AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



EXAM QUESTION PACK

4.4.1 PHOTOSYNTHESIS (PACK 4)

SCORE	PERCENTAGE
/169	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

This question is about photosynthesis.

(a) What are the **two** products of photosynthesis?

Tick **two** boxes.

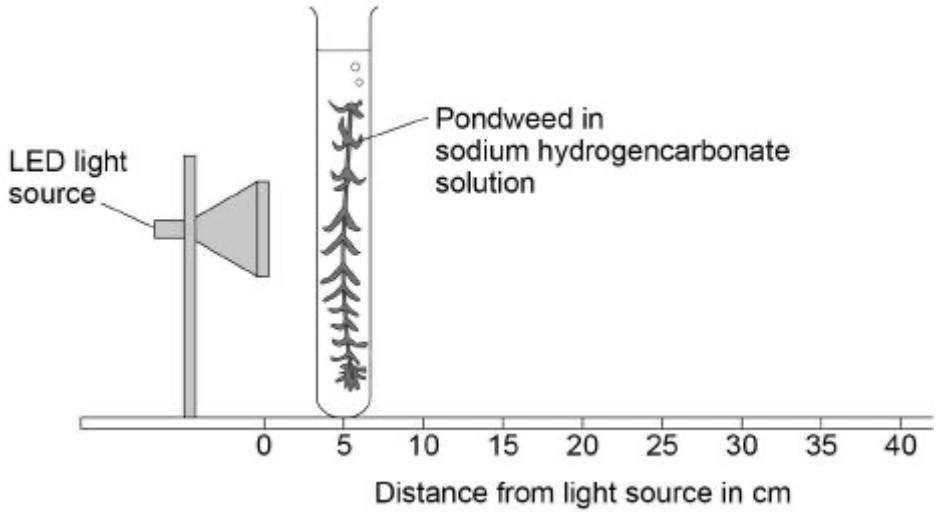
- Carbon dioxide ☐
- Chlorophyll ☐
- Glucose ☐
- Oxygen ☐
- Water ☐

(2)

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

Figure 1 shows the apparatus.

Figure 1



This is the method used.

1. Place the pondweed at 5 cm from the light source.
2. Measure the rate of photosynthesis by counting the number of bubbles produced in 30 seconds.
3. Repeat the investigation with the pondweed at different distances from the light source.

(b) How could the student measure the rate of photosynthesis more accurately?

STEMUP.CO.UK

Tick **two** boxes.

- Count the number of bubbles produced in 1 minute ☐
- Measure the change in mass of the pondweed in 30 seconds ☐
- Measure the volume of gas produced in 30 seconds ☐
- Place the pondweed further from the light source ☐
- Use water instead of sodium hydrogencarbonate solution ☐

(2)

(c) The LED light source does **not** get hot.

Why is this important?

_____

_____

_____

(1)

The table below shows the student's results.

Distance of light source from pondweed in cm	**Number of bubbles produced in 30 seconds**
5	40
10	13
15	5
20	2
25	1
30	0

(d) Calculate the number of bubbles produced in 2 minutes when the light source was 10 cm from the pondweed.

_____

_____

Number of bubbles produced in 2 minutes = _____

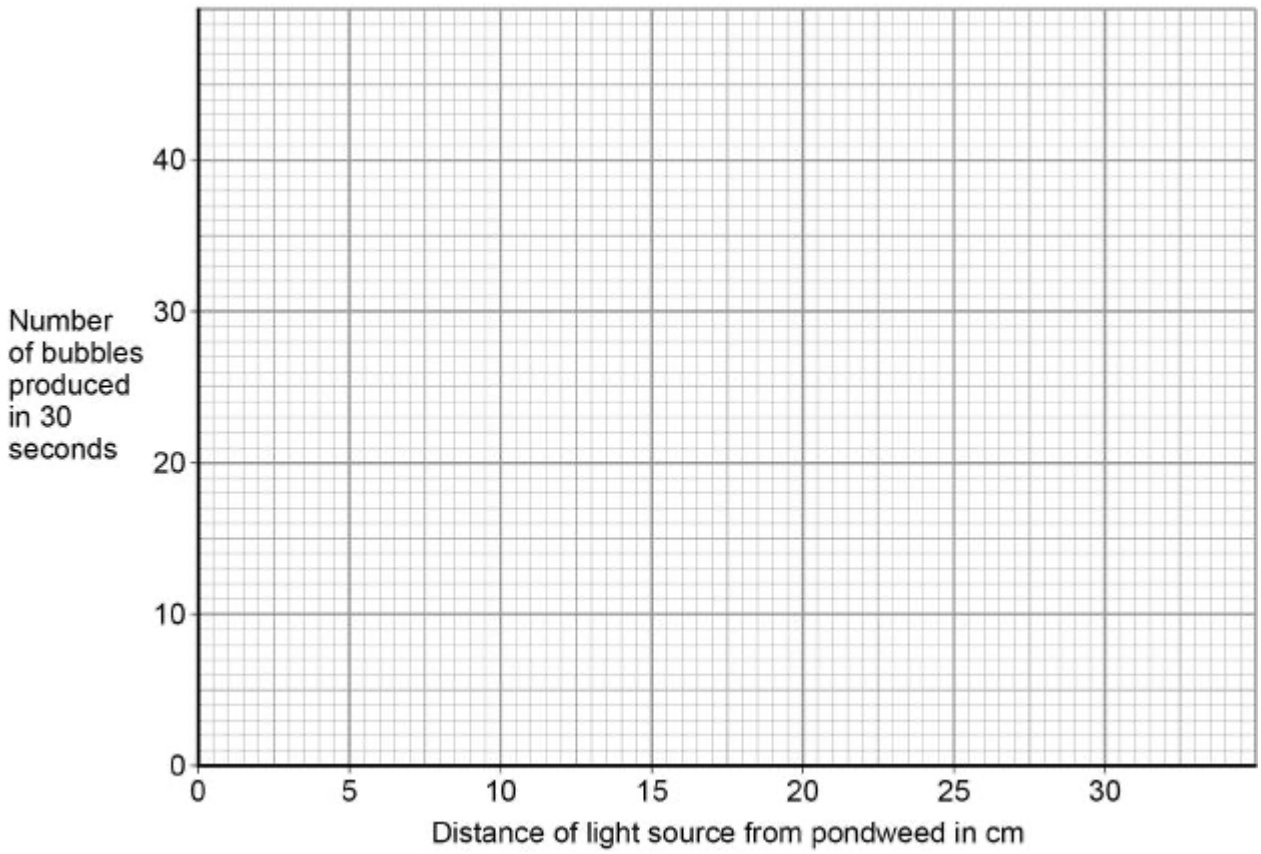
(1)

STEMUP.CO.UK

(e) Plot the data from the table above on **Figure 2**

Draw a line of best fit.

Figure 2



(3)

(f) Give **one** conclusion that can be made from these results.

_____

_____

(1)

(Total 10 marks)

Q2.

This question is about photosynthesis.

(a) What is the correct balanced equation for photosynthesis?

Tick **one** box.

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

$O_2 + H_2O \longrightarrow C_6H_{12}O_6 + CO_2$ ☐

STEMUP.CO.UK

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

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

(1)

(b) What type of reaction is photosynthesis?

