Questions are for both separate science and combined science students unless indicated in the question

Q1.

All living organisms respire.

(a) What is the chemical equation for aerobic respiration?

Tick (✓) **one** box.

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

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

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

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

(1)

(b) Name the sub-cellular structures where aerobic respiration takes place.

_____

(1)

(c) Energy is released in respiration.

Give **two** uses of the energy released in respiration.

1 _____

_____

2 _____

_____

(2)

(d) Describe **two** differences between aerobic and anaerobic respiration in humans.

Do **not** refer to oxygen in your answer.

1 _____

_____

2 _____

_____

(2)

(e) What are the **two** products of anaerobic respiration in plant cells?

Tick (✓) **two** boxes.

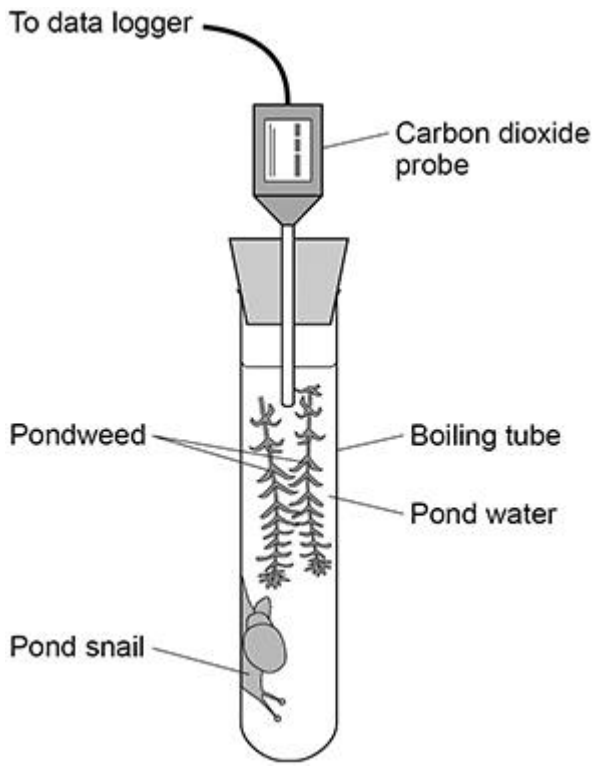
Carbon dioxide	☐
Ethanol	☐
Glucose	☐
Lactic acid	☐
Water	☐

(2)

A scientist investigated respiration and photosynthesis using some pondweed and a pond snail.

Figure 1 shows the apparatus used.

Figure 1



The apparatus was left in a well-lit room for 5 days.

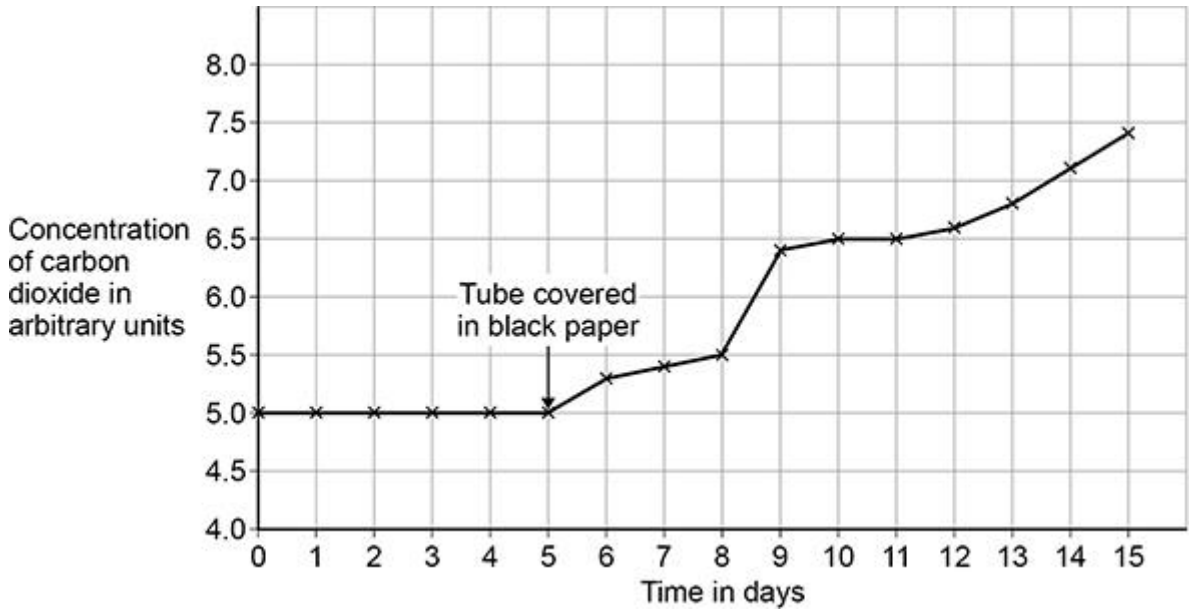
The data logger recorded the concentration of carbon dioxide continuously.

After 5 days, the scientist completely covered the boiling tube with black paper.

The data logger continued to record the concentration of carbon dioxide.

Figure 2 shows the concentration of carbon dioxide inside the boiling tube over 15 days.

Figure 2



(f) Explain why the concentration of carbon dioxide in the tube stayed the same between day 0 and day 5.

_____

_____

_____

_____

(2)

(g) Suggest why the concentration of carbon dioxide increased between day 5 and day 10.

_____

_____

_____

_____

(1)

(h) On day 10, the pond snail died.

Explain why the death of the pond snail caused the concentration of

carbon dioxide to increase after day 10.

_____

_____

_____

_____

_____

_____

(3)

(Total 14 marks)

Q2.

The growth of daisy plants on a lawn is affected by biotic factors and by abiotic factors.

