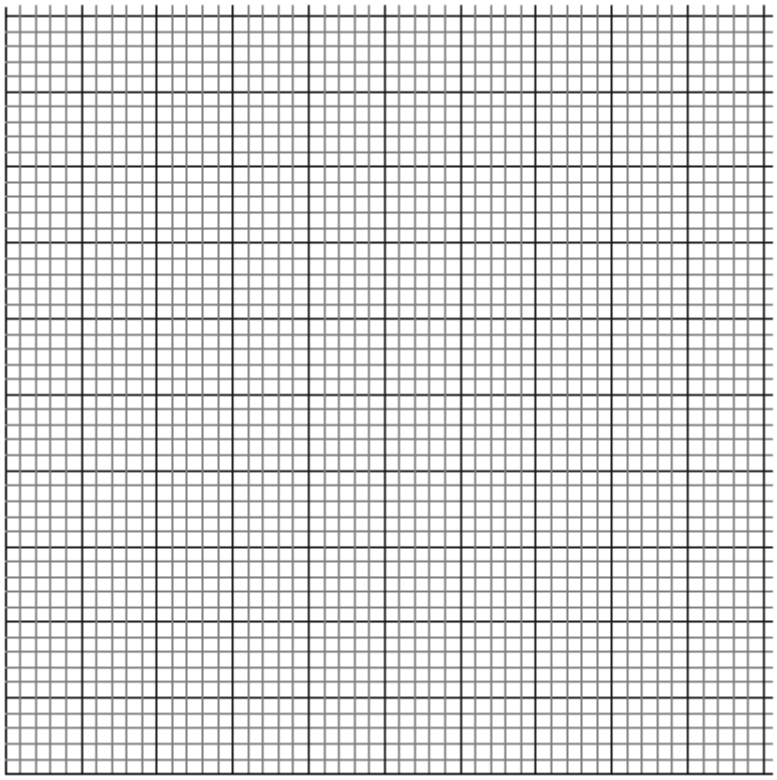
(Total 8 marks)

Q8.

The figures below show how the yield of a wheat crop is affected by adding nitrogen fertiliser.

Nitrogen fertiliser added (kg/hectare)	Yield (tonnes/hectare)
0	26
50	28
75	31
100	34
125	40
150	43
175	44
200	44

(a) Display these results on the graph paper in the most suitable way.



(4)

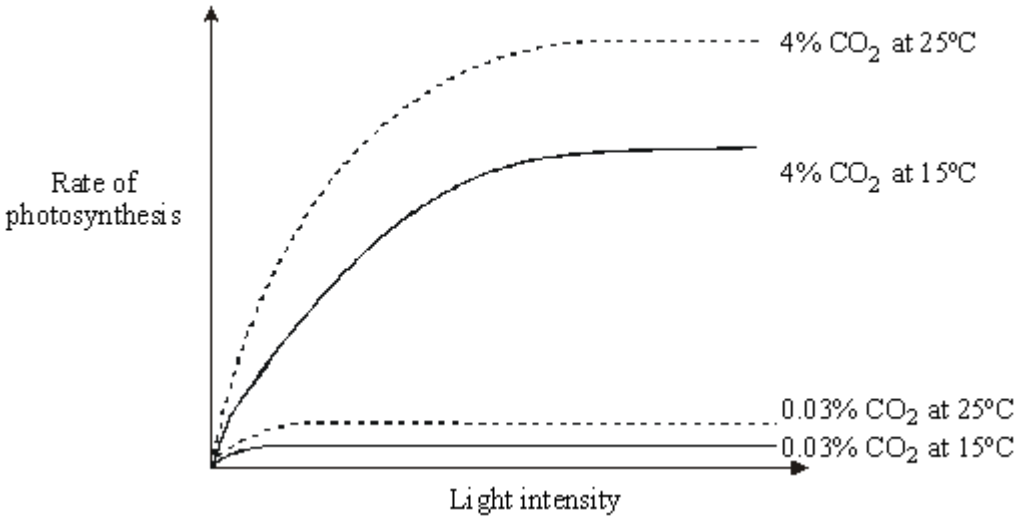
(b) What conclusions can you draw from the graph?

(3)

(Total 7 marks)

Q9.

The graph shows how the rate of photosynthesis is affected by different conditions.



(a) What patterns can you find from this graph?

