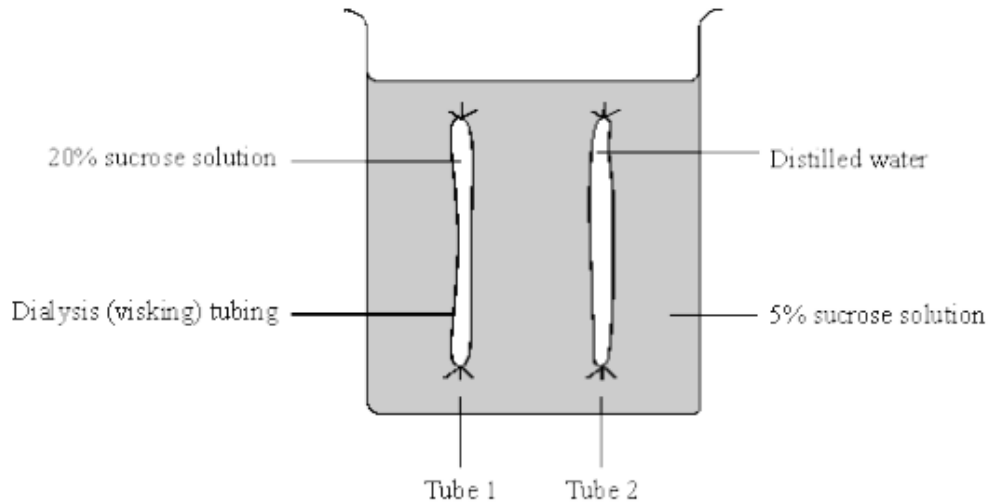


Cells

Some students set up this experiment to investigate osmosis. They filled two pieces of dialysis [visking] tubing with different liquids and left them both in a beaker of 5% sucrose solution for an hour.



- (a) Describe and explain the likely results after one hour.

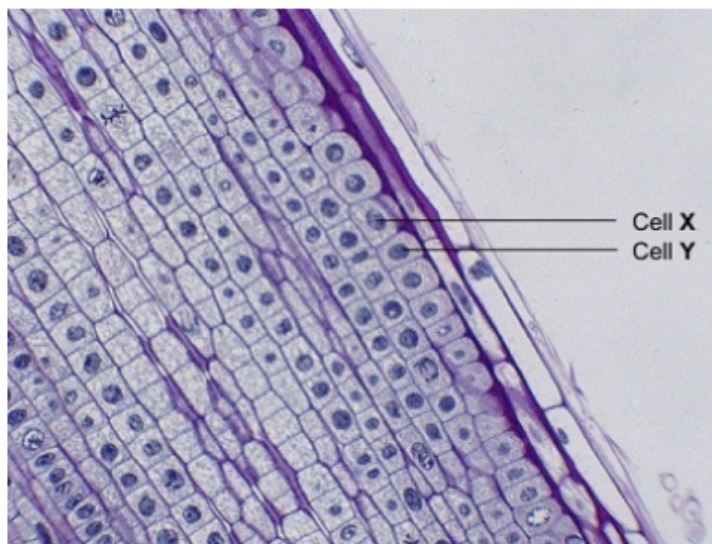
(6)

- (b) Describe **two** examples where osmosis is used in living things.

(2)

(Total 8 marks)

The photograph shows some cells in the root of an onion plant.



By UAF Center for Distance Education [CC BY 2.0], via Flickr

(a) Cells **X** and **Y** have just been produced by cell division.

(i) Name the type of cell division that produced cells **X** and **Y**.

(1)

(ii) What happens to the genetic material before the cell divides?

(1)

(b) A gardener wanted to produce a new variety of onion.

Explain why sexual reproduction could produce a new variety of onion.

(3)

(Total 5 marks)

Some students investigated the effect of pH on the growth of one species of bacterium.

They transferred samples of bacteria from a culture of this species to each of eight flasks. Each flask contained a solution of nutrients but at a different pH.

After 24 hours, the students measured the amount of bacterial growth.

- (a) It was important that the flasks in which the bacteria grew were not contaminated with other microorganisms.

Describe **two** precautions the students should have taken to prevent this contamination.

1. _____

2. _____

(2)

- (b) To see the effect of pH on the growth of the bacteria, other conditions should be kept constant.