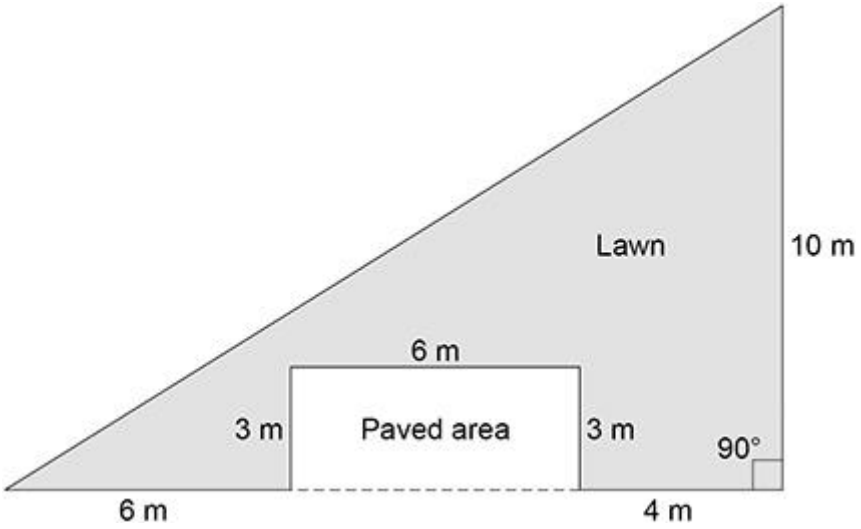
(a) The table below shows six factors.

Tick (✓) **one** box in each row to show whether the factor is biotic or abiotic.

Factor	**Biotic**	**Abiotic**
Nitrates in the soil		
Rabbits eating the plants		
Shading by a building		
Soil pH		
Temperature		
Trampling by people		

(3)

The figure below shows a plan of a garden.



A student estimates the number of daisy plants growing on the lawn.

The student places a quadrat at 10 different positions on the lawn.

The quadrat measures 50 cm × 50 cm.

The student counts the number of daisy plants in each quadrat.

(b) How should the student decide where to place the quadrat?

Give the reason for your answer.

_____

_____

_____

_____

(2)

(c) The mean number of daisy plants in each quadrat is 6.

Calculate the number of daisy plants on the lawn.

Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Number of daisy plants on the lawn = _____

(6)

(d) Using the mean from this investigation to calculate the number of daisy plants on the lawn may **not** be accurate.

Give **two** reasons why.

1 _____

_____

2 _____

_____

(2)

(Total 13 marks)

Q3.

This question is about photosynthesis.

(a) Complete the word equation for photosynthesis.

_____ + _____ → _____ + oxygen

(2)

(b) Describe how energy for the photosynthesis reaction is gained by plants.

_____

_____

_____

_____

(2)

Students investigated the effect of temperature on the rate of photosynthesis.

The students shone light from a lamp onto pondweed and measured the volume of oxygen produced per hour.

The table below shows the results.

Temperature in °C	Rate of photosynthesis in cm^3/hour			
	Test 1	**Test 2**	**Test 3**	**Mean**
20	18.5	19.3	19.5	**X**
25	32.6	34.1	32.9	33.2
30	41.9	45.2	44.9	44.0
35	38.6	39.8	44.0	40.8
40	23.1	20.5	22.4	22.0
45	1.9	14.2	2.2	2.1

(c) Calculate mean value **X**.

_____

_____

_____

X = _____ cm^3/hour

(2)

The students identified one anomalous result in the table above.

(d) Draw a ring around the anomalous result in the table above.

(1)

(e) Suggest **one** possible cause of the anomalous result.

_____

_____

(1)

(f) How did the students deal with the anomalous result?

_____

_____

(1)

(g) Give **one** factor the students should have kept constant in this investigation.

_____

(1)

The table above is repeated below.

Temperature in °C	Rate of photosynthesis in cm^3/hour			
	Test 1	**Test 2**	**Test 3**	**Mean**
20	18.5	19.3	19.5	**X**
25	32.6	34.1	32.9	33.2
30	41.9	45.2	44.9	44.0
35	38.6	39.8	44.0	40.8
40	23.1	20.5	22.4	22.0
45	1.9	14.2	2.2	2.1

(h) Why did the rate of photosynthesis decrease from 35 °C to 45 °C?

_____

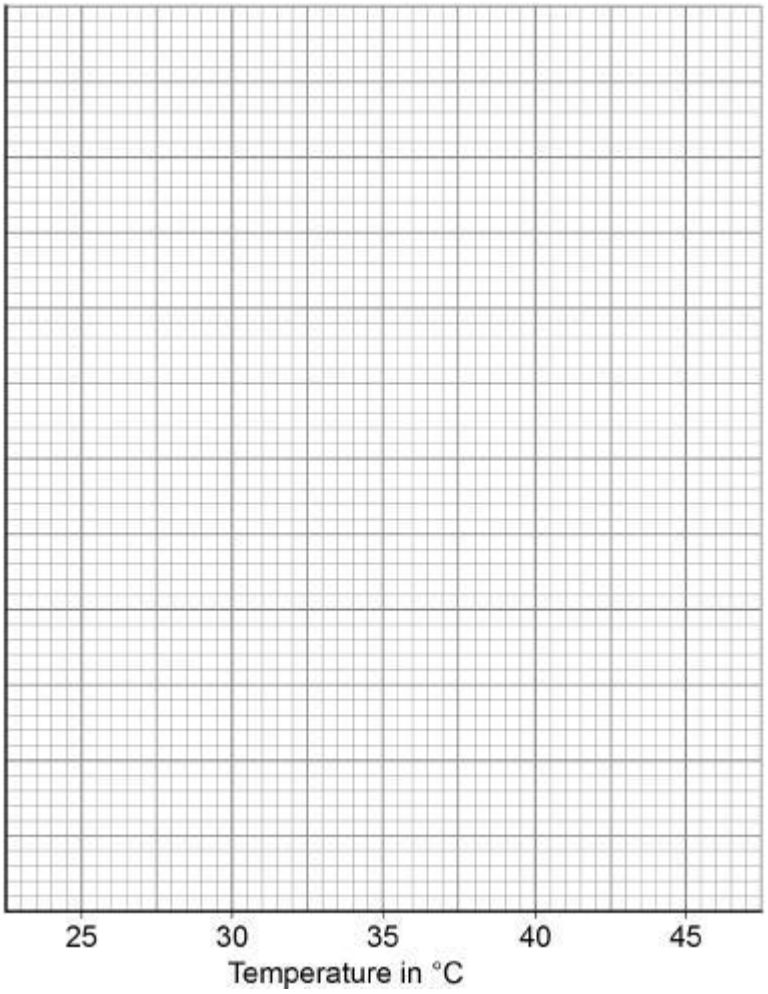
_____

(1)

(i) Complete the graph below using data from the table above.

