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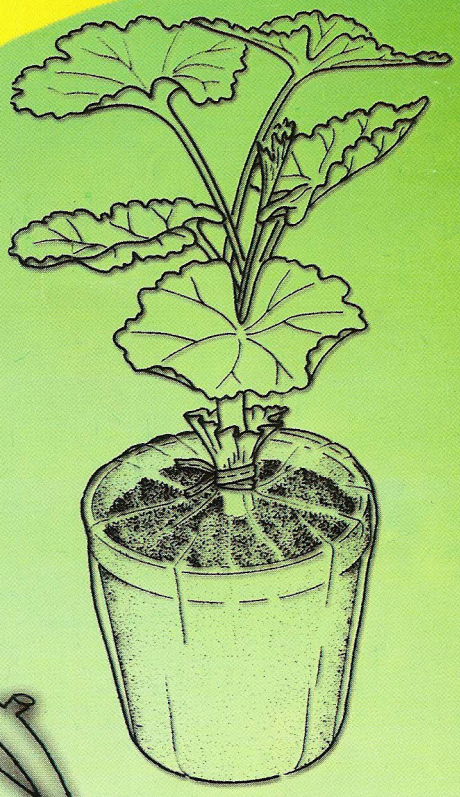
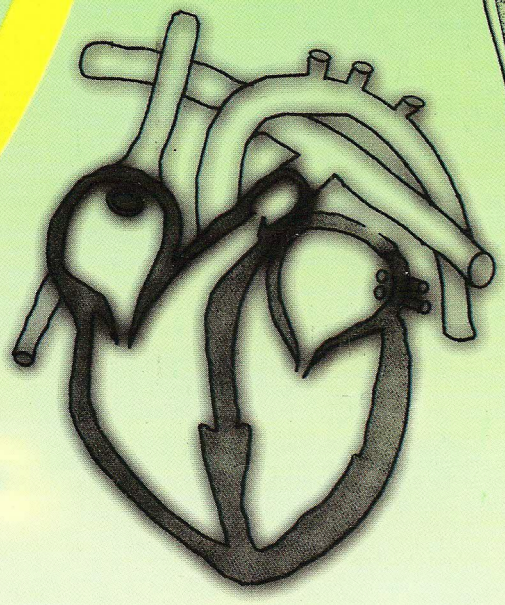
MSCE BIOLOGY

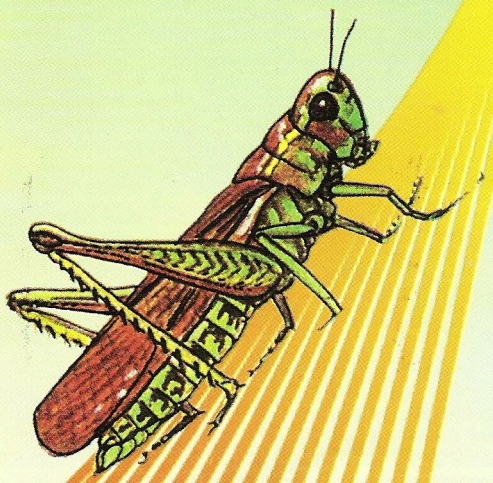
Questions

&

Answers







RITA DENT

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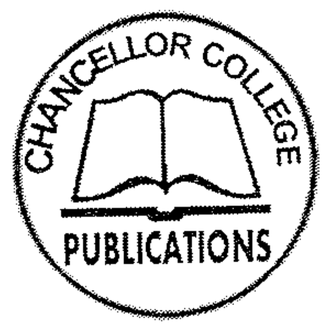
Teach yourself series

MSCE BIOLOGY

QUESTIONS & ANSWERS



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INTRODUCTION

Teach Yourself Series MSCE Biology Questions and Model Answers is a revised and updated version of Rita Dent's ***Biology Questions and Model Answers*** which was first published in 1995. The work was published with the objective to improve the teaching of Biology in the senior secondary school section in Malawi. It was an arrangement of the In-service training section of Chancellor College, INSET (now Chancellor College Publications) and the Science Teachers Association of Malawi, STAM. The merit of the venture was widely supported and funding for the project came from the British Development Division of Central Africa and the British High Commission.

Today, fifteen years down the line, after getting satisfied with the benefit the work has produced over the years in the country, Chancellor College Publications with its mandate to strengthen the teaching of all subjects in Malawi, made a decision to update the work. It now contains works from Biology past papers from 1990 to 2009, spanning a telling period of ninenteen years.

Each question in ***Teach Yourself Series MSCE Biology Questions and Model Answers*** is accompanied by an answer which is appropriate to that question. To quote Rita Dent herself, "The purpose of these answers is to offer general guidance to students on the content, style and length of a response which the examiners are likely to find acceptable to such a question. The answers given are not the only way that these questions could be answered nor are they necessarily the best way. They are there to guide the students *only* – not to be learned and reproduced wholesale."

Kingsley Jika – Teach Yourself Series Editor – Chancellor College Publications

ACKNOWLEDGMENTS

Chancellor College Publications wishes to thank the Malawi National Examinations Board (MANEB) for their initial kind permission to reproduce the examinations questions. The gesture proves that their commitment to improve the quality of education in Malawi does not only lie in setting and administering of examinations.

We also wish to thank Professor Al Mtenje (Director, Consultancy Bureau, Chancellor College), Professor Pascal Kishindo (Chair, Publications Advisory Committee, Chancellor College), Dr Emmanuel Dzama (Chancellor College), Mr Bright Phulanya (Police Secondary School) Mr Thom Kanyamuka (Likuni Boys Secondary School) and Mr Pearson Wamwawi Kaluwa (Zomba Catholic Secondary School).

In a special way we wish to express our heart-felt gratitude to the following headmasters for their kind permission for Chancellor College Publications to engage the teachers from their schools in this noble effort: Brother HRS Murakho (Likuni Boys Secondary School), Brother D Magomero (Zomba Catholic Secondary School) and Mr J Nkhoma (Police Secondary School).

This work has come to a completion because prior to our arrival at Chancellor College Publications, there were people who dedicated all their energies to serving a Malawi student through development of quality science books. We wish to acknowledge and remind them that we do not forget the role they played in the advancement and promotion of teaching of science in this country. These great men and women are Koos van Zegeren, Mark Poston, Oliver Thorntone, Ellen Mulaga, Daveson Nyadani, Linda Saka, Master Magwedeza, Ellen Tawakali and Eric Muliza.

During the production of this work, Gervasio Manyungwa, Dave Mfarari, Anderson Kankhomba and Rebecca Munthali gave the office the support it needed most. We wish to remind them that the greatest service is that which brings positive change in humanity. These people demonstrated they understand this.

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1. **Figure 1** represents a test tube containing blood which was left to stand overnight.

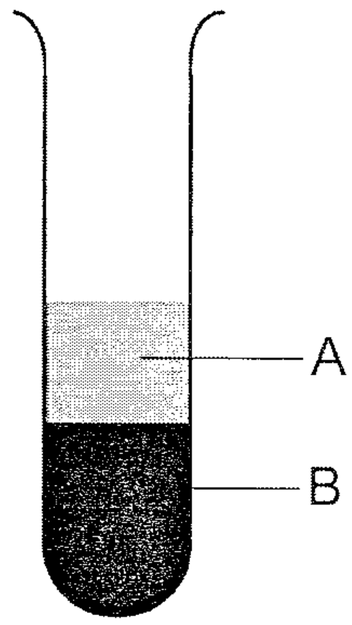


Figure 1

(a) Name the part of blood labelled A.

(b) Name any *two* structures you would find in the part labelled B and state a function of each.

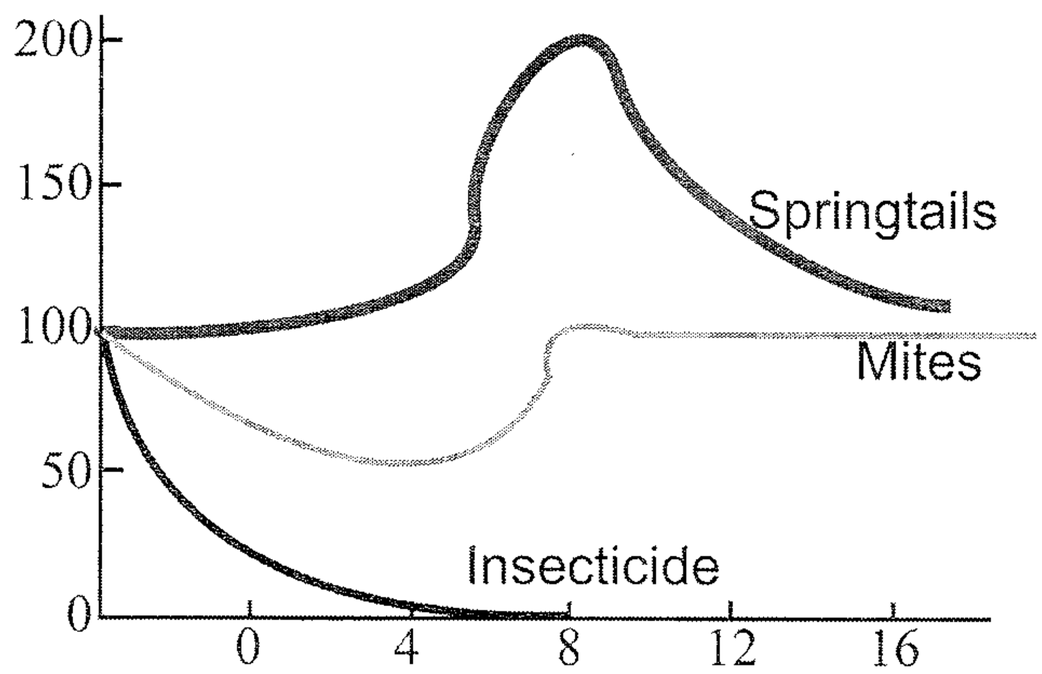
i. Structure:
Function:

ii. Structure:
Function:

(c) What anticoagulant could have been added to the blood to prevent it from clotting?

(d) Describe how you would use the contents of the test tube in Figure 1 to demonstrate that blood contains glucose.

2. Springtails and mites are small invertebrates living in the soil. **Figure 2** is a graph showing the effect of an insecticide on the populations of these organisms. The insecticide was applied once at the start of the experiment.



Horizontal axis: months after treatment
Vertical axis: Percentage of populations of springtails and mites, and of amount of insecticide in the soil

Figure 2

(a) On which population did the insecticide have a greater effect during the first 4 months?

(b) What happens to the springtail population after 4 months?

(c) Give *one* reason for your answer to 2(b).

(d) From the graph, suggest *two* disadvantages of chemical control.

3. **Figure 3** is a diagram of part of the human upper limb.

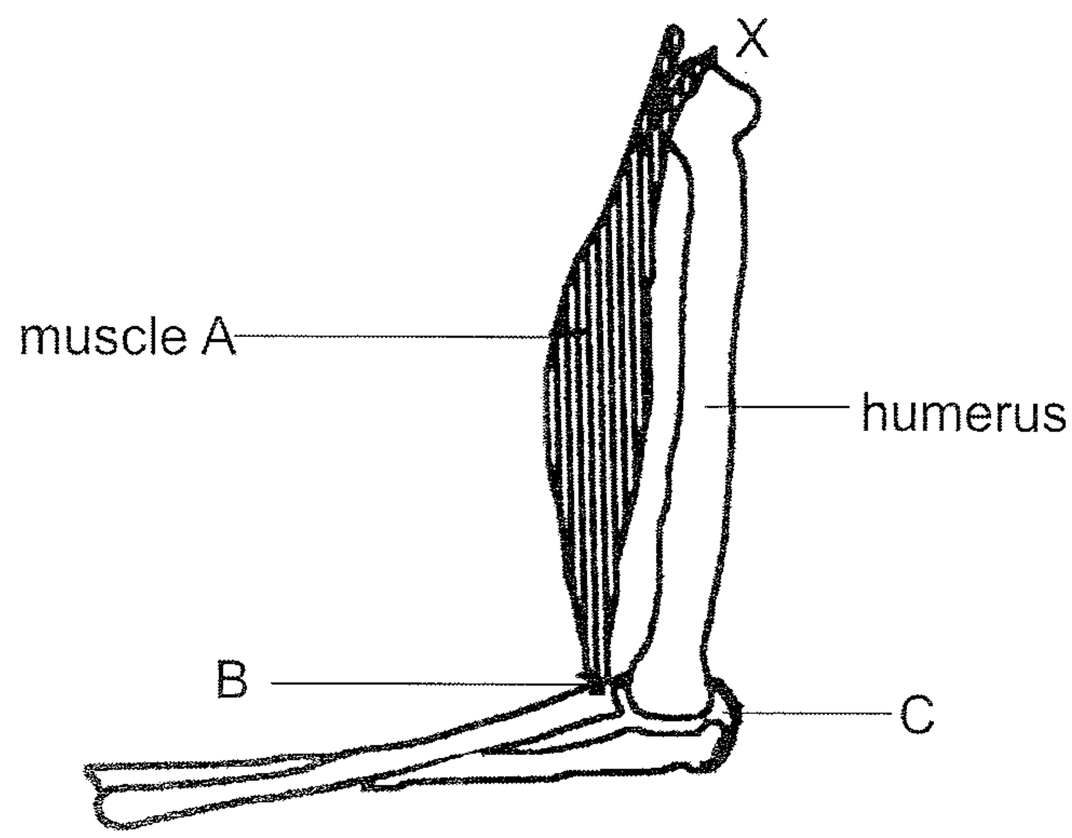


Figure 3

(a) The human skeleton is divided into two main parts. To which of the parts do the bones in figure 3 belong?

(b) i. Name the parts labelled B and C.

ii. What is the difference in function between structures B and C ?

(c) What bone makes a joint with the humerus at X?

(d) Name *two* other bones in the human body which make a joint similar to that at X in figure 3.

(e) Name the muscle that relaxes when muscle A contracts.

(f) What general term is given to muscles which work in pairs to bring about movement?

(g) Apart from structural differences, mention *one* other difference between muscle A in figure 3 and the cardiac muscle.

4. **Figure 4A** represents a petri dish containing agar mixed with powdered milk and allowed to settle. Small holes were made in the agar and three body fluids: saliva, bile, and gastric juice

represented by letters W, X and Y respectively, were poured into the holes. Afer 24 hours at room temperature the results were as shown in **figure 4B.**

Figure 4A

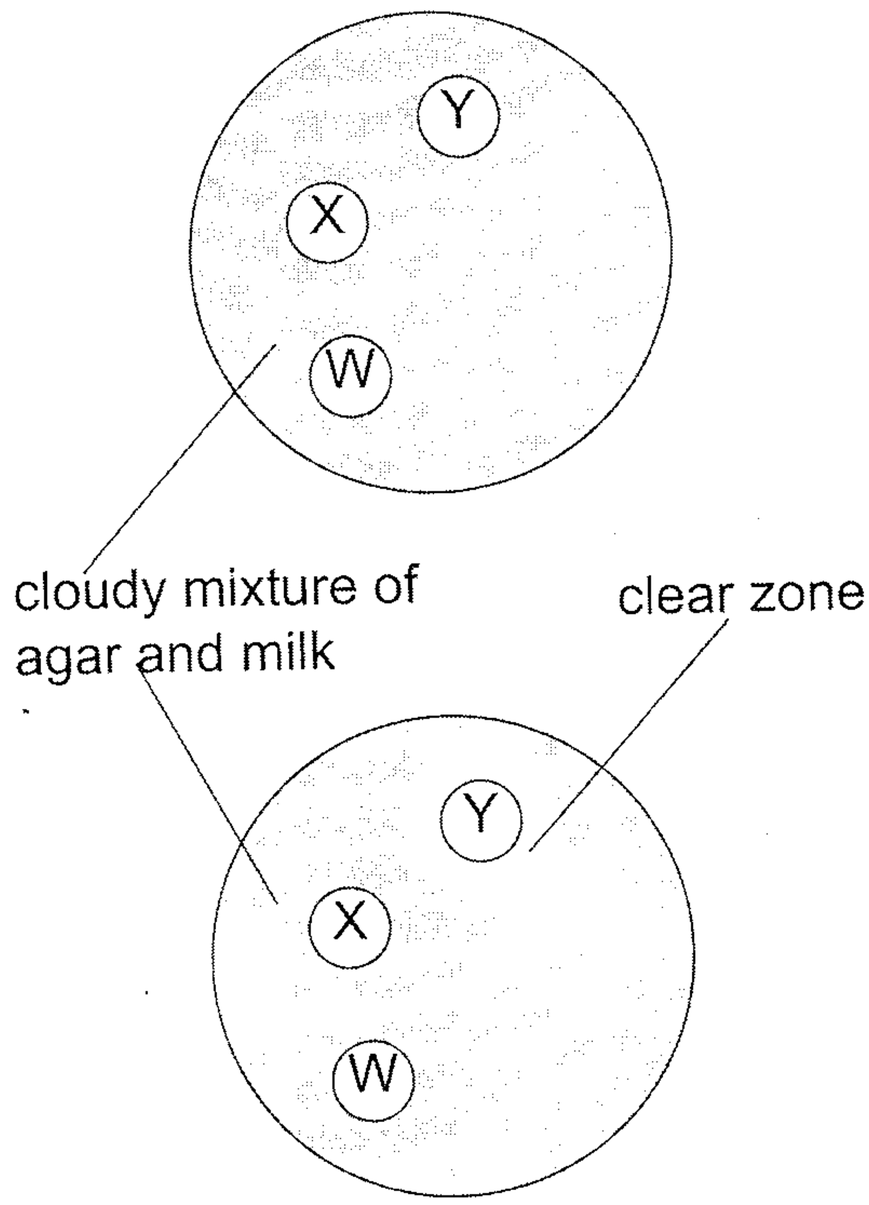


Figure 4B

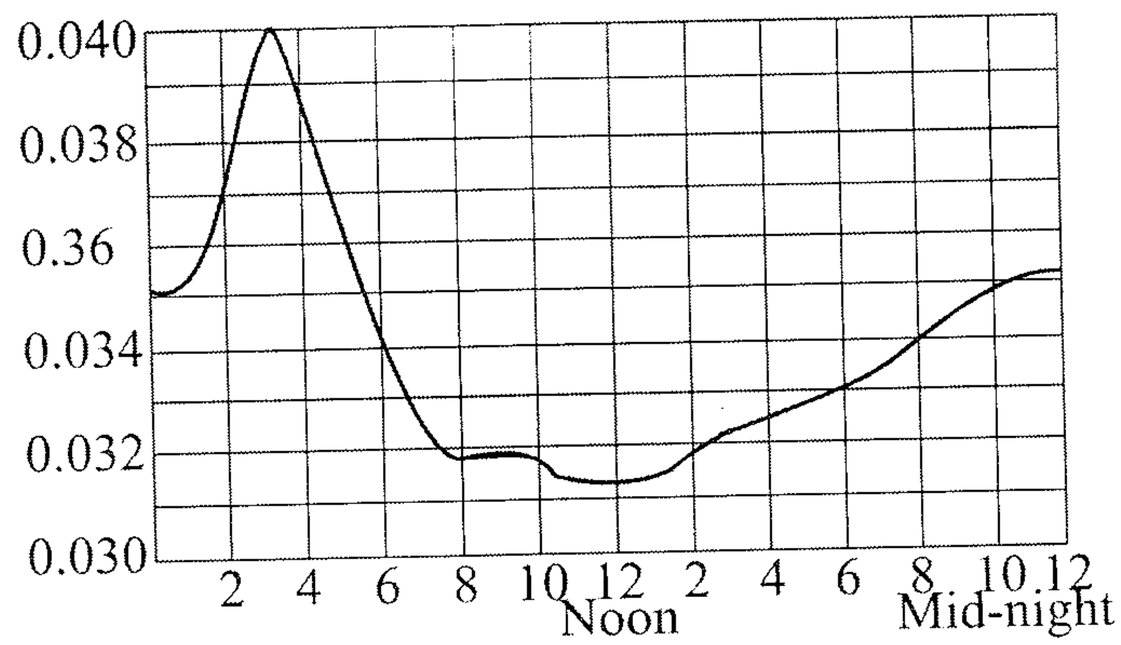
(a) Explain why there is a clear zone around Y.

(b) In another experiment, powdered milk was replaced by boiled starch solution.

i. What chemical would you add to the petri dish to enable you to see the results in this experiment?

ii. What results would you expect to observe?

5. **Figure 5** is a graph showing the average daily changes in carbon dioxide concentration 1 metre above an agricultural crop



(a) When was the carbon dioxide concentration in the atmosphere greatest?

(b) Name a process that was taking place in the crop which resulted in the concentration stated in (a) above.

(c) What condition in the environment caused the change in carbon dioxide concentration between 8 am and 4 pm?

(d) If you were asked to investigate oxygen concentration in the atmosphere above the crop, during which period would you find the greatest concentration and why?

i. Period of greatest concentration:

ii. Reason:

6. Rickets is one of the diseases of the bones which may develop in children.

(a) What nutrient substances must be available in the human diet in order to prevent the occurrence of this disease?

(b) What term is given to diseases such as rickets which are due to lack of certain food substances in the diet?

(c) Mention *two* other diseases of the bones and their causative organisms.

i. Disease:
Causative organism:

ii. Disease:
Causative organism:

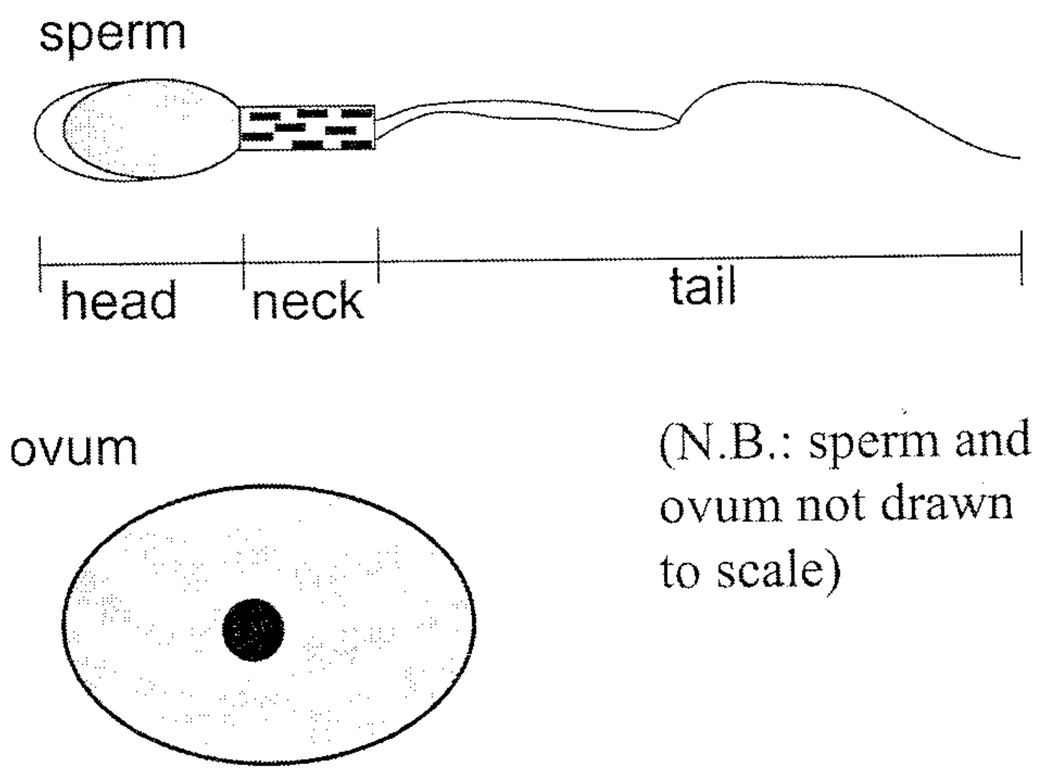
(d) Bones contain both organic and inorganic matter. What is the effect of removing organic matter from a bone?