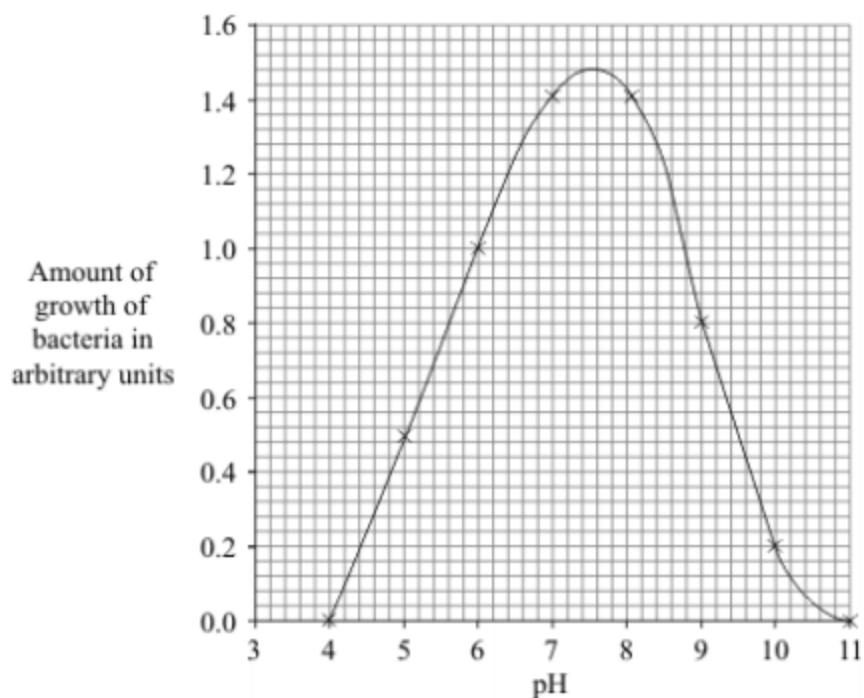
Suggest **two** conditions which should have been kept constant for all eight flasks.

1. _____

2. _____

(2)

- (c) The graph shows the results of the investigation.



The students wanted to find the best pH for the growth of this species of bacterium.

- (i) Use the graph to estimate the pH at which the bacteria would grow best.

pH _____

(1)

- (ii) What could the students do to find a more accurate value for the best pH for growth of the bacteria?

(1)

(Total 6 marks)

Organisation

Fresh milk is a mixture of compounds including fat, protein and about 5 % lactose sugar. Lactose must be digested by the enzyme lactase, before the products can be absorbed.

Lactase can be added to fresh milk to pre-digest the lactose. This makes 'lactose-free' milk, which is suitable for people who do not produce enough lactase of their own.

A student investigated the effect of changing pH and temperature on the digestion of lactose in milk.

The results are shown in **Tables 1** and **2**.

Table 1
Effect of pH

pH	Time taken to digest lactose in minutes
4.0	20
5.0	18
6.0	13
7.0	7
8.0	5
9.0	6

Table 2
Effect of temperature

Temperature in °C	Time taken to digest lactose in minutes
30	20
35	14
40	11
45	6
50	12
55	23

- (a) The label on a carton of lactose-free milk states:

'Lactase is normally produced in the stomach of mammals.'

The results in **Table 1** show that this statement is unlikely to be true.

Explain how.

- (b) Explain as fully as you can the results shown in **Table 2**.

(3)

- (c) Bile is produced in the liver and is released into the small intestine.

Explain how bile helps the digestion of milk.

(2)

(Total 7 marks)

Plants exchange substances with the environment.

- (a) Plant roots absorb water mainly by osmosis.
Plant roots absorb ions mainly by active transport.

Explain why roots need to use the two different methods to absorb water and ions.

(4)

- (b) What is meant by the *transpiration stream*?

