1 Fig. 1.1 is a photomicrograph of a leaf of the tea plant, *Camellia sinensis*.

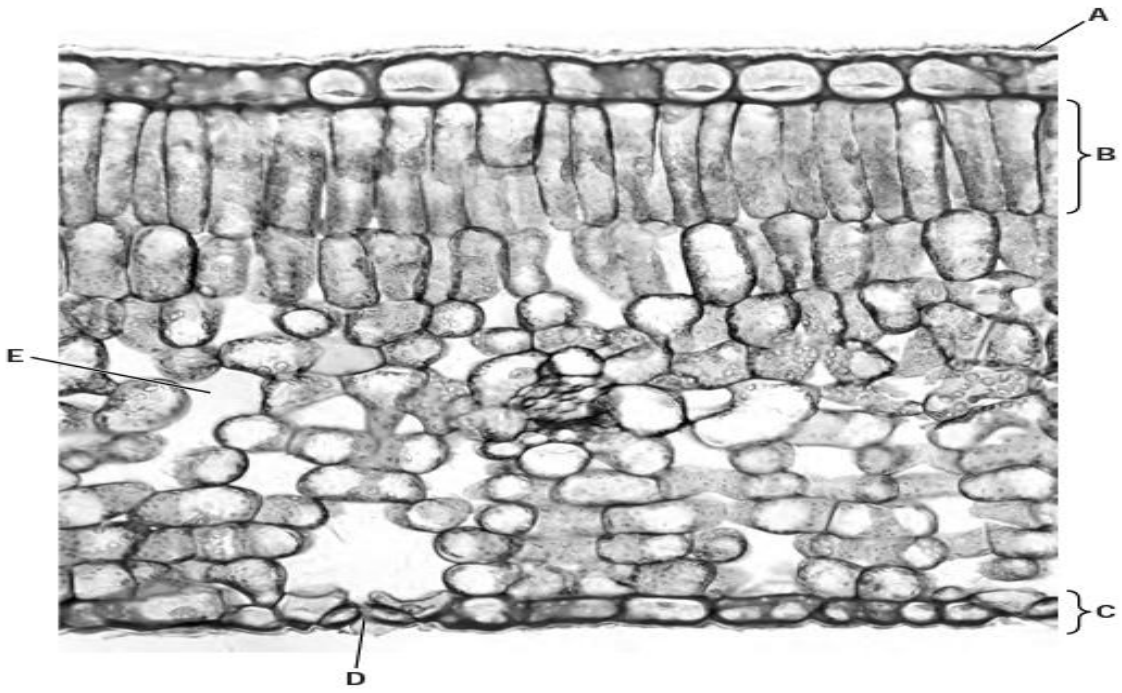

Fig. 1.1

(a) Name **A** to **E**.

A .....

B .....

C .....

D .....

E ..... [5]

(b) Fig. 1.2 shows a cell from region **B** of the leaf shown in Fig. 1.1.

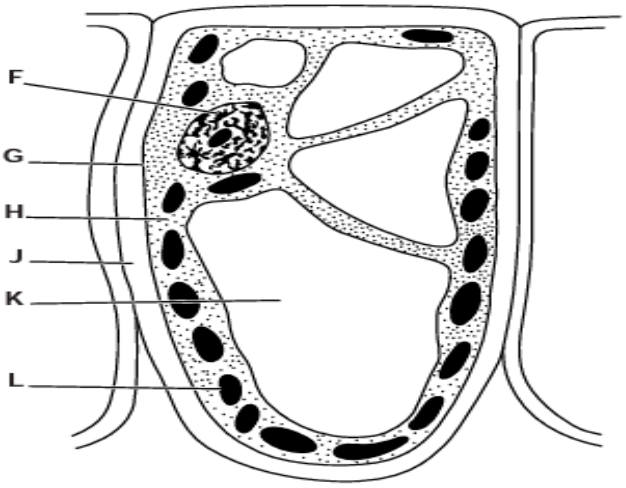

Fig. 1.2

Use the letters from Fig. 1.2 to complete Table 1.1.

Write **one** letter only in each box to identify the function. You may use each letter once, more than once or not at all.

Table 1.1

function	letter from Fig. 1.2
controls movement of substances into and out of the cell	
exerts a pressure to help maintain the shape of the cell	
produces sugars using light as a source of energy	
withstands the internal pressure of the cell	
controls all the activities of the cell	

[5]

2. Fig. 1.1 shows an animal cell and a plant cell as seen with a light microscope.

animal cell plant cell

Fig. 1.1

(a) Table 1.1 shows some structural features of the animal cell and the plant cell in Fig. 1.1.

Complete the table by

- finishing the row for nucleus
- adding **three** structural features, visible in Fig. 1.1, and indicating whether they are present (✓) or absent (✗) in the animal cell and in the plant cell.

Table 1.1

structural feature	animal cell	plant cell
cell wall	✗	✓
nucleus		

[4]

(b) The cells were kept in a dilute salt solution. They were then transferred to distilled water.

Explain what will happen to each of these two cells when they are placed into distilled water.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Magnesium is a plant nutrient. Scientists think that magnesium is involved in the transport of sucrose from the leaves to the rest of a plant.

(i) Name the tissue that transports sucrose in plants.

.....[1]

The scientists grew some tomato plants with their roots in a solution that contained all the mineral nutrients that plants require. After a while, the plants were divided into two groups.

- Group **A** continued to receive the solution containing all the nutrients.
- Group **B** received a solution that did not contain any magnesium.

After 12 days, measurements were made on the leaves and the results are shown in Fig. 1.2.

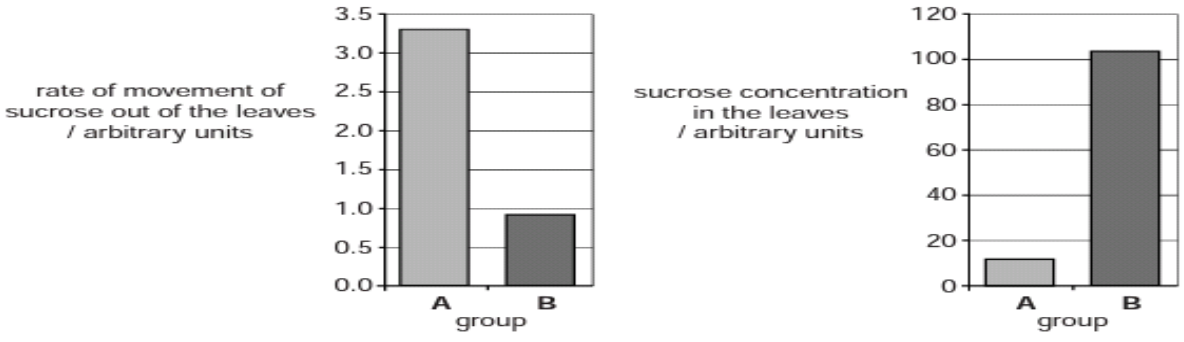

Fig. 1.2

(ii) Describe the effect of magnesium deficiency on the transport of sucrose out of the leaves and the sucrose concentration in the leaves.

transport of sucrose out of the leaves .....

.....

.....

.....

.....

concentration of sucrose in the leaves .....

.....

.....

.....

.....[4]

(iii) The plants in Group **B** remained in the magnesium-deficient solution for longer than 12 days. At the end of this time they showed symptoms of magnesium deficiency.

Describe and explain the symptoms that the plants would show.

.....

.....

.....

.....

.....[3]

[Total: 16]

3. An experiment was carried out to find out if carbon dioxide is needed for photosynthesis.

Stage 1.	Two plants, **A** and **B**, of the same size and species were kept in a dark place for 48 hours.
Stage 2.	A leaf from each plant was then tested for the presence of starch using iodine solution, to show that destarching was complete.
Stage 3.	Both plants were placed in sealed glass containers, for 24 hours, as shown in Fig. 5.1. Plant **A** was in the presence of potassium hydroxide beads (which absorb carbon dioxide). Plant **B** was in the presence of glass beads. All other conditions needed for photosynthesis were provided for both plants.
Stage 4.	After 24 hours a leaf from each plant was tested for the presence of starch.

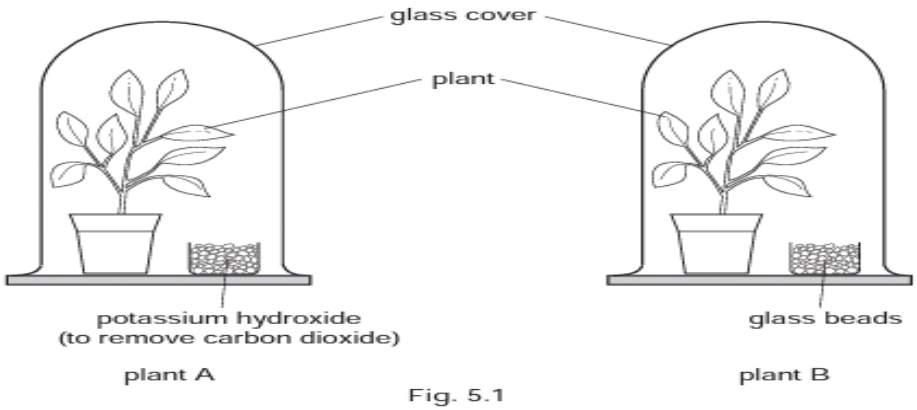

Fig. 5.1

(a) (i) The stages involved in testing a leaf for starch are shown below.
The stages are in the correct sequence, but the reasons are in the wrong order.
Use straight lines to match the stages with the correct reasons. One has been done for you.

stage	reason
boil the leaf in water	ethanol (alcohol) is flammable
turn off any naked flames	to test for starch
boil the leaf in ethanol (alcohol)	to break down cell membranes
soak the leaf in water	to remove chlorophyll
add iodine solution to the leaf	to soften the leaf

[4]

(ii) Explain why chlorophyll is removed from the leaf before testing it for starch.