(e) A group of students soaked a bone in a dilute

hydrochloric acid solution. After 24 hours, they found that the bone was rubbery (flexible).

Explain what caused the change.

7. **Figure 6** is a diagram of human gametes.



(N.B.: sperm and ovum not drawn to scale)

Figure 6

(a) Besides size and shape, in what *two* other ways are sperm and ovum different?

(b) Explain why the neck part of the sperm contains a large number of mitochondria.

(c) Name the structure in a flowering plant which is responsible for the production of:

i. female gametes;
ii. male gametes.

(d) What process takes place in the structures named in (c) above that leads to the production of gametes?

8. **Figure 7** is a diagram of a sprouting potato tuber.

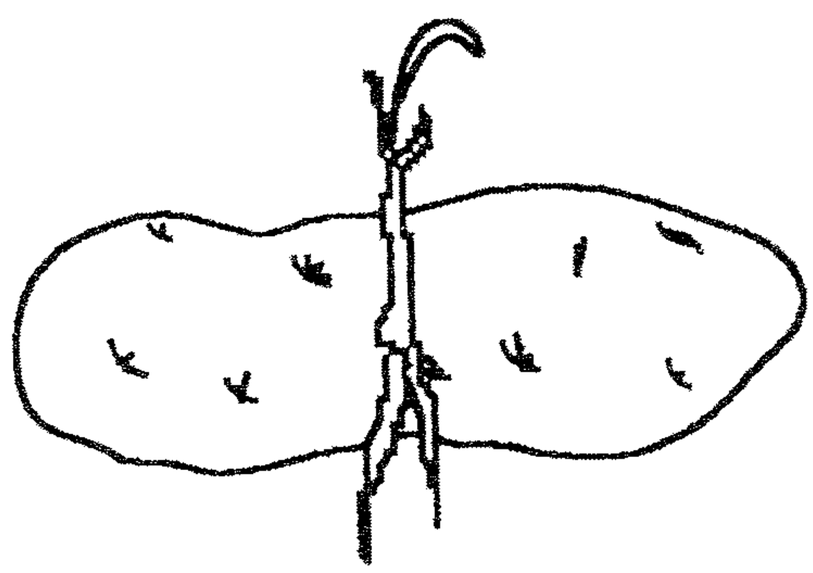


Figure 7

(a) Name one food substance that is stored in the tuber.

(b) How did the substance named in (a) above reach the tuber from the leaves?

(c) What happens to the stored substance as the tuber sprouts?

(d) Would you classify this tuber as a stem or root? Give a reason for your answer.

9. **Figure 8** is a diagram showing the location of some endocrine glands in the human body.

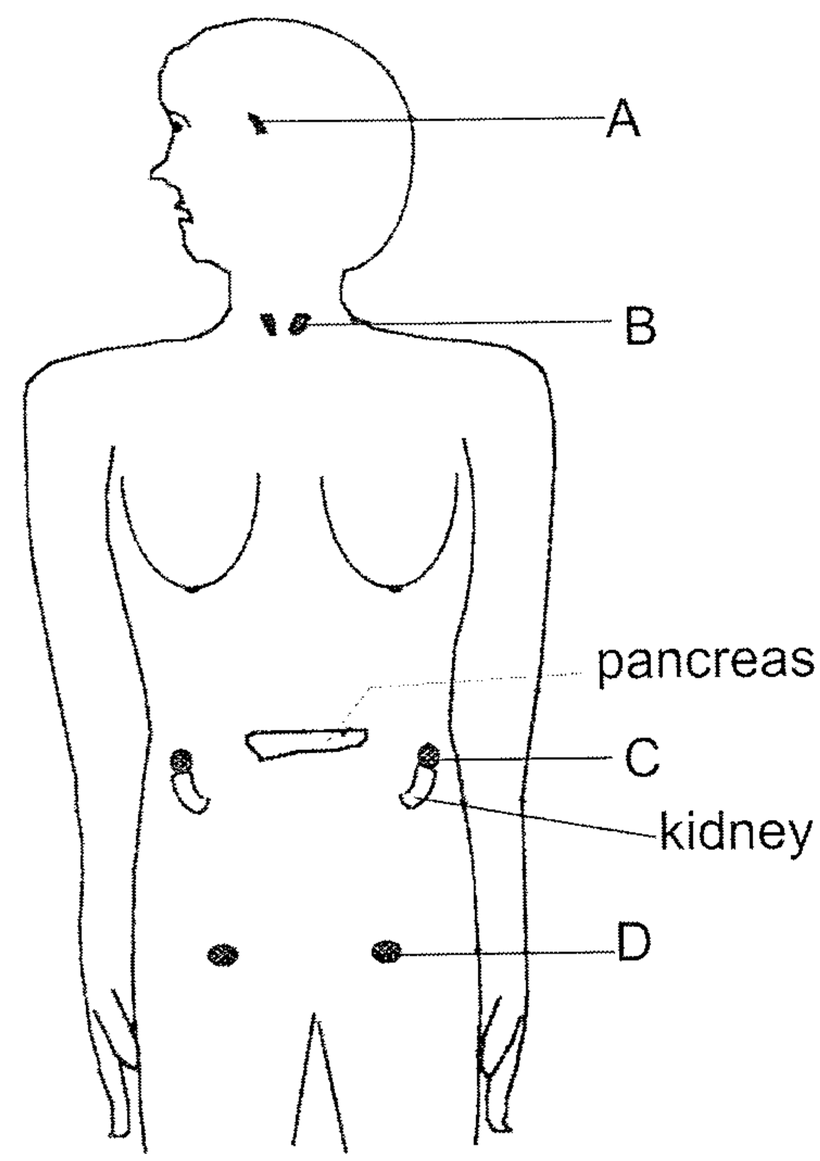


Figure 8

(a) Name the glands marked A and D.

(b) Endocrine glands have no ducts. How do their secretions reach their target areas?

(c) Name the hormones produced by glands B and C.

(d) i. What effect will the removal of the pancreas from an individual have on the food composition of his blood?

ii. Give a reason for your answer to (d)i above.

(e) What is the difference between secretion and excretion?

10. Warfarin is a poison used against rats. Some rats have evolved which are resistant to Warfarin. The resistant rats are pure breeding and have two recessive genes.

(a) If **N** represents the normal gene and **n** represents the resistant gene, state the genotype of resistant rats.

(b) i. Show by using the box below, a cross between two rats heterozygous for this condition.

Gametes		

ii. How many rats would you expect to be resistant in a litter of 16?

(c) How might a resistant gene evolve in a rat population?

(d) Rats are pests and need to be controlled. Since the use of chemicals may result in the evolution of resistant genes, suggest the best way of controlling the rat population.

11. **Figure 9** is a diagram of a human tooth.

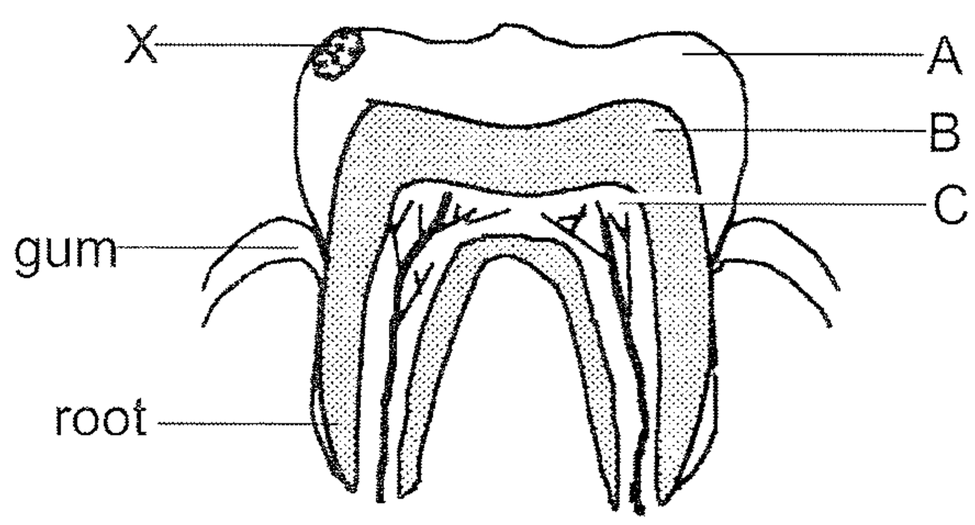


Figure 9

(a) Name the parts labelled A, B, and C.

(b) What property does part A have which makes it suitable for the function of the human tooth?

(c) The tooth in figure 9 has started decaying at point X.

i. Explain how tooth decay may be caused.

ii. Why would a person with this tooth not feel any pain from it?

12. **Figures 10A** and **10B** show two different diagrams representing two types of neurones (nerve cells).

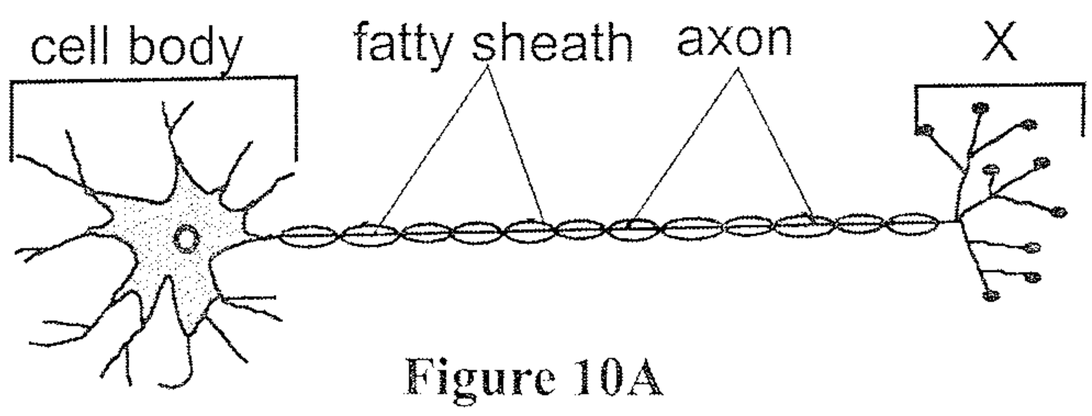


Figure 10A

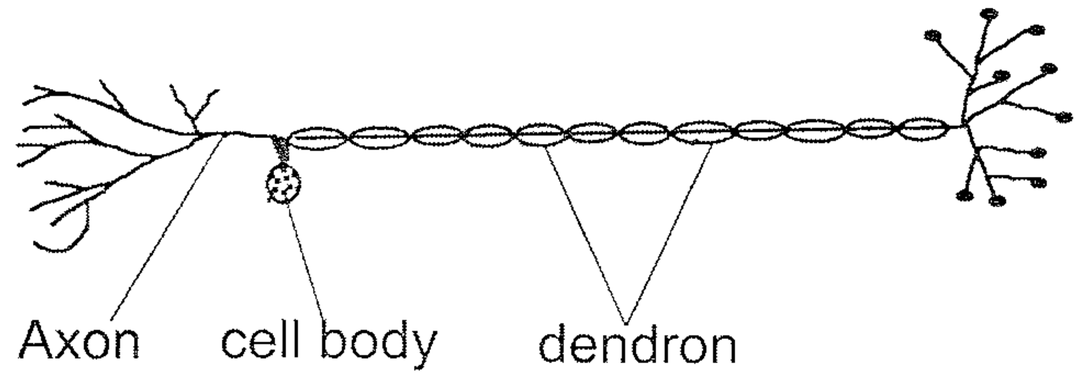


Figure 10B

(a) Identify the nerve cells in figure 10A and figure 10B.

Figure 10A:
Figure 10B:

(b) What is the functional difference between the cells in figure 10A and figure 10B?

(c) Give *one* structural difference between cheek cells and the cells in figure 10A and figure 10B.

(d) Name any *one* structure in a human body in which structures labelled X in figure 10A may be located.

(e) Give *one* function of the fatty sheath.

Source: Medi I.K. and Meredith H. M. (1989). *The Senior Certificate Biology*; p.232. fig. 11.1.

Figure11

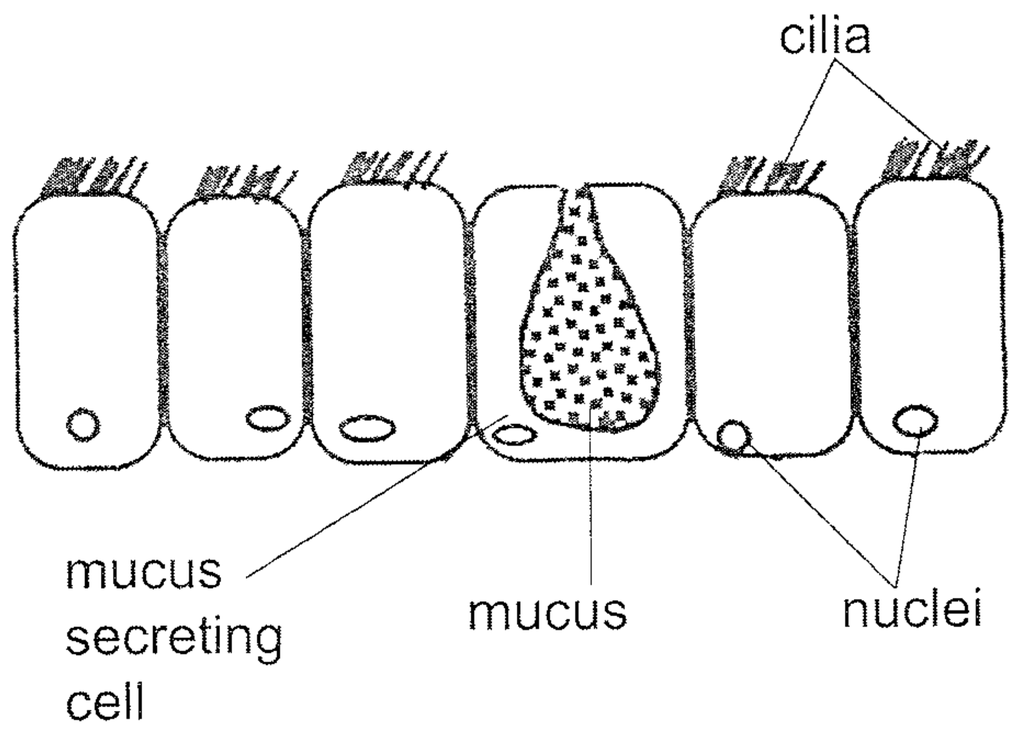
13. **Figure 11** is a photograph of *Brachystegia* woodland on the slopes of Hora Mountain.

(a) Considering the slope of the area, suggest *two* ways in which this land can be conserved.

(b) Give *two* advantages to humans of conserving this land.

(c) Suggest any *two* types of plants that are likely to grow on the rocky part of the mountain.

1. **Figure 1** shows epithelial cells of a bronchus, greatly magnified.



(a) One function of the bronchus is to filter air passing through it. Looking at Figure 1, give *two* ways by which the bronchus carries out this function.

(b) What is cell differentiation?

(c) How is the bronchus kept open to allow air to enter and leave the lung?

2. **Figure 2** is a diagram of some parasitic worms from the intestine of a child.

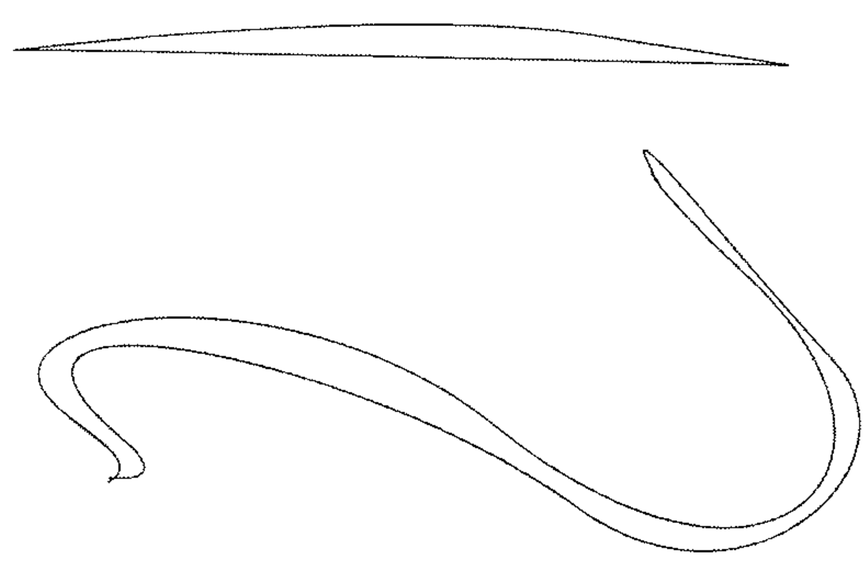


Figure 2

(a) What type of worms are these?

(b) Calculate the actual length in cm of the worm marked **W**.

(c) Give *three* symptoms a child may show when infected by these worms.

(d) In many areas in Malawi children are infected by these parasites. Suggest *two* ways in which parents could minimise this problem.

3. **Figure 3** is a diagram of a nephron, a structure in the kidney.

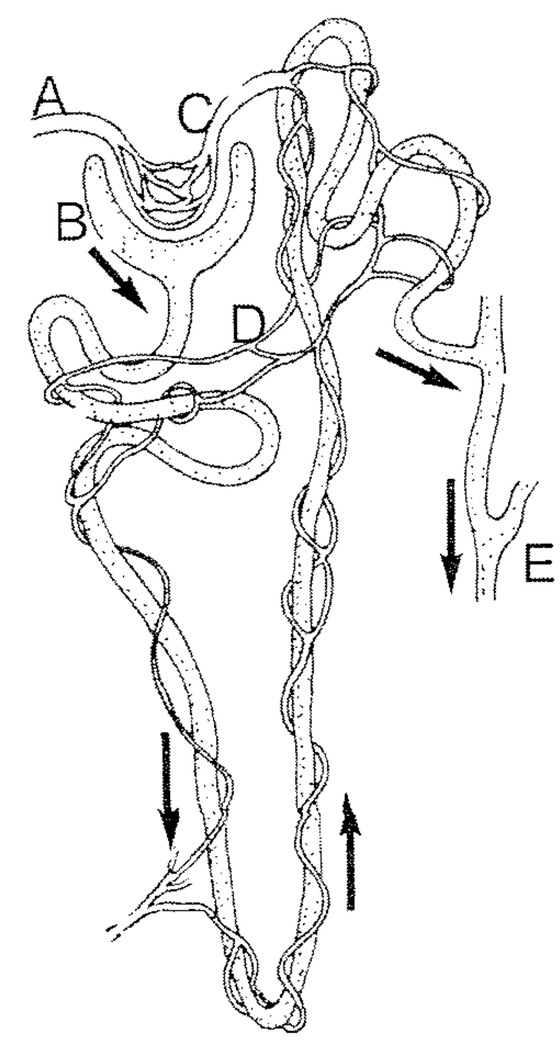


Figure 3

(a) Name the parts labelled B, C, and E.

(b) Mention *two* functions of the kidney.

(c) Mention *one* difference between blood-vessels A and D as seen in the diagram, which results in the creation of high pressure in the part labelled C in figure 3.

(d) Name any *two* useful substances that may be filtered into structure B.

(e) The reabsorption of these useful substances into the blood is sometimes against a concentration gradient.

i. What do you understand by the term concentration gradient?

ii. How are these useful substances reabsorbed into the blood against a concentration gradient?

4. Differences in blood type involve antigens on the surface of red cells. Type A blood has A antigens, type B blood has B antigens. Before blood is given to a patient, the patient's blood group must first be identified by mixing small samples of his blood with sera containing anti-B and anti-A antibodies. **Figure 4** is a diagram showing the results of such a test.

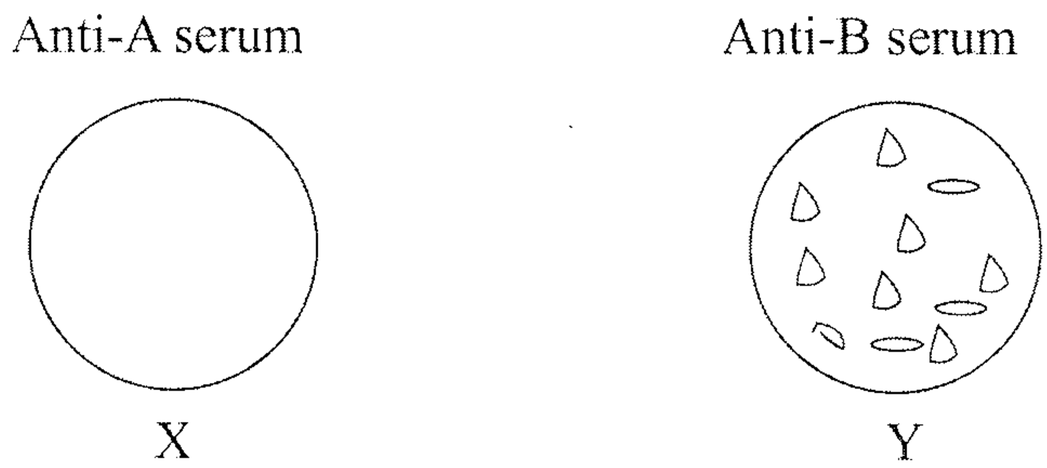


Figure 4

(a) i. To which blood group does the patient's blood in the above test belong?

ii. Explain your answer to (a) i.