Tick **one** box.

Aerobic ☐

Endothermic ☐

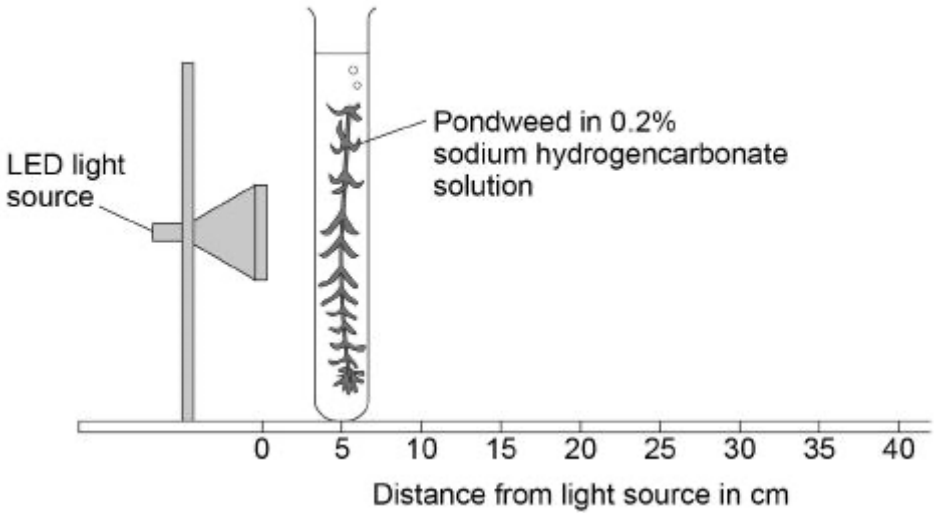
Exothermic ☐

Oxidation ☐

(1)

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

The diagram below shows the apparatus used.



Sodium hydrogencarbonate solution releases carbon dioxide gas for the pondweed.

This is the method used.

1. Place the pondweed at 5 cm from the light source.
2. Measure the rate of photosynthesis by counting the number of bubbles produced in 1 minute.
3. Repeat with the pondweed at 10 cm and at 20 cm from the light source.

(c) Counting the number of bubbles produced in 1 minute is not an accurate way to

STEMUP.CO.UK

measure the rate of photosynthesis.

Suggest **two** ways the method could be improved to measure the rate of photosynthesis more accurately.

1. _____

_____

2. _____

_____

(2)

(d) The LED light source does **not** get hot.

Explain why it is important that the pondweed remains at a constant temperature.

_____

_____

_____

_____

(2)

(e) Light intensity can be calculated using the inverse square law:

$$I \propto \frac{1}{d^2}$$

Where I is light intensity and d is the distance of the pondweed from the light source.

The student placed the pondweed at 5, 10 and 20 cm from the light source.

Explain how light intensity changes as the distance of the pondweed from the light source is doubled.

You **must** include calculations in your answer.

_____

_____

_____

_____

_____

_____

(3)

(f) The student's results are shown in the table below

Distance of the	**Number of bubbles**

STEMUP.CO.UK

pondweed from the light source in cm	produced in 1 minute
5	129
10	31
20	8

Predict how many bubbles of gas would be produced in 1 minute if the pondweed was placed 40 cm from the light source.

Give a reason for your prediction.

_____

_____

_____

_____

(2)

(g) Describe how the student could change the method to investigate the effect of carbon dioxide concentration on the rate of photosynthesis.

You should include:

- how to change the independent variable
- **two** control variables.

Use the diagram above to help you answer this question.

_____

_____

_____

_____

_____

_____

(3)

(Total 14 marks)

Q3.

Many biotic and abiotic factors can affect the growth of plants.

(a) Are the factors in **Table 1** biotic or abiotic?

Tick **one** box for each factor.

Table 1

STEMUP.CO.UK

Factor	Biotic	Abiotic
Diseases		
Herbivores		
Temperature		
Water		

(2)

Two students investigated the effect of light intensity on the distribution of small plants.

The plants are growing under a tree in a park.

The students made the following hypothesis:

'As you move outwards from a tree there will be more plant growth.'

(b) Explain why the students thought their hypothesis would be correct.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) The students used two pieces of equipment.

Give the scientific name of each piece of equipment.

A square frame measuring 0.5 m × 0.5 m _____

An electronic device to measure light intensity _____

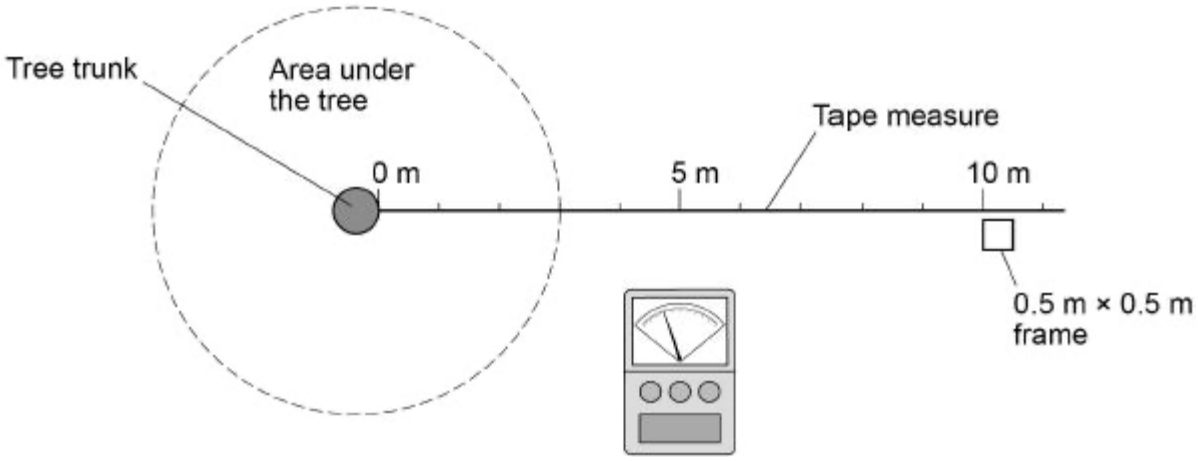
(2)

This is the method used.

1. Fix one end of a tape measure at the base of the tree.
2. Fix the other end of the tape measure 11 metres from the tree.
3. At 0 metres put the square frame on the ground.
4. Identify all the plant species growing inside the frame./p>
5. Estimate and record the percentage cover of each plant species.
6. Measure the light intensity inside the frame.
7. Put the square frame on the ground every 2 metres along the tape to 10 metres.
8. Repeat steps 4 − 6 in every frame.

STEMUP.CO.UK

The diagram below shows the equipment in this investigation.



(d) Calculate the total area sampled.

_____

_____

Total area sampled = _____ m^2

(1)

(e) The whole investigation was done as quickly as possible on the same day.

Suggest **one** reason why.

_____

_____

(1)

(f) Give **one** way the investigation could be improved.

_____

_____

(1)

Table 2 shows the results.