.....

..... [1]

(b) State two factors, **other than carbon dioxide**, that both plants would need in order to photosynthesise.

1. .....

2. ..... [2]

(c) Plant **B** was used as a control in the experiment. Explain the importance of this control.

.....

..... [1]

(d) Explain why the plants were destarched.

.....

..... [1]

(e) Complete the table. Use ticks and crosses to show if the starch test for plants **A** and **B** would be positive (✓) or negative (×) at **stage 2** and **stage 4**. In each case, explain your answer.

stage	leaf from plant	starch test (✓ or ×)	explanation
2	A and B		
4	A		
	B		

[3]

(f) In a further experiment, another destarched plant was kept in the dark.

The concentration of carbon dioxide in the container was measured at regular intervals and was found to increase with time.

Explain why the concentration of carbon dioxide increased.

.....

.....

.....

..... [3]

[Total: 15]

4. Fig. 2.1 shows crop productivity for a range of plants but the bar graph is incomplete.

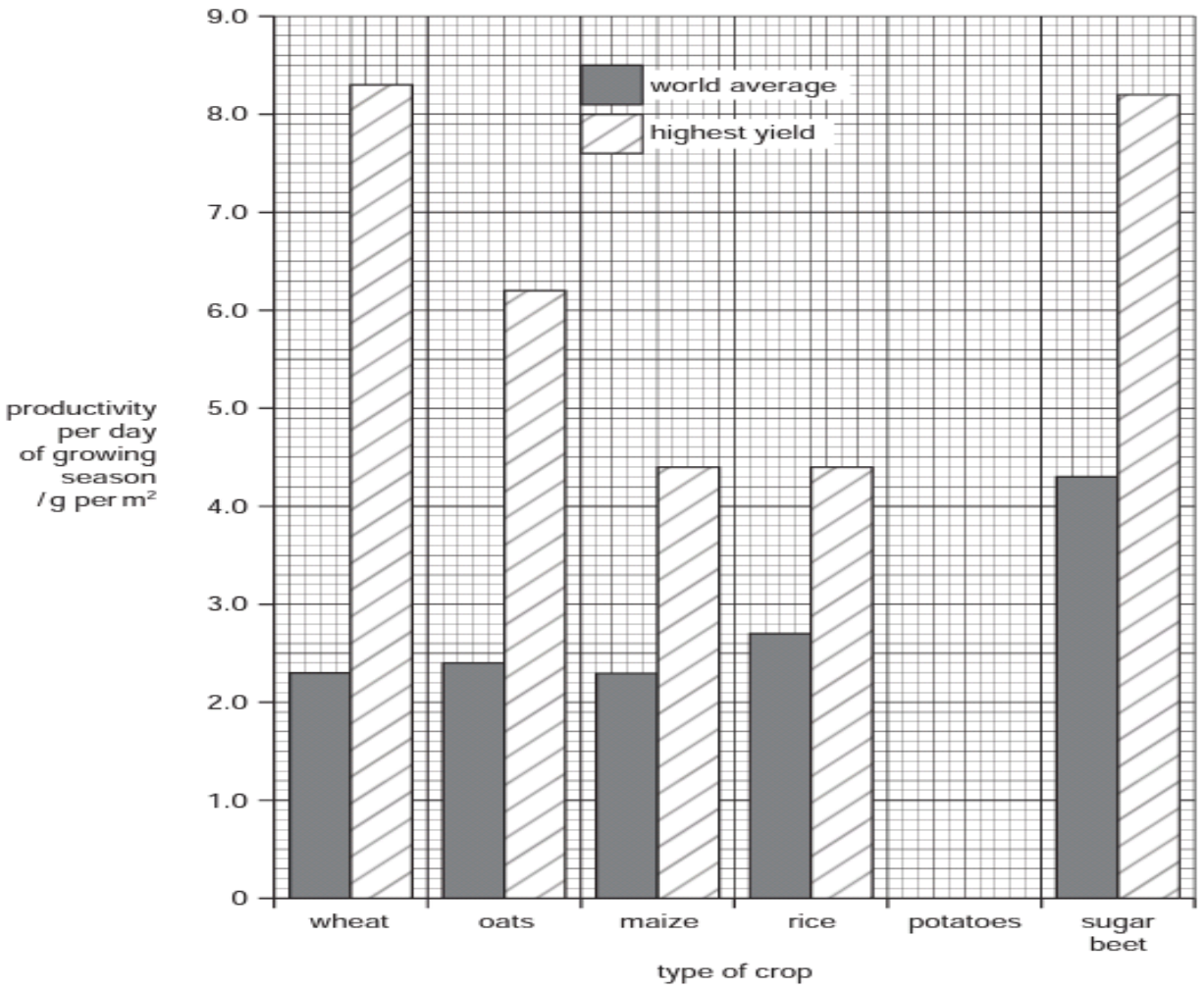

Fig. 2.1

(a) Complete Fig. 2.1 using the following data.

crop	productivity per day of growing season / g per m^2	
	world average	highest yield
potatoes	2.6	5.6

[2]

(b) State which crop has

(i) the highest average productivity,

.....

(ii) the greatest difference between the average yield and the highest yield.

..... [2]

(c) Outline how modern technology could be used to increase the productivity of a crop from the average yield to a high yield.

.....

.....

.....

..... [3]

(d) When the yield is measured, dry mass is always used rather than fresh mass.

Suggest why dry mass is a more reliable measurement than fresh mass.

.....

..... [1]

(e) Maize is often used to feed cows, which are grown to provide meat for humans.

Explain why it is more efficient for humans to eat maize rather than meat from cows that have been fed on maize.

.....

.....

..... [3]

(f) **(i)** Complete the equation for photosynthesis.

$$6CO_2 + 6H_2O \xrightarrow{\text{light energy}} C_6H_{12}O_6 + \text{.....}$$

[1]

(ii) Describe how leaves are adapted to trap light.

.....

.....

..... [2]

(iii) With reference to water potential, explain how water is absorbed by roots.

.....

.....

.....

..... [3]

(iv) Explain how photosynthesising cells obtain carbon dioxide.

.....

.....

..... [2]

[Total: 19]

5. **(a)** List four chemical elements that are found in proteins.

1. .....
2. .....
3. .....
4. ..... [4]

Fig. 6.1 is a photograph of some root nodules from a pea plant, which is a type of legume.

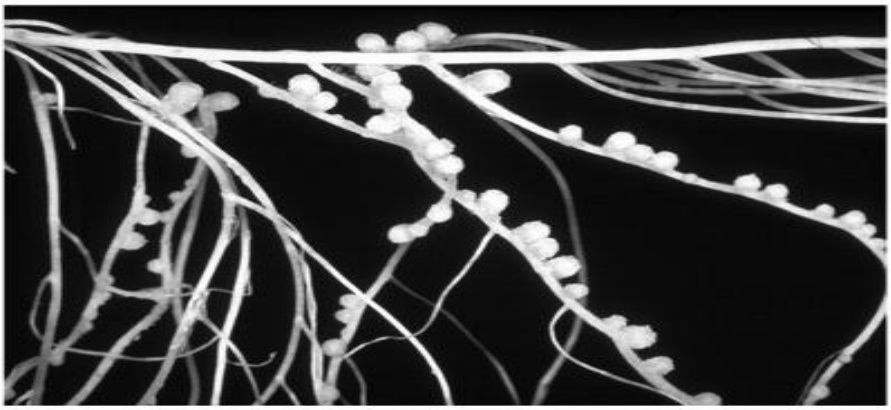

Fig. 6.1

(b) Nodules like those in Fig. 6.1 develop on the roots of pea plants and other legumes when the soil is lacking in nitrate ions.

Explain what happens inside the nodule to help legume plants grow in soils lacking nitrate ions.

.....

.....

.....

.....

.....

..... [3]

(c) After the peas have been harvested, the plants are ploughed back into the soil.

Describe what happens in the soil to convert dead plant material into nitrate ions that plants can absorb.

.....

.....

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.....

.....

.....

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.....

.....

..... [6]

(d) Nutrients in the soil can act as a limiting factor for crop growth.

List three **other** factors that may limit the growth of a crop plant.

1. .....
2. .....
3. ..... [3]

6. Fig. 1.1 shows a vertical section through a flower of soybean, *Glycine max*, following self-pollination. Fig. 1.2 shows part of the section at a higher magnification.