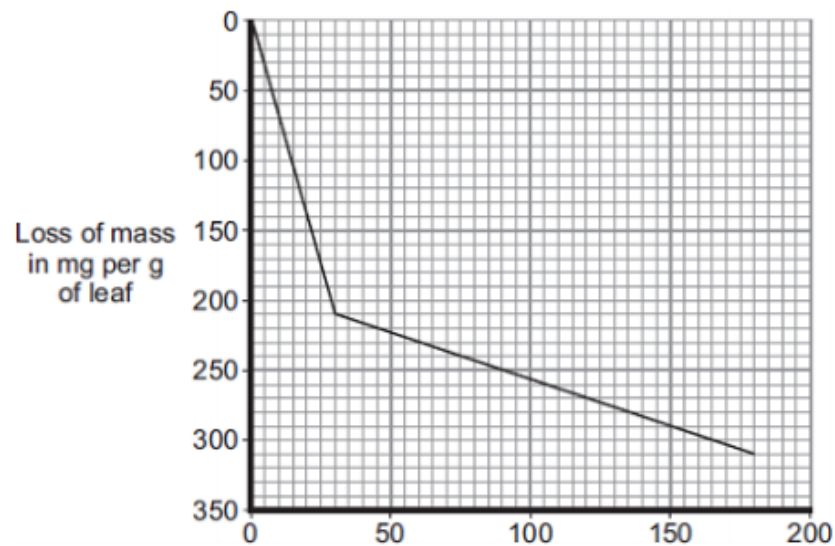
(3)

- (c) Students investigated the loss of water vapour from leaves.

The students:

- cut some leaves off a plant
- measured the mass of these leaves every 30 minutes for 180 minutes.

The graph shows the students' results.



- (i) The rate of mass loss in the first 30 minutes was 7 milligrams per gram of leaf per minute.

Calculate the rate of mass loss between 30 minutes and 180 minutes.

Rate of mass loss = _____ milligrams per gram of leaf per minute

(2)

- (ii) The rate of mass loss between 0 and 30 minutes was very different from the rate of mass loss between 30 and 180 minutes.

Suggest an explanation for the difference between the two rates.

(2)

(Total 11 marks)

Infection and Response

Read the following passage.

'The immune system is the body's defence force. It protects against infections which might enter the body. The potential invaders include bacteria and viruses. The two basic defences are cells and chemicals. The best known action of defence cells is the ingesting and killing of microbes. The best known chemical defence is the antibody - a protein specially made to match with the surface of an invading microbe. Once covered with antibody, the microbe becomes easier to destroy.

So how do the invaders ever win? Part of the answer is that the chemical defenders take some time to become effective. When the body is infected for the first time by a particular microbe, there is a race between the multiplying microbes and the multiplying cells producing the antibody. Given time, the body usually wins; eventually enough antibodies are formed to overcome the invaders. But if the initial invasion force is large, or the immune system is weak, the battle may be lost.'

- (a) (i) Which type of cells ingest and kill invading microbes? (lines 3 - 4)

(1)

(ii) Give **two** circumstances in which the initial invasion force might be very large (lines 11 - 12).

1. _____

2. _____

(2)

(iii) After being ingested, the microbes are digested in the cells. Briefly explain what happens to the proteins that the microbes contain.

(2)

(b) Explain how bacteria cause disease once they get into the body.

(2)

(c) Name a type of medicine that kills bacteria inside the body.

(1)

- (d) People often risk first-time infection by a particular microbe while visiting other countries. People can be immunised against the disease that the microbe causes.

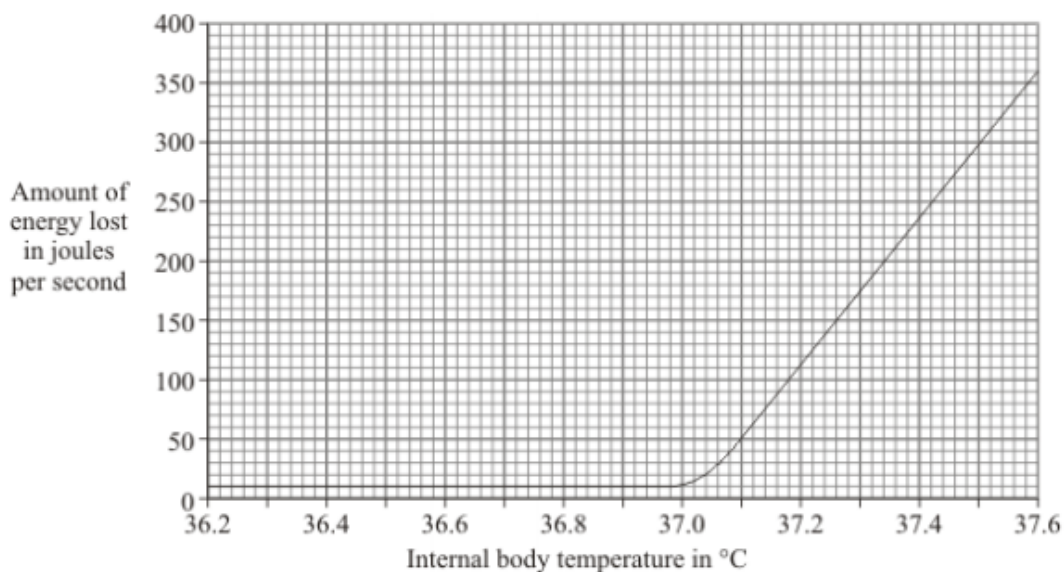
Explain, as fully as you can, how immunisation works.