Table 2

	Distance from tree in metres					
	0	**2**	**4**	**6**	**8**	**10**
Percentage cover of grass	15	50	35	16	15	15
Percentage cover of plantain	0	5	10	40	25	30
Percentage cover of daisy	0	0	0	4	20	10
Percentage cover of clover	1	10	25	40	40	45

STEMUP.CO.UK

Total percentage cover of plants	16	65	70	100	100	100
Light intensity in arbitrary units	37	59	150	175	>200	>200

(g) Which plant species in **Table 2** will only grow at high light intensity?

_____

(1)

(h) What conclusion can be made about the relationship between light intensity and the total percentage cover of plants?

Use data from **Table 2** in your answer.

_____

_____

_____

_____

(2)

(i) Light intensity might **not** be the cause of this pattern of plant distribution.

Suggest **one** different factor that may cause these results.

Give **one** reason for your answer.

Factor _____

Reason _____

_____

(2)

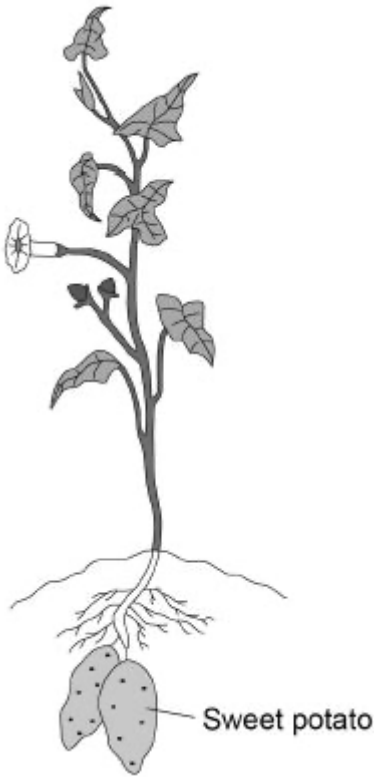
(Total 15 marks)

Q4.

The diagram below shows a sweet potato plant.

The sweet potatoes grow underground and can be cooked and eaten.

STEMUP.CO.UK



The table below shows some of the nutrients in cooked sweet potato.

Nutrient	**Mass in grams per 100 grams of cooked sweet potato**
Water	73.83
Protein	2.01
Fat	0.15
Total carbohydrate of which sugars	20.71 6.55
Fibre	3.30

(a) After cooked sweet potato is digested, sugars (including glucose) pass into the blood.

Give **two** other soluble molecules that would pass into the blood after cooked sweet potato is digested.

1. _____

2. _____

(2)

(b) Calculate the mass of sugars in 180 g of cooked sweet potato.

Use the information from the table above.

_____

STEMUP.CO.UK

_____

Mass of sugars = _____ g

(1)

(c) The sweet potatoes found underground contain starch.

Explain how starch in the sweet potato is produced from carbon dioxide in the air.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 9 marks)

Q5.

Plants make glucose by photosynthesis.

(a) Complete the word equation for photosynthesis.

_____ + _____ → glucose + _____

(1)

(b) What is the name of the chemical that makes a leaf look green?

Tick **one** box.

Cellulose ☐

Chlorophyll ☐

Chloroplast ☐

STEMUP.CO.UK

Chromosome ☐

(1)

(c) A test for starch is used to show that a plant has photosynthesised.

How does the presence of starch show that photosynthesis has taken place?

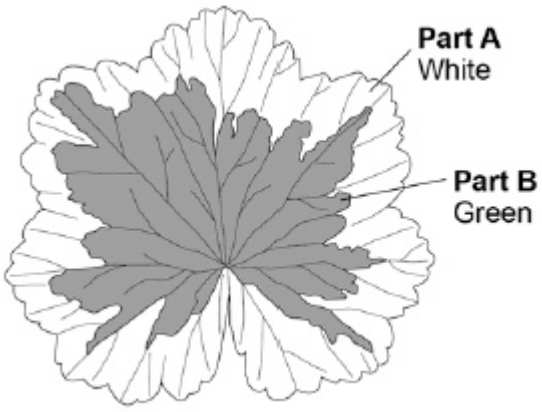
_____

_____

(1)

A student investigated where starch was made in a leaf.

She used a leaf that was part green and part white as shown in the diagram.



This is the method used.

1. Put the leaf in boiling water for 1 minute.
Reason: stops all chemical reactions in the leaf.

2. Transfer the leaf to boiling ethanol for 5 minutes.
Reason: removes the green colour.

3. Dip the leaf in hot water.
Reason: softens the leaf.

4. Spread the leaf on a white tile and test with iodine solution.
Reason: stains any starch.

(d) If the chemical reactions in the leaf were not stopped, the amount of starch in the leaf would decrease.

Give the reason why.

_____

_____

(1)

(e) Suggest why it is important to remove the green colour from the leaf before adding iodine solution.

STEMUP.CO.UK

_____

_____

(1)

(f) Ethanol is flammable.

The student wore safety goggles when testing the leaf for starch.

Give one other safety precaution the student should have taken.

_____

_____

(1)

(g) Look at the leaf in the diagram.

What colour would part **A** and part **B** stain with iodine solution after the starch test?

A _____

B _____

(2)
(Total 8 marks)

Q6.

This question is about ecology.

(a) Give **two** abiotic (non-living) factors which will affect the growth of plants on a school playing field.

Give a reason why each factor will affect the growth of the plants.

Abiotic factor 1 _____

Reason _____

_____

Abiotic factor 2 _____

Reason _____

_____

(4)

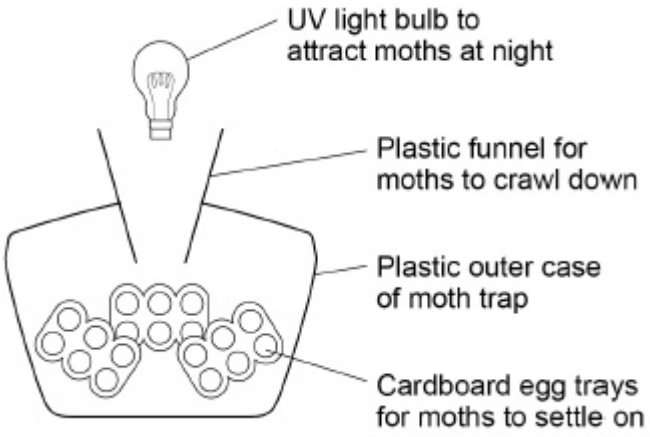
Students were studying the ecology of their playing field.

They wanted to count the population of ruby tiger moths.

Figure 1 shows the moth trap they used.

Figure 1

STEMUP.CO.UK



This is the method used.

1. Set up the moth trap on the playing field.
2. Leave the trap for several days with the light on.
3. Take the trap to the laboratory and carefully remove the egg trays.
4. Count the number of ruby tiger moths.
5. Release the moths on the playing field.

(b) The students needed other equipment to identify the ruby tiger moths.

What **two** other pieces of equipment did the students need?

Tick **two** boxes.

- Electron microscope ☐
- Hand lens ☐
- Moth guide ☐
- Quadrat ☐
- Tape measure ☐

(2)

(c) Suggest **one** reason why the moths were counted in the laboratory.

_____

(1)

(d) Suggest **one** hazard in using the moth trap.