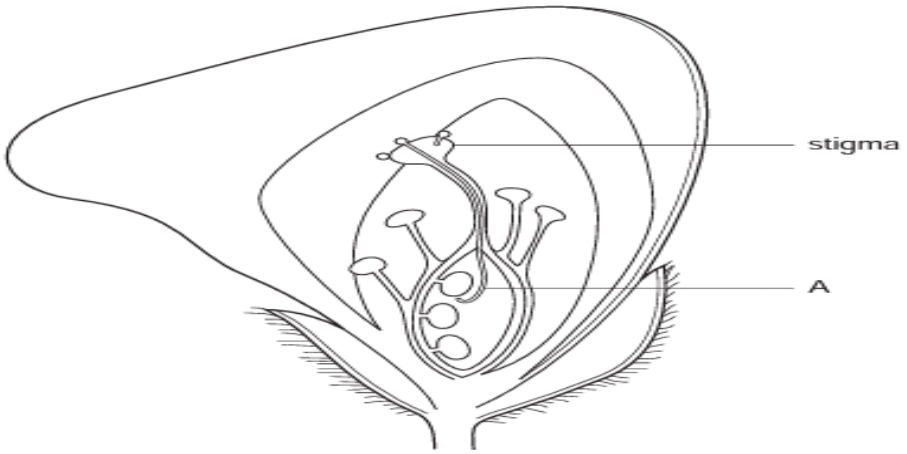

Fig. 1.1

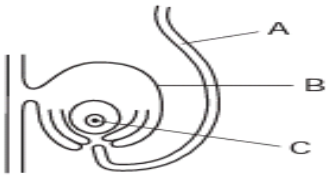

Fig. 1.2

(a) (i) Name the parts labelled **A** to **C** shown in Figs. 1.1 and 1.2.

A .....

B .....

C ..... [3]

(ii) Describe what happens to the structures shown in Figs. 1.1 and 1.2 to bring about fertilisation. You may refer to the structures labelled **A** to **C** by their letters if you wish.

.....

.....

.....

.....

.....

..... [3]

(iii) Explain the advantages **and** disadvantages of self-pollination for flowering plants, such as soybean.

advantages .....

.....

.....

.....

disadvantages .....

.....

.....

.....

..... [4]

(b) Soybean is a dicotyledonous plant.

(i) Name the genus to which the soybean belongs.

..... [1]

(ii) State two features which are **only** found in dicotyledonous plants.

1. .....

2. ..... [2]

[Total: 13]

7. Seeds of the mung bean, *Phaseolus aureus*, were germinated and grown in a dish for a few days in the dark. The dish was then placed as shown in Fig. 7.1 **A**.

Fig. 7.1 **B** shows the seedlings after a further two days in the dark.

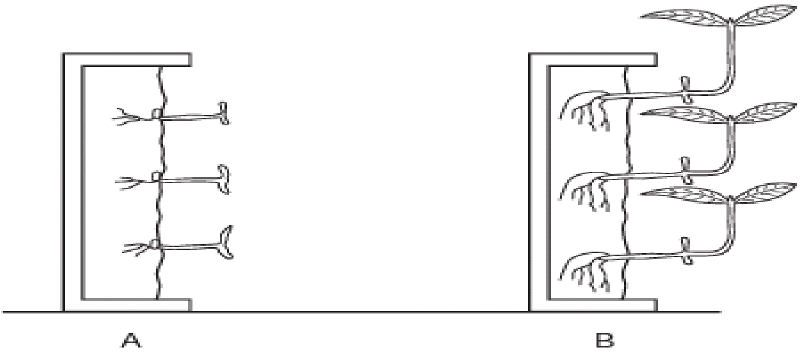

Fig. 7.1

(a) Name the response shown by the roots in Fig. 7.1.

.... [1]

(b) Suggest why the seedlings were kept in the dark during this investigation.

....

....

.... [1]

(c) Explain why it is important for their early growth that the roots and shoots of seedlings respond in the way shown in Fig. 7.1**B**.

....

....

....

....

....

.... [2]

(d) The response shown by the shoots in Fig. 7.1**B** is coordinated by auxins.

Explain how auxins bring about this growth response in shoots.

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.... [3]

(e) Weed seedlings are sprayed with synthetic auxins to kill them.

Suggest how these weedkillers spread throughout the plant.

....

....

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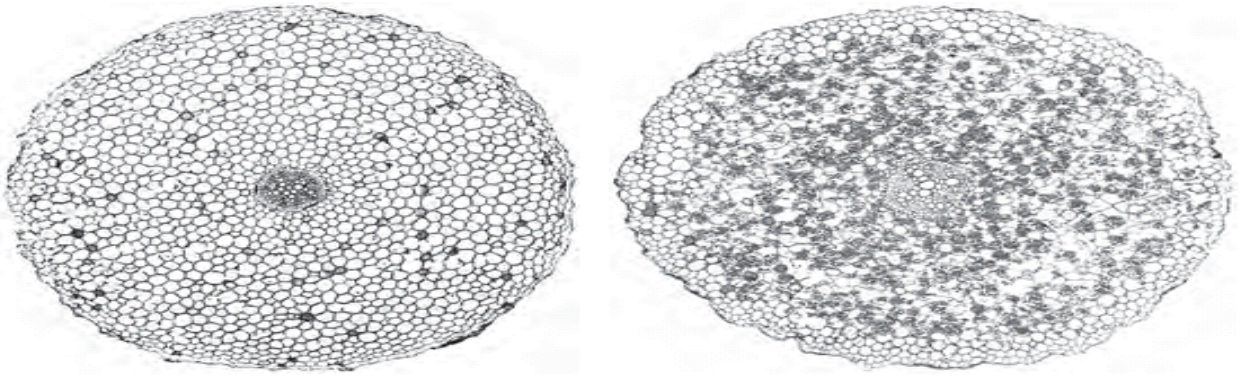
....

.... [2]

[Total: 9]

8. Fig. 1.2 shows a transverse section through a buttercup root at the end of the cold winter (**W**) and at the end of the warm, moist summer (**S**). At the end of the winter, the cells contain very few starch grains. At the end of the summer, most of the root cells contain many starch grains.



W S

Fig. 1.2

(b) Suggest why there are few starch grains in the cells of **W** compared with a large number of starch grains in the cells of **S**.

.....

.....

.....

.....

.....

..... [3]

(c) Describe how enzymes in root cells synthesise starch.

.....

.....

.....

.....

..... [3]

(d) As temperature is increased, for example from 10 °C to 30 °C, enzyme activity increases.

Explain how increasing temperature affects enzyme activity.

.....

.....

.....

..... [2]

[Total: 10]

9. Fig. 1.1 shows a flowering shoot of tiger lily, *Lilium tigrinum*.

Fig. 1.1

(a) State the name of the genus of the tiger lily.

..... [1]

(b) Name the parts labelled **A** to **D**.

A .....

B .....

C .....

D ..... [4]

(c) The tiger lily plant is a monocotyledon.

List two features, **visible in Fig. 1.1**, that show it is a monocotyledon.

1 .....

2 ..... [2]

(d) The tiger lily in Fig. 1.1 reproduces sexually.

Plants reproduce sexually and asexually.

Complete Table 1.1 to show the advantages and disadvantages of asexual and sexual reproduction to a flowering plant species.

Table 1.1

type of reproduction in flowering plants	advantages	disadvantages
asexual		
sexual		

[4]

[Total: 11]

10. The sweet potato plant, *Ipomoea batatas*, has fibrous roots and storage roots. Fibrous roots absorb water and ions from the soil. Storage roots store insoluble carbohydrates.

Fig. 3.1 shows the growth of these roots on a sweet potato plant.

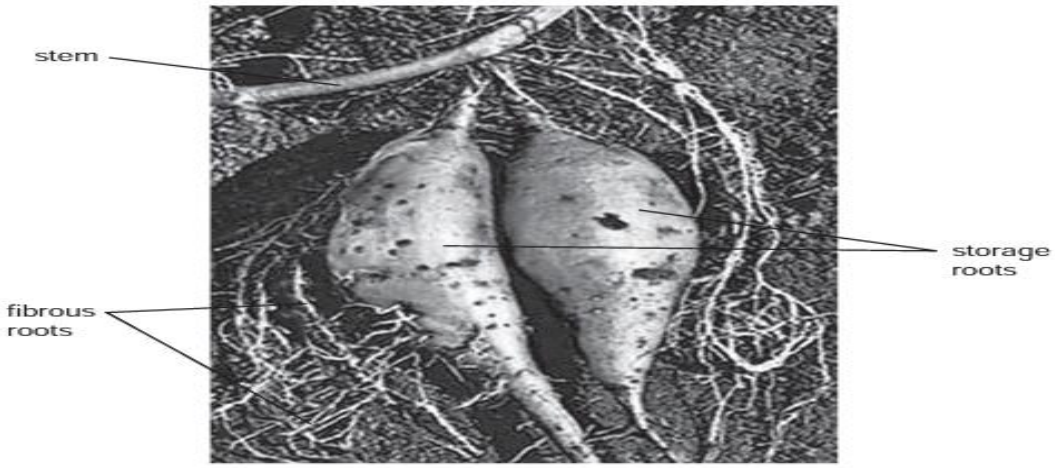


Fig. 3.1

(a) Explain, using the term **water potential**, how fibrous roots absorb water.

.....

.....

.....

.....

.....

..... [3]

The membranes of root hair cells contain proteins for the absorption of ions.