(3)

(Total 11 marks)

Homeostasis and Response

The internal body temperature determines how much a person sweats. The graph shows the effect of different internal body temperatures on a person's rate of energy loss by sweating.



- (a) How much more energy was lost from the body each second by sweating when the body temperature was 37.6 °C than when it was 36.6 °C? Show clearly how you work out your final answer.

Amount of energy = _____ joules per second

(2)

- (b) Explain why a person would feel more thirsty when the body temperature was 37.6 °C than when it was 36.6 °C.

(2)

- (c) Explain how sweating helps to control body temperature.

(3)

(Total 7 marks)

- (a) When a seed starts to grow, the young root grows downwards towards gravity.
The young shoot grows upwards, away from gravity.

- (i) Name this type of plant response to gravity.

(1)

- (ii) Give **two** reasons why it is useful for a young root to grow towards gravity.

1.

2.

(2)

- (iii) The root grows towards gravity due to the unequal distribution of a substance in the root.

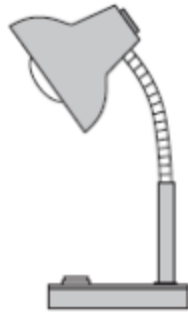
Draw a ring around the correct answer to complete the sentence.

This substance is

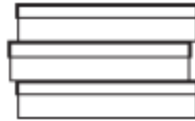
auxin.
chlorophyll.
sugar.

(1)

(b) The drawings show some apparatus and materials.



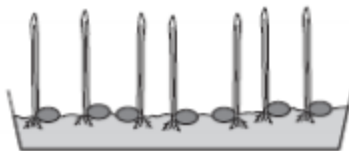
Lamp



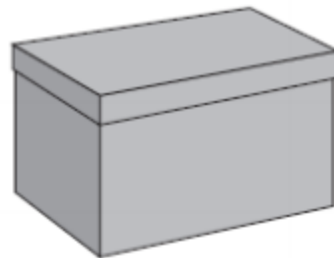
Petri dishes



Forceps



50 maize seedlings
on damp cotton wool



Supply of cardboard boxes with lids



Ruler



Scissors

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

Describe how the students could use some or all of the apparatus and materials shown in the drawings to investigate the growth response of maize seedlings to light shining from one side.

You should include a description of the results you would expect.

(6)
(Total 10 marks)

Inheritance, Variation and Evolution

Cystic fibrosis is an inherited disease which causes the tubes in the lungs to be blocked with sticky mucus. Two parents who do not have the disease can still produce children who do have the disease.

- (a) Explain how children can inherit this disease from parents who do not have it (use a genetic diagram in your answer if you want to).

(4)

- (b) Mucus contains protein. The information for the production of this protein is stored in a gene.

Explain how a change in a gene causes a different protein to be produced.

(3)

(Total 7 marks)

Doctors give antibiotics to patients to kill bacteria in their bodies.

Explain how the overuse of antibiotics has led to the evolution of antibiotic-resistant bacteria.