_____

(1)

STEMUP.CO.UK

(e) What precaution should the students take to minimise the hazard you suggested in part (d)?

_____

(1)

Figure 2 shows a caterpillar of the ruby tiger moth.

The head is sometimes bright orange in colour or there is a red stripe on the back.

Figure 2



(f) Give **one** reason why caterpillars of the ruby tiger moth have very few predators.

_____

_____

(1)

(Total 10 marks)

Q7.

In 2017, the city of Manchester began a 'City of Trees' project.

The project plans to plant 3 million trees over the next 25 years.

The trees will be used to:

- make existing woodlands larger
- link existing woodlands
- create new woodlands
- plant in parks, public gardens and along streets
- give to people to plant in private gardens.

(a) It was suggested that the council plant 3.6×10^5 trees in the first year.

The rest of the trees would be planted in equal numbers over the remaining years.

Calculate how many trees would need to be planted in each of the remaining years.

STEMUP.CO.UK

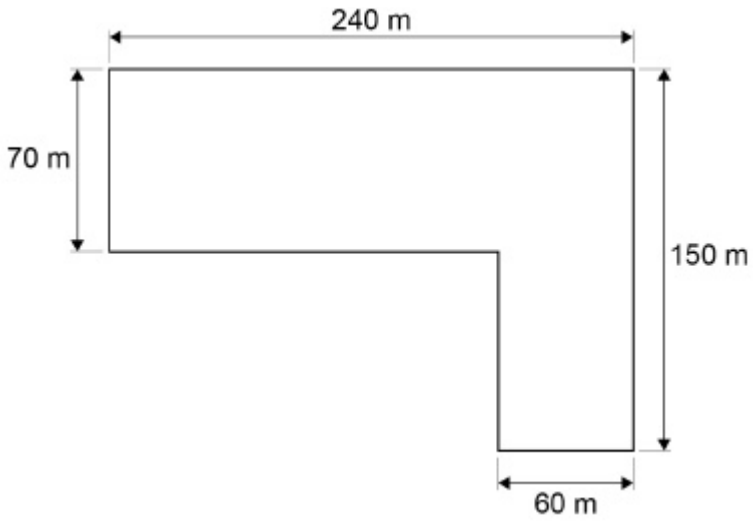
Give your answer in standard form.

Number of trees = _____ per year

(3)

(b) Students investigated the number of bluebells in one of the existing woodlands.

The diagram shows the dimensions of the woodland.



The students used a 0.25 m^2 quadrat to sample the bluebell population.

The mean number of bluebells per quadrat was 6

Estimate the population of bluebells in the woodland.

Population = _____ bluebells

(2)

(c) A Manchester resident says that this project will 'fight pollution' and 'increase biodiversity' in their city.

Explain how the 'City of Trees' project will:
- reduce pollution
- increase biodiversity.

STEMUP.CO.UK

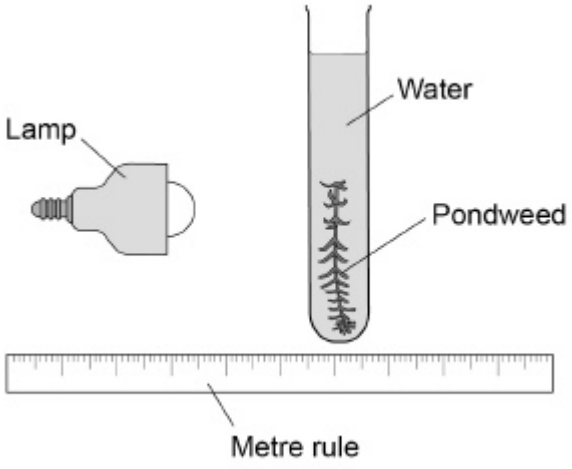
(6)

(Total 11 marks)

Q8.

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

The diagram shows the equipment the students used.



This is the method used.

1. Place the lamp 50 cm from the pondweed.
2. Count the number of bubbles of gas released in two minutes.
3. Repeat steps 1–2 with the lamp at different distances from the pondweed.

STEMUP.CO.UK

(a) The students could not make a firm conclusion because their method did not control enough variables.

Give **two** variables the students have **not** controlled that would affect the rate of photosynthesis.

1. _____

2. _____

(2)

The table shows the students' results.

Distance of lamp from the pondweed in cm	**Number of bubbles released in two minutes**				
	1	**2**	**3**	**4**	**Mean**
50	5	8	6	5	6
40	10	8	9	4	9
30	12	12	15	17	14
20	25	17	23	24	24
10	22	34	31	31	**X**

(b) Calculate the mean rate of bubbles produced per minute when the lamp was 10 cm from the pondweed.

_____

_____

_____

_____

_____

_____

Mean rate = _____ bubbles per minute

(3)

(c) The mean number of bubbles released when the lamp was 30 cm away from the plant was greater than when the lamp was 50 cm away.

How many times greater?

_____

Number of times greater = _____

(1)

(d) The students wanted to find out if different wavelengths of light affect the number of bubbles released.

STEMUP.CO.UK

Describe how the method could be adapted to find the effect of different wavelengths of light.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q9.

Pathogens cause infectious diseases in animals and plants.

(a) Draw **one** line from each disease to the type of pathogen that causes the disease.

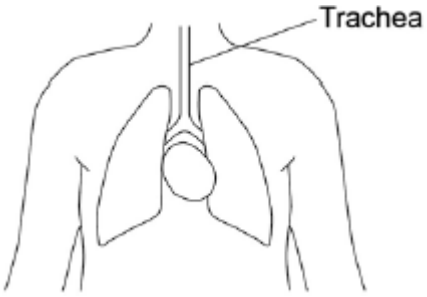
Disease	Type of pathogen
Gonorrhoea	Bacterium
Malaria	Fungus
Measles	Protist
	Virus

(3)

(b) Some parts of the human body have adaptations to reduce the entry of live pathogens.

Look at **Figure 1**.

Figure 1



Explain how the trachea is adapted to reduce the entry of live pathogens.

_____

STEMUP.CO.UK

_____

_____

_____

_____

_____

_____

_____

_____

(4)

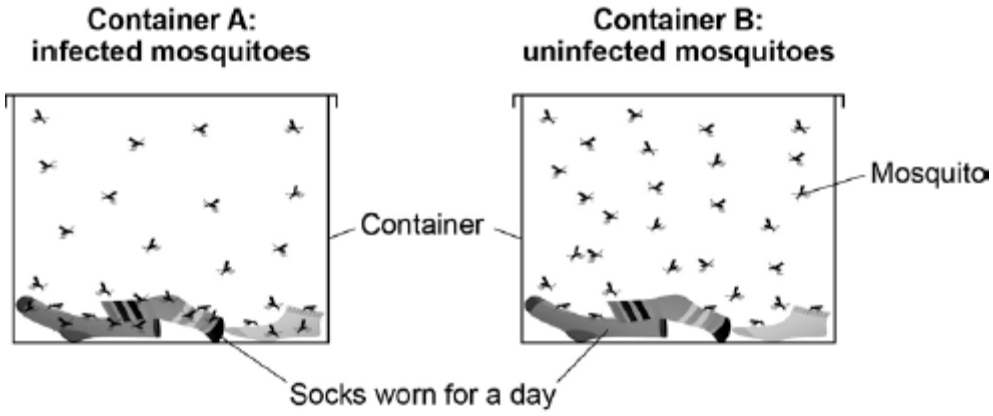
(c) Malaria is a serious disease that can be fatal.