(b) What is the difference between blood plasma and serum?

(c) i. To which blood group do universal donors belong?

ii. Explain why agglutination does *not* occur in the person receiving blood from a universal donor.

5. **Figure 5** is a diagram showing the relationship between the placenta and the foetus in a mammal. The foetal heart pumps blood through the blood vessels of the umbilical cord.

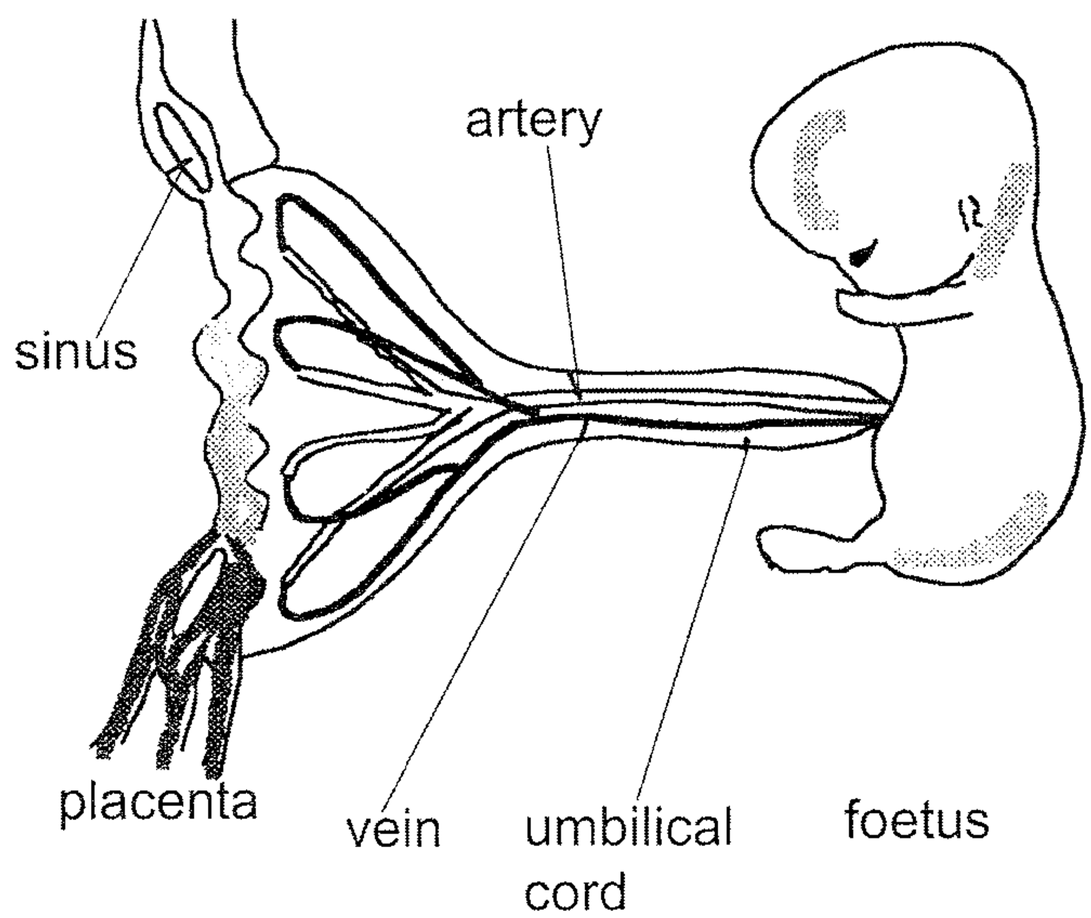


Figure 5

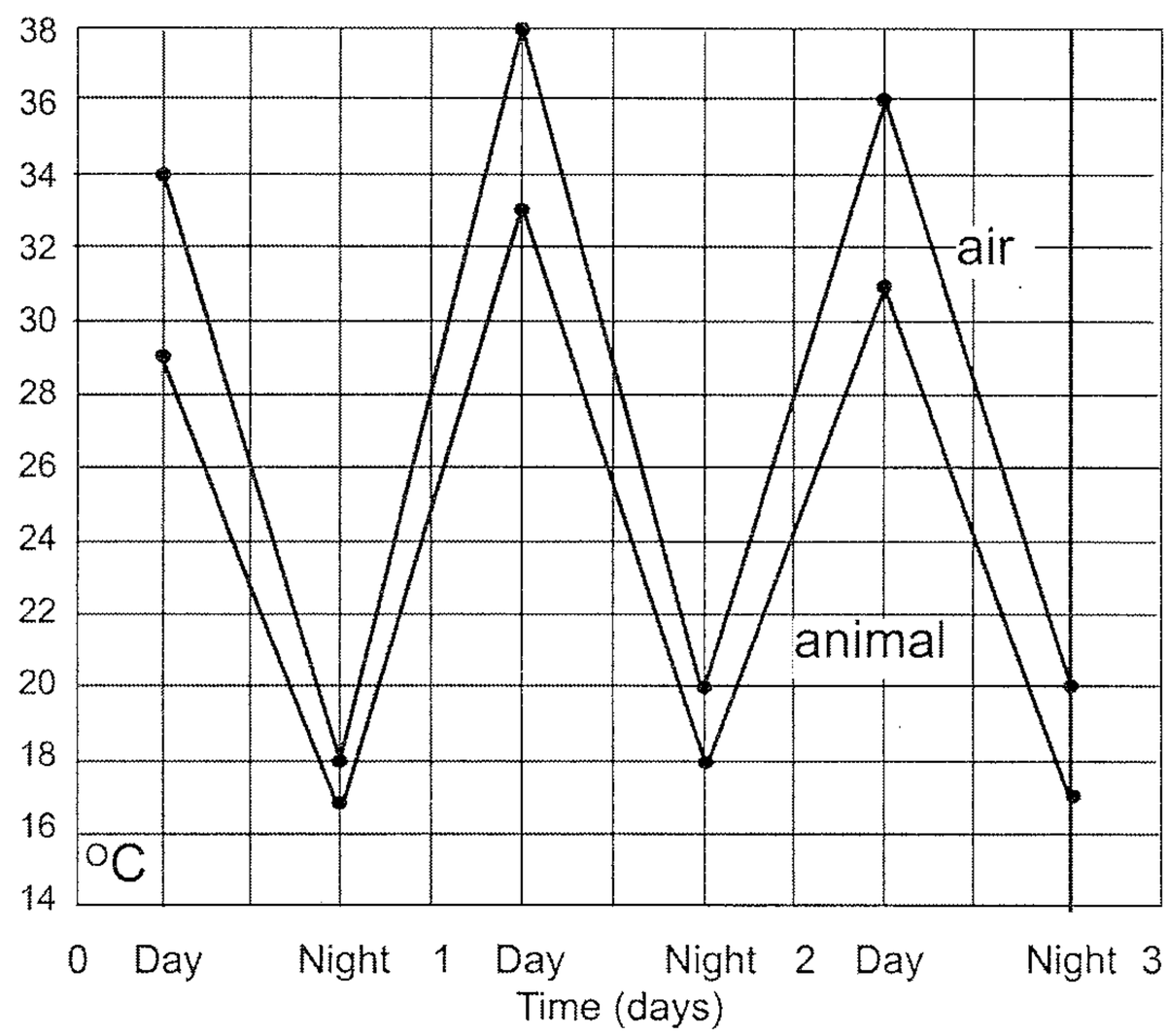
(a) On the diagram indicate with arrows the direction of blood flow in the:
i. artery;
ii. vein.

(b) Which of the blood vessels will have:
i. the greater concentration of amino acids?
ii. the greater concentration of oxygen?
iii. the greater concentration of carbon dioxide?

(c) Looking at figure 5, suggest why there is no mixing of maternal and foetal blood.

(d) What is found in the sinus?

6. A biologist kept a small animal in an open enclosure. Every day for three days she measured the animal's rectal temperature and the temperature of the air around it. Her readings were plotted as shown in **figure 6**.



(a) Describe the relationship between the temperature of the air around and that of the animal.

(b) Suggest an animal that may have been used in this experiment.

(c) Why did the animal's body temperature fluctuate each day?

(d) If the biologist had performed a similar experiment on a pig, what results would you expect and why?

i. Expected results:

ii. Reason:

7. **Figure 7** represents a family tree of organisms in the process of evolution.

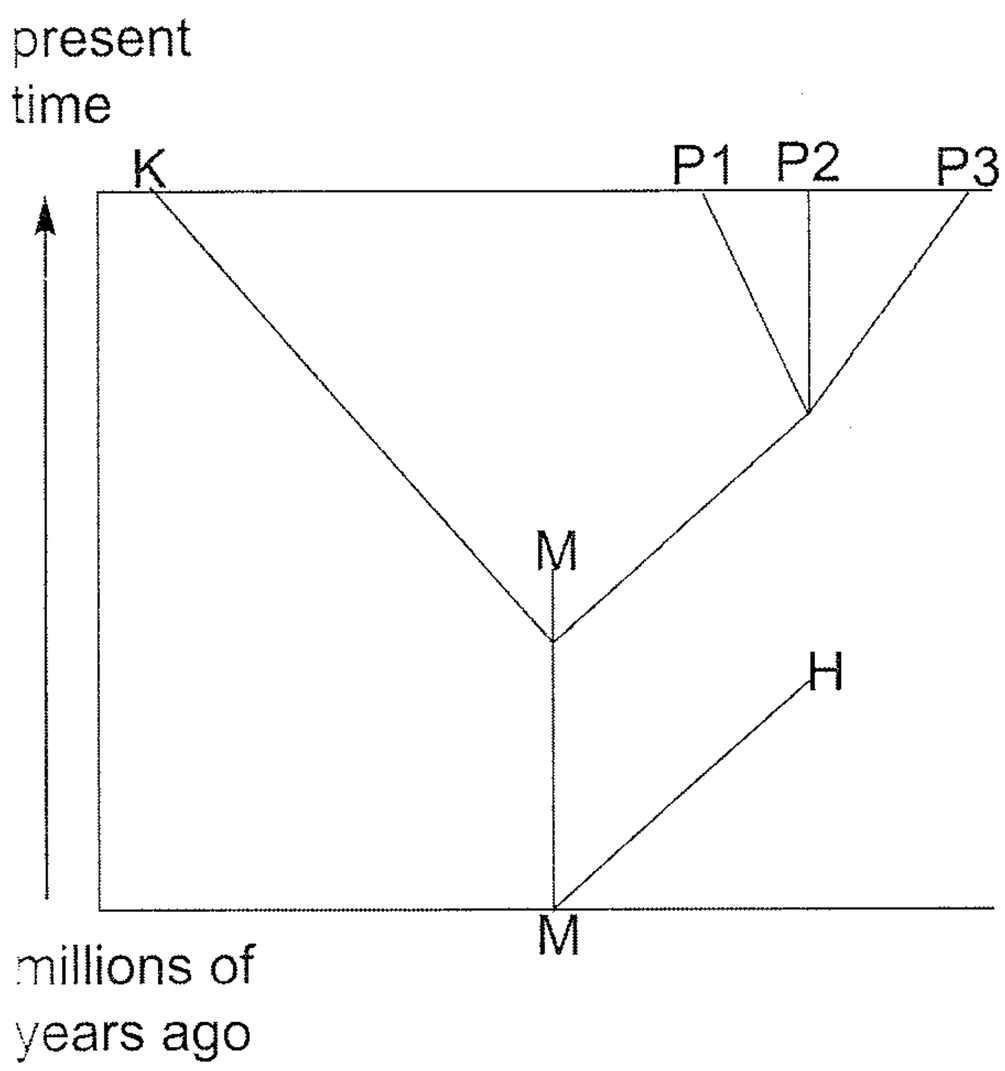


Figure 7

In this figure each letter, M, H, K, and P represents a species.

(a) By using the diagram, select:

i. those species which have become extinct;
ii. a common ancestor to more than one species.

(b) State the relationships that exist among the organisms P1, P2 and P3.

(c) Suggest *two* factors that may have caused all the organisms in figure 7 to evolve into different species.

8. **Figure 8** is a diagram of the apparatus used to demonstrate how nutrients are absorbed in the wall of a mammalian small intestine.

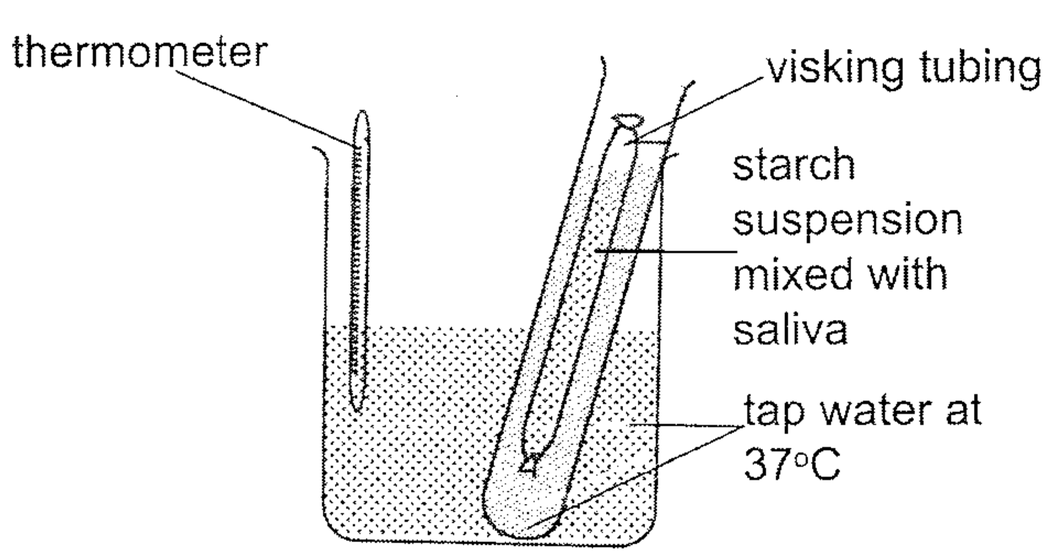


Figure 8

(a) After the apparatus was left for 30 minutes, starch and sugar tests were carried out on the water in the test tube.

i. State the results of the starch test.
ii. State the results of the sugar test.

(b) Give an explanation of the results in (a)ii above.

(c) In what way is the visking tubing like the wall of the small intestine?

(d) Explain why diffusion through the walls of the small intestine is more efficient than through the wall of the visking tubing.

9. **Table 1** shows the results of an investigation into the effect of light intensity on the rate of photosynthesis. The number of oxygen bubbles released per minute by the cut end of the stem of the water plant *Elodea* indicates the rate at which photosynthesis was taking place. A light bulb was placed at different positions away from the plant.

Table 1

Distance from plant (cm)	Units of light intensity	Number of oxygen bubbles per minute
100	4	4
60	11	10
40	25	19
30	40	24
25	64	25
20	100	25

(a) Using the results given in the table and the graph paper provided, plot a graph of number of oxygen bubbles per minute, against units of light intensity.

(b) From the graph you have plotted:

i. What is the light intensity when the rate of photosynthesis is 12 bubbles of oxygen per minute?
ii. What is the rate of photosynthesis when the light intensity is 30 units of light?

(c) What happens to the rate of photosynthesis between 64 and 80 units of light?

(d) From the results of this investigation, suggest how light intensity affects the rate of photosynthesis.

10. **Figure 9** is a diagram of a soil profile.

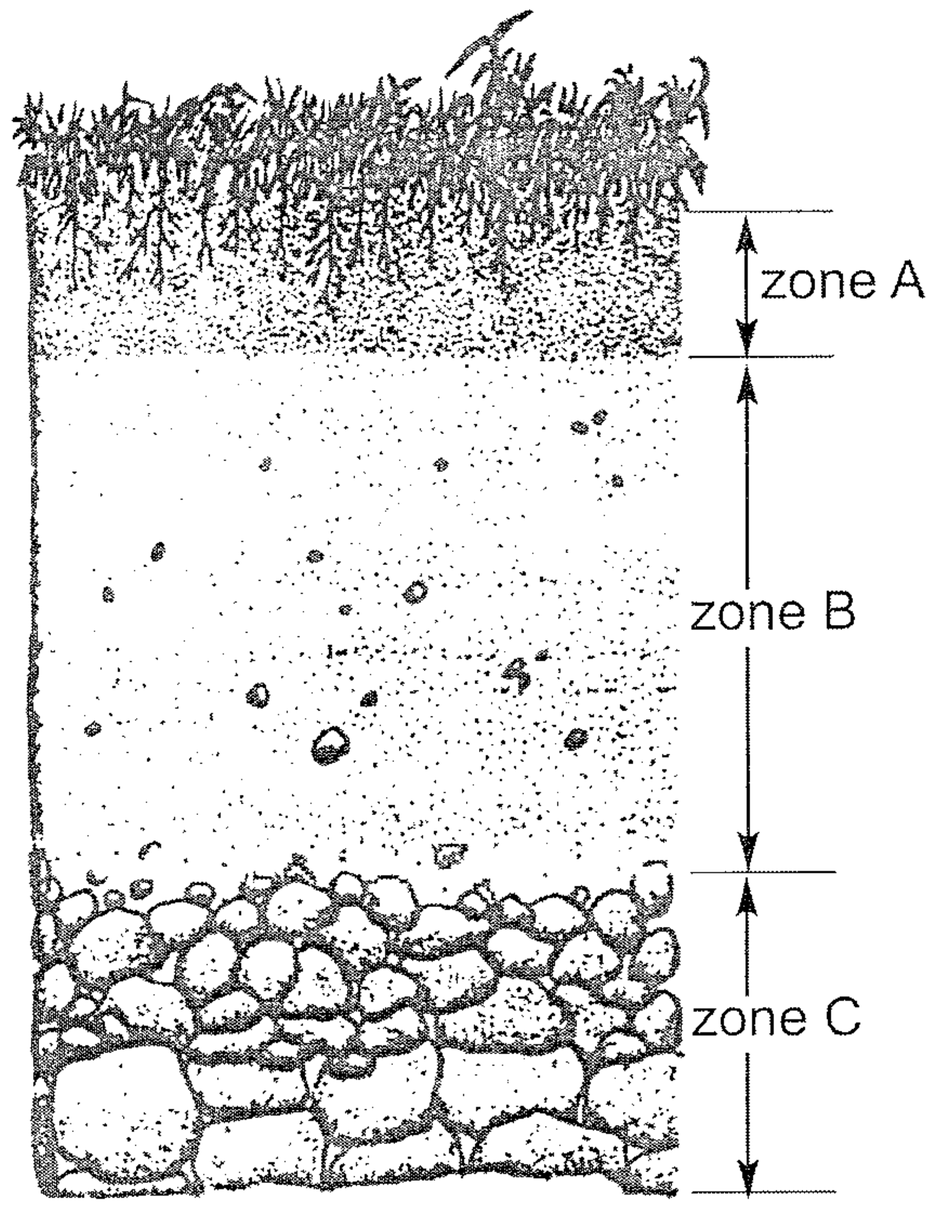


Figure 9

(a) Name zones A and B.

(b) Give *two* reasons why plant growth is restricted to zone A.

(c) Why is soil in zone A more likely to have a lower pH than soil in zone B?

(d) How would a farmer improve the soil structure of zone B?

(e) i. Which zone mainly determines the type of soil in figure 9?

ii. Which zone is the origin of the inorganic salts in this soil?

11. Explain how the eye functions in order for a person to see an object.

12. Nitrogen is an important element in the synthesis of proteins which are essential for growth. Starting with atmospheric nitrogen, describe how this element is recycled in nature.

1. **Figure 1** is a diagram representing the cross section of a dicotyledonous leaf.

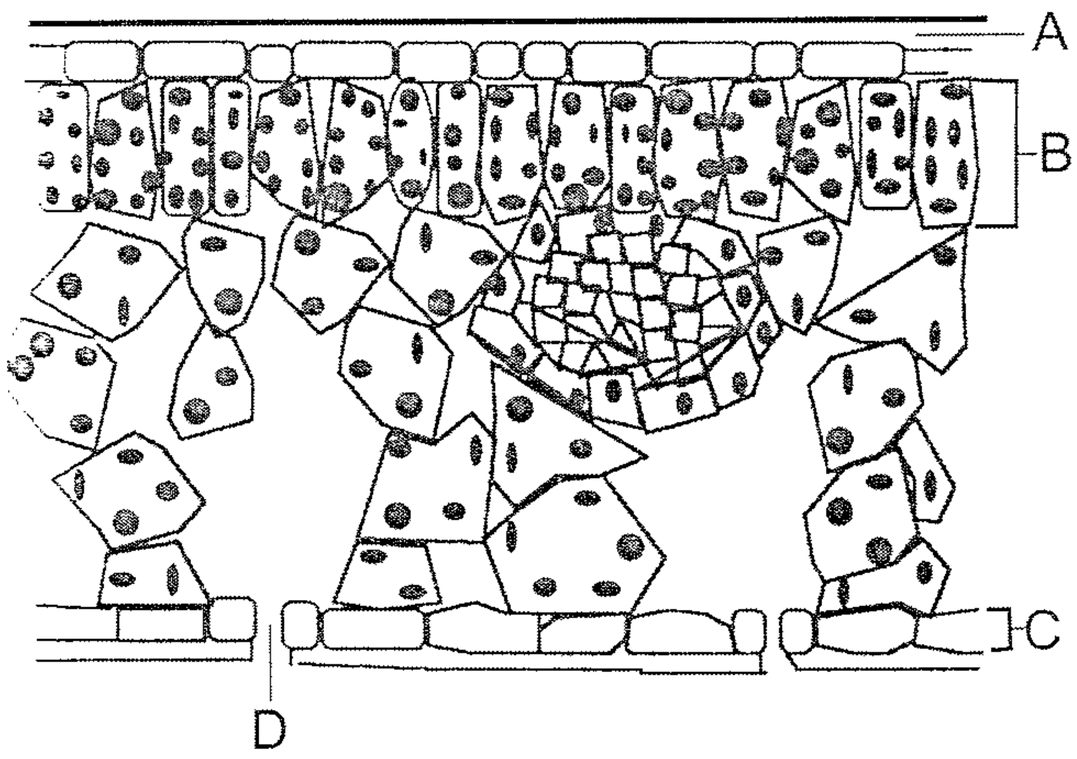


Figure 1

(a) Name the parts labelled B, C, and D.

(b) State the function of the part labelled A.