You should:

- label the y-axis
- use a suitable scale for the y-axis
- plot the mean data from the table above for temperatures from 25 °C to 45 °C
- draw a line of best fit.



(5)

(Total 16 marks)

Q4.

Lipases break down lipids.

(a) Which **two** products are formed when lipids are broken down?

Tick (✓) **two** boxes.

Amino acids ☐

Fatty acids ☐

Glucose ☐

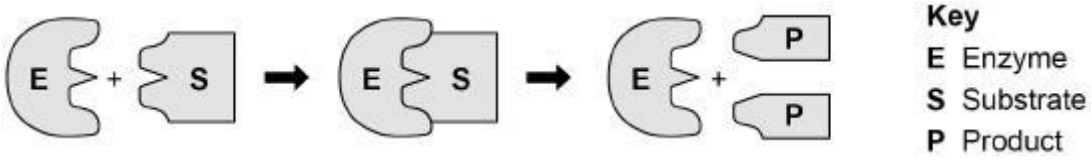
Glycerol ☐

Glycogen ☐

(2)

One model used to explain enzyme action is the 'lock and key theory'.

The diagram below shows a model of the theory.



(b) Explain the 'lock and key theory' of enzyme action.

Use information from the diagram above in your answer.

_____

_____

_____

_____

_____

_____

_____

(3)

(c) There are many different types of lipase in the human body.

Why does each different type of lipase act on only **one** specific type of lipid molecule?

_____

_____

Students investigated the presence of starch and glucose in the leaves of geranium plants.

This is the method used.

1 Place two identical geranium plants on a bench near a sunny window for two days.

2 After two days:

- leave one plant near the window for two more days.
- place one plant in a cupboard with no light for two more days.

3 Remove one leaf from each plant.

4 Crush each leaf to extract the liquid from the cells.

5 Test the liquid from each leaf for glucose and for starch.

(1)

(d) Describe how the students would find out if the liquid from the leaf contained glucose.

_____

_____

_____

_____

_____

_____

(3)

(e) Describe how the students would find out if the liquid from the leaf contained starch.

_____

_____

_____

_____

(2)

The table below shows the students' results.

Test	**Leaf from plant kept in light for four days**	**Leaf from plant kept in light for two days and then no light for two days**
Glucose	Strong positive	Weak positive
Starch	Positive	Negative

(f) Explain why the leaf in the light for four days contained both glucose and starch.

_____

_____

_____

_____

(2)

(g) Explain why the leaf left in a cupboard with no light for two days did contain glucose but did **not** contain starch.

_____

_____

_____

_____

_____

_____

(3)

(h) Suggest **one** way the students could develop the investigation to find out more about glucose and starch production in plants.

_____

_____

(1)

(Total 17 marks)

Q5.

This question is about photosynthesis.

(a) Complete the word equation for photosynthesis:

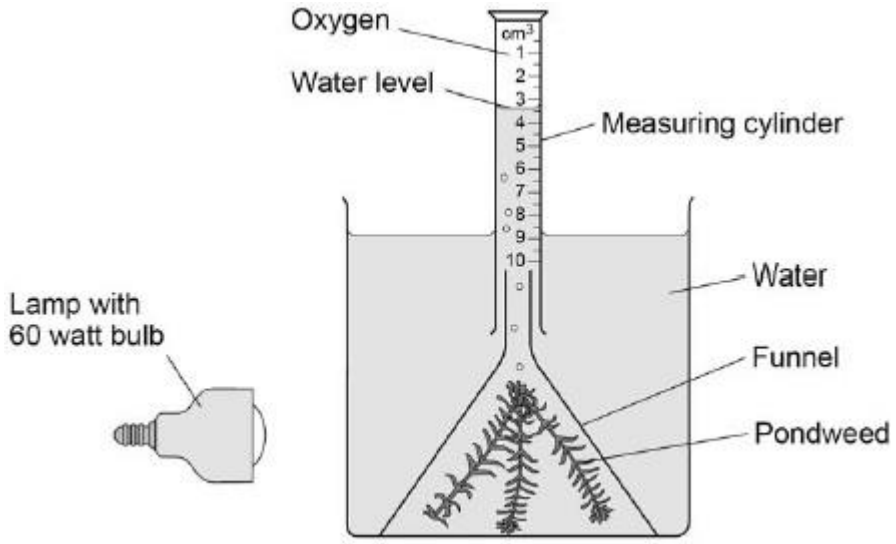
_____ + _____ → _____ + oxygen

(2)

A student investigated photosynthesis using pondweed.

Figure 1 shows the apparatus the student used.

Figure 1



This is the method used.

1. Set up the apparatus as shown in **Figure 1**.

2. Switch on the lamp.

3. After 20 minutes, record the volume of oxygen collected in the measuring cylinder.

4. Repeat steps 1–3 using bulbs of different power output.

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

Tick (✓) **one** box.

Power output of bulb	☐
Rate of photosynthesis	☐
Time to collect oxygen	☐
Volume of oxygen collected	☐

(1)

(c) Suggest **two** ways the method could be improved so the results would be more valid.

1 _____

_____

2 _____

_____

(2)

The table below shows the student's results.

Power output of bulb in watts	**Volume of oxygen collected in 20 minutes in cm^3**	**Rate of photosynthesis in cm^3/hour**
60	0.5	1.5
100	0.8	2.4
150	1.1	**X**
200	1.2	3.6
250	1.2	3.6

(d) Calculate value **X** in the table above.