Malaria is spread to humans by infected mosquitoes.

Scientists investigated the behaviour of mosquitoes to understand how the spread of malaria could be controlled.

Figure 2 shows the equipment the scientists used.

Figure 2



This is the method used.

1. 30 mosquitoes **infected with malaria** were placed in Container **A**.

2. 30 **uninfected** mosquitoes were placed in Container **B**.

3. The total number of times the mosquitoes landed on the socks was recorded.

Name the dependent variable and suggest **one** control variable in this investigation.

Dependent variable _____

_____

Control variable _____

STEMUP.CO.UK

(2)

(d) Infected mosquitoes landed on the socks three times more often than uninfected mosquitoes.

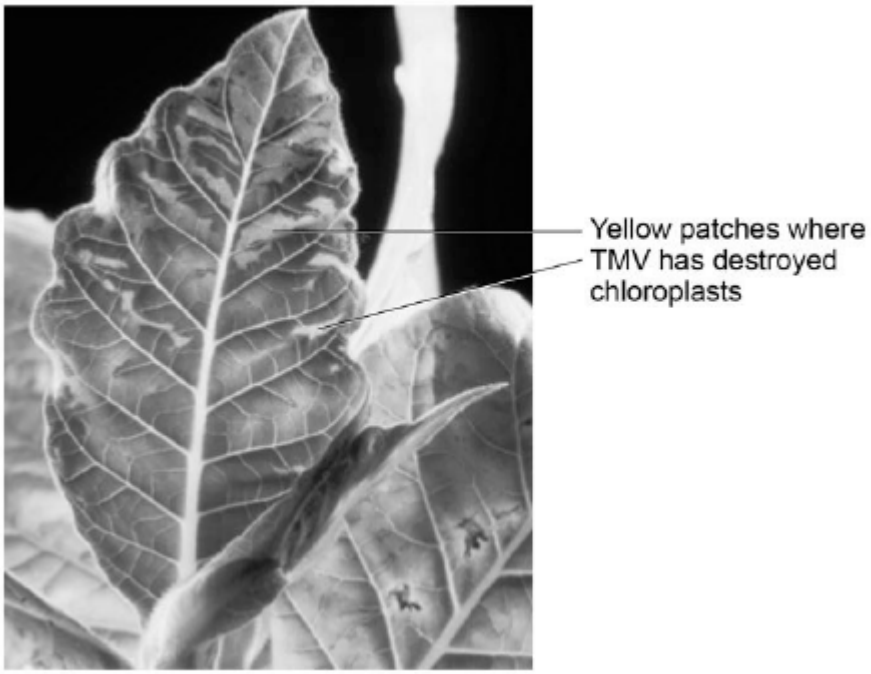
Explain how this information can be used to reduce the spread of malaria.

(2)

(e) Tobacco mosaic virus (TMV) affects many species of plant.

Figure 3 shows a leaf infected with TMV.

Figure 3



© Nigel Cattlin/Getty Images

TMV destroys chloroplasts in the leaf.

Explain how this could affect the growth of the plant.

STEMUP.CO.UK

_____

_____

(3)

(Total 14 marks)

Q10.

Plants absorb light to photosynthesise.

(a) What is the correct word equation for photosynthesis?

Tick **one** box.

carbon dioxide + glucose → oxygen + water ☐

glucose + oxygen → carbon dioxide + water ☐

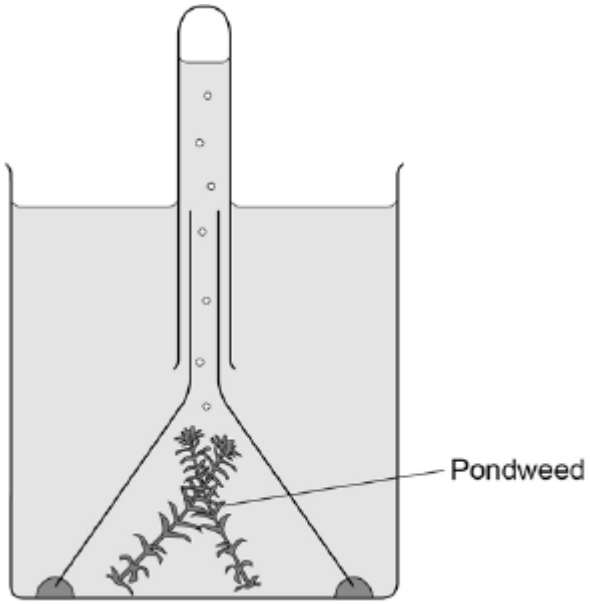
oxygen + water → carbon dioxide + glucose ☐

water + carbon dioxide → oxygen + glucose ☐

(1)

(b) **Figure 1** shows some of the apparatus that can be used to measure the rate of photosynthesis.

Figure 1



The rate of photosynthesis in the pondweed is affected by different colours of light.

Describe a method you could use to investigate this.

You should include:

STEMUP.CO.UK

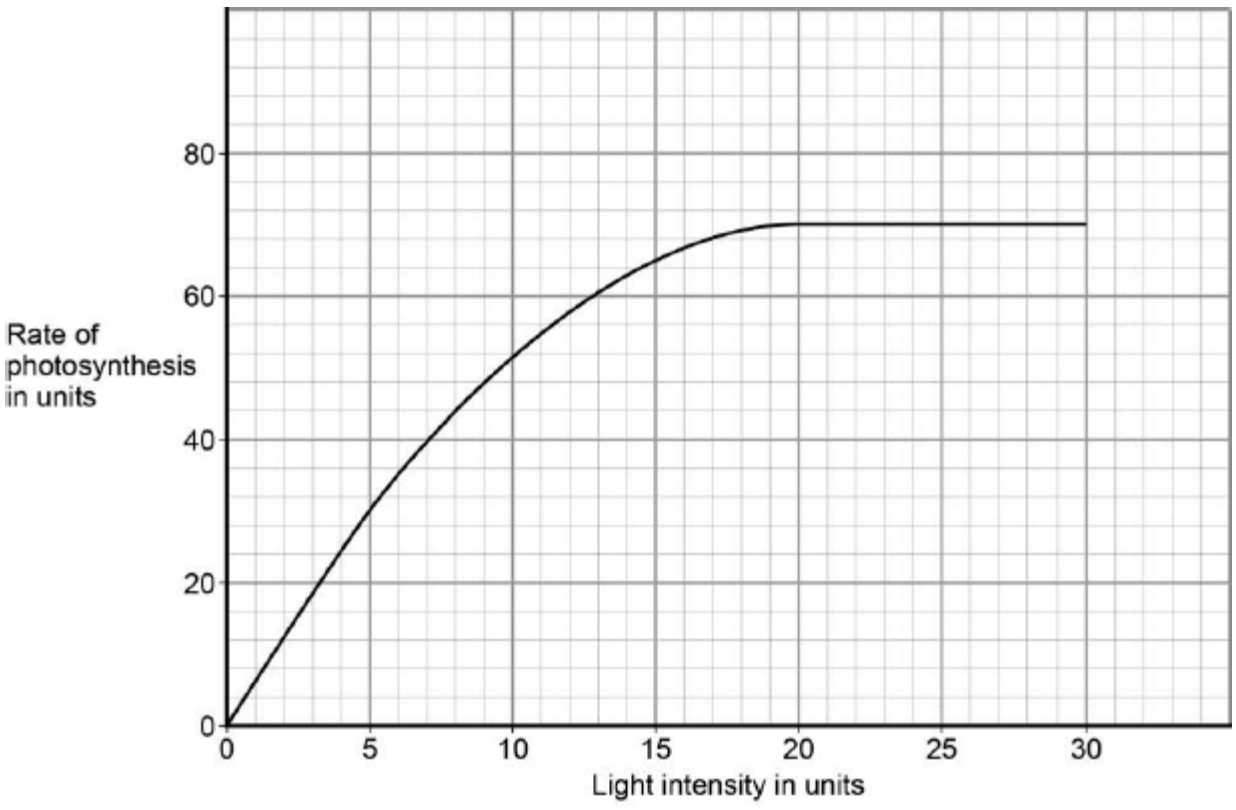
- what you would measure
- variables you would control.