(b) Describe how root hair cells are adapted for the absorption of ions.

.....

.....

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.....

.....

..... [3]

Sweet potato plants produce flowers to reproduce sexually. Sweet potato plants also reproduce asexually when shoots grow from the storage roots to form new plants.

Fig. 3.2 shows the life cycle of sweet potato. The diploid number of this species is 90.

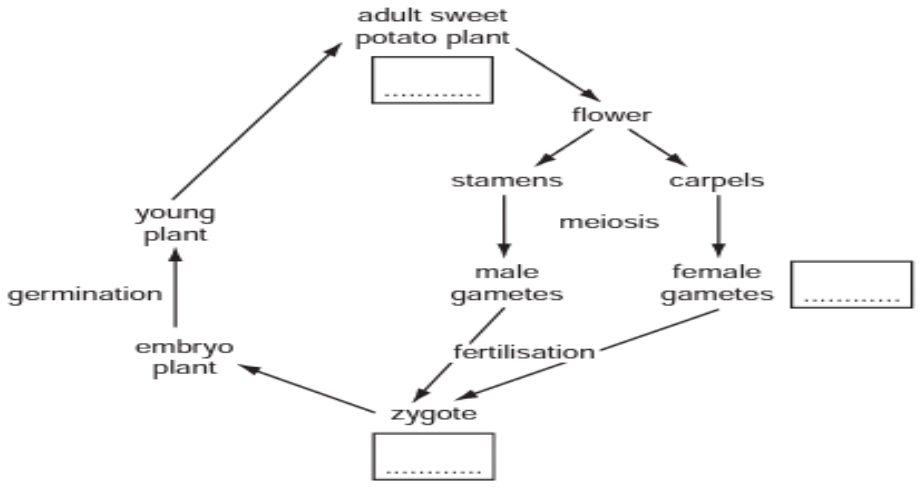

Fig. 3.2

(c) Complete Fig. 3.2 by writing the number of chromosomes in the three boxes. [2]

(b) Some farmers increase the fertility of their soils by adding organic fertilisers, such as manure, and by using legume crops in a crop rotation. Manure contains protein, urea and ammonia in the waste from farm animals.

(i) Explain how nitrogen, in the form of nitrate ions, becomes available in a soil after the addition of manure.

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.....

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.....

.....

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.....

..... [4]

(ii) Explain why legume crops, such as peas, beans, alfalfa and clover are used in crop rotations.

.....

.....

.....

.....

.....

..... [3]

(c) The overuse of fertilisers can lead to environmental problems. Soils, rivers, lakes, the sea and the atmosphere have all been affected by this pollution.

Outline the undesirable effects of the overuse of fertilisers.

.....

.....

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.....

.....

.....

.....

..... [5]

[Total: 17]

11. Fig. 4.1 shows a cross section of part of a stem of buttercup, *Ranunculus*.

Fig. 4.2 is an outline drawing of one vascular bundle from the stem of *Ranunculus*.

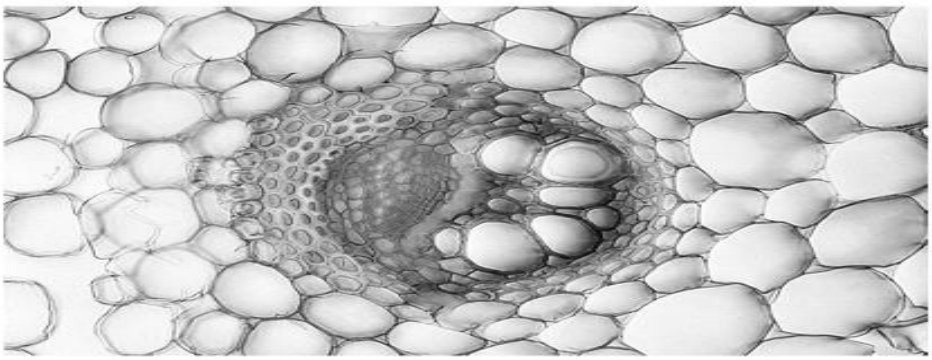

Fig. 4.1

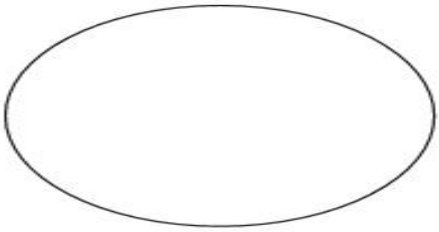

Fig. 4.2

(a) Draw **and** label the position of the xylem and the phloem in the outline of the vascular bundle in Fig. 4.2. [2]

(b) Name the carbohydrate that is transported in the phloem.

..... [1]

(c) Substances transported in the phloem are carried upwards in the stem at some times of the year and downwards at other times.

Explain why substances are transported in the phloem upwards at one time of the year **and** downwards at another.

.....

.....

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.....

..... [4]

(d) Define the term *transpiration*.

.....

.....

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.....

.....

..... [3]

(e) The rattan palm is a plant that climbs on rainforest trees to heights of about 40 metres.

Explain how water is moved to the tops of tall plants, such as the rattan palm.

.....

.....

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.....

.....

.....

.....

..... [4]

[Total: 14]

12. The pea plant, *Pisum sativum*, is a legume which is grown both as a human food and as livestock feed.

Fig. 6.1 shows some of the root nodules on a pea plant.

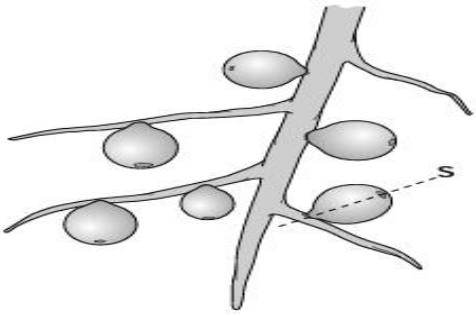

Fig. 6.1

Fig. 6.2 shows a cross-section through the root nodule at **S** on Fig. 6.1.

T indicates the transport tissue in the root.

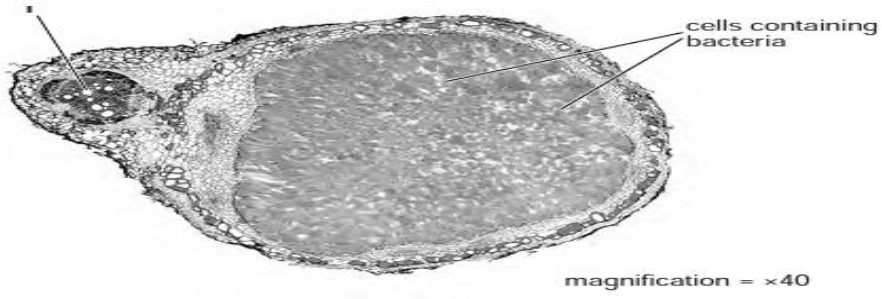

Fig. 6.2

(a) The maximum diameter of the root nodule in Fig. 6.2 is 73 mm.

Calculate the actual diameter of the root nodule.

actual diameter ..... [1]

(b) Describe the role of the bacteria in the root nodules of *P. sativum*.

.....

.....

.....

.....

.....[2]

(c) The bacteria require carbohydrates that are supplied by the pea plant.

Describe how the carbohydrates are produced and transported by the plant to the bacteria.

(i) produced

.....

.....

.....

.....[2]

(ii) transported

.....

.....

.....

.....[2]

(d) Pea plants grow well in soils that are deficient in nitrogen.

Explain how root hair cells of pea plants absorb nitrate ions from soils with low nitrate concentrations.

.....

.....

.....

.....

.....[2]

[Total: 9]

13.

(a) Fig. 4.1 shows a section through the anther of a lily flower. The cells in the centre are dividing by meiosis.

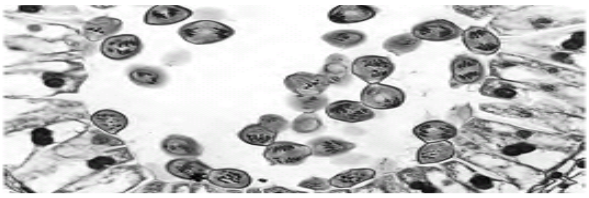

Fig. 4.1

(i) Name the product of meiosis that is formed in anthers.

.....[1]

(ii) Explain the importance of meiosis in sexual reproduction.

.....

.....

.....

.....

.....[2]

(b) Fig. 4.2 shows a flower of *Lilium polyphyllum,* a lily that grows in the Himalayan mountains. This species is cross-pollinated by insects.

Fig. 4.2

(i) Explain what is meant by *cross-pollination*.

.....

.....

.....

.....

.....[2]

(ii) Name **one** feature **visible** in Fig. 4.2 that helps to attract insects.

.....[1]

(c) Plants of this species that grow at low altitudes produce flowers 60 days before the plants of the same species that grow at high altitudes.

(i) Suggest **one** environmental reason why lilies that grow at lower altitudes flower earlier than the lilies at higher altitudes.

.....[1]

(ii) Explain why flowering time is an example of continuous variation.

.....

.....

.....

.....

.....[2]

(d) Scientists think that plants of *L. polyphyllum* growing at high altitudes may evolve into a new species.