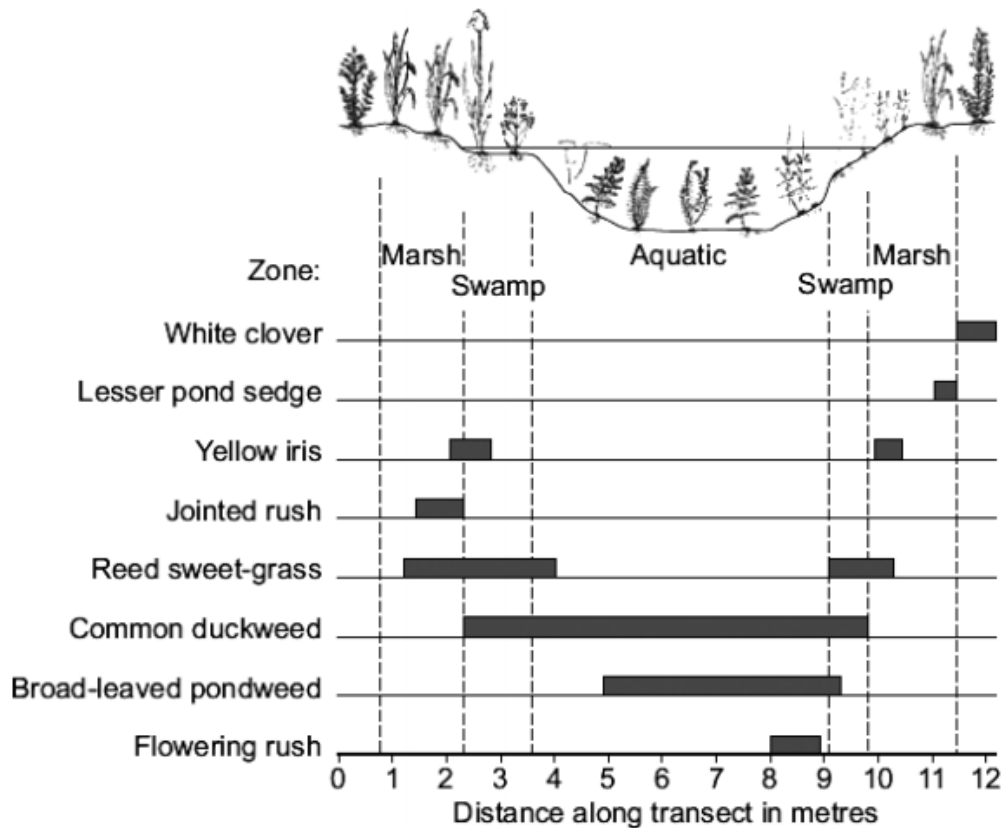
*To gain full marks in this question you should write your ideas in good English.
Put them into a sensible order and use the correct scientific words.*

(Total 3 marks)

Ecology

Some students investigated the distribution of some of the plants growing in and around a shallow stream. They sampled along a transect line.

The diagram shows their results.



- (a) (i) Name the **one** species that grew only in the driest conditions.

(1)

- (ii) Only **one** species grew in the marsh, the swamp and in the aquatic zones.

Which species?

(1)

- (iii) Duckweed grows floating in water. What evidence is there for this in the students' results?

(1)

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

Describe how you would use a $\frac{1}{2}$ -metre $\times$ $\frac{1}{2}$ -metre quadrat frame and a 30-metre tape measure to obtain data similar to the data shown in the diagram.

You should include details of how you would make sure that you would obtain valid results.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(6)

(Total 9 marks)