_____

_____

X = _____ cm^3/hour

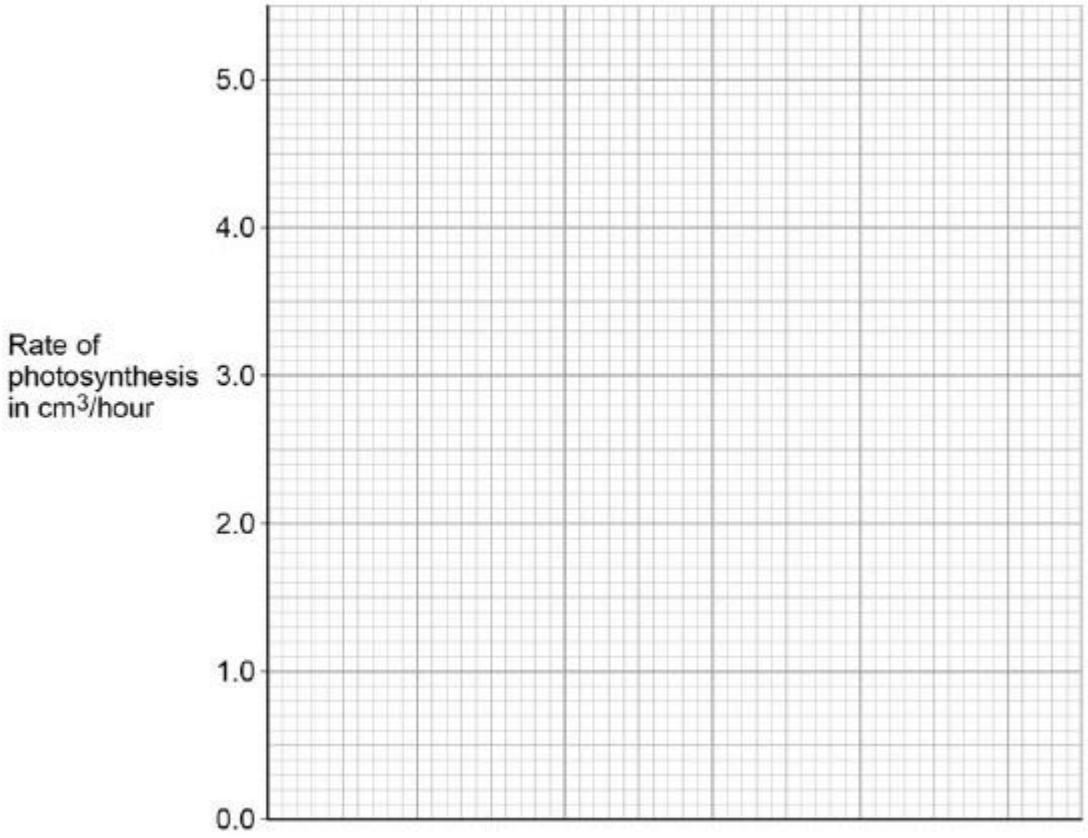
(1)

(e) Complete **Figure 2**.

You should:

- label the x-axis
- use a suitable scale
- plot the data from the table above and your answer to part (d)
- draw a line of best fit.

Figure 2



(4)

(f) Determine the expected rate of photosynthesis with a bulb of power output 75 watts.

Use **Figure 2**.

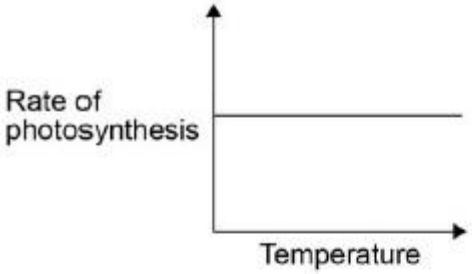
_____

Rate of photosynthesis at 75 watts = _____ cm^3/hour

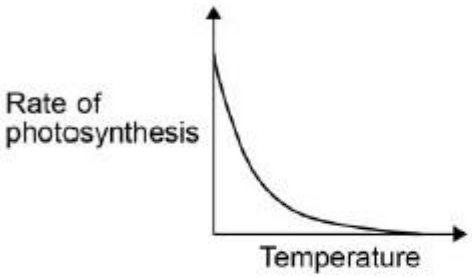
(1)

(g) Which graph shows the effect of temperature on the rate of photosynthesis?

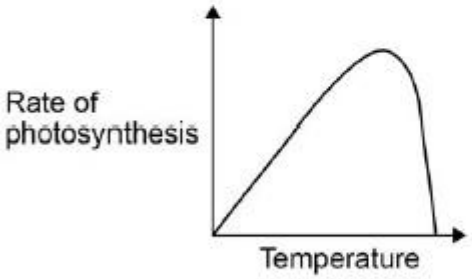
Tick (✓) **one** box.



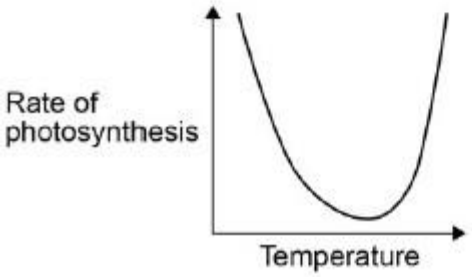
☐



☐



☐



☐

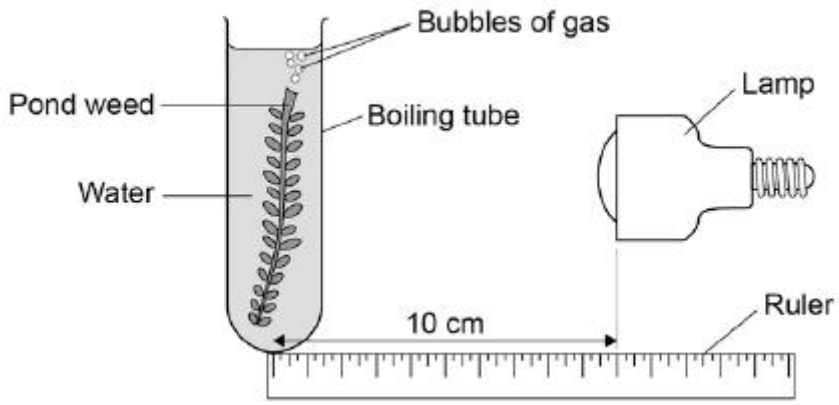
(1)

(Total 12 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.