(6)

(c) A scientist carried out a similar investigation.

Her results are shown in **Figure 2**.

Figure 2



The scientist said:

STEMUP.CO.UK

‘Light stops being a limiting factor at a light intensity of 20 units.’

Give evidence from **Figure 2** to support this statement.

_____

_____

(1)

(d) What could be limiting the rate of photosynthesis at a light intensity of 25 units?

Give **one** factor.

_____

(1)

(Total 9 marks)

Q11.

A student investigated the effect of pond organisms on the amount of carbon dioxide in their surroundings.

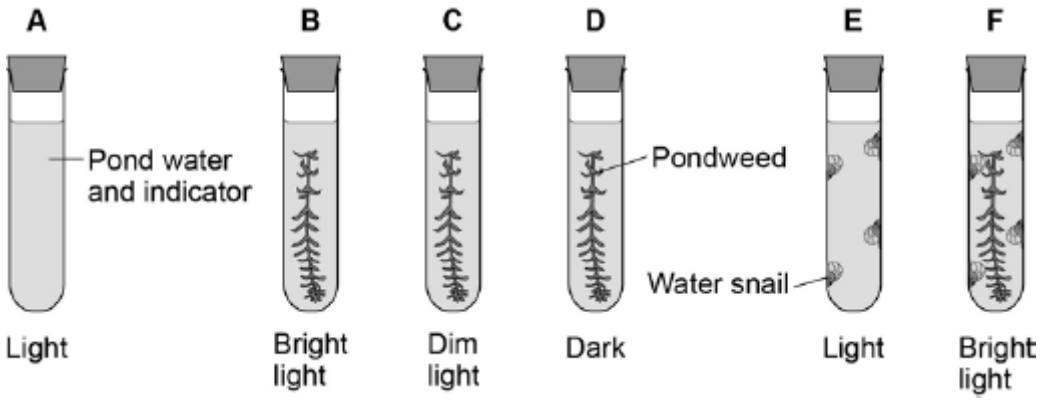
The student set up six boiling tubes as shown in the figure below.

They were left for 2 days.

Each boiling tube contained pond water with an indicator.

The indicator was pink at the start of the investigation.

- If the amount of carbon dioxide in the water increased the indicator turned yellow.
- If the amount of carbon dioxide in the water decreased the indicator turned purple.



(a) What is the purpose of boiling tube **A**?

_____

_____

_____

_____

STEMUP.CO.UK

(2)

(b) In which boiling tube would the indicator be the **most yellow** after 2 days?

Explain your answer.

Boiling tube _____

Explanation _____

_____

_____

(3)

(c) The colour of the indicator in boiling tube **C** had not changed after 2 days.

Suggest why.

_____

_____

(1)

(Total 6 marks)

Q12.

Students used quadrats to estimate the population of dandelion plants on a field.

(a) Describe how quadrats should be used to estimate the number of dandelion plants in a field.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The field measured 40 m by 145 m.

The students used 0.25 m^2 quadrats.

The students found a mean of 0.42 dandelions per quadrat.

Estimate the population of dandelions on the field.

_____

STEMUP.CO.UK

Estimated population of dandelions = _____

(2)

(c) In one area of the field there is a lot of grass growing in the same area as dandelions.

Suggest why the dandelions may **not** grow well in this area.

(4)

(Total 10 marks)

Q13.

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

(a) The formula for glucose is $C_6H_{12}O_6$

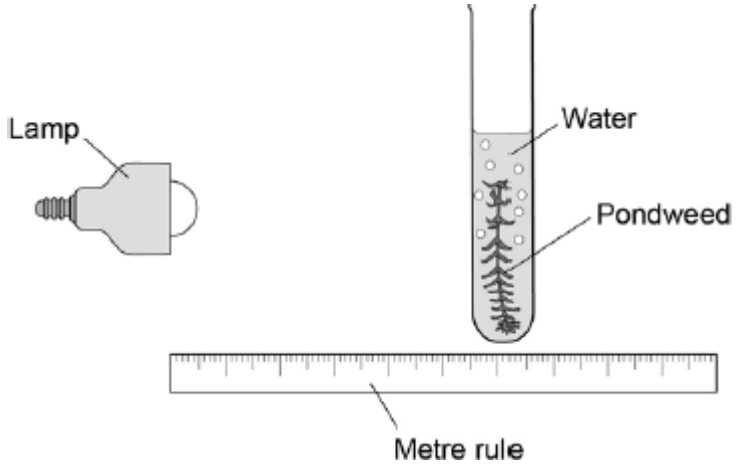
Use the formula for glucose to write the balanced symbol equation for photosynthesis.

(2)

(b) **Figure 1** shows the apparatus the student used.

Figure 1

STEMUP.CO.UK



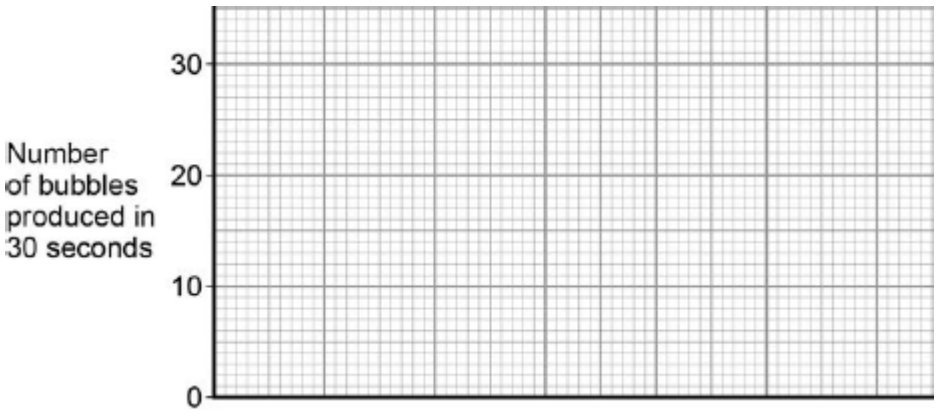
The student altered the distance of the lamp from the pondweed and counted the number of bubbles produced in 30 seconds for each distance.