Explain how natural selection could lead to the evolution of a new species of lily.

.....

.....

.....

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.....

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.....

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.....

.....

.....[5]

[Total: 14]

14. Some plants can be grown in water using the technique of hydroponics. The roots are in water and supplied with the ions that they need at the concentrations that support maximum growth. Some ions can be absorbed both by diffusion and by active transport.

(a) (i) State **two** features of diffusion that do not apply to active transport.

1 .....

.....

2 .....

.....

[2]

(ii) Explain how roots are adapted to absorb ions.

.....

.....

.....

.....

.....[2]

A group of students investigated the effect of soaking small onion bulbs in different concentrations of sodium chloride solution. They peeled off the outer papery leaves of the onion bulbs and divided the onions into 6 batches, each with 10 onions.

The onions were surface dried with paper towels and weighed. The mean mass of the onions in each batch was calculated. The onions were then left in sodium chloride solutions for three hours.

After three hours the students surface dried the onions and weighed them again. Their results are given in Table 2.1.

Table 2.1

concentration of sodium chloride solution / g dm^{-3}	mean mass of onions / g		percentage change in mass
	before soaking	after soaking for 3 hours	
0	147	173	+17.7
25	153	165	+7.8
50	176	172	−2.3
100	154	149	−3.2
150	149	142	−4.7
200	183	175	

(b) (i) Calculate the percentage change in mass of the onions that were in the most concentrated solution of sodium chloride. Show your working. Write your answer in Table 2.1.

[2]

(ii) Explain why the students calculated the percentage change in mass of the onions.

.....

.....

.....

.....

.....[2]

(c) The students plotted a graph of the results as shown in Fig. 2.1.

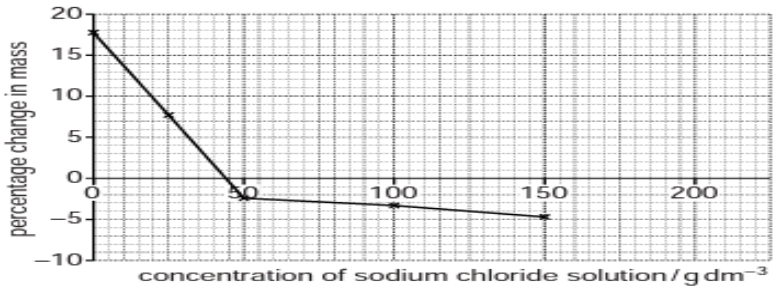

Fig. 2.1

(i) Complete the graph using your answer to **(b)(i)**. [1]

(ii) Use the graph in Fig. 2.1 to estimate the concentration of the sodium chloride solution that has the same water potential as the onions.

.....[2]

(d) Using the term **water potential**, explain why the onions:

gained mass when soaked in dilute solutions of sodium chloride

.....

.....

.....

.....

lost mass when soaked in concentrated solutions of sodium chloride.

.....

.....

.....

.....

[4]

[Total: 15]

15. Fig. 1.1 shows a longitudinal section through a broad bean seed.

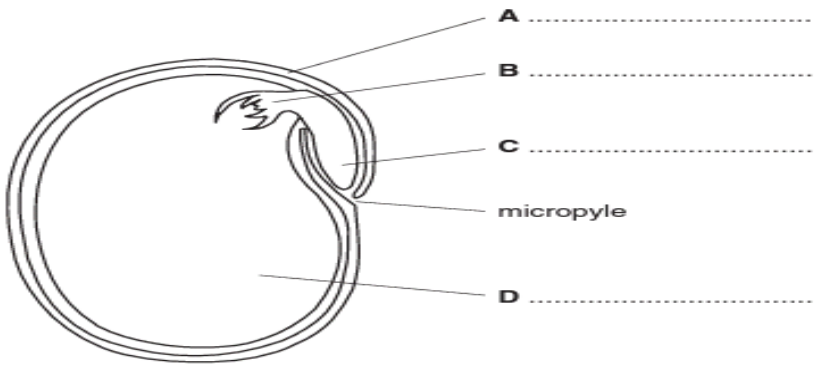

Fig. 1.1

(a) On Fig. 1.1, label parts **A**, **B**, **C** and **D**. [4]

(b) Name the part of the flower in which the seed was formed.

.....[1]

(c) Broad bean flowers are pollinated by insects such as bees.

(i) Describe the function of bees in pollination.

.....

.....

.....[2]

(ii) State two structural adaptations you would expect to find in a flower, such as a broad bean, that would attract bees.

1. .....

2. .....[2]

(iii) The activity of bees usually results in cross-pollination.
Explain why cross-pollination may be an advantage to a species of plant.

.....

.....

.....[2]

(d) The micropyle is shown on Fig. 1.1.
Describe the role of the micropyle in

(i) fertilisation;

.....

.....

.....[2]

(ii) germination.

.....

.....[1]

(e) The carbohydrate stored inside the broad bean seed is mainly starch.

What must happen to the starch before the seed can use it for growth?

.....

.....[1]

[Total : 15]

16. **(a)** With reference to a suitable example, define the term *tissue*. [3]

(b) Identify parts **A**, **B**, **C** and **D** shown on Fig. 7.1 and describe their main features and functions.

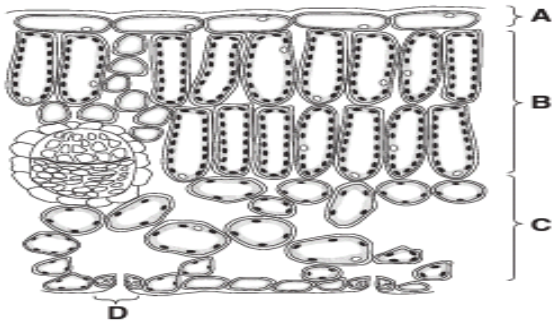

Fig. 7.1

[12]

[Total : 15]

.....

.....

.....

.....

.....

.....

17. In an experiment, pea seeds were germinated on moist cotton wool.

Ten seedlings with straight radicles were selected.

Five of these seedlings were pinned to a vertical piece of cork and enclosed in a transparent cover (apparatus **X**). The other five were treated in the same way, but the cork was attached to a motor that turned the seedlings four times an hour (apparatus **Y**).

Both sets were left in the dark for 24 hours. The results are shown in Fig. 5.1.

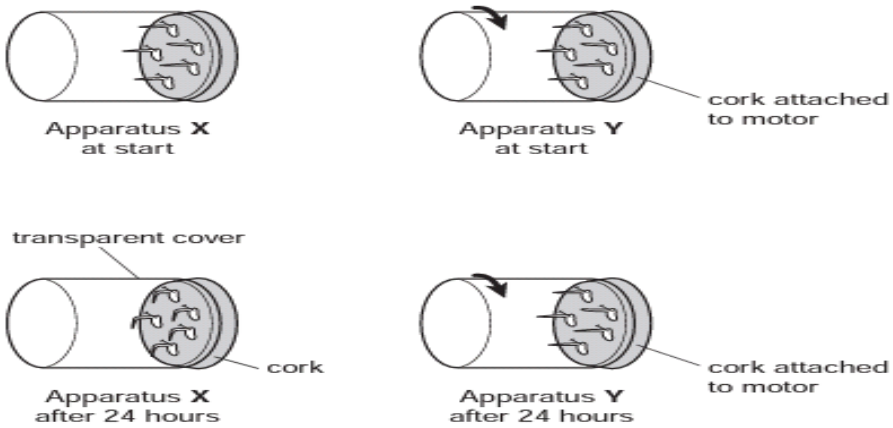

Fig. 5.1

(a) **(i)** Name the response shown by the seedlings in apparatus **X**.

.....[2]

(ii) Explain the mechanism that caused the roots in apparatus **X** to grow downwards.

.....

.....

.....

.....[3]

(iii) State two advantages to a plant of this response.

1. .....

2. .....[2]

(b) **(i)** Explain the purpose of apparatus **Y** in this experiment.

.....[1]

(ii) Explain why the experiment was carried out in the dark.

.....

.....[1]

(c) After obtaining the results, another sample of germinating pea seeds was left in the dark for several days. A further sample was kept in the light. Describe how the plumules of the seedlings kept in the dark would differ from those of the seedlings kept in the light.

.....

.....

.....[2]

[Total: 11]

18. In 2003, 25 000 square kilometres of Amazon rainforest were cut down and cleared. The land was then used for agriculture, producing beef and soya beans for export. However, within three years the land was no longer suitable for agriculture and had to be abandoned.

(a) **(i)** State the term used for cutting down and clearing areas of forest.

..... [1]

(ii) Complete Table 3.1, to state different reasons why forests are cut down. The first has been done for you.

Table 3.1

	reason
1	for agricultural land
2	
3	

[2]

(iii) Outline and explain the likely effects of clearing forests.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

(b) Soya beans and beef produced on the land are both good sources of protein. Table 3.2 shows the nutritional content of products made from soya and beef.

Table 3.2

	nutritional content per 100 g of product			
product	energy / kJ	protein / g	saturated fat / g	fibre / g
corned beef	905	26.9	12.1	0.0
soya sausages	1128	19.0	2.1	2.0

(i) Using data from Table 3.2, state and explain two reasons why soya sausages may be healthier than corned beef as a major item in the diet.