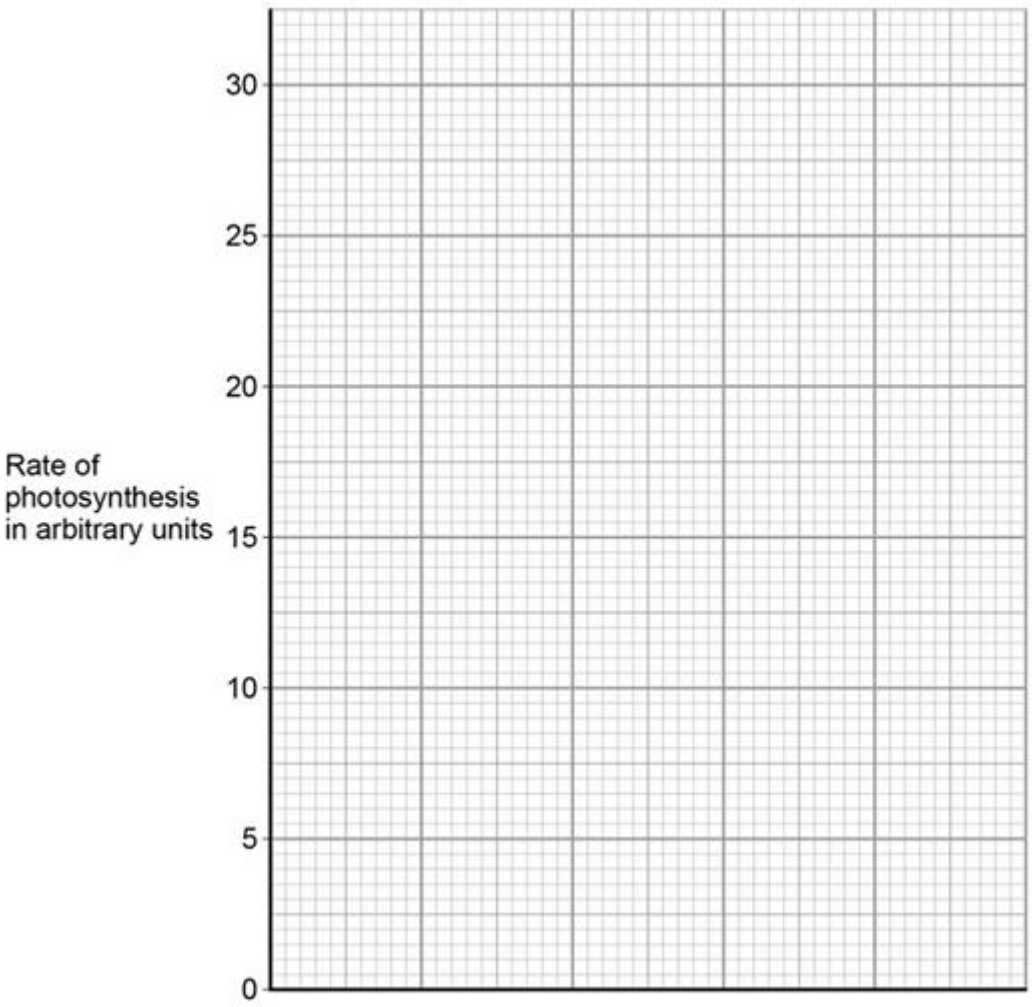
The results are shown in **Table 2**.

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 _____ .

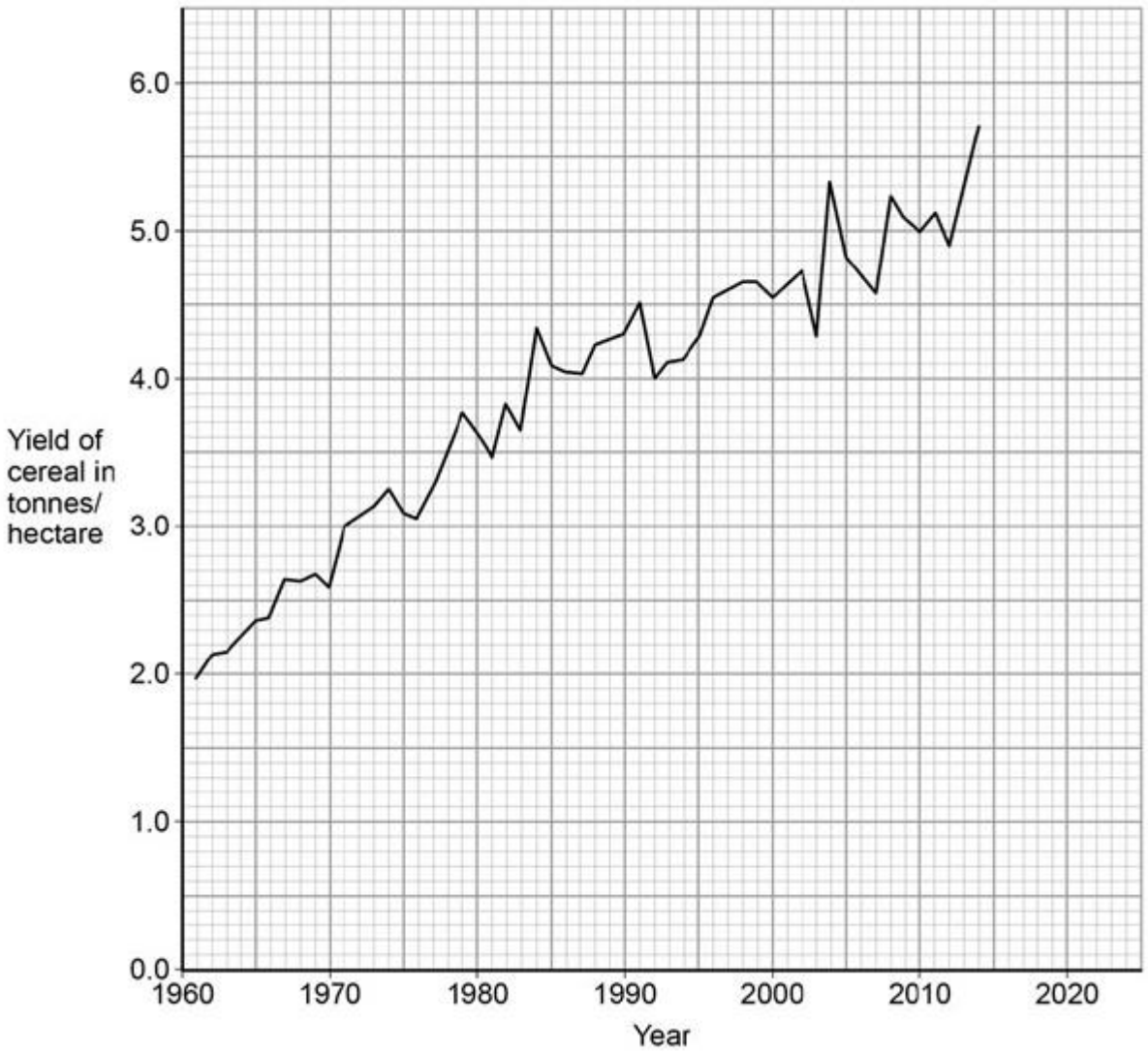
Glucose can be stored as _____ .