(5)

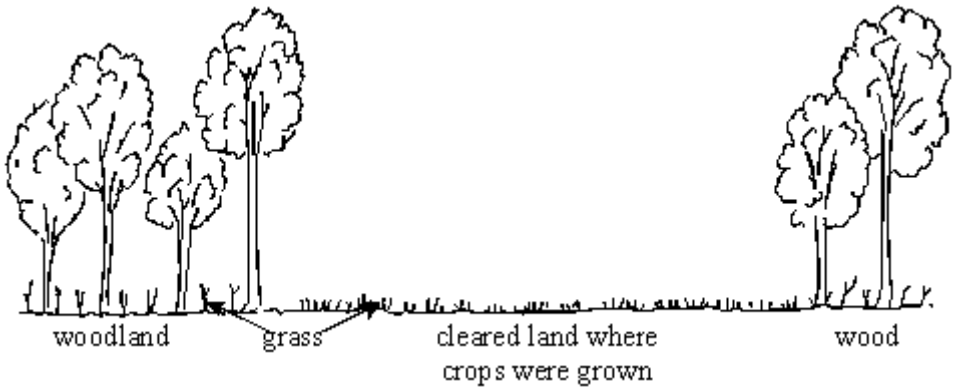
(b) How useful could this information be to a grower using glasshouses? Give reasons for your answer.

(2)

(Total 7 marks)

Q10.

In some developing countries woodland is cut down and burned. The ash acts as fertiliser. Crops are grown for three years. The land is then left as it is too poor to grow any more crops.



(a) In the original woodland trees and plants died and grew for hundreds of years. When cleared the land grew crops for only three years. Explain this difference in as much detail as you can.

_____

_____

_____

_____

(3)

(b) What could farmers do to make crops grow on the cleared land for more than three years?

_____

_____

(2)

(Total 5 marks)

Q11.

Plants produce glucose by a process called photosynthesis.

$$\text{carbon dioxide + water} \xrightarrow[\text{chlorophyll}]{\text{light}} \text{oxygen + glucose}$$

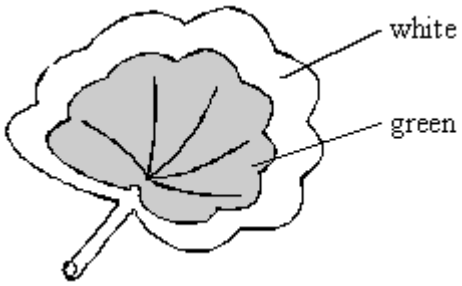
The plant uses glucose to grow.

(a) The graph shows the change in concentration of carbon dioxide in a glasshouse full of plants over 24 hours.

Draw a line on the graph to show how the concentration of oxygen changes in the glasshouse.

(3)

(b)



Some plants have variegated leaves with white parts which contain no chlorophyll.

How do you think a variegated geranium would grow compared to a similar sized geranium with all green leaves?

Explain your answer _____

_____

_____

(2)

(Total 5 marks)

Q12.

Plants are grown in glasshouses to protect them from the weather or extend the growing season.

Plants make food by photosynthesis.

$$6CO_2 + 6H_2O \xrightarrow[\text{light}]{\text{energy from}} C_6H_{12}O_6 + 6O_2$$

glucose

In winter, when days are shorter, glasshouses are heated to keep the enzyme reactions in plants at optimum rates.

What else should a grower do to make sure that the plants are photosynthesising at the optimum rate? Give a reason for your answer.

_____

_____

_____

_____

_____

_____

(Total 3 marks)

Q13.

The table below shows a wheat farmer's calendar.

October	Winter Wheat is sown and germinates. Phosphate/potash fertiliser is applied.
March	Wheat plants resume growth. Nitrate fertiliser is applied.
April	Ammonium nitrate, the main fertiliser, is applied. Fungicide may be sprayed to control mildew or rust on wheat.
May	Extra ammonium nitrate fertiliser may be applied. A second spraying of fungicide may be needed. Dwarfing hormone sprayed to keep wheat straw (stalks) short.
June	Insecticide spray against aphids may be needed. Extra spraying of fungicide may be needed.
August	Wheat is harvested.
August/ September	Ground sprayed with weedkiller. Stubble (remains of wheat plants) is ploughed in ready for the next crop.