1 .....

.....

.....

2 .....

.....

..... [4]

(ii) Soya beans are harvested from plants. Corned beef is produced from cattle that have fed on grass.

Explain why it is more energy efficient for humans to eat soya products as a source of protein than corned beef. Use the food chains involved to support your answer.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 17]

19. **(a)** A typical dicotyledonous leaf contains a number of different types of cells, including:

guard cells, **palisade mesophyll**, **spongy mesophyll** and **upper epidermal** cells.

Using the types of cells listed above, complete the table by

(i) writing the types of cells in the order that sunlight passes through them,

(ii) stating the proportion of chloroplasts in each of the types of cells. Use the terms **none**, **some** and **many**.

type of cell	number of chloroplasts

[3]

Stomatal pores are surrounded by pairs of guard cells. When the stomata are closed the rate of photosynthesis is affected, due to a limiting factor.

(b) **(i)** Write a balanced equation, **using chemical symbols,** for the process of photosynthesis.

..... [2]

(ii) Define the term *limiting factor*.

.....

.....

..... [2]

(iii) State the factor that limits photosynthesis when the stomata are closed.

..... [1]

(c) Vascular bundles, containing xylem and phloem tissue, are situated in the leaf.

(i) Describe the structure of xylem tissue.

.....

.....

.....

..... [3]

(ii) State the functions of xylem and phloem.

Function of xylem .....

.....

Function of phloem .....

..... [4]

(d) Some plants close their stomata during the hottest part of the day, despite the effect on photosynthesis. Suggest what benefit this might be to the plants.

.....

..... [1]

[Total: 16]

20. Crop production in many areas of the world needs the application of large volumes of water. However, when the water evaporates from the soil, traces of salts are left behind. After several years, the soil becomes too salty for most plants to grow in it.

(a) (i) State three functions of water in plants.

1. .....

2. .....

3. ..... [3]

(ii) With reference to the water potential gradient, explain why plants may die when grown in salty soil.

.....

.....

.....

..... [3]

(b) Some plants are able to pump salts out of their roots.

(i) Name the process plants could use to pump salts out of their roots.

..... [1]

(ii) Suggest how the process named in **(i)** could affect the rate of growth of the plants if the process was operating all the time.

.....

.....

.....

..... [2]

(iii) Plants need mineral salts for normal, healthy growth. Complete the table by naming two minerals that plants need and stating their functions.

mineral	name	function
1	.....	.....
		.....
2	.....	.....
		.....

[4]

(c) An article in a school science magazine stated, 'Many plants contain genes which enable them to pump salts out of their roots. These genes can be made more active by genetic engineering, enabling the plants to remove salts before the plants are damaged.'

Explain whether you think that the process described in the article above **is** an example of genetic engineering.

.....

.....

.....

..... [3]

(d) Some scientists believe that washing the salts out of the soil using even more water is a better alternative to genetic engineering.

State two problems that could be caused by washing the soil with extra water.

1. .....

2. ..... [2]

[Total: 18]

21. Transpiration and translocation are processes responsible for transporting materials around a plant.

(i) Complete the table by stating the materials moved by these processes, their sources and their sinks.

process	materials moved	source of materials in the plant	sink for materials in the plant
transpiration	1 ..... 2	.....	.....
translocation	1 ..... 2	.....	.....

[6]

(ii) State **two** reasons why the source and sink for translocation in a plant may change at different stages in the growth of a plant.

.....

.....

..... [2]

[Total: 8]

22. Fig. 4.1 is a photograph of a root of radish covered in many root hairs.

Fig. 4.1

(a) Using the term *water potential*, explain how water is absorbed into root hairs from the soil.

.....

.....

.....

.....

.....

..... [3]

A potometer is a piece of apparatus that is used to measure water uptake by plants.

Most of the water taken up by plants replaces water lost in transpiration.

A student used a potometer to investigate the effect of wind speed on the rate of water uptake by a leafy shoot. As the shoot absorbs water the air bubble moves upwards.

The student's apparatus is shown in Fig. 4.2.

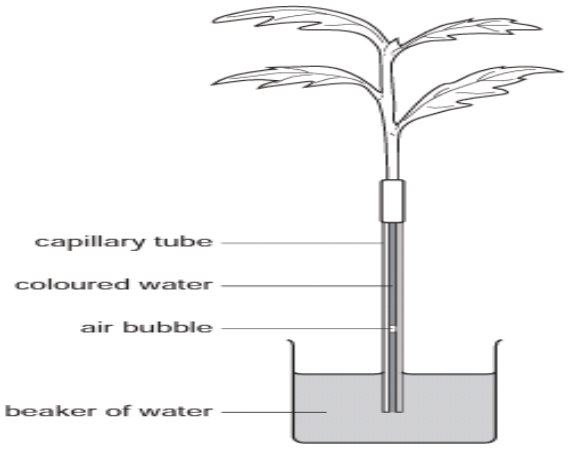

Fig. 4.2

The student used a fan with five different settings and measured the wind speed. The results are shown in Table 4.1.

Table 4.1

wind speed / metres per second	distance travelled by the air bubble / mm	time / minutes	rate of water uptake / mm per minute
0	4	10	0.4
2	12	5	2.4
4	20	5	4.0
6	35	5	7.0
8	40	2	.....

(b) Calculate the rate of water uptake at the highest wind speed and write your answer in the table.

[1]

(c) Describe the effect of increasing wind speed on the rate of water uptake. You may use figures from Table 4.1 to support your answer.

.....

.....

.....

..... [2]

(d) State two environmental factors, **other than wind speed**, that the student should keep constant during the investigation.

1. .....

2. ..... [2]

(e) Some of the water absorbed by the plants is **not** lost in transpiration.

State two **other** ways in which water is used.

1. .....

2. ..... [2]

(f) Water moves through the xylem to the tops of very tall trees, such as giant redwoods of North America. The movement of water in the xylem is caused by transpiration.

Explain how transpiration is responsible for the movement of water in the xylem.

.....

.....

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.....

.....

.....

.....

..... [4]

(g) Plants that live in hot, dry environments show adaptations for survival.

State three **structural** adaptations of these plants.

1. .....

2. .....

3. ..... [3]

[Total: 17]

23. Fig. 2.1 shows the root systems of two species of desert plant, **A** and **B**.

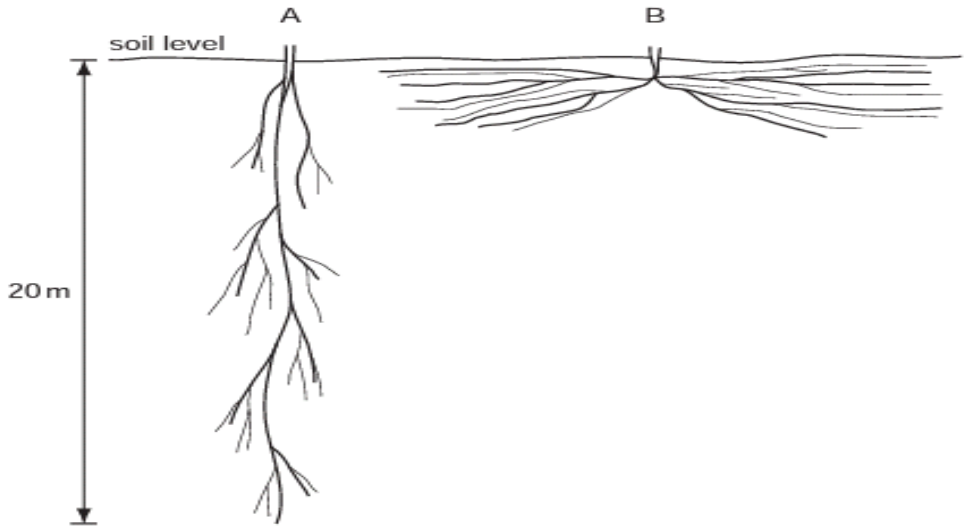

Fig. 2.1

(a) Describe the two root systems shown in Fig. 2.1 **and** explain how each is an adaptation for survival in a desert ecosystem.

.....

.....

.....

.....

.....

.....

..... [4]

(b) Describe **and** explain two ways in which the **leaves** of desert plants reduce water loss in transpiration.

1. .....

.....

.....

2. .....

.....

..... [4]

(c) Xylem and phloem are transport tissues in plants. They transport substances from organs that are known as sources to organs known as sinks.

Complete the table to show:

- **two** substances being transported in each tissue
- an organ that is a source for substances being transported in each tissue
- an organ that is a sink for substances being transported in each tissue.

tissue	substances being transported	source of substances in the plant	sink for substances in the plant
xylem	1 ..... 2		
phloem	1 ..... 2		

[6]
[Total: 14]

24. **(a)** Write a balanced equation for photosynthesis using symbols.

.....

[3]

Plants that live in water are called hydrophytes.

Fig. 5.1 shows a cross-section of a leaf of the hydrophyte, *Nuphar lutea*. The leaves of *N. lutea* float on the surface of water.