(c) During day time oxygen gas diffuses out of the leaf, and carbon dioxide diffuses into the leaf.

i. What process, taking place in the leaf, produces oxygen gas?

ii. Name any *two* conditions which are needed for the production of oxygen gas in the leaf.

iii. Explain why not all the oxygen produced in the process named in (c)i comes out of the leaf.

iv. Explain why a diffusion gradient for carbon dioxide exists between the atmosphere and the intercellular spaces of the mesophyll cells.

2. **Figure 2** is a diagram representing blood as seen under a microscope.

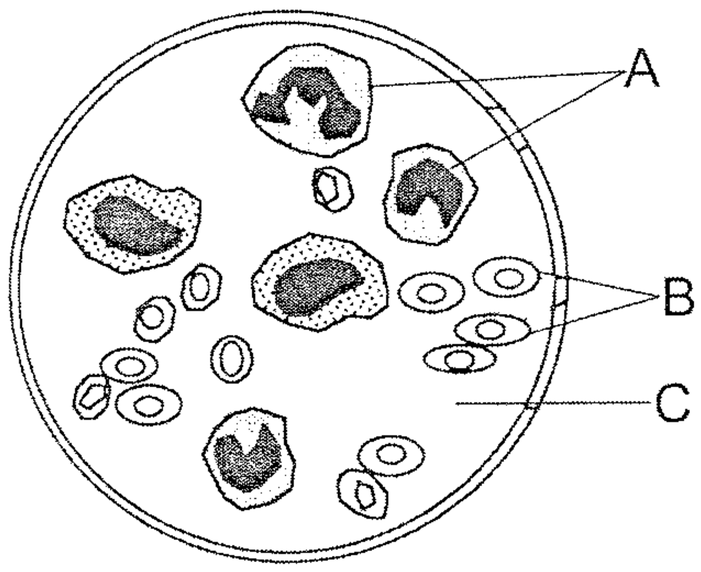


Figure 2

(a) Name the parts marked A and C.

(b) In what *one* way are the cells labelled A different from those labelled B in their *function?*

(c) In what *two* ways do antibodies function in the body?

(d) i. Where in the body would you expect haemoglobin to combine with oxygen to form oxyhaemoglobin?

ii. Under what condition would this formation of oxyhaemoglobin take place?

3. (a) i. Name *one* enzyme produced by the pancreas.

ii. Give the food substance on which this enzyme acts.

iii. What is the end-product of the digestion of the food substance named in (a)ii?

(b) i. State *one* digestive function of the liver.

ii. Name the blood vessel that transports digested food from the small intestine to the liver.

(c) Explain what happens to excess amino acids in the liver.

4. **Figure 3** is a diagram showing an experimental set-up to demonstrate the importance of certain elements to plant growth.

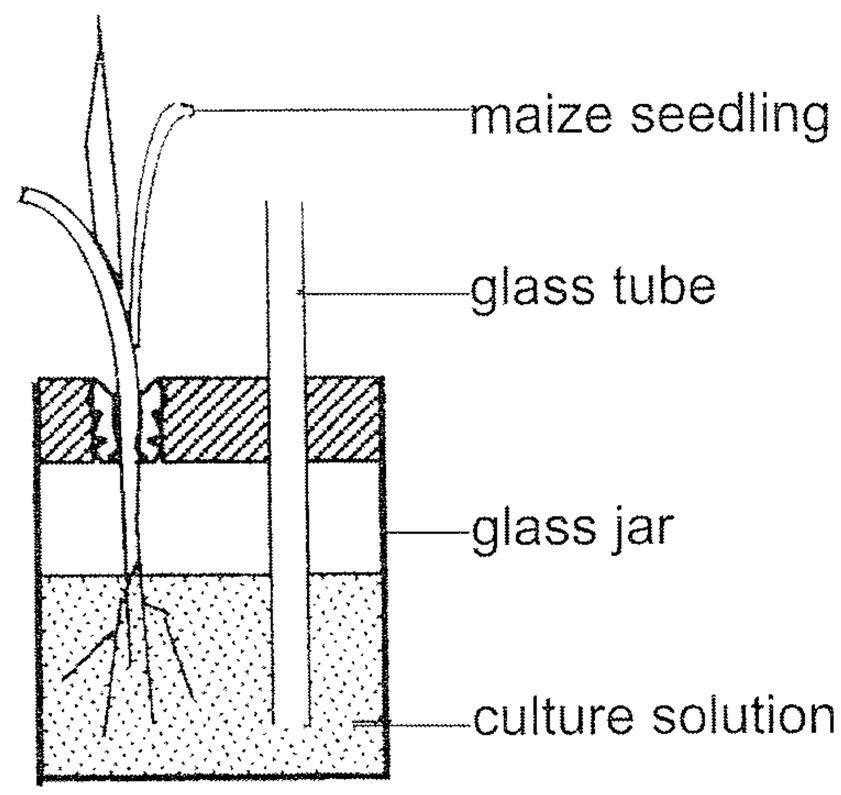


Figure 3

(a) Most of the seed was cut off from the seedling before setting up the experiment. Explain why this was done.

(b) By the second week, the culture solution was green due to algal growth.

i. What could have been done to prevent the growth of algae in the culture solution?

ii. Explain your answer to (b)i.

iii. How could the growth of algae in the culture solution affect the results of the experiment?

(c) What is the advantage of using culture solutions over poor or sandy soil in such experiments?

5. (a) Study the following equations representing two types of respiration.

A. $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 2830kJ$

B. $C_6H_{12}O_6 \longrightarrow 2CO_2 + 2C_2H_5OH + 118kJ$

i. Write down *two* differences that you can notice between these two equations.
ii. Name the type of respiration represented by B.
iii. Which of the *two* types of respiration A and B is more efficient?
iv. Give a reason for your answer to (a)iii.

(b) Where in the cells does the process represented by the two equations take place?

6. Trypanosoma is a protozoan that causes sleeping sickness in humans.

(a) Name the vector of the Trypanosoma.

(b) Name one reservoir animal of Trypanosoma.

(c) In the case of Trypanosoma infection, what is the difference between the reservoir and the vector?

(d) Give *two* ways of controlling sleeping sickness.

7. **Figure 4** shows a diagram of apparatus used in an experiment on digestion.

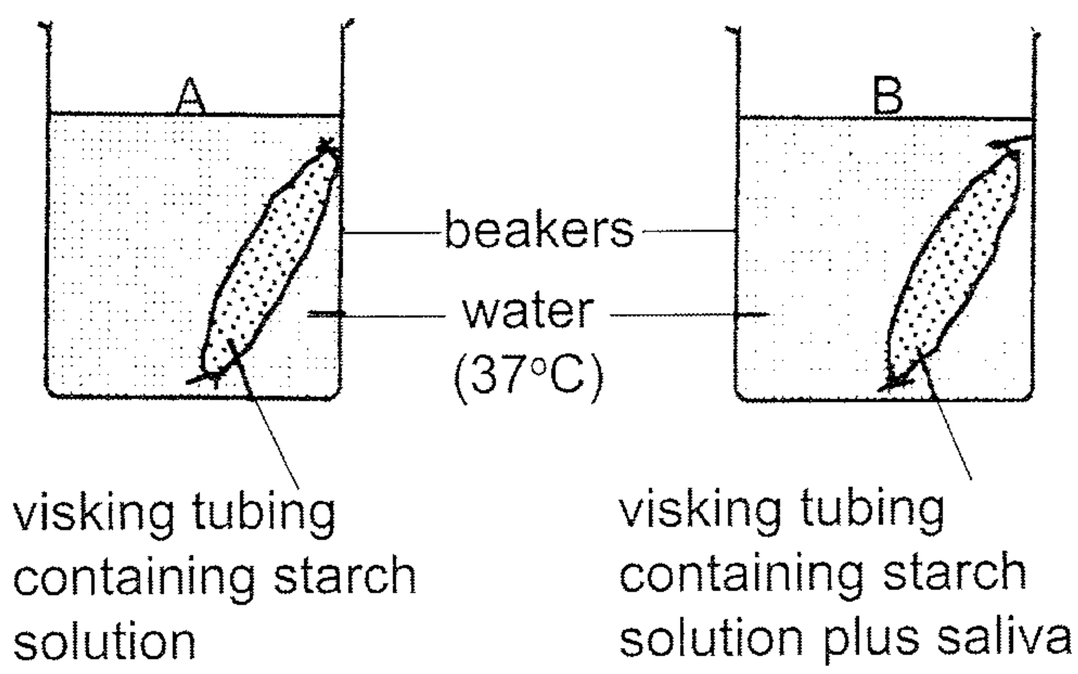


Figure 4

The water in both beakers was tested for starch and sugar before immersing the visking tubing. The results showed that water did not contain starch or sugar. Thirty minutes later, the water in both beakers was again tested for starch and sugar.

(a) What results might have been obtained in:

i. beaker A?
ii. beaker B?

(b) Explain your answer to (a)ii.

(c) What do the results in (a)i and (a)ii tell you about the property of visking tubing?

(d) What was the importance of keeping the water in the beakers at 37°C in the above experiment?

8. (a) What role do the following play in a fertile soil:

i. nitrogen gas?
ii. water?
iii. humus?

(b) State any *three* reasons why some artificial fertilisers are considered inferior to natural fertilisers.

9. **Figure 5** is a drawing of part of the human skeleton.

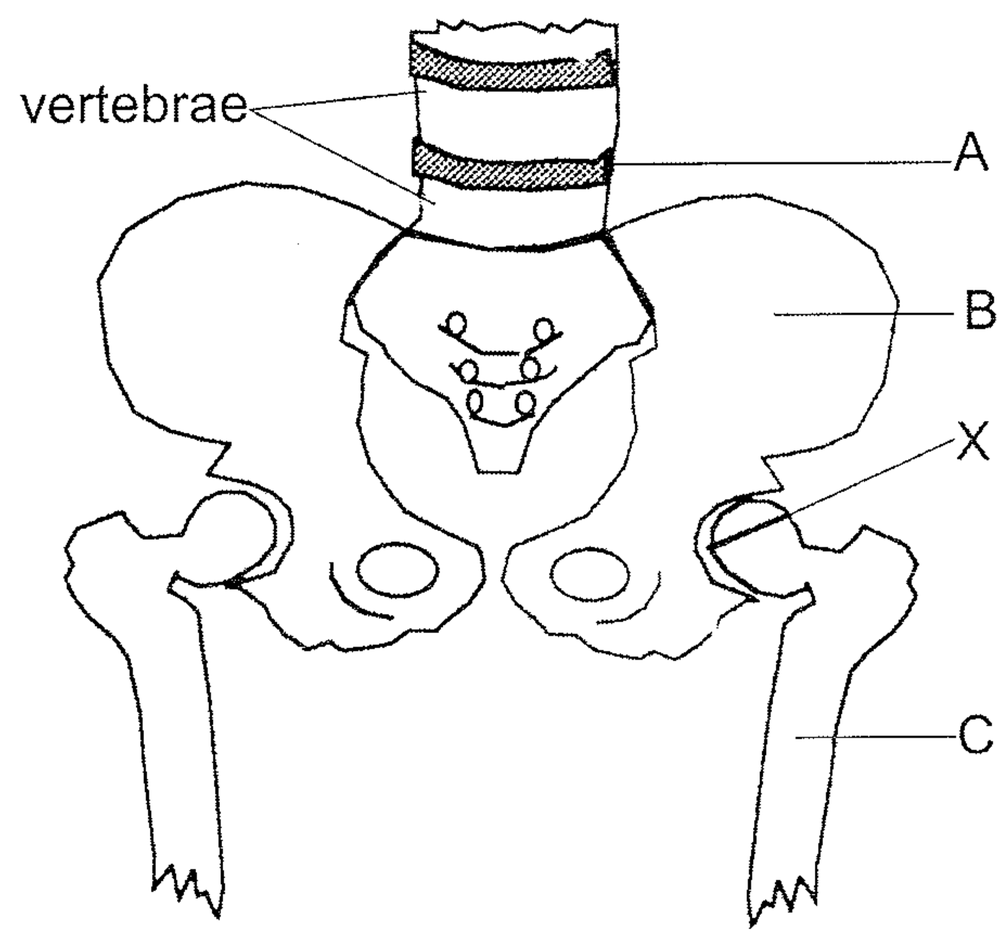


Figure 5

(a) Name the parts labelled A, B, and C.

(b) What property does the part labelled A have which makes it suitable for the position it occupies?

(c) Apart from support, give *two* other functions of the skeleton.

(d) Name the type of joint formed between structures B and C at X.

10. (a) What do the following terms mean:
    i. reduction division?
    ii. phenotype?

    (b) What is fertilisation?

    (c) i. What is meant by variation in a species?
    ii. State any *three* processes that may bring about variation in a species.

11. A few weeks after heavy rains the algae population in a dam below some maize fields increased excessively. After some time it was discovered that fish in the dam were dying at night.

    (a) What could have caused the increase in the algae population?

    (b) Suggest why the fish in the dam were dying at night.

    (c) Suggest *two* ways in which the situation stated in (b) could be prevented.

12. **Figure 6** is a diagram of a human brain as seen from the side.

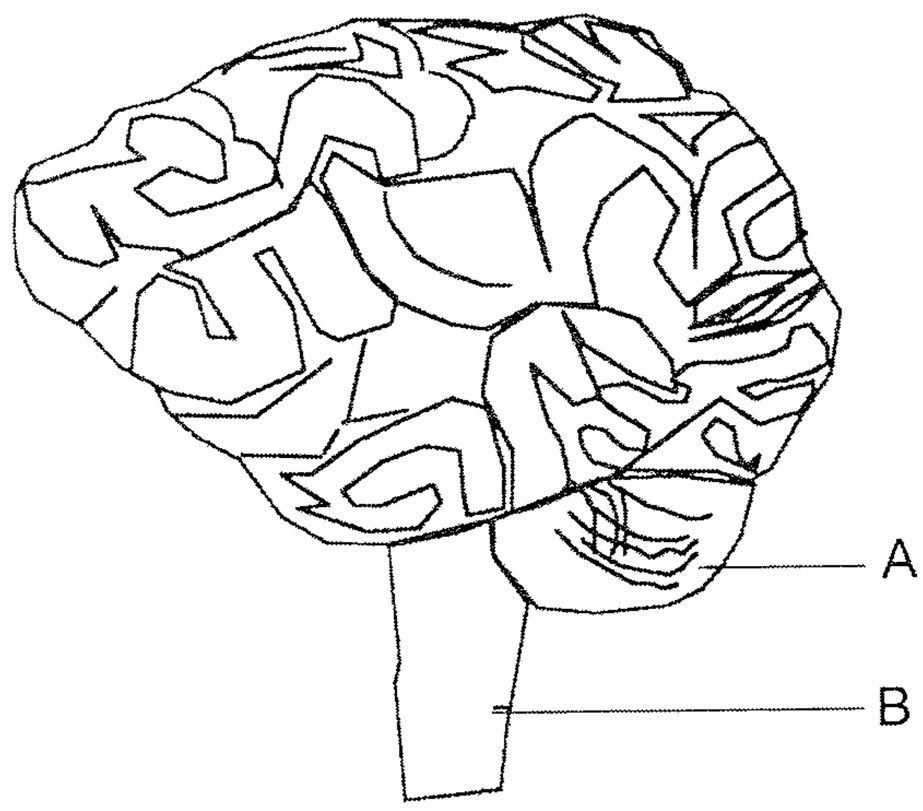


Figure 6

(a) What are the parts labelled A and B?

(b) State any *two* functions of the part labelled B.

(c) i. What is the effect of the folding on the surface area of the brain?

    ii. Explain the importance of this effect to *Homo sapiens*.

13. **Figure 7** shows two graphs. One indicates the mass of a group of dead seeds plotted against time, and the other indicates the mass of a similar number of germinating seeds plotted against time.

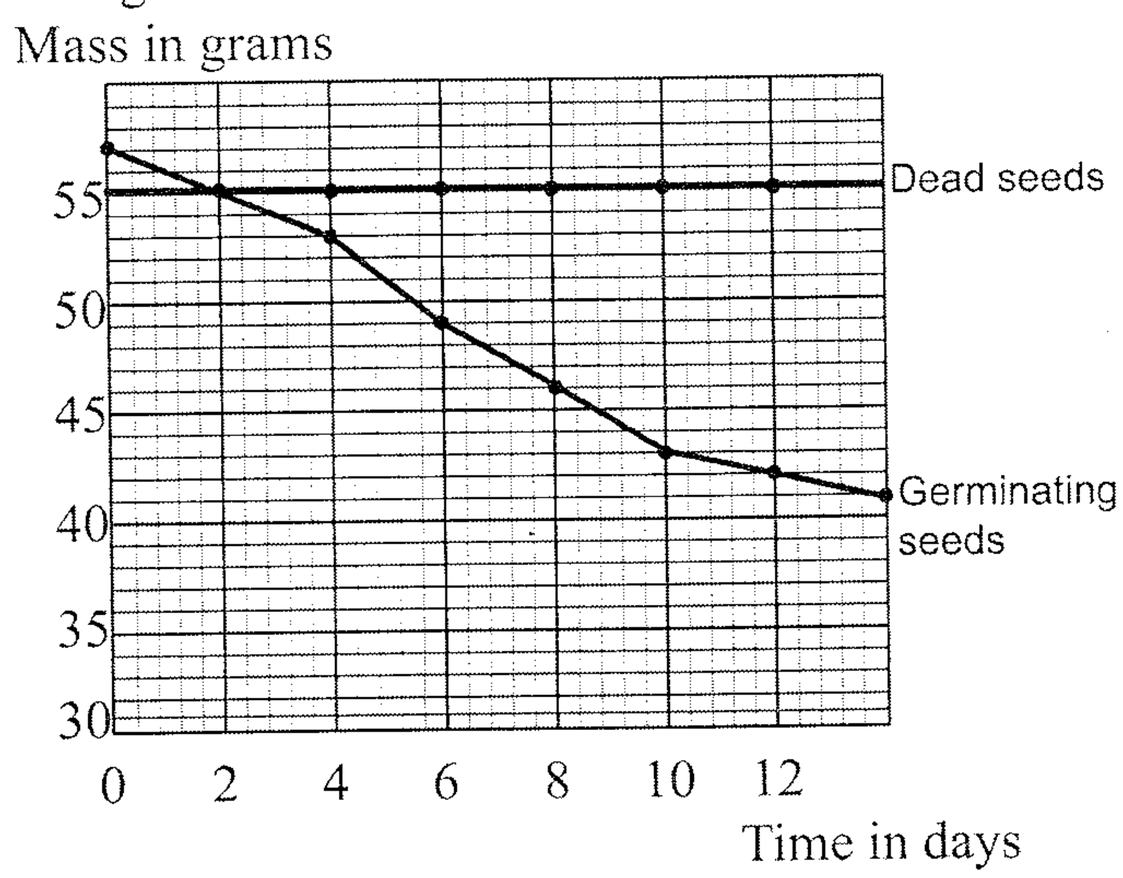


Figure 7

(a) i. What is the difference in mass between dead and germinating seeds on the 6th day of the experiment?
    ii. Explain the difference in mass between the two sets of seeds after day two.

(b) How was the mass of seed determined during the course of the experiment?

(c) Apart from water give any *two* substances in a bean seed that would account for the mass.

1. (a) Name *three* cell structures which can only be seen with the aid of an electron microscope.

   (b) Paramecium is a unicellular organism that can lead an independent life. State any *three* activities in Paramecium that can support the above statement.

   (c) Explain why a liver cell may contain as many as one thousand mitochondria.

2. **Figure 1** is a graph which shows the effect of temperature on the activity of an enzyme in an experiment on digestion.

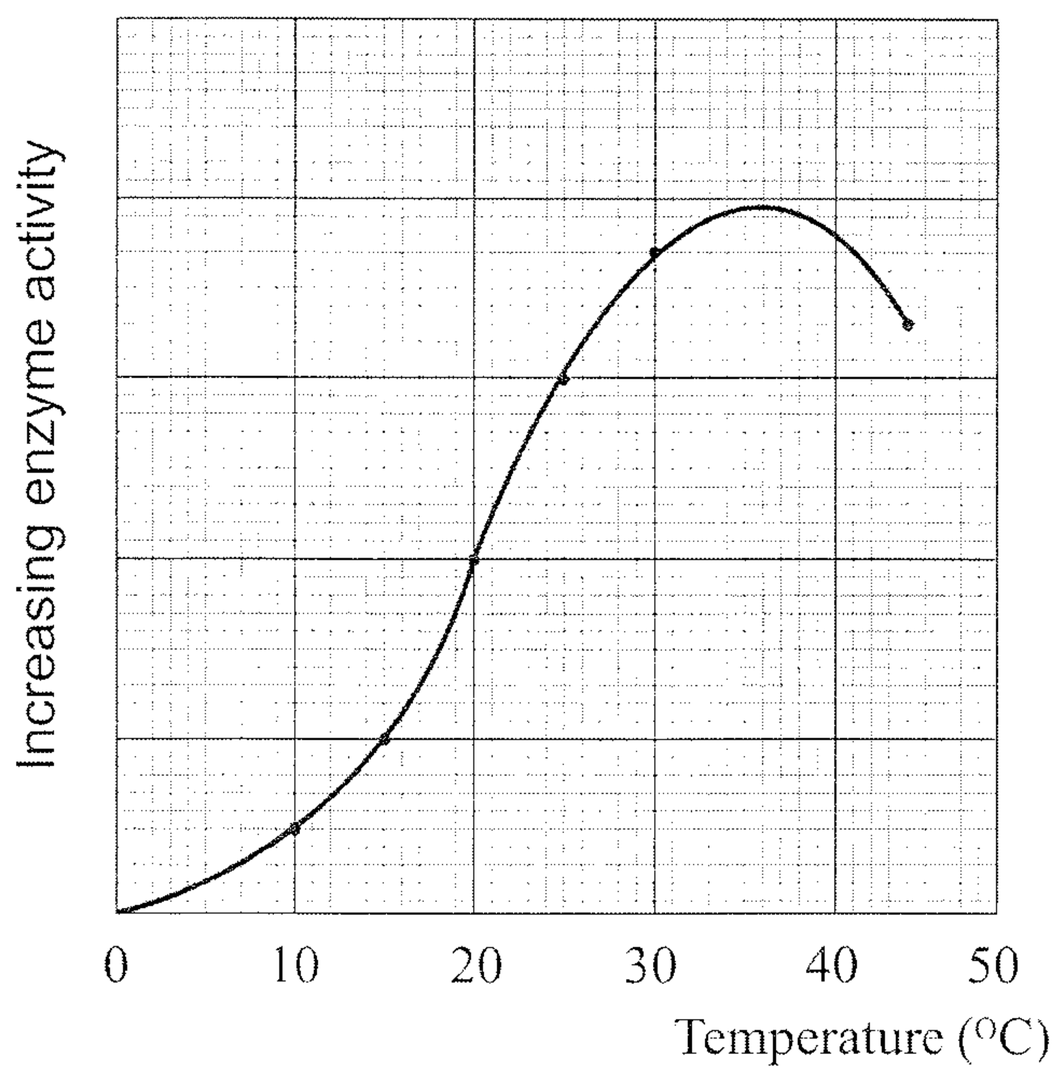


Figure 1

   (a) What is the relationship between temperature and the activity of an enzyme between °C and 30°C?