(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

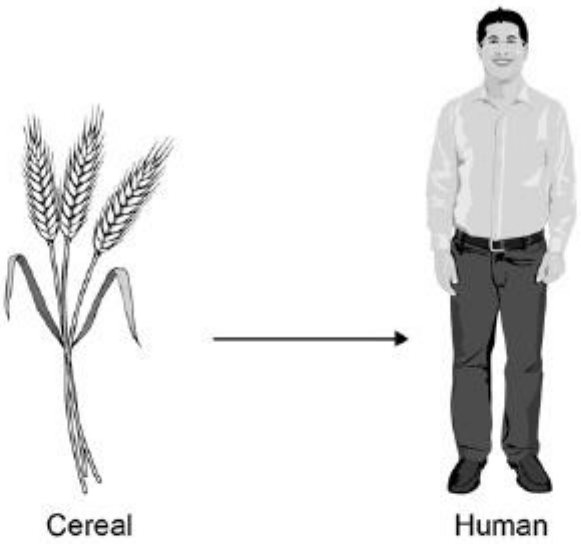
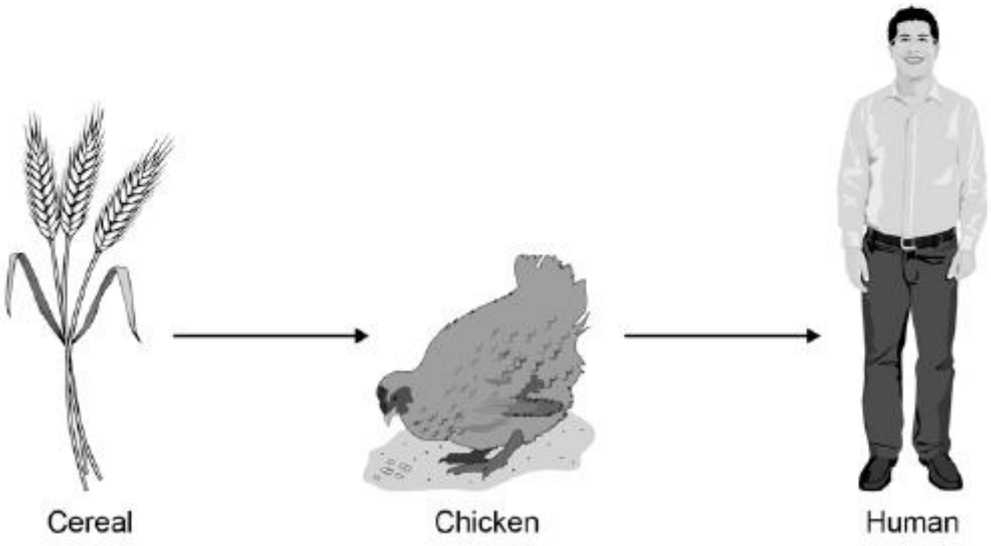
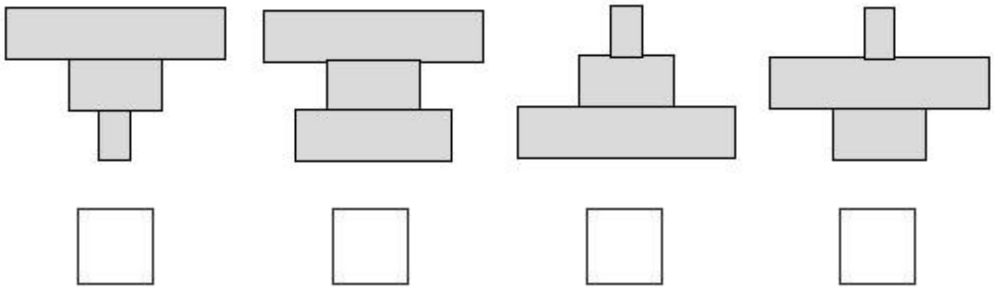


Figure 2



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

Tick **one** box. **(separate only)**



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. **(separate only)**

_____

_____

Answer = _____ times

(1)

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

Tick **two** boxes. **(separate only)**

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)

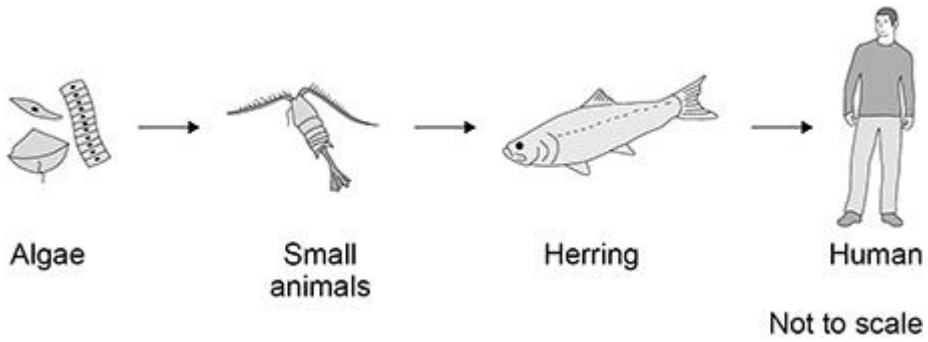
(Total 11 marks)

Q8.