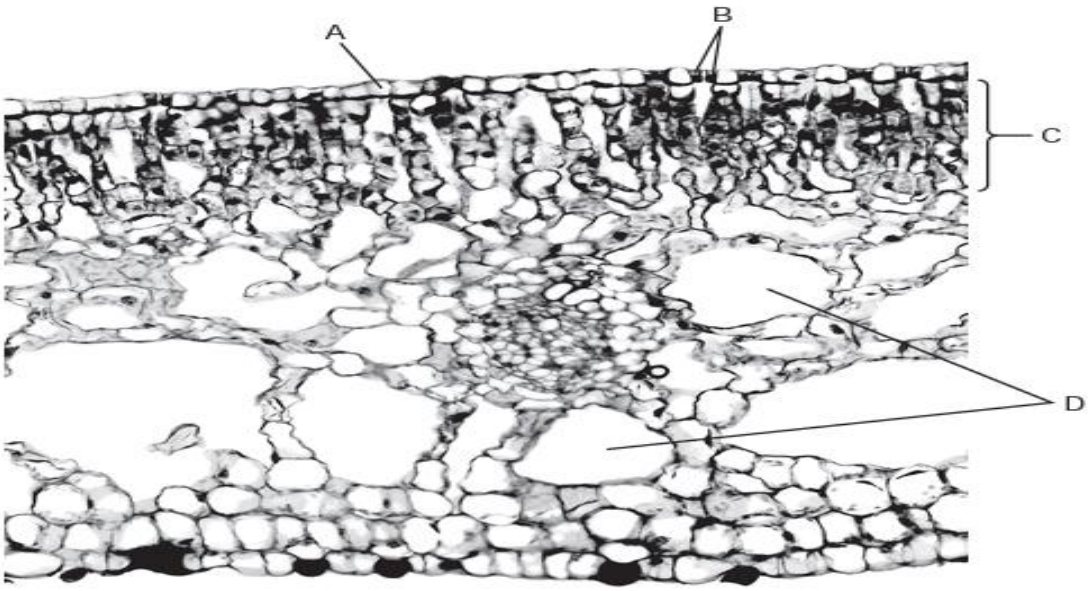

Fig. 5.1

(b) Complete Table 5.1 by describing the function of each feature.
The function for feature **A** has already been completed.

Table 5.1

feature	function
A	transparent to allow light to penetrate into the leaf
B	.....
C	.....
D	.....

[3]

(c) State **and** explain **one** way in which the leaves of *N. lutea* are adapted to their environment.

.....

.....

.....

..... [2]

25 **(a)** Define the term *growth*.

.....

.....

.....

..... [2]

Some students investigated the responses of tomato seedlings to receiving light from one side (unidirectional light).

The students germinated tomato seeds in the dark and then placed the seedlings in test-tubes with water. The seedlings were treated in four different ways, **E** to **H**, as shown in Fig. 2.1. The responses of the seedlings are shown in Fig. 2.2.

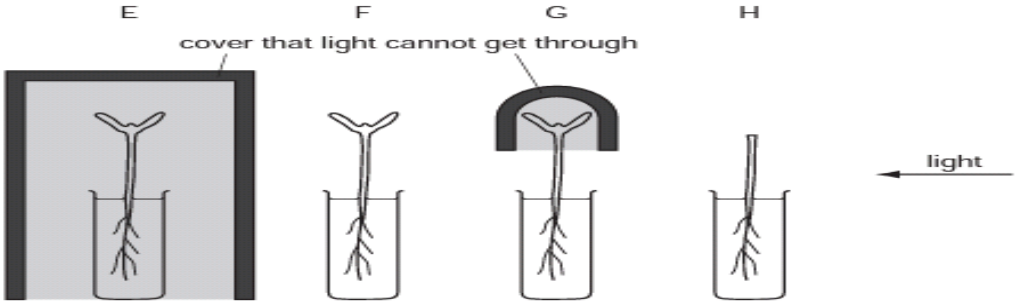

Fig. 2.1

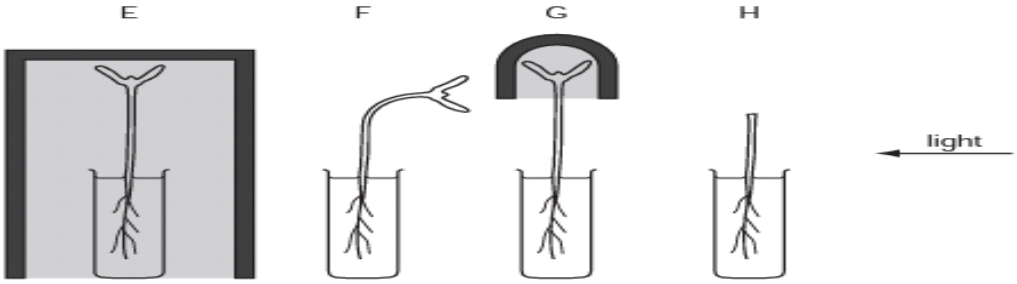

Fig. 2.2

(b) Name the response shown by the tomato seedling, **F**, which has bent 90° towards the light.

..... [2]

(c) Using the results shown in Fig. 2.2, suggest what conclusions may be made about how the tomato seedlings detected the stimulus of unidirectional light.
You may refer to the seedlings by the letters **E** to **H**.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(d) Explain the advantage of the response shown by seedlings to unidirectional light.

.....

.....

.....

.....

..... [2]

(e) Responses to light are coordinated by plant growth substances known as auxins.

Explain the role of auxins in coordinating the response.

.....

.....

.....

.....

..... [2]

26. Many growers of crops in glasshouses use carbon dioxide enrichment to improve yields.

(a) Explain the advantages of carbon dioxide enrichment of glasshouses.

.....

.....

.....

..... [2]

Fig. 3.1 shows the carbon dioxide concentrations inside three glasshouses, **D**, **E** and **F**, on a hot day with bright sunlight.

- Glasshouses **D** and **E** received carbon dioxide enrichment and were ventilated by opening the windows.
- Glasshouse **F** did not receive any extra carbon dioxide and the windows were closed.

The carbon dioxide concentrations in the glasshouses and in the atmosphere were measured. The concentration in the atmosphere was 0.039 %.

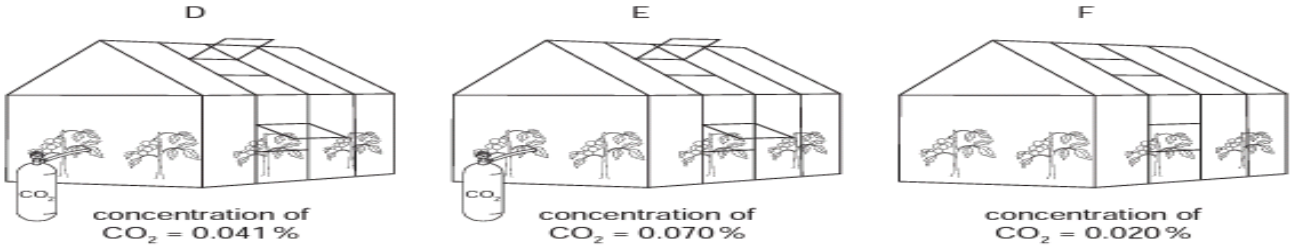

Fig. 3.1

The rate of uptake of carbon dioxide by the crop plants was measured in grams of carbon dioxide absorbed per square metre of glasshouse per hour. These results are shown in Table 3.1.

Table 3.1

glasshouse	rate of uptake of carbon dioxide by crop plants / g per m^2 per hour
D	2.5
E	5.7
F	1.0

(b) Suggest why it may **not** be cost effective to maintain a high concentration of carbon dioxide in glasshouse **E** compared to the concentration of carbon dioxide in the atmosphere.

.....

.....

.....

.....

.....

..... [2]

(c) **(i)** Concentrations of carbon dioxide in all three glasshouses in Fig. 3.1 increased at night. State why this happened.

.....

..... [1]

(ii) Explain why it is important to ventilate glasshouses by opening the windows.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 9]

27. Fig. 6.1 shows a leaf and a flower of *Helleborus orientalis*.

Fig. 6.1

(a) *H. orientalis* is a dicotyledonous plant.
State three features **visible** in Fig. 6.1 that show it is a dicotyledonous plant.

1. .....
2. .....
3. ..... [3]

Fig. 6.2 is a photograph of a section through a leaf of *H. orientalis*.

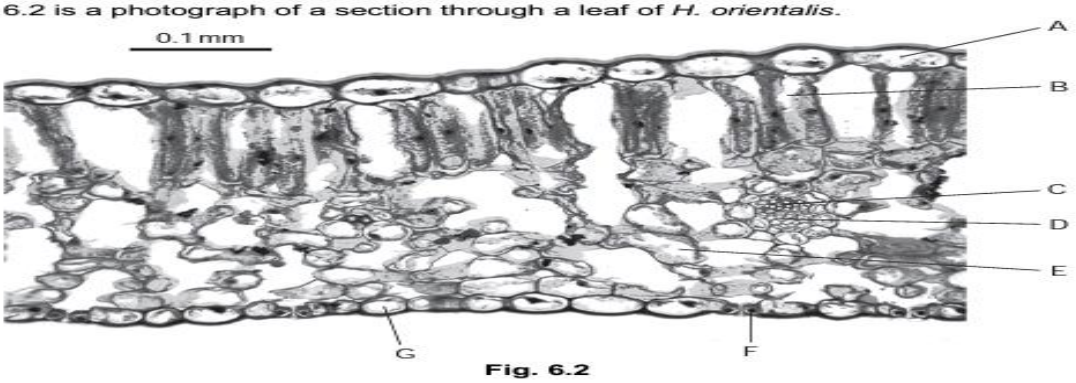

Fig. 6.2

(b) Complete the table, using ticks (✓), to show the cells that carry out photosynthesis.

cell	cells that carry out photosynthesis
A	
B	
C	
D	
E	
F	
G	

[2]

(c) Explain how two features of leaves, **visible** in sections such as that shown in Fig. 6.2, are adaptations for efficient photosynthesis.