   (b) What is the optimum temperature for the reaction of the enzyme in the graph?

   (c) i. What happens to the rate of reaction when the temperature is above 40°C?

   ii. Explain your answer in (c)i.

   (d) Besides temperature, name *one* other factor that can affect the activity of an enzyme.

3. **Figure 2** is a diagram of a head of a fish with one operculum removed to expose the gills. The arrows indicate the movement of water into and out of the fish.

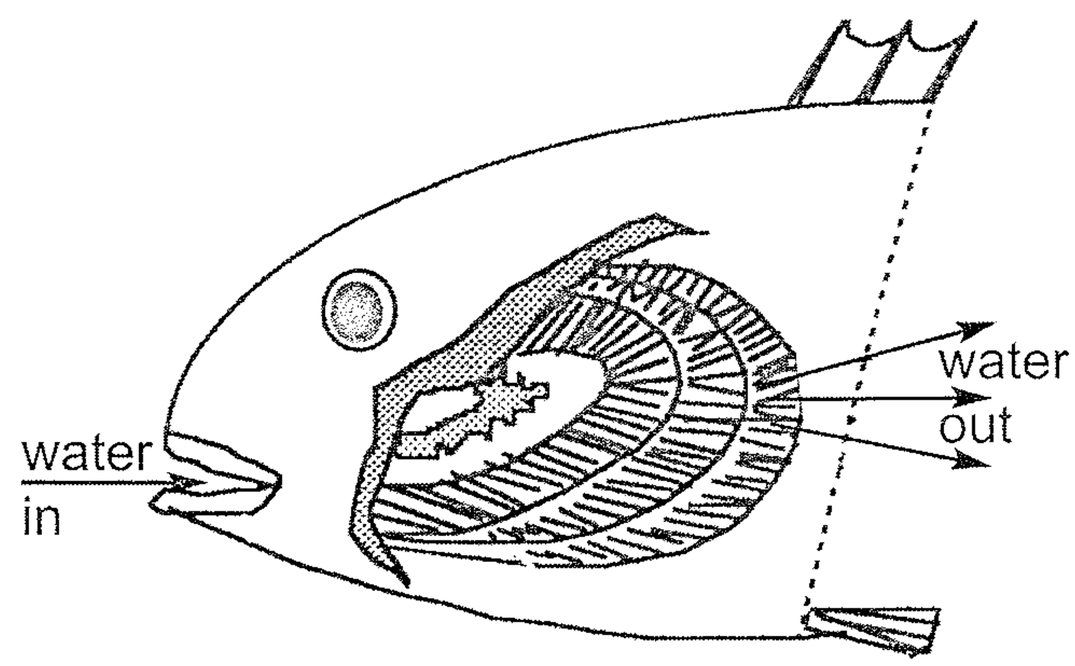


Figure 2

   (a) i. What might be the difference in carbon dioxide concentration between the water entering and the water leaving the fish?

   ii. What is the cause of the difference stated in (a)i?

   (b) Apart from the exchange of gases, state *two* other functions of the water entering the fish.

   (c) The gills are respiratory organs of a fish. State any *three* features which make the gills suitable for the function they perform.

4. (a) **Figure 3** is a diagram of an anterior view of a vertebra.

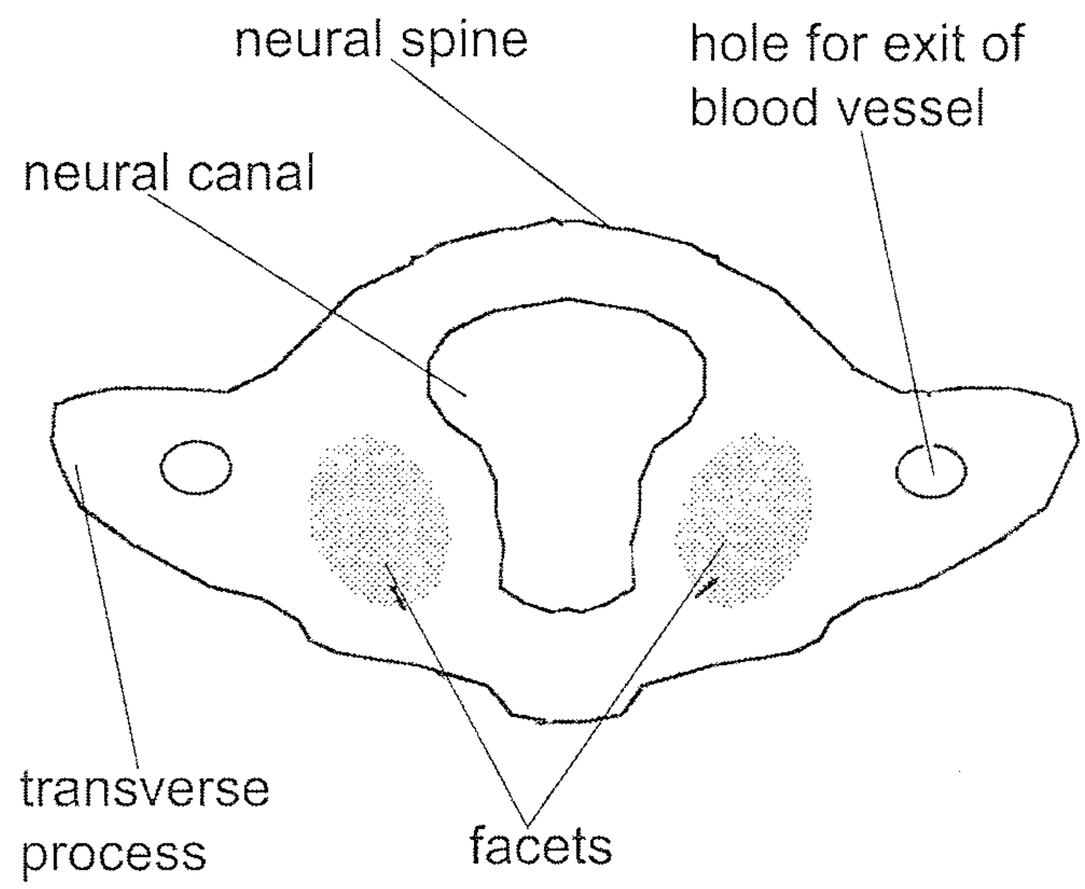


Figure 3

   i. What is the name of this vertebra?

   ii. Give *two* distinguishing features you have used to identify the vertebra.

   iii. State *two* specific functions of this vertebra.

(b) **Figure 4** is a diagram showing one type of lever found in the human body.

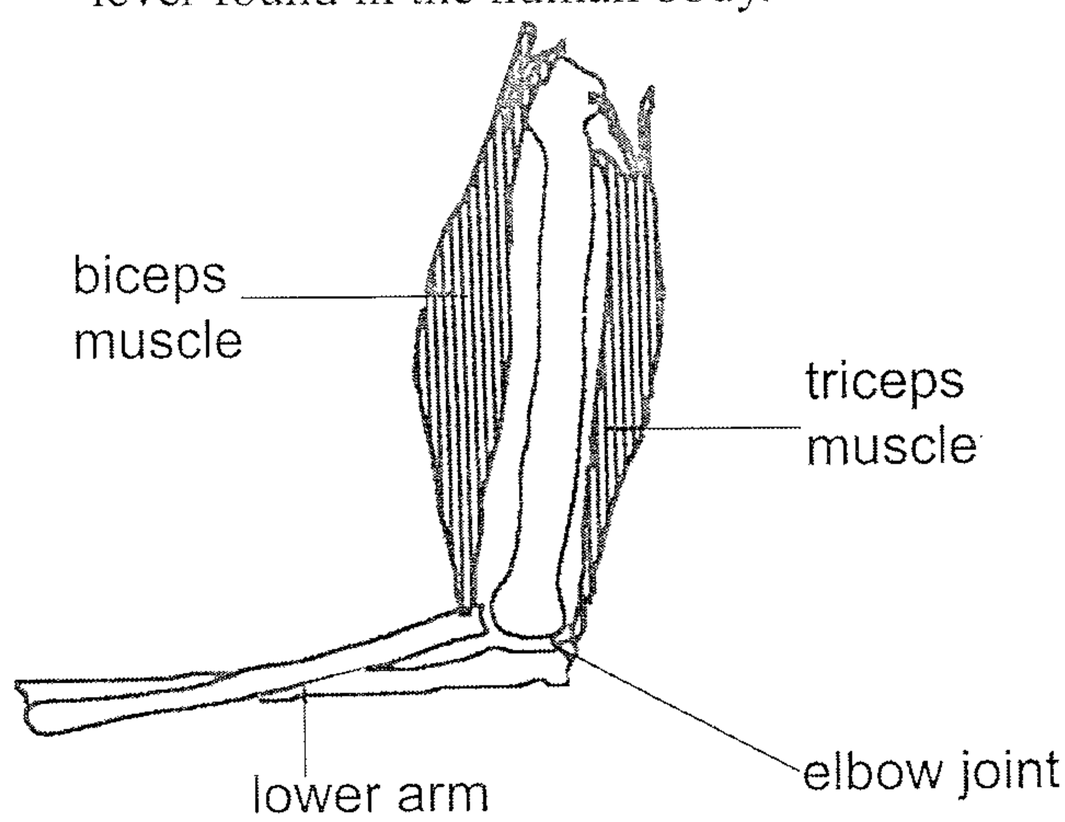


Figure 4

i. When the lower arm is being lifted, which parts of figure 4 correspond to: Effort? Fulcrum? Load?

ii. What type of lever is shown in figure 4?

5. **Figure 5** shows two graphs, one showing the rate of transpiration and the other the water uptake in a plant.

(a) From the graph, find the time at which each of the following occurs:

i. Maximum rate of transpiration.

ii. The rate of water uptake equals the rate of transpiration.

(b) Between 6 pm and 12 midnight the water content of the plant increases. Suggest a reason for this.

(c) i. What would happen to the rate of transpiration if the lower surface of the leaves were coated with Vaseline?

ii. Give a reason for your answer to (c)i.

6. (a) Explain how deforestation causes soil erosion.

(b) The following are the results of an experiment on a sample of soil: Mass of air dried soil = 10 g.

Mass of air dried soil after gentle heating = 9.9 g.

i. Calculate the % of water in the soil sample.

ii. What name is given to the water which is removed by heating the air-dried soil gently?

(c) Give *two* organic constituents of the soil.

7. One way to control malaria is to eliminate mosquitoes. Some of the ways in which this can be done are given below:

1. Introduce fish in ponds to eat mosquito larvae and pupae.
2. Cut grass around homes and dry all stagnant water to destroy breeding areas.
3. Spray insecticides on mosquitoes.

(a) State the type of pest control in each of the *three* ways given, 1 to 3.

(b) i. Give *one* advantage of method 1.

ii. Give *two* disadvantages of method 3.

(c) The population of fish in Lake Malawi can be increased or decreased by biological or physical factors. State *two* biological factors which can increase the population of fish.

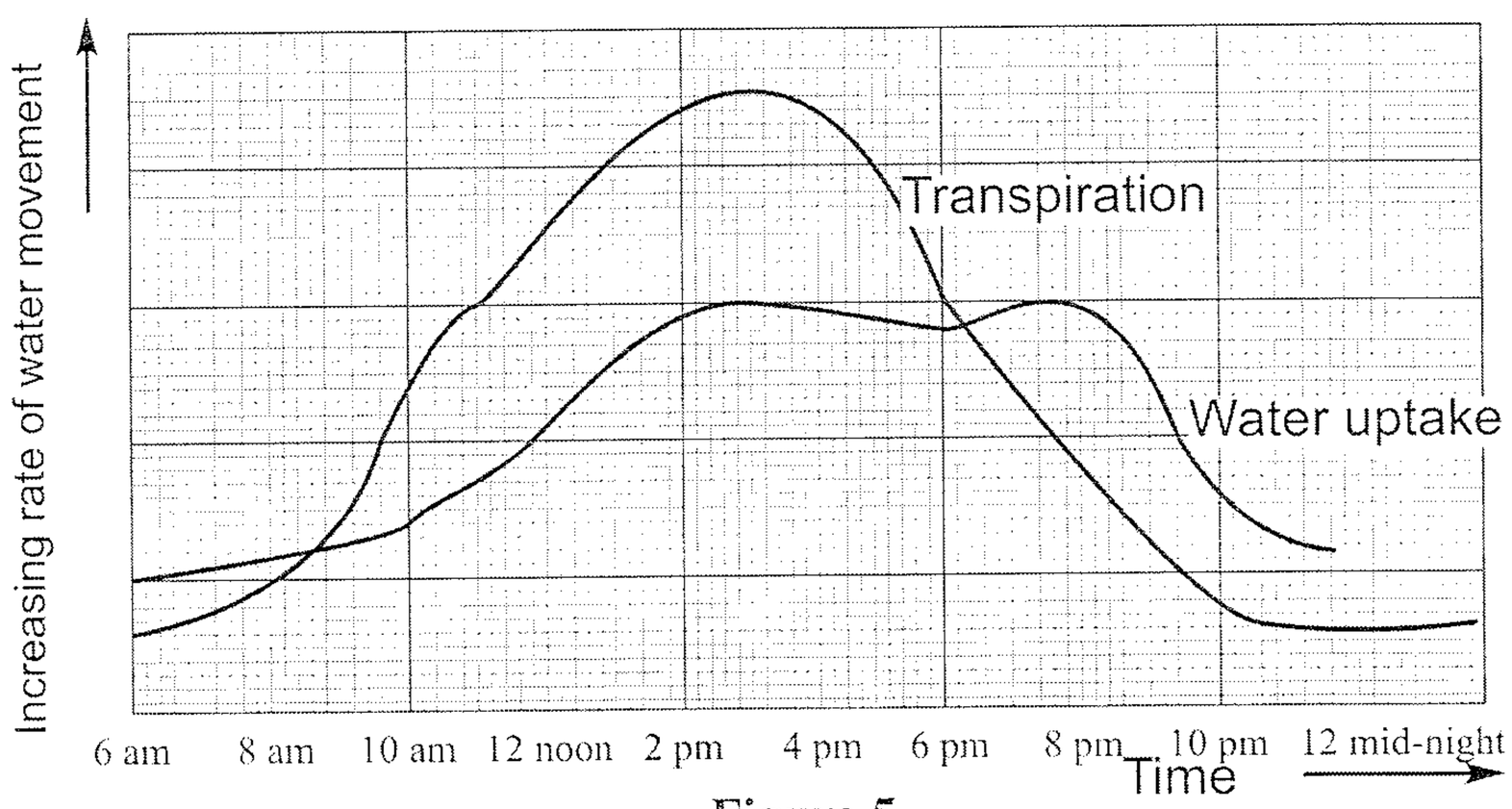


Figure 5

8. **Figure 6** is a diagram of a choice-chamber.

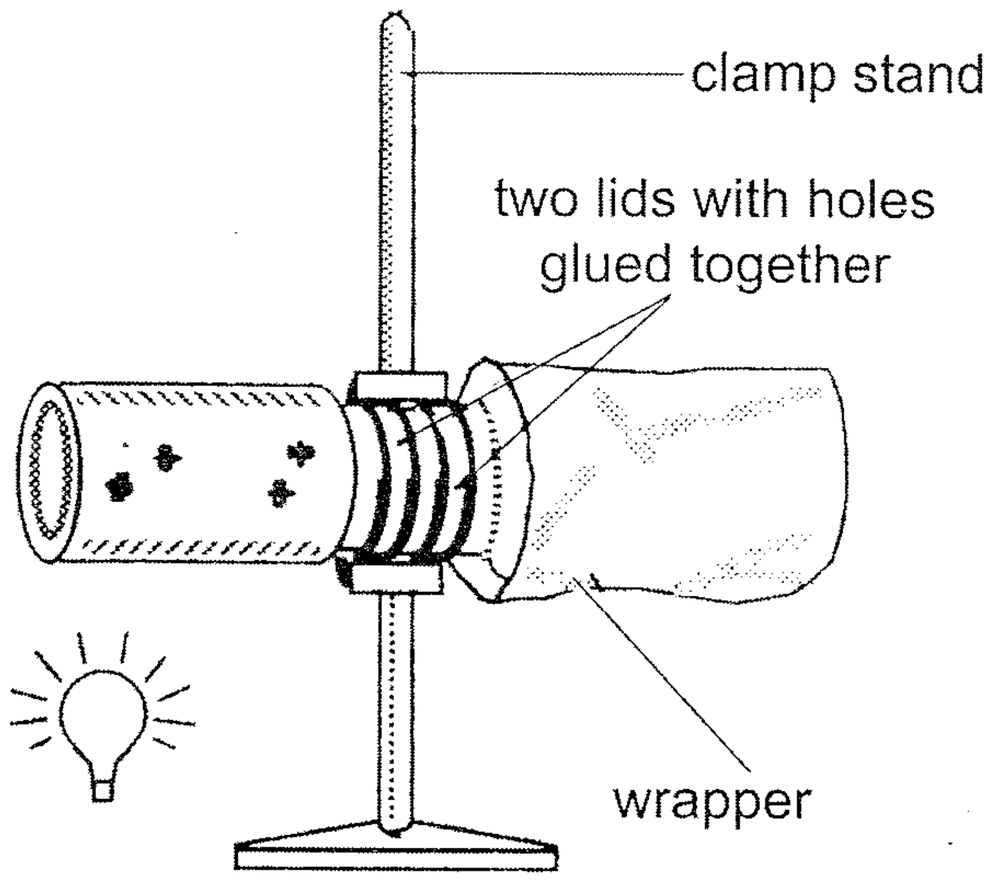


Figure 6

A student used this apparatus to carry out an experiment as follows:

1. He placed 5 live cockroaches in each of the two chambers.
2. He wrapped both chambers with black plastic for the first two minutes.
3. He removed the plastic wrapper from one of the chambers and illuminated this part with a bright light while the other part remained covered as shown in the diagram.
4. Every two minutes he exchanged the wrapper and the light bulb from one chamber to the other and recorded the number of cockroaches in each chamber. This went on for 10 minutes.

The results of the experiment are shown in Table 1.

Table 1

Time from start (minutes)	Number of cockroaches	
	Dark chamber	Light chamber
2	9	1
4	10	0
6	8	2
8	10	0
10	9	1

(a) What hypothesis was being tested in this experiment?

(b) Why were the cockroaches first placed in darkness at the beginning of the experiment?

(c) Why was the black wrapper and light exchanged from one chamber to the other?

(d) What do the results of this experiment suggest?

(e) What name is given to this type of response?

(f) How is the response to the stimulus in this experiment related to the habits of cockroaches?

9. Bacteria are very small organisms measuring between 1 micrometre and 5 micrometres (0.001 mm to 0.005 mm) in size.

(a) Explain how such small organisms manage to recycle elements.

(b) What are the three main types of bacteria?

(c) List two differences between bacteria and viruses.

10. A rat from a pure-breeding strain with grey fur was crossed with a rat from a pure breeding strain with black fur. All the F_1 were grey. Use **A** for dominant alleles and **a** for the recessive alleles.

(a) Give the genotypes of the:

i. two parents;
ii. F_1 rats.

(b) The F_1 rats were allowed to mate. They produced a total of 48 offspring.

i. What will be the ratio of grey rats to black rats?
ii. How many rats were black? (show your working)

11. **Figure 7** is a diagram of the human heart which has been cut open to show the four chambers

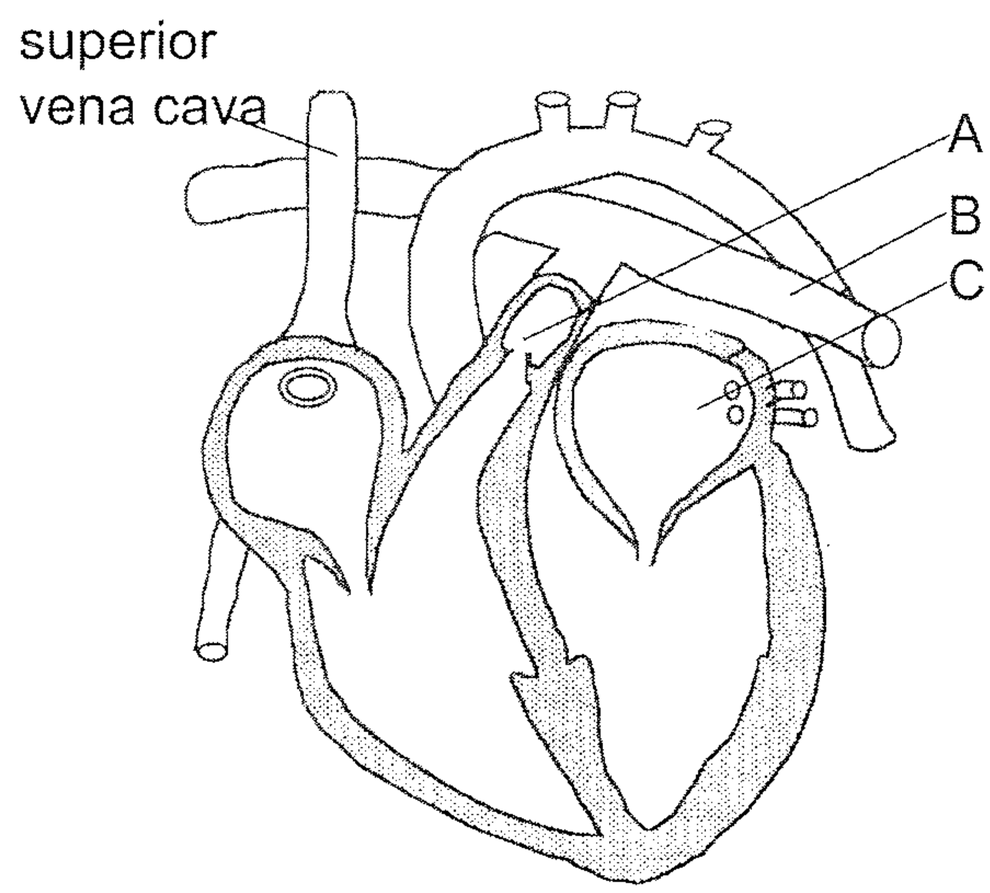


Figure 7

(a) Name the structures labelled A, B, and C.