People eat fish caught in the North Sea.

Figure 1 shows a food chain.

Figure 1



(a) The algae make glucose by photosynthesis.

Which **two** substances do the algae need for photosynthesis?

Tick (✓) **two** boxes.

Carbon dioxide	☐
Nitrogen	☐
Oxygen	☐
Starch	☐
Water	☐

(2)

(b) What is the source of energy for photosynthesis?

Tick (✓) **one** box.

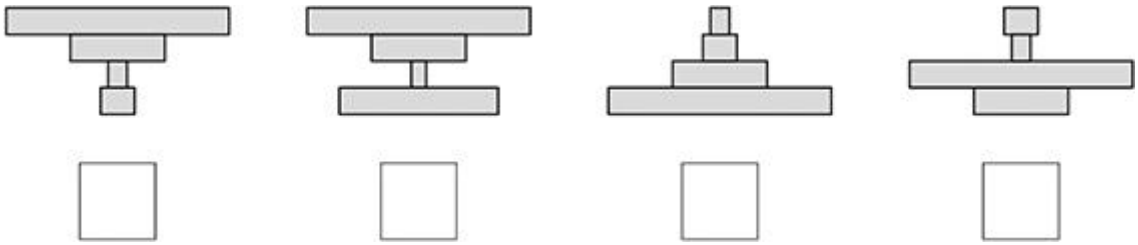
Light	☐
Mineral ions	☐
Protein	☐

Water ☐

(1)

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

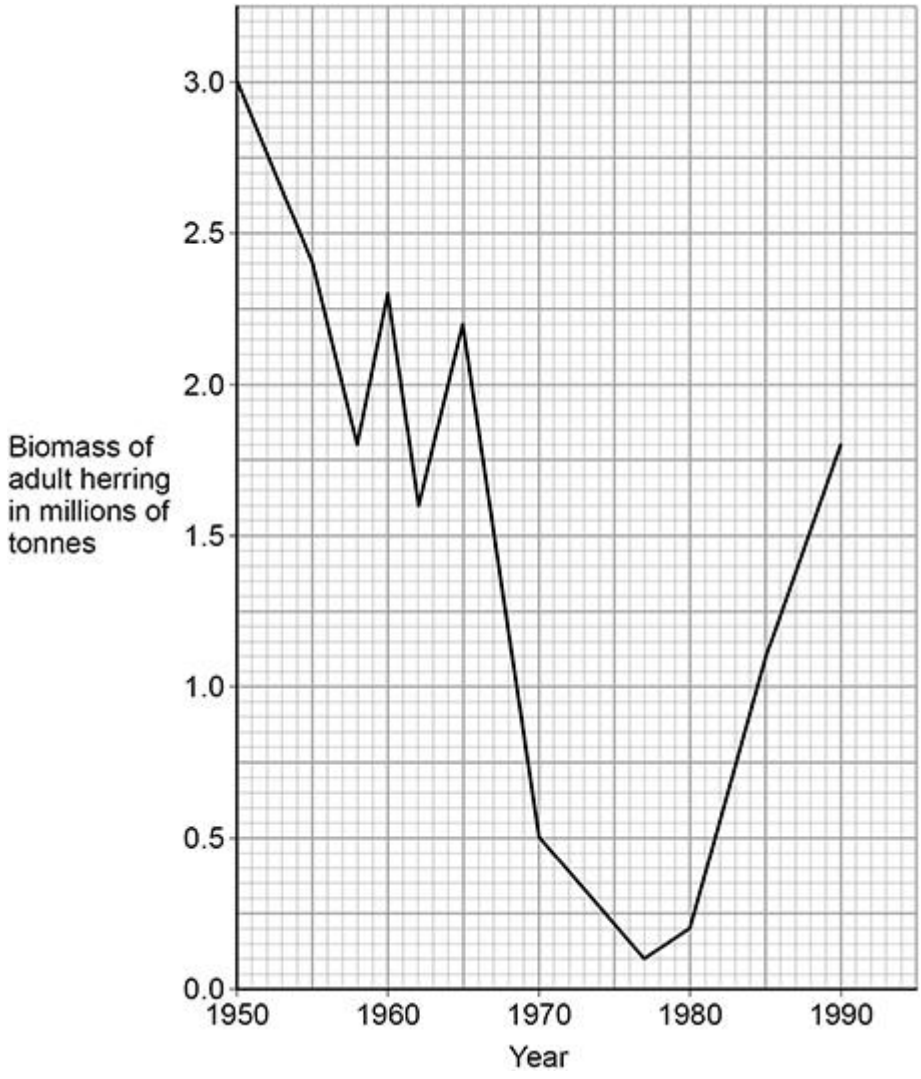
Tick (✓) **one** box. **(separate only)**



(1)

Figure 2 shows the biomass of adult herring in the North Sea between 1950 and 1990.

Figure 2



(d) Too many herring were caught in the 1960s.

Calculate the percentage decrease in the biomass of adult herring between 1960 and 1970.

Use the equation:

$$\text{percentage decrease} = \frac{(\text{biomass in 1960} - \text{biomass in 1970})}{\text{biomass in 1960}} \times 100$$

Give your answer to the nearest whole number. **(separate only)**

Percentage decrease = _____ %

(4)

From 1977, laws were introduced to help conserve herring.

(e) Describe the change in biomass of adult herring from 1977 to 1990.