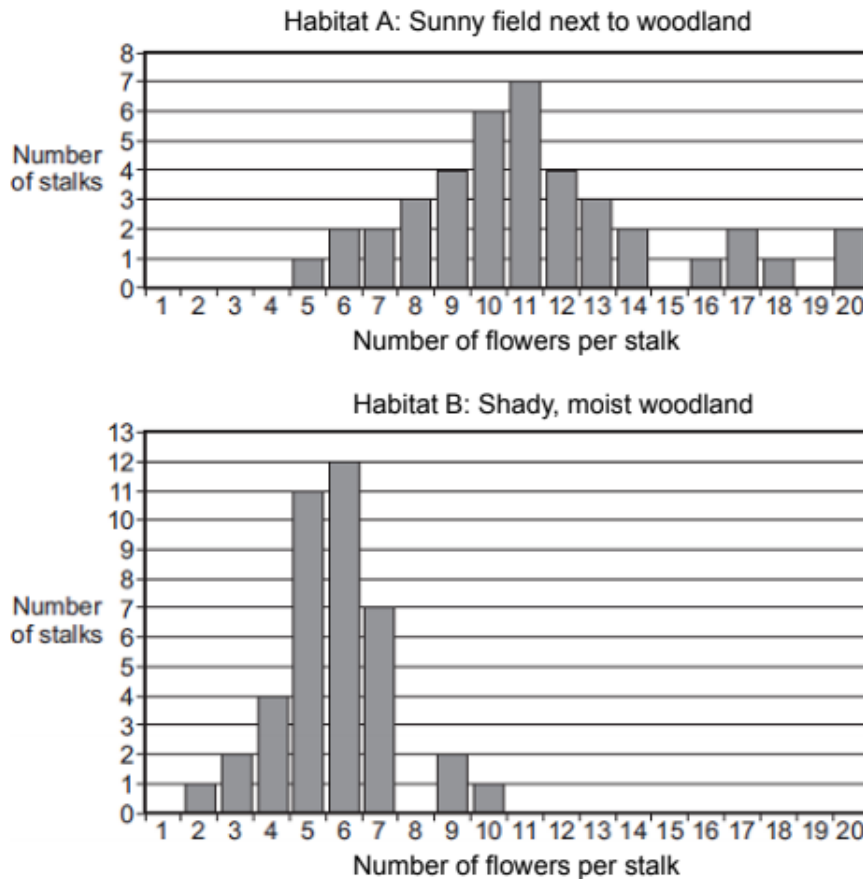
Some students studied bluebell plants growing in two different habitats.

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.

- (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.

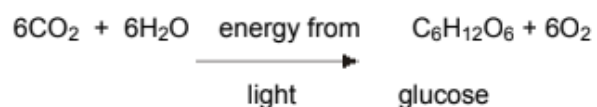
(2)

(Total 9 marks)

Bioenergetics

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

Plants make food by photosynthesis.

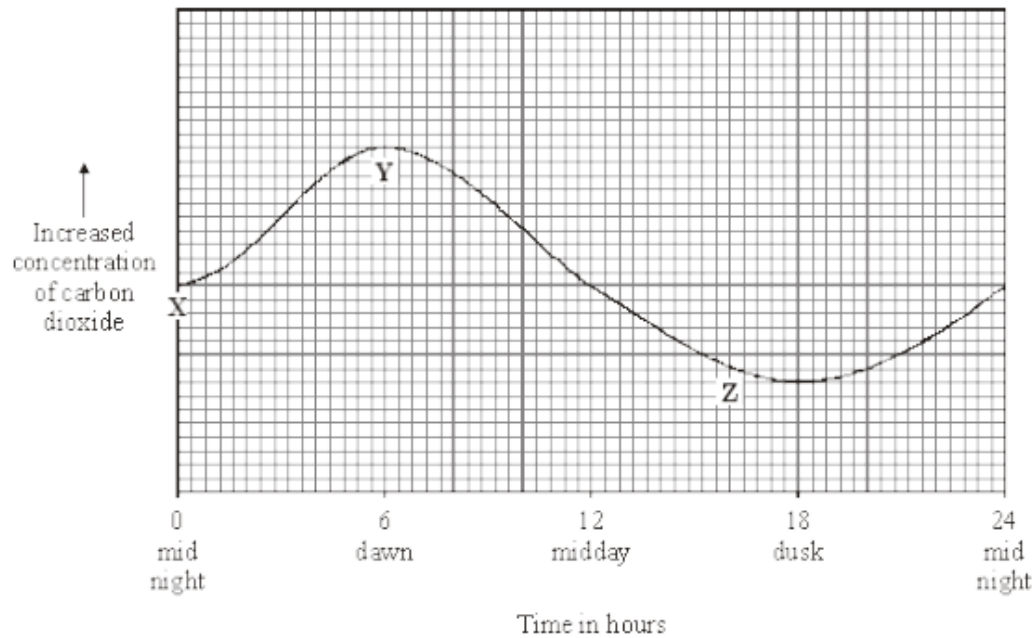


In winter, when days are shorter, glasshouses are heated to keep the enzyme reactions in plants at optimum rates.

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)

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)