(b) i. What difference do you see between the wall muscle of the left ventricle and that of the right ventricle?

ii. State the reason these muscles are different.

(c) i. What is the function of the coronary artery?

ii. If the coronary artery is blocked by a clot, heart failure occurs. Why?

12. Explain how the body of a mammal keeps its temperature constant when the atmospheric temperature rises.

13. Explain the ways in which the Shire River could become polluted by human activities.

1. **Figure 1** is a diagram of a villus in the small intestine of mammal.

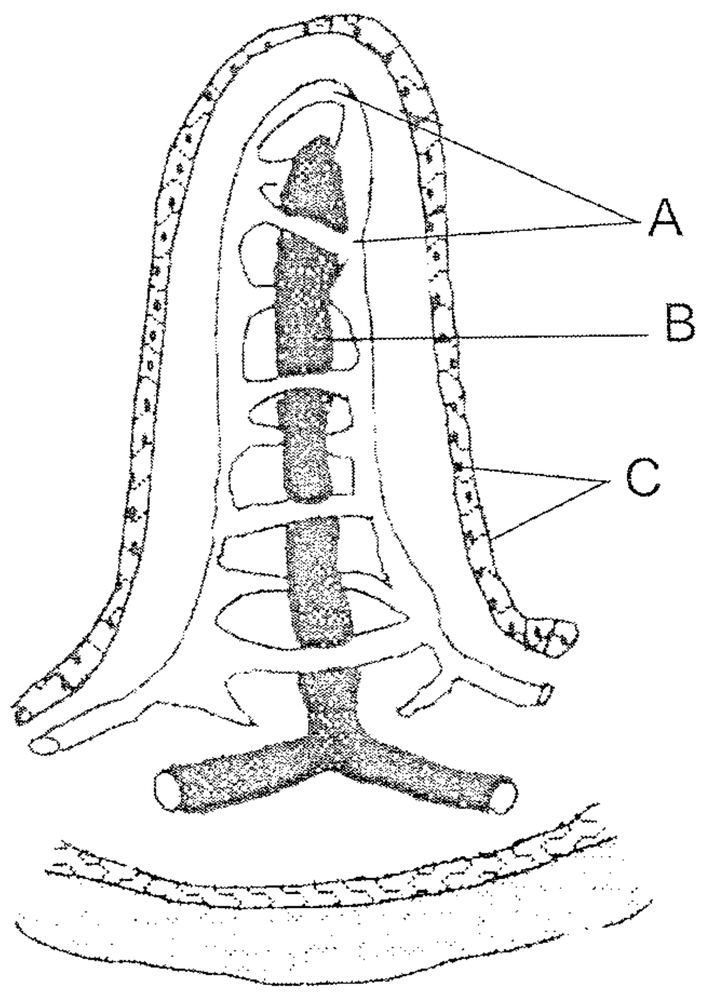


Figure 1

(a) Name the structures labelled A, B, and C.

(b) The most important function of the villus is absorption.

i. From figure 1 give *two* ways in which this structure is adapted to this function.

ii. Explain how these two adaptations enable the villus to function efficiently.

(c) What substances are absorbed into structure B in figure 1?

2. (a) What is the linking (together) of various processes in an organism called?

(b) Name *two* systems that link the processes of the body.

(c) State the difference in the direction the impulse travels in an axon and a dendrite.

(d) Explain why nerve impulses do not jump from one fibre to another even though the fibres are close to one another.

(e) How do sensory and motor neurones differ in their function?

3. **Figure 2** shows graphs of rate of photosynthesis against light intensity.

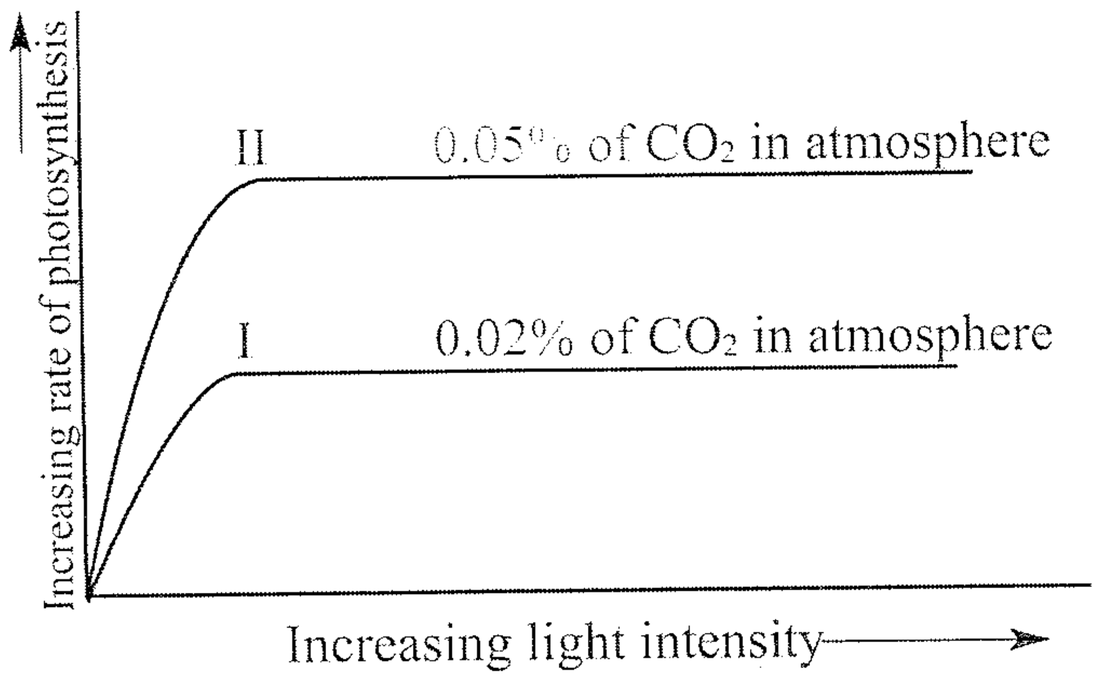


Figure 2

(a) Apart from light name *three* requirements for photosynthesis.

(b) From graph I describe the change of rate of photosynthesis with increasing light intensity

(c) Explain why graph II is higher than graph I.

4. (a) What is the main difference in reproduction between bacteria and viruses?

(b) Sterile nutrient agar was poured into two sterile petri dishes. One dish was covered, the other was left open. Both dishes were incubated at room temperature. After 3 days it was observed that there was growth in the uncovered dish but no growth in the covered one.

i. What is the objective of this experiment?

ii. If growth was observed in both Petri dishes after 3 days, what would have gone wrong with the experiment? (give *two* reasons).

5. **Figure 3** is a diagram showing gaseous exchange in the alveolus.

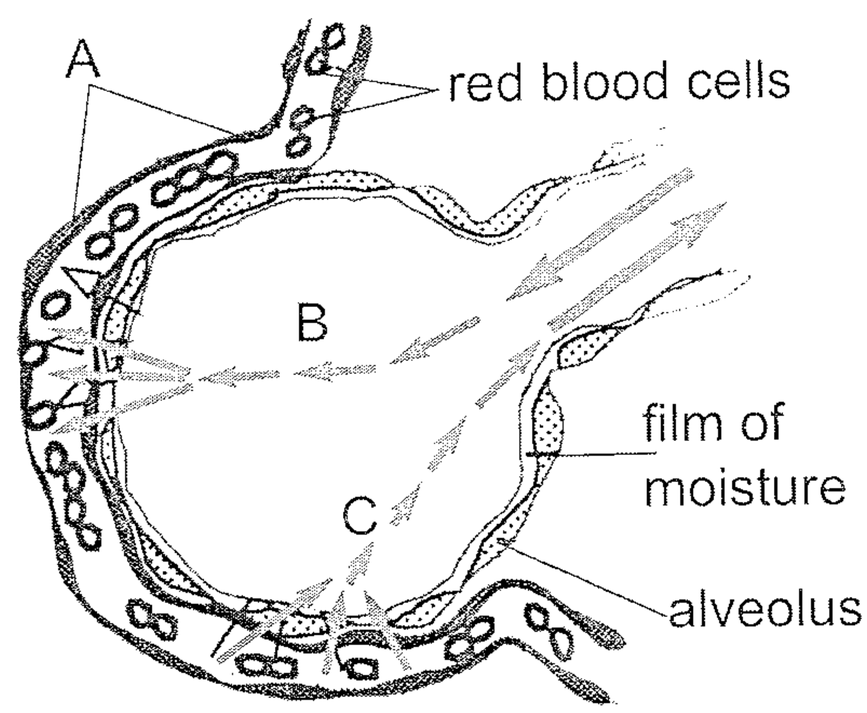


Figure 3

(a) Label A, gas B and gas C.

(b) How is the diffusion gradient for gas B maintained in the alveolus?

(c) Suggest a possible function of the thin film of moisture on the lining of the alveolus.

(d) Give *three* differences between the air entering and the air leaving the alveolus.

6. **Figure 4** is an outline diagram of an animal cell.

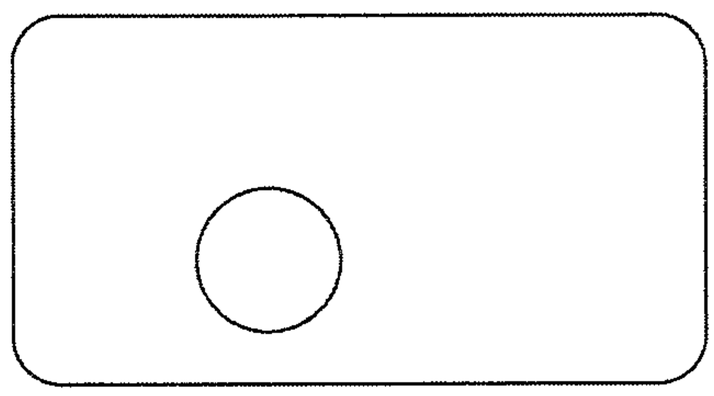


Figure 4

(a) In the diagram draw and label:
i. two pairs of chromosomes;
ii. one mitochondrion.

(b) If the cell in figure 4 underwent meiosis, how many chromosomes would each daughter cell have?

(c) In humans, the allele for blown eyes is dominant to the allele for blue eyes. However, a blue-eyed baby may be produced by a brown-eyed father and brown-eyed mother.

i. Using **B** for a dominant allele and **b** for the recessive allele for blue eyes, what would be the genotype of such parents?

Father:
Mother:

ii. Using the genotypes you have given in i. above, show with the aid of a labelled diagram how two brown eyed parents can produce a blue-eyed child.

7. **Figure 5** is a graph of average body temperature of animals A and B against environmental temperature.

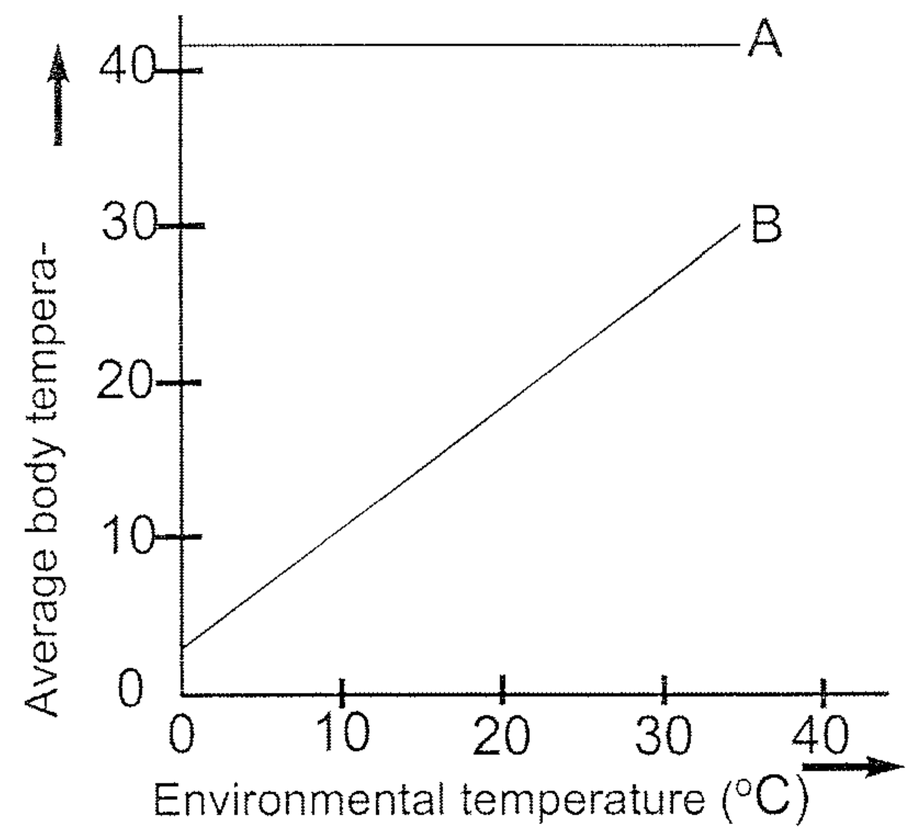


Figure 5

(a) i. If *one* of the animals is a lizard, which graph represents the lizard?
ii. Give a reason for your answer.

(b) Explain why the other graph does not represent the temperature of a human being.

8. The lakes or rivers in which fish live may have warm water discharged into them from nearby industries. Table 1 shows the relationship between water temperature and its ability to dissolve oxygen.

Table 1

Water Temperature °C	Amount of oxygen dissolved (mg/litre)
0	14.5
5	12.5
10	11.0
15	10.0
20	9.0
25	8.0
30	7.5

(a) Plot a graph of amount of dissolved oxygen against temperature.

(b) What is the relationship between water temperature and the amount of dissolved oxygen in the water?

(c) In a certain river in which the water had become warmed, the number of fish present dropped. Give *two* possible reasons for the drop in the fish population.

(d) i. What name is given to the contamination of the environment by human activities?

ii. Apart from heat, give another example of environmental contamination.

9. When a perforated tin of soil was immersed in a graduated cylinder containing 50 cm^3 of water, the water level rose to 100 cm^3. After some time the water level dropped to 85 cm^3.

(a) Calculate the volume of air in the soil sample from the results given. Show your working.

(b) What other measurement is missing in the procedure?

(c) If we take the measurement in (b) to be negligible, calculate the percentage of air in the soil sample.

(d) Explain *two* ways in which soil air is important

10. Diarrhoea is one of the signs of cholera. It should be treated immediately as it may be fatal if left untreated.

(a) Explain why diarrhoea may be fatal.

(b) What first aid should be given to someone with diarrhoea?

(c) The immunity acquired from cholera vaccine is an example of passive immunity.

i. Name another form of immunity given in a vaccine.

ii. Explain how it works.

(d) **Figure 6** shows a graph of a person suffering from an infectious disease.

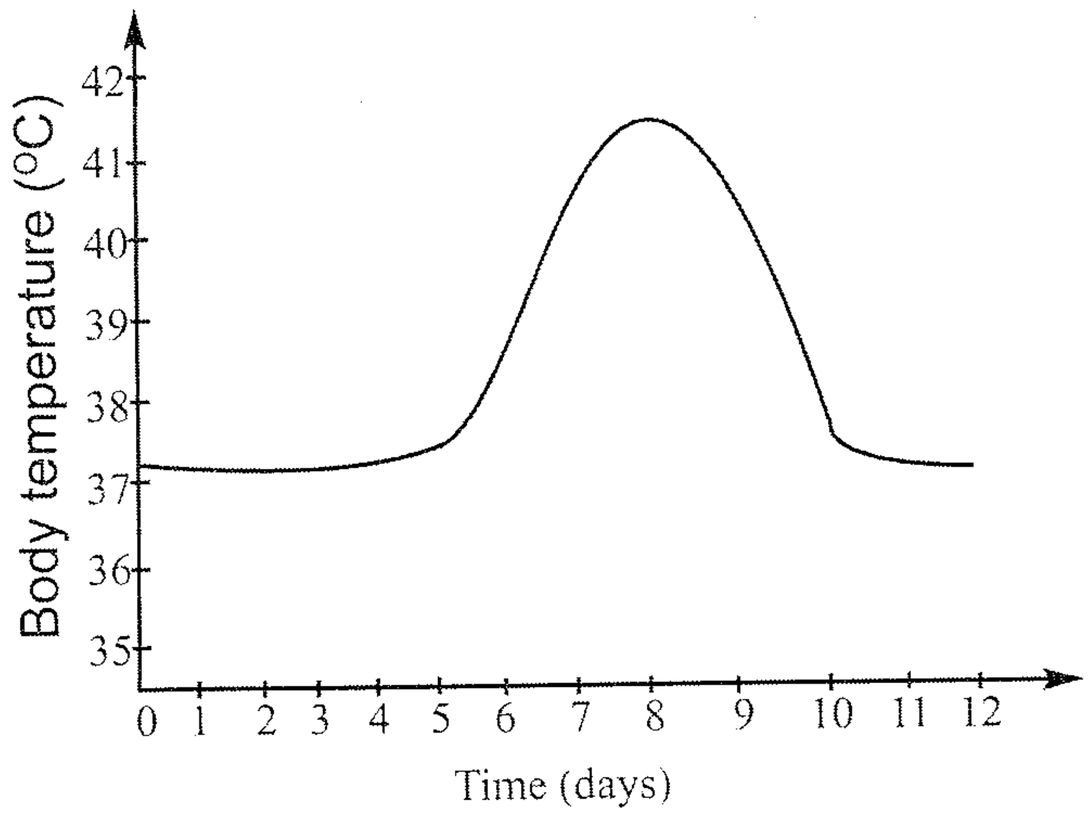


Figure 6

i. What was the incubation period of the disease?

ii. What was the highest body temperature reached?

iii. How do you account for the shape of the graph between:

5 and 8 days?

8 and 10 days?

11.(a) What is transpiration?

(b) Name *three* environmental conditions which could affect the rate of transpiration.

(c) Desert plants have to survive long periods of drought. State *three* ways by which these plants are adapted to survive in dry conditions.

12. **Figure 7** shows diagrams representing a plant root tip and three cells taken from points B, C, and D

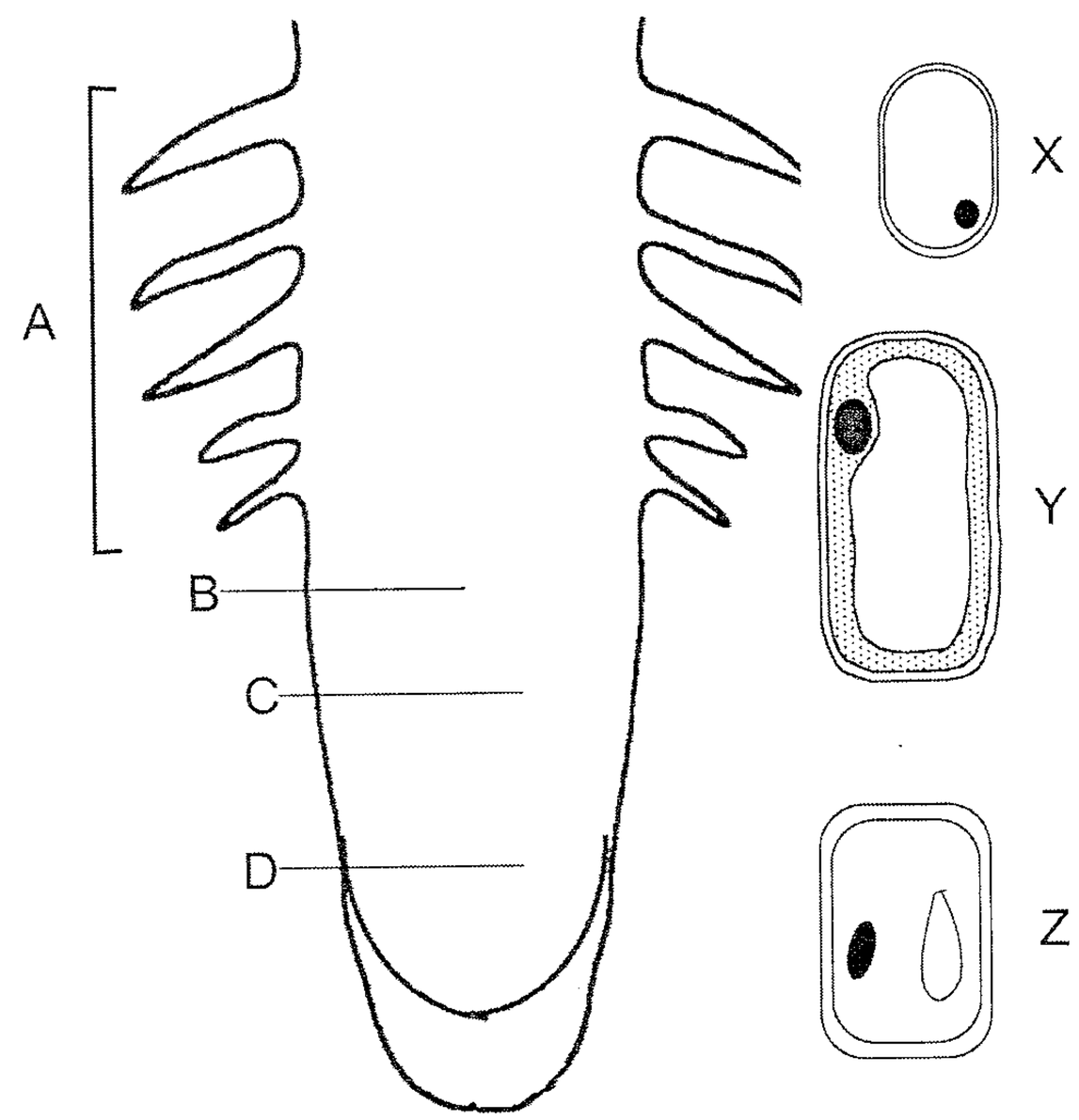


Figure 7

(a) Complete the table to show the region of the root tip from which each cell has been taken.

Region of root tip:	Cell:
B	
C	
D	

(b) i. Further behind the tip, the cells become specialised for their functions. What name is given to this process of specialisation?

ii. Give *three* types of specialised cells which could be produced just above the root tip.

(c) i. Name the structures shown in region A.

ii. Using the diagram, explain how the structures in region A are adapted to their function.

1. (a) Name the process through which a complex sugar is converted into a simple sugar.

   (b) Besides glucose, give *one* other example of a monosaccharide sugar.