This process uses expensive fertilisers and pesticides to grow pest free crops which may be produced in excess.

What are the reasons for and against growing wheat in this way?

For _____

_____

_____

(3)

Against _____

_____

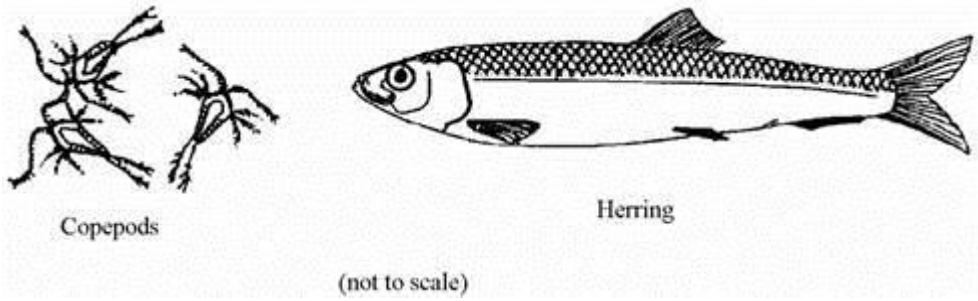
_____

(4)

(Total 7 marks)

Q14.

Copepods are tiny animals which live in the sea.



During the day they live deep down near the sea bed.
At night they move up to the surface where they feed on tiny plants.
When the sun rises they move down to the bottom again.

(a) Suggest why the tiny **plants** live near the surface of the sea.

_____

_____

(2)

(b) Herring feed on copepods.

Where will herring be found during the day? Give a reason for your answer.

_____

_____

_____

(2)

(Total 4 marks)

Mark schemes

Q1.

carbon dioxide concentration

1

since atmospheric concentration very low / value give e.g. 0.03%

allow carbon dioxide used up

1

temperature high

allow if light chosen as a factor

1

light intensity high

allow If temperature chosen as a factor

1

[4]

Q2.

(a) genes

1

asexual

1

clones

1

(b) keeps cuttings damp / prevents wilting

allow keeps warm / acts like a greenhouse
allow keeps pests off

1

[4]

Q3.

use less nitrate / fertiliser

accept use none
use a different fertiliser is neutral
prevent nitrate fertiliser run off is neutral

1

any **two** from:

explanation that with less or none the crops still grow

make more land available to grow more crops

monitoring of water

legislation

organic farming / manure

genetically modified crops

give babies bottled water

2

[3]

Q4.

(a) respiration

reject start respiring / respire only at night

1

no photosynthesis because no light

1

(b) photosynthesis rate greater than respiration rate

1

reject no respiration / photosynthesis only

photosynthesis since light

1

[4]

Q5.

(a) 6 6 6

all required

accept a '6n 6 n n 6n' version of the balanced equation provided it is correct in every detail

1

(b) any **two** of

- (presence of) chlorophyll **or** (amount of) chloroplasts

  accept green leaves (or other green parts)

- (sufficient) light (intensity)

- (light) of **a** suitable wavelength

  any light other than green light

  do not credit Sun's energy or sunshine or Sun

2

(c) **guard cells**

any **two** of

* control by osmosis
* the movement of gases

*accept movement of carbon dioxide **or** oxygen **or** water vapour beware movement of CO_2 out*

accept a diagram or description

* through the stoma

2

palisade cells

any **two** of

* near the upper surface
* contain (a great) many **or** more chloroplasts
* (so) contain the most chlorophyll

2

(d) any three of

* for respiration
* conversion to (insoluble) starch

or to food store **or** to (other)carbohydrates
* (conversion to) sucrose **or** to food store **or** to (other) carbohydrates

or polysaccharides

*do not credit just to grow **or** live*
***or** survive*
accept conversion to food store
***or** to (other) carbohydrates once only*

* (conversion to) lipids **or** fats **or** oils
* (conversion to) amino acids **or** (plant) proteins **or** auxins **or** (plant) hormones **or** enzymes

3

[10]

Q6.