The table below shows the student's results.

Distance in cm	Number of bubbles produced in 30 seconds
10	27
20	23
30	16
40	7
50	2

Use the data in the table above to complete the graph on **Figure 2**.

Figure 2



(3)

(c) The student concluded that the rate of photosynthesis is inversely proportional to the distance of the lamp from the pondweed.

Does the student's data support this conclusion?

STEMUP.CO.UK

Use data from **Figure 2** to justify your answer.

(3)

(d) The volume of one bubble can be calculated using the equation:

$$V = 4 / 3 \pi r^3$$

The radius of one bubble is 0.1 cm.

The value for π is 3.14

Use data from the table above and the information above to calculate the rate of gas production at a distance of 40 cm.

Give your answer in standard form to three significant figures.

Rate of reaction = _____ cm^3 per minute

(5)

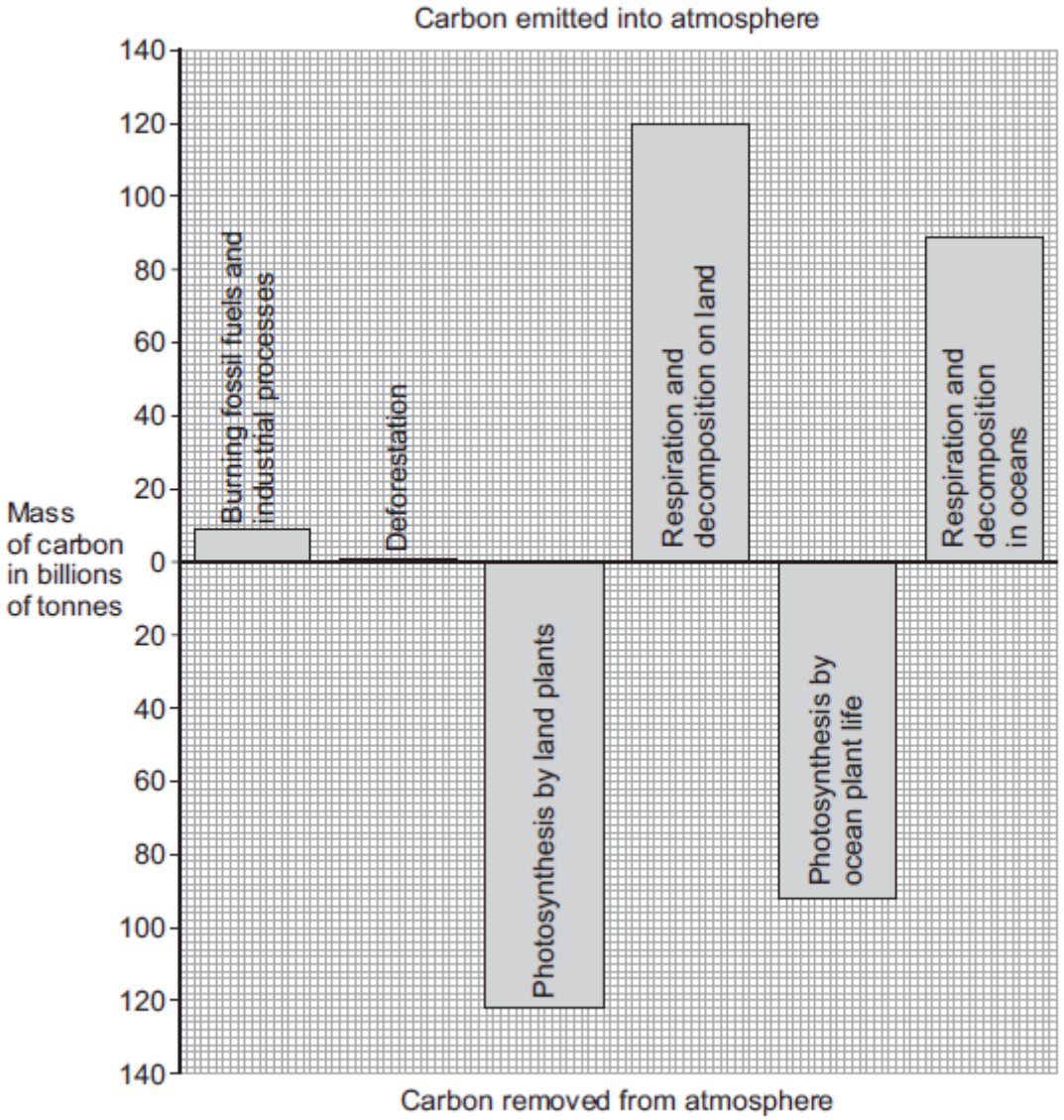
(Total 13 marks)

Q70.

The amount of carbon in the atmosphere is increasing.

The graph shows the mass of carbon in billions of tonnes involved in some processes in the carbon cycle each year.

STEMUP.CO.UK



(a) (i) Use information from the graph to calculate the total mass of carbon removed from the atmosphere each year.

_____

_____

_____ billions of tonnes

(2)

(ii) The mass of carbon in the atmosphere is increasing by 5 billion tonnes each year.

One tonne of carbon is equivalent to 3.67 tonnes of carbon dioxide.

Calculate the increase in the mass of carbon dioxide in the atmosphere each year.

_____

_____

STEMUP.CO.UK

_____ billion tonnes

(1)

(b) (i) Many scientists think the burning of fuels is the main cause of the increasing amount of carbon dioxide in the atmosphere. Other scientists disagree.

Use information from the graph to suggest why some scientists do **not** think that burning fuels is the main cause of the increase in carbon dioxide in the atmosphere.

_____

_____

_____

(1)

(ii) Some scientists think we should eat less meat and eat more food from plants.

Suggest how eating less meat and eating more food from plants could reduce the amount of carbon dioxide in the atmosphere.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q71.

In a stable community, the processes that remove carbon are balanced by processes that return carbon.

The figure below shows a woodland community.



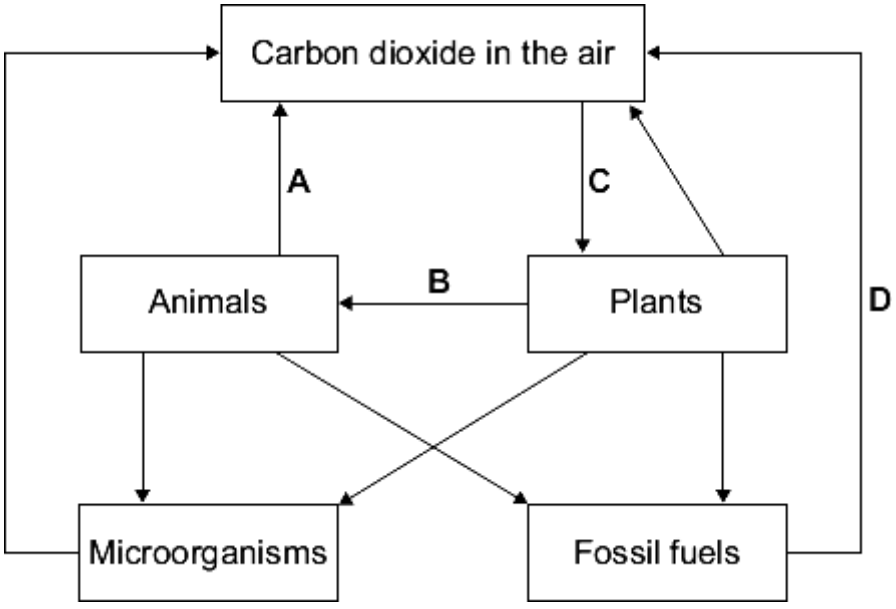
Describe how carbon is recycled in a woodland community.