1. .....
.....
.....
2. .....
.....
..... [4]

(d) During the period when *H. orientalis* is photosynthesising at a fast rate, substances are transported through the plant in the phloem from sources to sinks.

(i) Name **two** substances that are translocated from a source to a sink.

.....
..... [2]

(ii) For these substances state the source and **two** possible sinks.

source .....
sink 1 .....
sink 2 ..... [2]

[Total: 13]

28. Three plants were grown to study the effects of nitrate and magnesium ion deficiency on their development. They were kept in the same conditions, except for the types of minerals supplied.

Plant **A** was provided with all essential minerals.

Plant **B** was given all minerals except nitrate ions.

Plant **C** was given all minerals except magnesium ions.

Fig. 1.1 shows the plants a few weeks later.

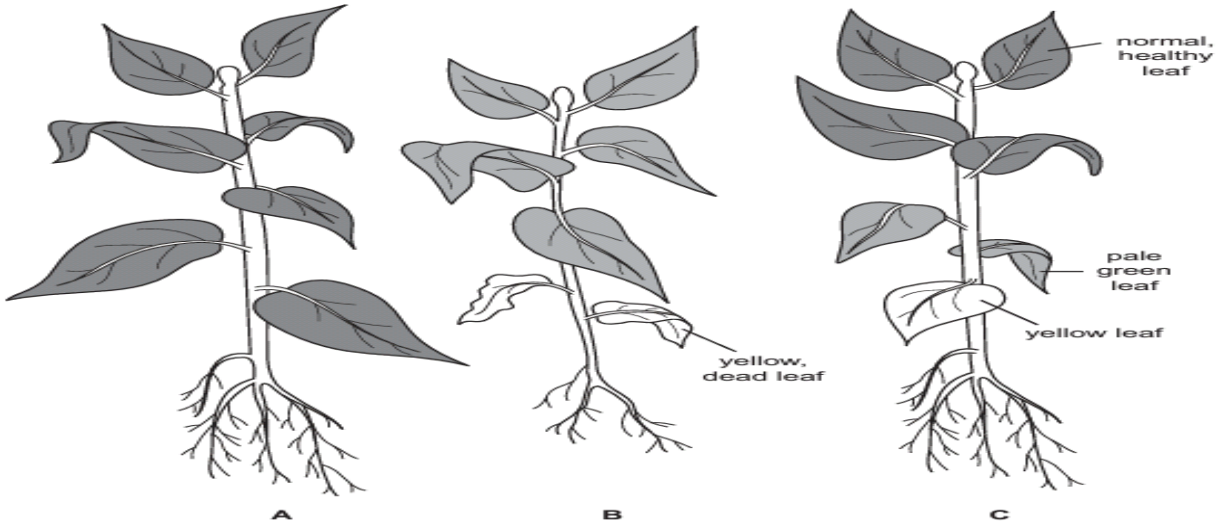

Fig. 1.1

(a) State three conditions, **other than** water and the concentration of mineral ions, that would need to be kept the same for all the plants, in order to make the investigation a fair test.

1. .....
2. .....
3. ..... [3]

(b) Describe and explain the effect on plant growth of

(i) a deficiency of nitrate ions on plant **B**;

description .....

.....

.....

explanation .....

.....

..... [4]

(ii) a deficiency of magnesium ions on plant **C**.

description .....

.....

explanation .....

..... [2]

(c) A farmer tested the soil in a field and found that there was a high nitrate ion concentration.

The farmer then grew a crop in this field.

After the crop was removed, the soil was tested again. The nitrate ion concentration had decreased.

(i) Suggest two reasons why the nitrate ion concentration had decreased.

1. .....
2. ..... [2]

(ii) Describe two methods the farmer could use to improve the nitrate ion concentration in the soil.

1. .....

.....

2. .....

..... [2]

(d) Some species of plant grow well in soil that is always low in nitrate ions.

Explain how they can obtain a source of nitrogen compounds.

.....

.....

.....

..... [3]

[Total: 16]

29. Fig. 4.1 shows a transverse section through an *Ammophila* leaf. This plant has very long roots.

Fig. 4.2 shows a cactus plant.

Both plants live in very dry conditions.

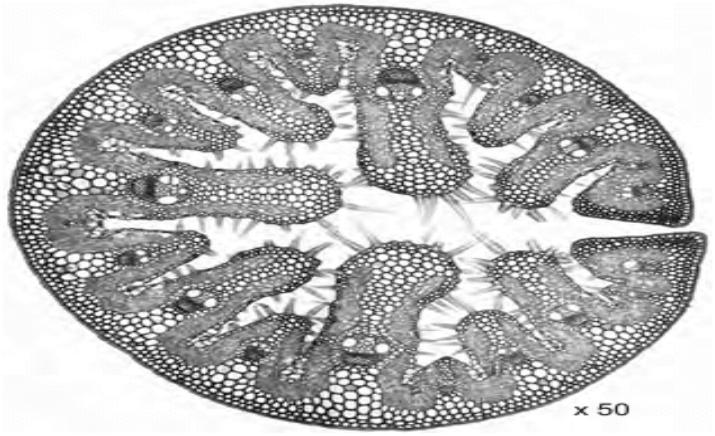

Fig. 4.1

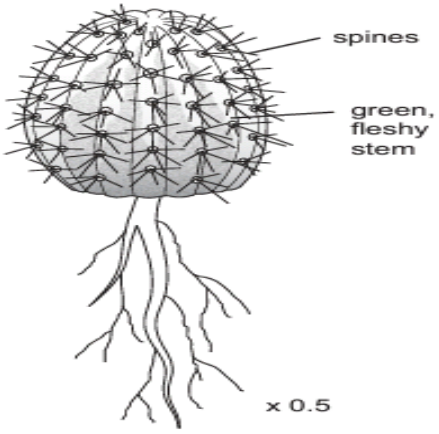

Fig. 4.2

(a) Suggest how each of the following adaptations would enable the named plant to survive in very dry conditions.

(i) *Ammophila*

1. rolled leaves with stomata on the inside of the leaf

.....

.....

..... [2]

2. thick waxy cuticle on the outside of the leaf

.....

.....

..... [1]

(ii) Cactus

1. very long roots

.....

.....

..... [1]

2. fleshy green stem

.....

.....

..... [2]

(b) Suggest why having only a few, very small leaves could be a disadvantage to a plant.

.....

.....

..... [2]

(c) Water is involved in a number of processes in plants.

Complete the table by

(i) naming the processes described;

(ii) stating one variable that, if increased, would speed up the process.

description of process	name of process	variable that, if increased, would speed up the process
absorption of water from the soil	.....	....
using water to form glucose	.....	....
movement of water vapour out of leaves	.....	....

[6]

[Total: 14]

30. Fig. 4.1 shows part of a root.

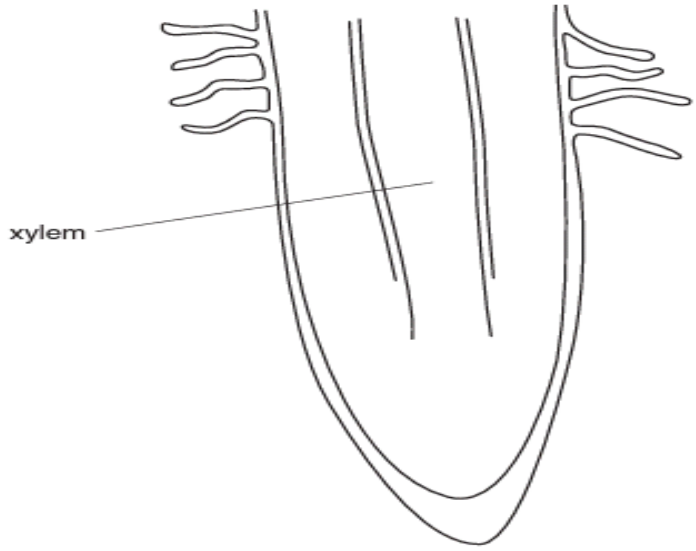

Fig. 4.1

(a) Explain how the presence of root hair cells on roots enables the efficient absorption of water and minerals.

.....

.....

.....[2]

(b) Root hair cells can absorb mineral ions by diffusion and active transport.

(i) Define the term *active transport*.

.....

.....[2]

(ii) Explain why respiration rates may increase in root hair cells during the uptake of mineral ions.

.....

.....[1]

(c) Fig. 4.1 shows the position of xylem in the root.

(i) Describe how the structure of xylem tissue is adapted to its functions.

.....

.....

.....

.....[3]

(ii) Describe the mechanism of water movement through the xylem.

.....

.....

.....[2]

[Total : 10]