(a) (i) photosynthesis

1

(ii) respiration

do not credit combustion
do not credit decay

1

(iii) dry

*accept hot **or** windy **or** drought*

1

(b) any **three** from

* evaporation (of water)

***or** loss of water vapour*

* (mostly) from the leaf / leaves

do not credit incorrect reference to leaves

* through the stomata

accept through each stoma

accept through the stomas(sic)

* causing a pull

***or** causing an increase in osmotic potential (at the top of the plant)*
***or** causing an increase in water potential (at the top of the plant) **or** causing a decrease in osmotic pressure (at the top of the plant)*

* (so that) water moves up (through the plant)

do not credit water vapour moves up through the plant

* as the transpiration stream

* water enters through roots (and goes up plants)

3

[6]

Q7.

(a) diatoms photosynthesise **or** are producers

1

the amount of growth depends upon the energy **or** light they get

accept more light means more growth
***or** they multiply more in more light*
do not accept they need light

1

(b) (i) eaten by small fish

do not accept eaten by fish

1

minerals **or** nitrate **or** phosphates
or nutrients **or** food supply used up
or reduced

1

(ii) any **two** from

gets colder
light decreases
end of their life span **or** die

accept more being eaten than being formed

eaten by small fish

do not accept a decrease in nitrates
***or** phosphates*

1

(c) increased minerals **or** nitrates **or** phosphates

1

any **one** from

due to death **or** decay of diatoms **or** fish

do not accept death of large fish

1

influx of minerals in an ocean current

*do not accept extraneous pollution **or** dumping by a ship*

1

[8]

Q8.

(a) both axes labelled
both axes appropriate scale
plotting 7 correct
good attempt at line graph

each for 1 mark

4

(b) more fertiliser added more yield increased

gains 1 mark

but
yield increases with fertiliser up to maximum

gains 2 marks

yield **increase** slows down above 125/150 kg/ha

either for 1 further mark

(do **not** allow yield falls)
maximum yield with 175 kg/ha

3

[7]

Q9.

(a) + light = + photosynthesis
+ light = + photosynthesis to a limit
limit depends on temp/CO_2 levels
+ CO_2 = + photosynthesis
+ temp = + photosynthesis

each for 1 mark

5

(b) need to raise optimum levels
when one other raised
to get max/economic yield

each for 1 mark

2

[7]

Q10.

(a) *idea:*
wood goodness recycled/crops goodness removed
gains 1 mark

1

but
wood minerals/nutrients recycled/crops remove nutrients/minerals
gains 2 marks

wood and crops compared
for 1 mark

2

(b) (add) fertiliser/nutrients/minerals
(add) manure/animal waste/compost
any two for 1 mark each

(accept move to new area for 1 mark)
rotation
max marks 2

2

[5]

Q11.

(a) line increasing in daylight 6 – 18 ($\pm$ 2 hr)
line decreasing 0 – 6 ($\pm$ 2 hr)
line decreasing 18 – 24 ($\pm$ 2 hr)
for 1 mark each

but
mirror image (i.e. opposite gradients)
gains 3 marks

3

(b) *idea:*
slower growth (credit even if refers only to leaves)
less photosynthesis/glucose (than if leaves fully green)
each for 1 mark

2

[5]

Q12.

idea
provide (more) light
provide (more) CO_2
provide (plenty of) water
if any one of these is low it will limit the reaction
[Do not allow answers referring to temperature,
as optimum is specified in question 3)
any three for 1 mark each

[3]

Q13.

ideas for

- more food produced/increased yield
- cheaper food
- bigger income for farmer (allow profit)
- less loss/damage/spoilage of crop
- allow less wasted growth (of straw due to drawing)

any three for 1 mark each

3

ideas against

- chemicals harm people (do not accept "affect flavour")
- fertiliser costly
- fewer worms (in soil)
- weedkillers kill valued/useful wild plants
- insecticides/pesticides kill useful insects/other animals

(general idea that chemicals harm plants/animals gets only 1 of these)

- (weedkillers insecticides/pesticides/fungicides/hormones/chemicals) contaminate water
- (increased risk) pesticide resistance over production/food mountains
- possible eutrophication/nitrate in river/extra plant growth/
- explanation of eutrophication

for 1 mark each to a maximum of 4 marks

4

[7]

Q14.

(a) idea that

- light doesn't reach deeper parts
- plants need / absorb light
- to make food

gain 1 mark each to maximum of 2

but
so they can photosynthesise

gains 2 marks

2

(b) herring will be on the bottom
herring follow / will be feeding on the copepods

independent marking points

for 1 mark each

2

[4]