   (c) Sucrose is a common example of a disaccharide.

      i. Give *one* common source of sucrose.

      ii. How would you convert sucrose to glucose in the laboratory?

2. **Figures 1A** and **1B** show an experiment which was set up to test the hypothesis that light is necessary for photosynthesis. Similar plants which had been kept in the dark for 24 hours were used in the experiment. The experiment was set up in the sun for about 5 hours.

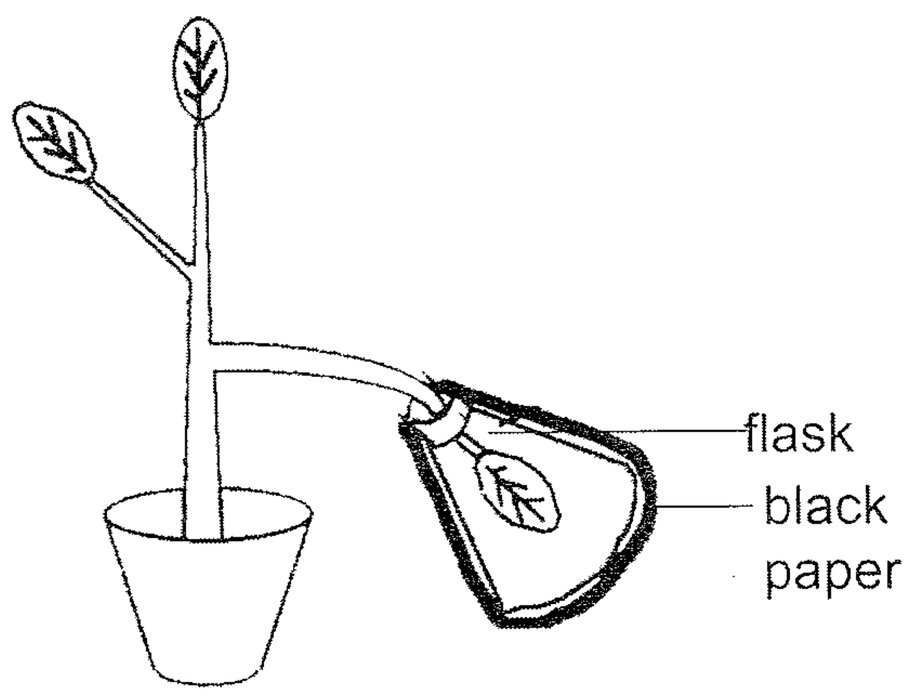


Figure 1A

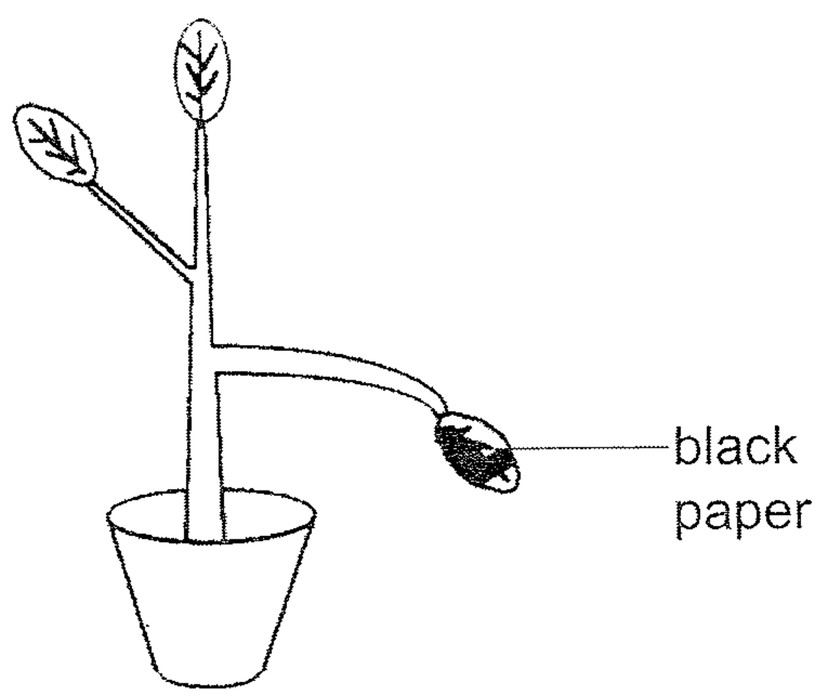


Figure 1B

   (a) What was the purpose of keeping both plants in the dark for 24 hours?

   (b) Besides light, state *two* environmental factors which have been altered in figure 1A.

   (c) What would be the distribution of starch in the partially covered leaf from figure 1B after 5 hours? Give a reason for your answer.

      Distribution:

      Reason:

   (d) Regardless of the changes to other environmental factors, suggest why the experiment represented by figure 1B is better than the experiment in figure 1A.

3. **Figure 2** shows the growth rate of a bacteria population in a culture medium.

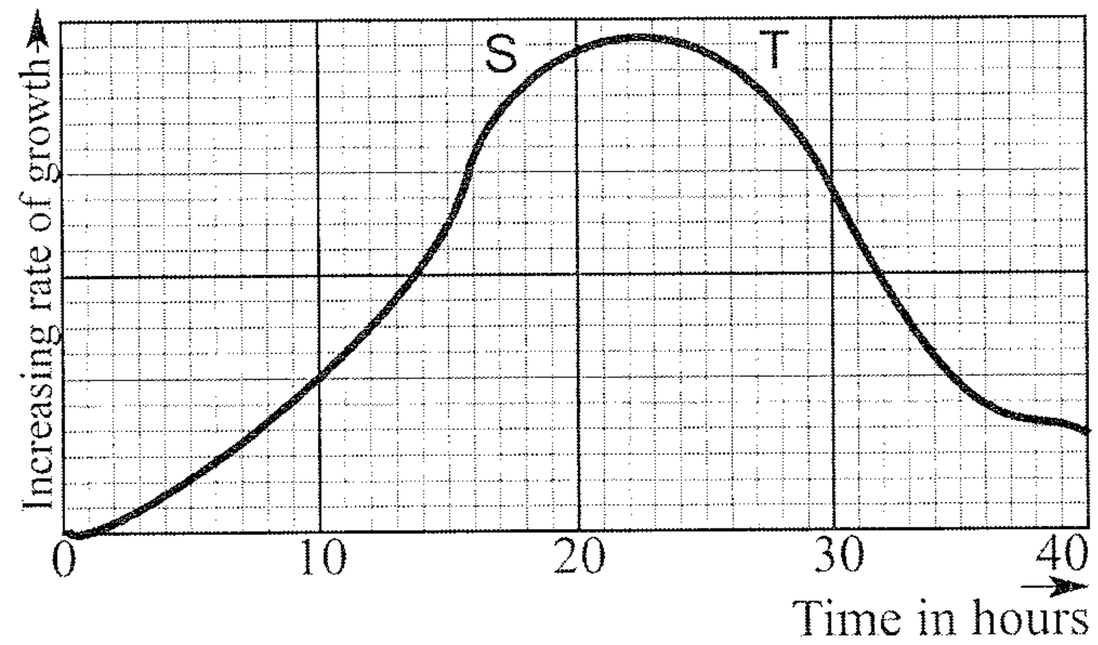


Figure 2

   (a) When is the growth rate increasing most rapidly? Indicate your answer by shading the appropriate time period on the graph.

   (b) What happens to the growth rate between S and T?

   (c) Suggest *three* reasons for the decline in growth rate.

4. (a) Unlike mammals, arthropods have an exoskeleton.

      i. Name *two* disadvantages of an exoskeleton to arthropods.

      ii. In what *two* ways is the structure of a bone different from that of the exoskeleton tissue?

	Bone:	**Exoskeleton tissue:**
(1)		
(2)		

   (b) **Figure 3** is a cross-section of the thorax of an arthropod showing muscles that cause the wings to move up and down during flight.

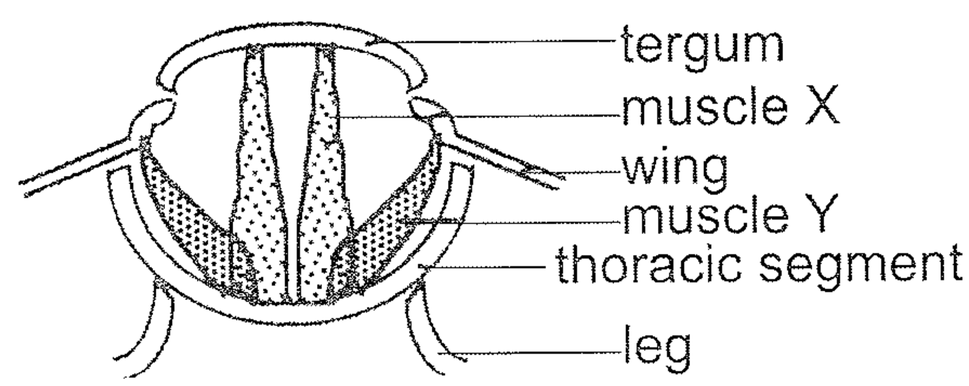


Figure 3

i. What happens to the following structures when the muscles marked X contract?
Tergum:
Wings:
Muscle marked Y:

ii. What type of lever is formed between the wing and the thoracic segment?

5. **Table 1** shows the average amounts of urine collected from the same group of students in the hot season and then in the cold season. In both parts of the experiment the diet and activity of the students were the same.

Table 1

Average volume of urine (cm^3)					
	Day 1	Day 2	Day 3	Day 4	Day 5
Hot season	890	895	905	880	910
Cold season	1280	1340	1330	1290	1295

(a) i. Compare the average volumes of urine for both experiments.
ii. Explain your answer to (a) i.

(b) Why is it important to keep the diet and activity the same during both experiments?

(c) If you were told that some of the students from the group were suffering from diabetes (diabetes mellitus), describe how you would test the urine to confirm the presence of diabetes patients in the group.

6. A glass tube was plugged at one end with gauze and filled with dry sand. A similar tube was set up containing dry clay. Each tube was clamped with the gauze end in a beaker of water. The side of each tube was marked at regular intervals of time to show the level of water inside it. The results were plotted in the graphs shown in figure 4.

(a) i. Which graph represents the rise in water level in the tube of sand?
ii. Explain your answer to (a) i.

(b) After how many hours was the rise in water level in each tube the same?

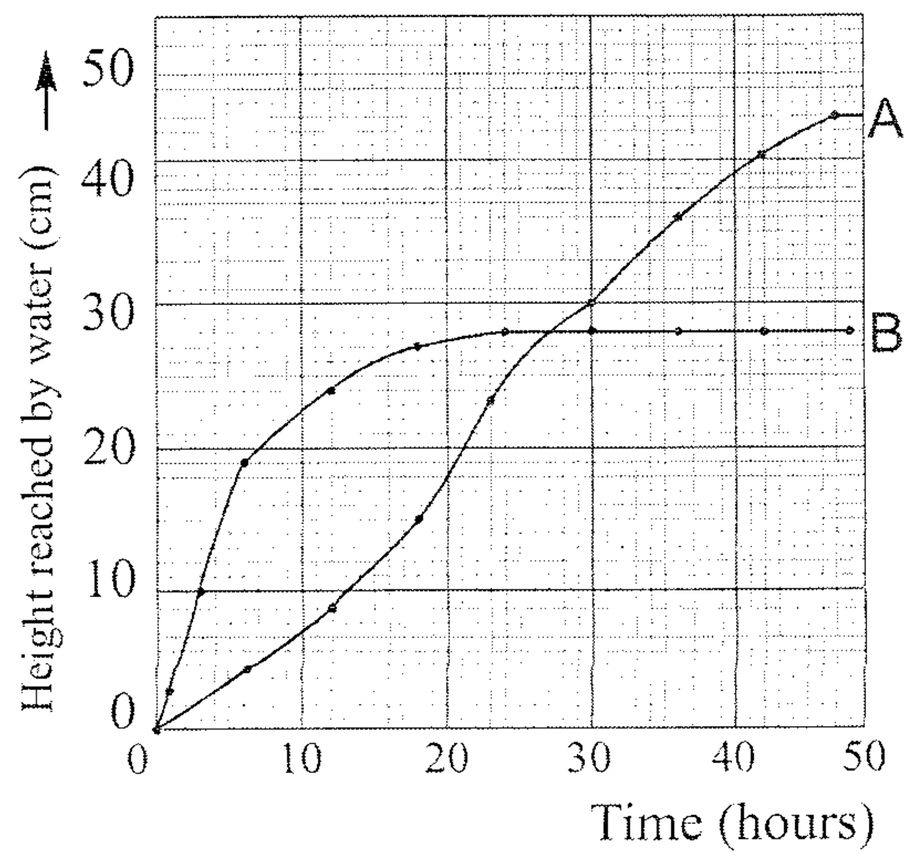


Figure 4

7. (a) Describe how each of the following disease control methods works in plant pathology:

i. Exclusion.
ii. Biological Control.

(b) In most maize stores, some weevils have developed resistance to insecticides like Malathion and Lindane while others are susceptible.
i. Under what condition would resistant weevils continue producing resistant offspring?
ii. What type of selection would result from such maize stores?

(c) Using Koch's Principles, describe how you would obtain conclusive evidence that fungi found in a diseased plant are the actual cause of the disease.

8. **Figure 5** is a diagram showing four pieces of fresh Irish potato each placed in a different tube. The pieces were of the same size and each had a mass of 2.5 g at the beginning of the experiment.

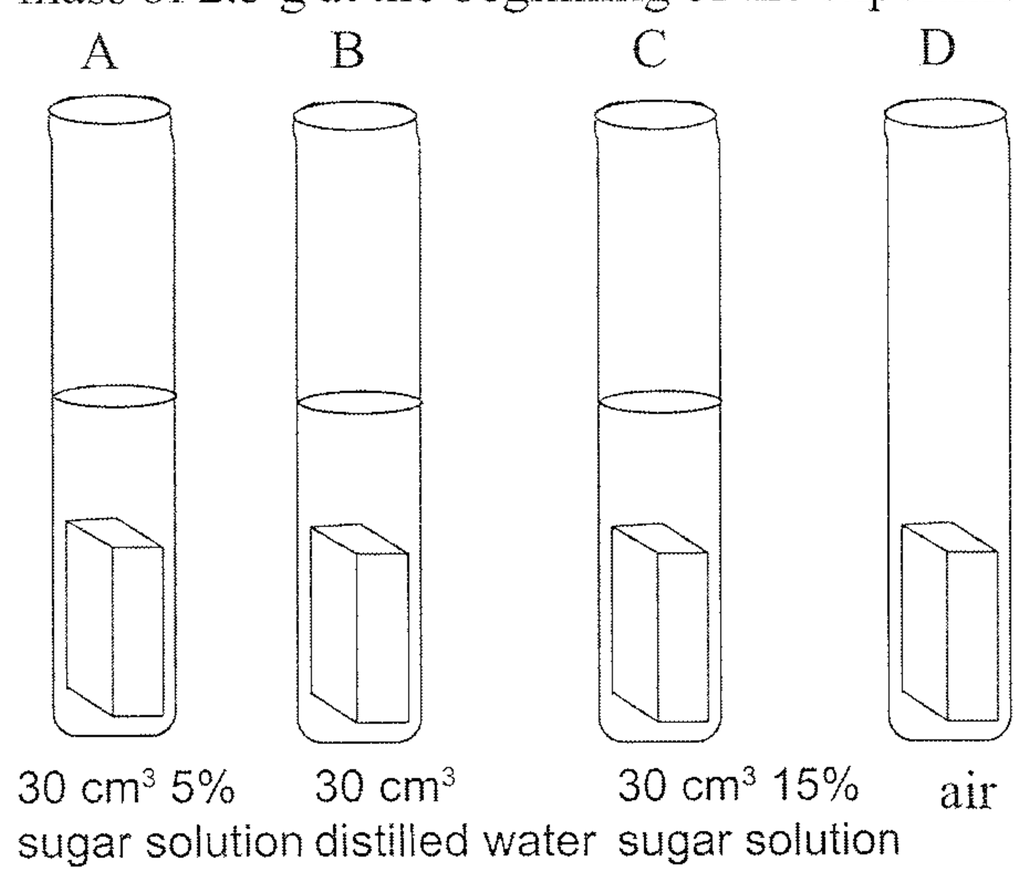


Figure 5

(a) i. In tubes A, B, and C, which piece of potato would have the smallest mass after two days?
ii. Explain your answer to (a) i.

(b) After the same two day period, how would the mass of the piece of potato in diagram D compare with its mass at the beginning of the experiment? Give a reason for your answer.

Comparison:
Reason:

(c) **Figure 6** shows a transverse section of a fresh maize stem after it had been immersed in a solution of a blue dye for several hours.

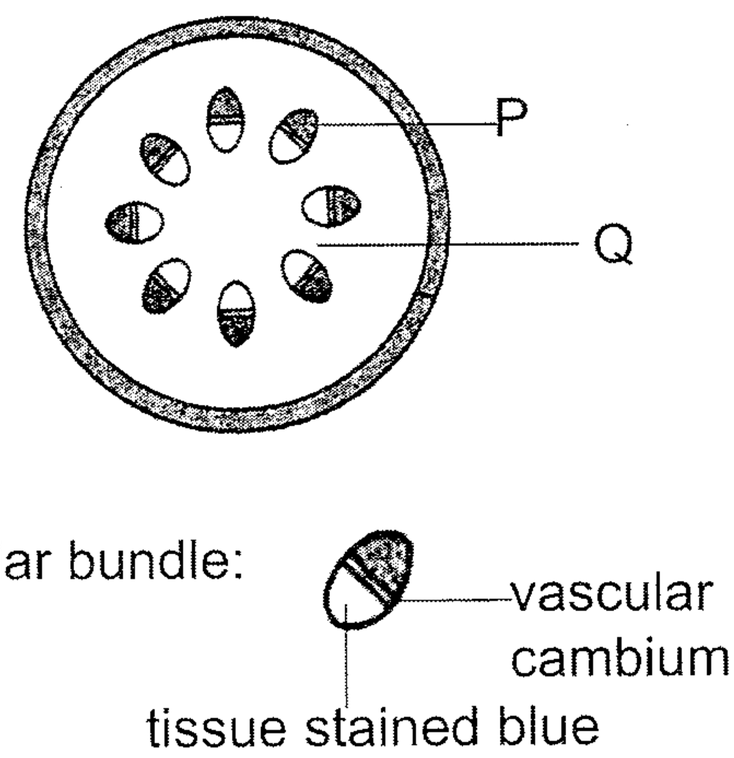


Figure 6

i. Name parts marked P and Q.
ii. What is the function of vascular cambium?
iii. Suggest a reason the tissue marked P is not stained blue.
iv. Give *one* way in which you would distinguish a transverse section of a maize stem from that of a bean stem.

9. **Figure 7** is a diagram showing the average number of decayed teeth per child in relation to different concentrations of sodium fluoride added to drinking water in different areas.

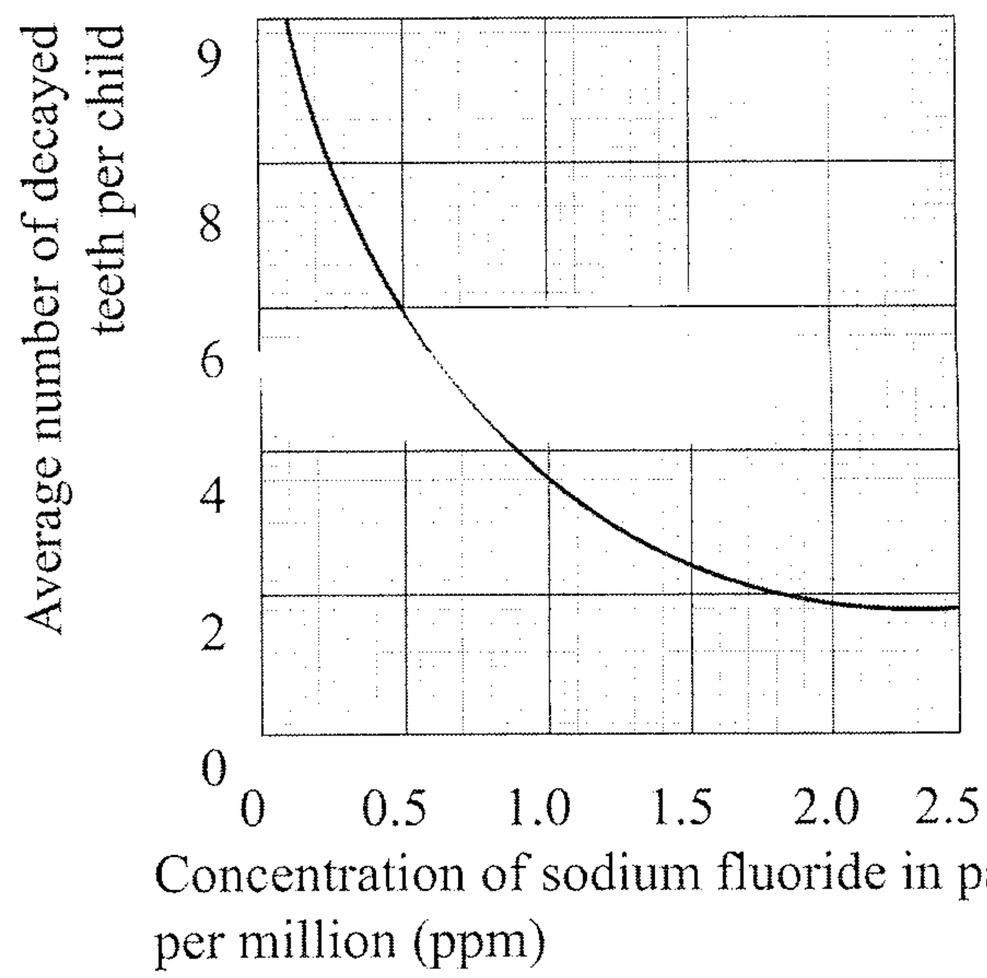


Figure 7

(a) What is the average number of decayed teeth per child in an area of 0.25 ppm of sodium fluoride?

(b) i. From the graphs, give the optimum concentration of sodium fluoride which results in least dental decay.
ii. Give a reason for your answer to (b)i.

(c) What do you think would happen to the average number of decayed teeth if the sodium fluoride content was made greater than 2.5 ppm?

(d) Assume that each child examined for tooth decay began with the dental formula:

$$i\,\frac{2}{2}\quad c\,\frac{1}{1}\quad p\,\frac{2}{2}\quad m\,\frac{0}{0}$$

Calculate the average number of healthy teeth possessed by a child living in an area of 0.5 ppm of sodium fluoride in the drinking water.
Show your working.