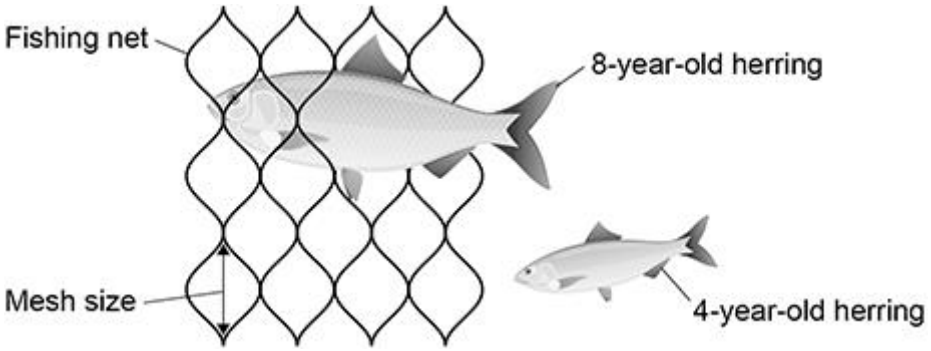
Use data from **Figure 2** in your answer. **(separate only)**

(2)

(f) One of the laws was to control mesh size of fishing nets.

Figure 3 shows a fishing net with a legal mesh size.

Figure 3



Herring can live for up to 12 years.

Herring start to reproduce when they are 3 to 4 years old.

Explain how the control of mesh size of fishing nets has helped to conserve stocks of herring. **(separate only)**

_____

_____

_____

_____

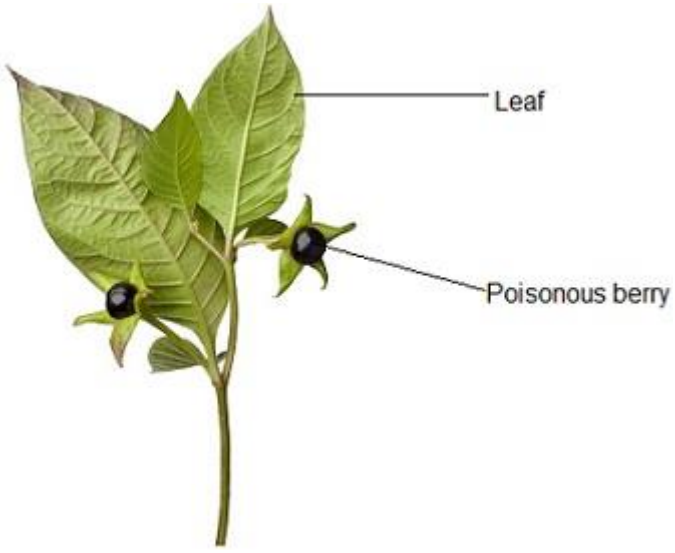
(2)

(Total 12 marks)

Q9.

Figure 1 shows part of a deadly nightshade plant.

Figure 1



(a) How will the poisonous berries help the deadly nightshade plant to survive? **(separate only)**

_____

_____

(1)

(b) Which type of defence mechanism are the berries?

Tick (✓) **one** box. **(separate only)**

Chemical ☐

Mechanical ☐

Physical ☐

(1)

Figure 2 shows part of a gorse plant.

Figure 2

(c) Suggest how the gorse plant is adapted to defend itself. **(separate only)**

_____

_____

(1)

(d) The green leaves of the gorse plant make glucose for the plant to use.

What are **two** uses of glucose in the gorse plant?

Tick (✓) **two** boxes.

For defence ☐

For respiration ☐

To absorb water ☐

To release minerals ☐

To store as starch ☐

(2)

(e) A student wanted to show that the leaves of a gorse plant contain glucose.

The student crushed the leaves to extract the liquid from the cells.

Describe the method the student could use to test the liquid from the cells for glucose.

Include the result if glucose is present.

_____

_____

_____

_____

_____

_____

(3)

(f) The roots of the gorse plant have bacteria that turn nitrogen gas into nitrate ions.

Explain why nitrate ions are needed by the gorse plant. **(separate only)**

_____

_____

_____

_____

(2)

(g) The roots of gorse plants can be infected by honey fungus.

The honey fungus produces tiny spores underground.

Suggest how the honey fungus spores travel from the roots of an infected gorse plant to the roots of a healthy gorse plant.

_____

_____

(1)

A drug can be extracted from gorse seeds.

Doctors want to trial the drug from gorse seeds to see if it can treat diarrhoea.

(h) Which **two** factors must the doctors test the drug for in the trial?

Tick (✓) **two** boxes.

- Appearance ☐
- Dosage ☐
- Solubility ☐
- Taste ☐
- Toxicity ☐

(2)

(i) In the trial some patients will take tablets made from gorse seeds and some patients will take tablets made from sugar.

What are the tablets made from sugar called?

Tick (✓) **one** box.

- Antibiotics ☐
- Antibodies ☐
- Painkillers ☐
- Placebos ☐

(1)

(Total 14 marks)

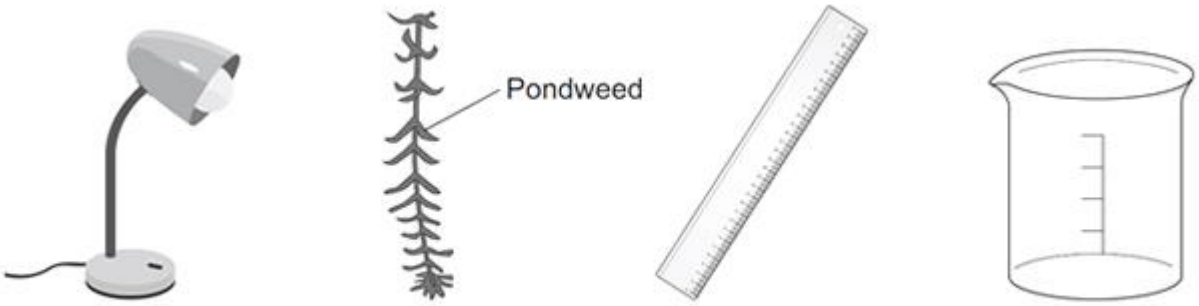
Q10.

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)