STEMUP.CO.UK

(Total 6 marks)

Q72.

The diagram shows part of the carbon cycle.



Name the processes labelled **A**, **B**, **C** and **D**, on the diagram.

A _____

B _____

C _____

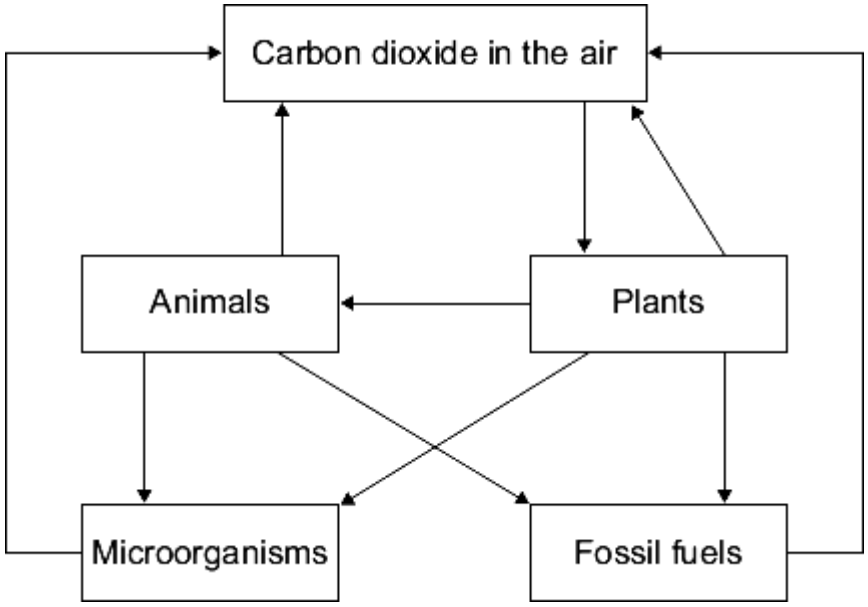
D _____

(Total 4 marks)

STEMUP.CO.UK

Q73.

The diagram shows part of the carbon cycle.



Use the information in the diagram and your own knowledge to describe in detail how carbon is cycled between living organisms and the air.

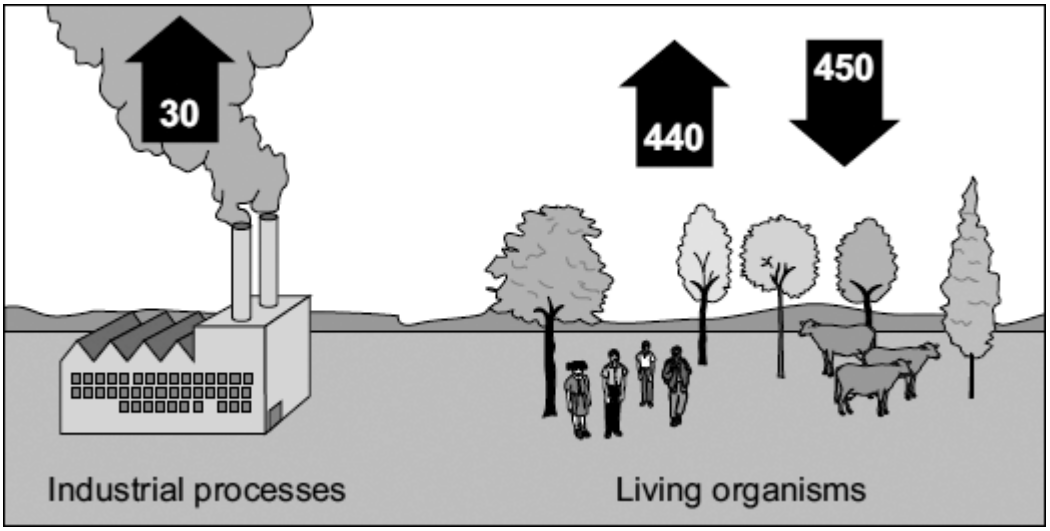
Your answer should include the names of any processes involved.

(Total 6 marks)

Q74.

The diagram shows the mass of carbon dioxide released into and removed from the air each year in billions of tonnes.

STEMUP.CO.UK



(a) Complete the following sentences.

(i) Plants remove carbon dioxide from the air by a process

called _____

(1)

(ii) All organisms produce carbon dioxide during a process

called _____

(1)

(b) Too much carbon dioxide in the atmosphere can harm the environment.

Suggest **two different** ways of reducing the amount of carbon dioxide in the atmosphere.

_____

_____

_____

_____

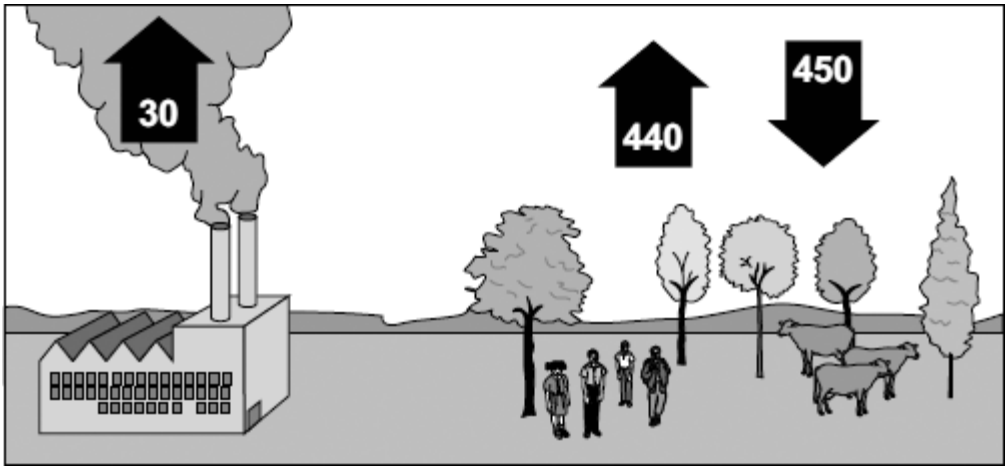
(2)

(Total 4 marks)

Q75.

The diagram shows the mass of carbon dioxide released into and removed from the air each year in billions of tonnes.

STEMUP.CO.UK



Describe the processes **shown on the diagram** that exchange carbon dioxide with the air.

Explain the overall effect of these processes on the mass of the carbon dioxide in the air.

(Total 6 marks)

STEMUP.CO.UK