10. **Figure 8** shows some of the stages which occur in the female reproductive system of a mammal.

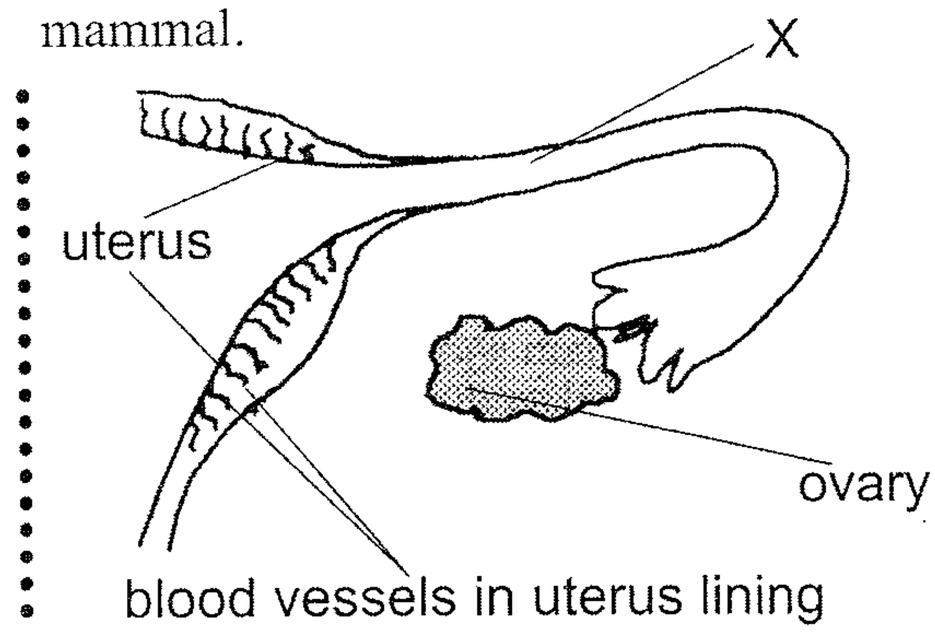


Figure 8-A

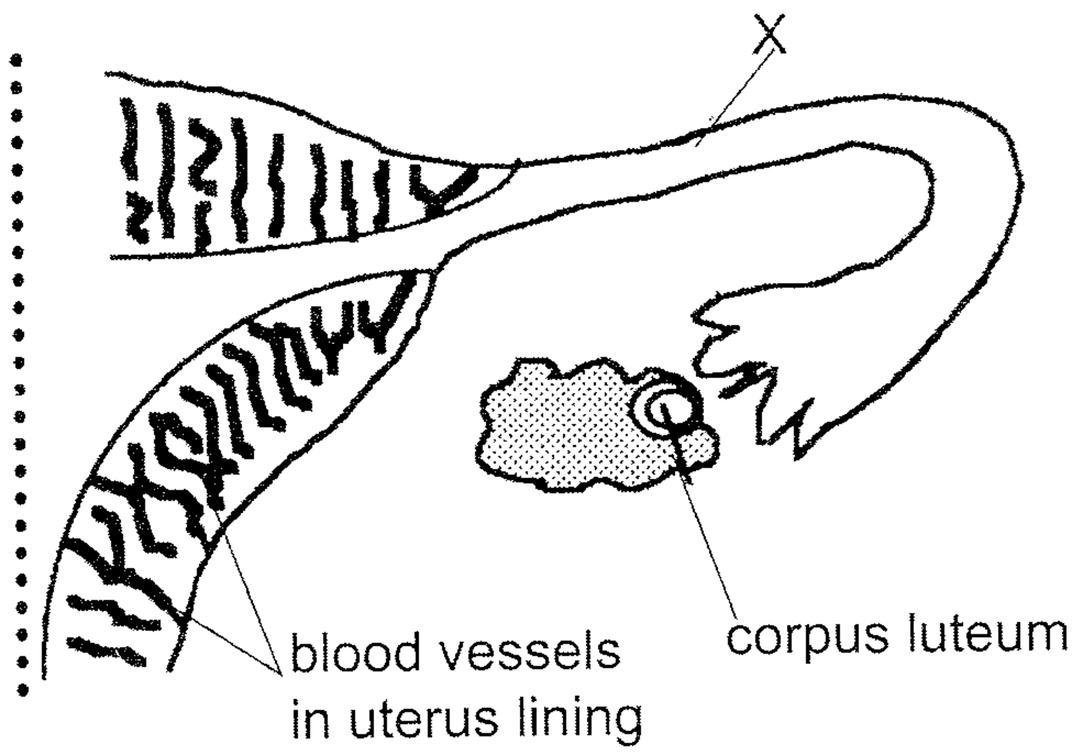


Figure 8B

(a) Give *one* structural adaptation of the part marked X.

(b) Write down *two* structural defferences shown in A and B.

(c) i. Which gland in the brain secretes a follicle stimulating homorne (FSH)?

ii. State *one* function of follicle stimulating hormone.

(d) Progesterone is one of the essential hormones during pregnancy.

i. What happens to the level of progesterone to cause the changes seen in figure 8B?

ii. Give a reason for your answer to (d) i.

11. **Table 2** shows the approximate values for the blood flow at rest through various organs.

Table 2

Organ	Blood flow (cm^3 per 100 g of tissue)
Liver	150
Heart muscle (coronary circulation)	100
Brain	65
Hand	10

(a) What is a tissue?

(b) Explain why the blood flow through the liver is so high.

(c) i. How many times greater is the blood flow through the heart muscle than the hand? Show your working.

ii. Explain why the blood to the heart muscle is greater than that to the hand.

(d) The results in the table apply to someone at rest. Name an organ listed in the table which would receive about the same volume of blood during vigorous exercise as it does at rest.

12. A student hears the ringing of a bell at the end of the day and begins to pack his books to go home. Describe the path of the stimulus from the source (bell) to its appropriate centre in the brain.

13. Explain the energy flow in a woodland ecosystem in different feeding levels.

1. **Figure 1** is a diagram of the liver and its related structures.

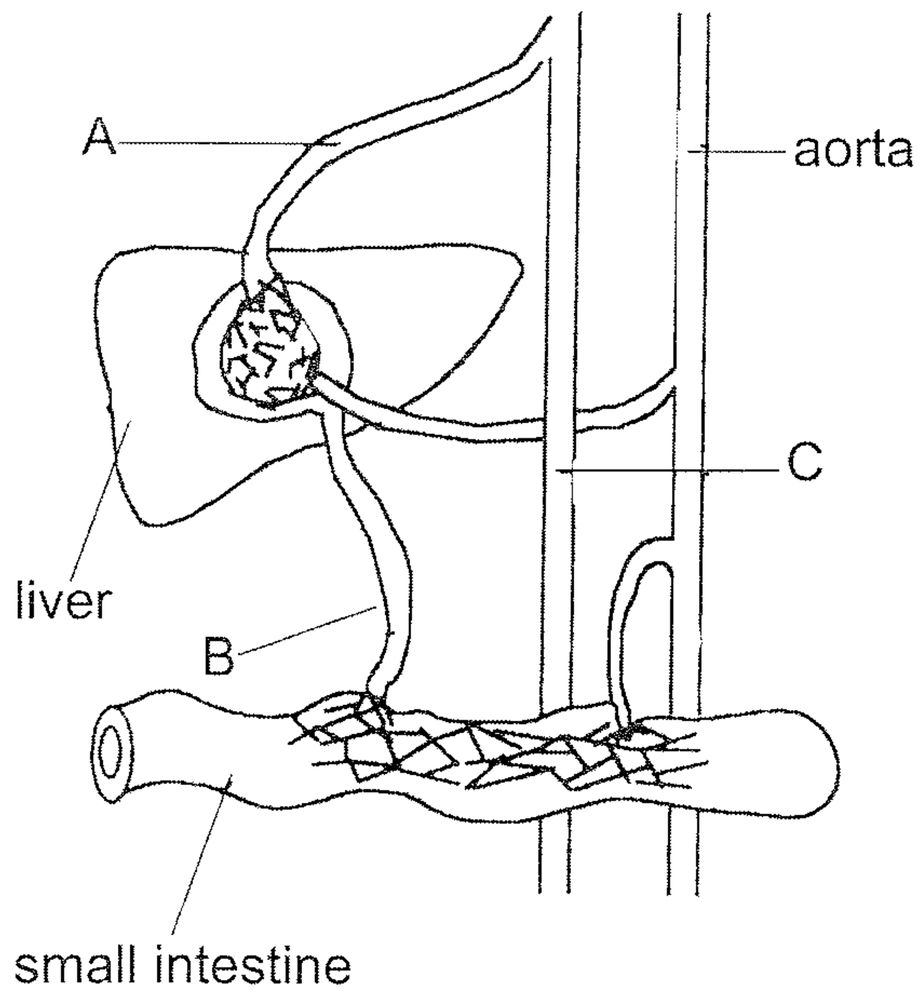


Figure 1

(a) Name the blood vessels labelled A, B, and C.

(b) On the diagram itself draw arrows to show the direction of blood flow in A, B, and C.

(c) i. What will be the difference in sugar levels between the blood in vessel A and the blood in vessel B soon after a meal?
ii. Explain your answer to (c)i.

(d) What is deamination?

(e) Besides deamination, name *one* other function of the liver.

2. (a) Give *two* differences between heavy soils and light soils.

Heavy soil	**Light soil**
1. 2.	

(b) State *one* advantage and *one* disadvantage of each of the soils mentioned in 2(a).

Type of soil	**Advantage**	**Disadvantage**
Light		
Heavy		

(c) In what *two* ways might lime improve heavy soil?

3. **Table 1** shows cases of malaria which were treated at a heath centre in 1989.

Table 1

Time (months)	Jan	Feb	Mar	Apr	May	June
No of cases	704	612	861	705	666	393

Time (months)	July	Aug	Sept	Oct	Nov	Dee
No of cases	318	410	529	186	439	459

(a) Draw a histogram of number of cases against time (months).

(b) i. From the histogram, in which month was the incidence of malaria highest?

ii. Suggest a possible reason for your answer to 3(b)i.

(c) List *three* methods of preventing malaria.

4. (a) Explain the advantages to the green plant of the following adaptations in connection with photosynthesis.

i. Broad and flat leaves;
ii. More chloroplasts on the upper surface.

(b) Write down a balanced chemical equation which summarises the process of photosynthesis.

(c) i. Under what condition would a green leaf give out carbon dioxide and take in oxygen?
ii. Explain your answer to 4(c)i.

5. (a) What is variation?

(b) Name *two* factors which may bring variation within species.

(c) Pest control campaigns in some tropical areas were mounted in the 1950s using DDT in order to eradicate malarial mosquitoes. The mosquito population was considerably reduced and numbers remained low for several years. Then in the 1960s the numbers began to rise again in spite of the repeated application of DDT.

i. Explain these results.
ii. From your answer to 5(c)i, suggest how variation may be beneficial to a species.

6. **Figures 2A** and **2B** represent a section of the skin of a warm blooded animal at different environmental temperatures.

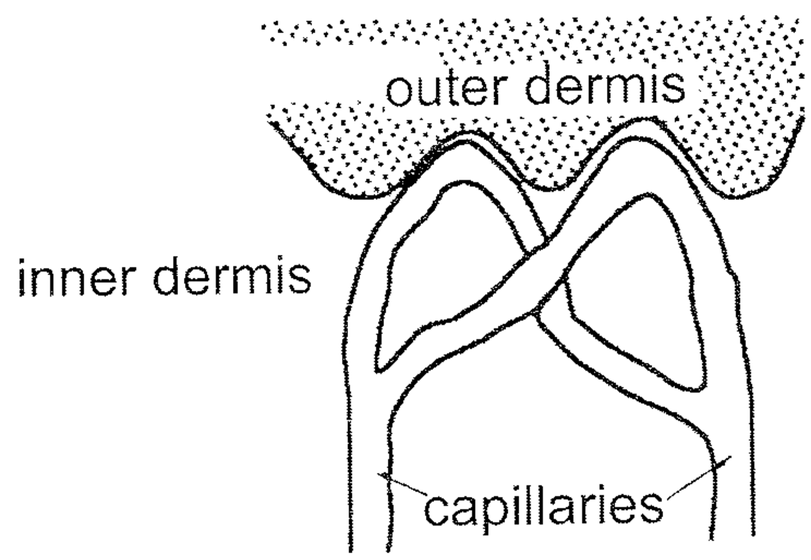


Figure 2A

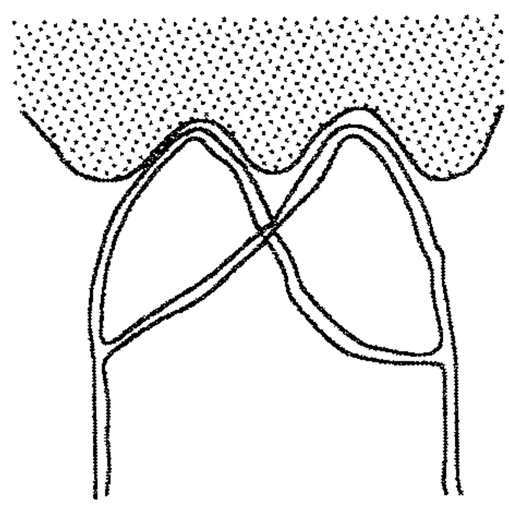


Figure 2B

(a) i. Which figure is showing the skin at a higher temperature?
ii. Explain your answer to 6(a)i.

(b) Give *two* ways by which the human body responds to low environmental temperature.

(c) Why is it necessary for mammals to keep a constant body temperature?

7. **Figures 3A** and **3B** show skulls of a herbivore and a carnivore.

Figure 3A

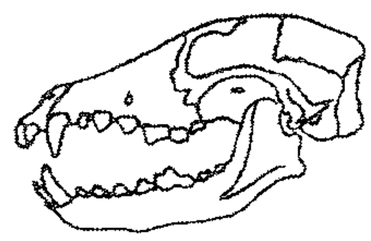


Figure 3B

(a) i. Which figure is showing a carnivore skull?
ii. Explain your answer to 7(a)i.

(b) What is the significance of the gap between incisors and premolars in figure 3A?

(c) One reason why teeth stop growing is that openings into the pulp cavities of the roots get smaller and reduce the blood supply to the teeth. Suggest why this reduction of blood supply stops growth of the teeth.

8. **Figure 4** is a diagram of a feather.

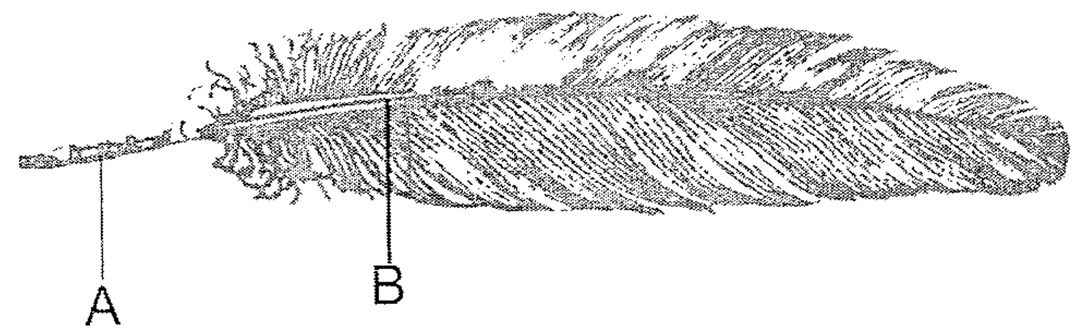


Figure 4

(a) Name the parts labelled A and B.

(b) What type of feather is shown in figure 4?

(c) Give *two* ways in which a bird's wing is adapted for flying.

(d) One of the forces which a bird experiences during flight is drag.

i. Explain how drag is caused.
ii. State how a bird overcomes the drag during flight.

9. **Figure 5** is a diagram representing part of the human ear in longitudinal section.

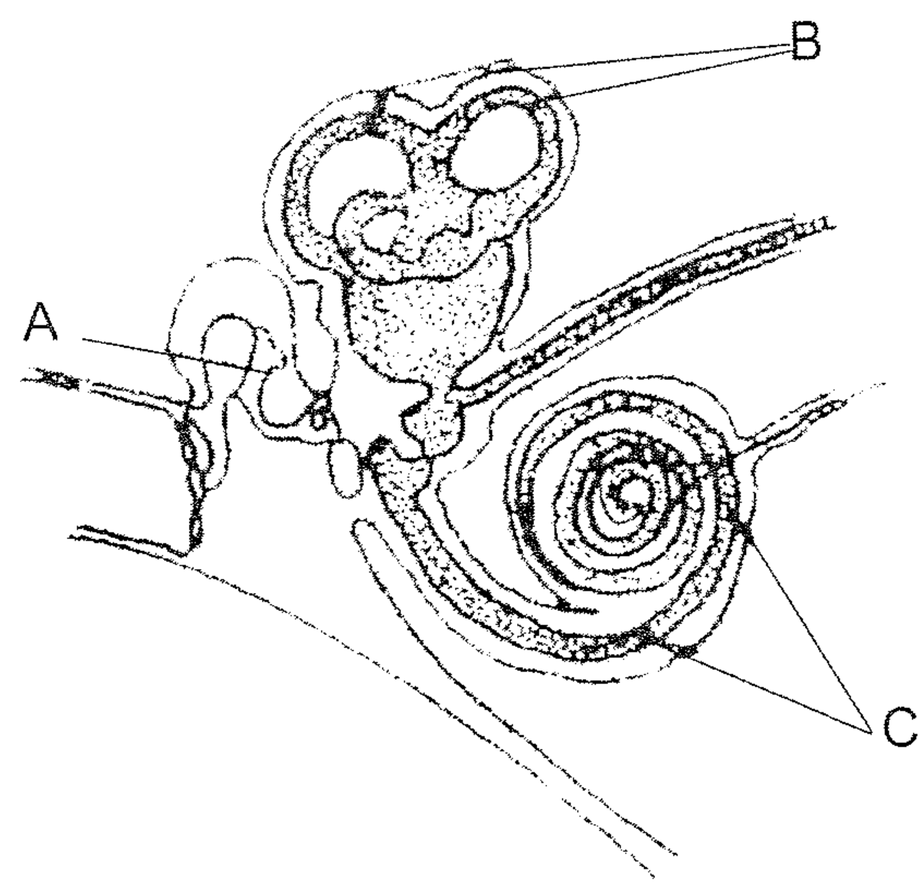


Figure 5

(a) Name the structures labelled A, B, and C.

(b) State *one* function of the structure labelled B.

(c) State *two* functions of ear ossicles.

(d) Give *two* ways by which the ear-drum may be damaged.

(e) What *three* energy changes take place from the time sound is produced to the time you hear the sound?

10. **Figure 6** shows a diagrammatic outline of the process of sexual reproduction.

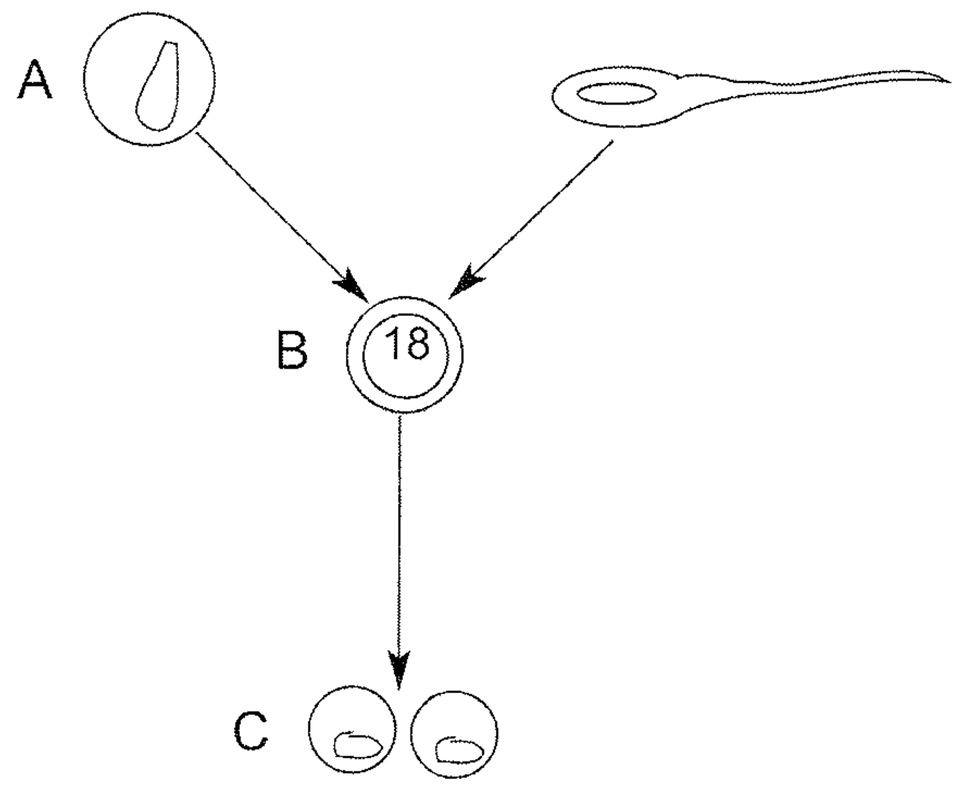


Figure 6

(a) i. What name is given to the cell formed at B?

ii. What name is given to the process taking place in the cell formed at B that gives rise to the cells at C?

iii. Write down the number of chromosomes present in each of the cells at A and C.

(b) State the importance of the process leading to the formation of the cell at B.

(c) In what part of the flowering plant does the process leading to the formation of the cell at B take place?

11. **Table 2** shows sugar concentration in plant leaves at different times of the day.

Table 2

Time of day	4.00 am	8.00 am	12.00 noon	4.00 pm	8.00 pm	12.00 mid night	4.00 am
Sugar conc. (mg):	0.45	0.60	1.75	2.00	1.40	0.50	0.45

(a) Plot a graph of the data on the graph paper provided, putting sugar concentration on the vertical axis, and time on the horizontal axis.

(b) What is the concentration of sugar in the leaves at 2.00 pm?

(c) At what times would the concentration of sugar in the leaves be 0.9 mg?

(d) Explain why the concentration of sugar decreases after the maximum.

12. (a) Below are some methods of food preservation. Explain the biological principles underlying each one of them.

i. Dehydration.
ii. Freezing.
iii. Salting.

(b) State *two* ways in which micro-organisms may be beneficial to human beings.

1. **Figure 1** is a diagram of an apparatus in an experiment on photosynthesis. The potted plant was destarched before setting the experiment in the sun.

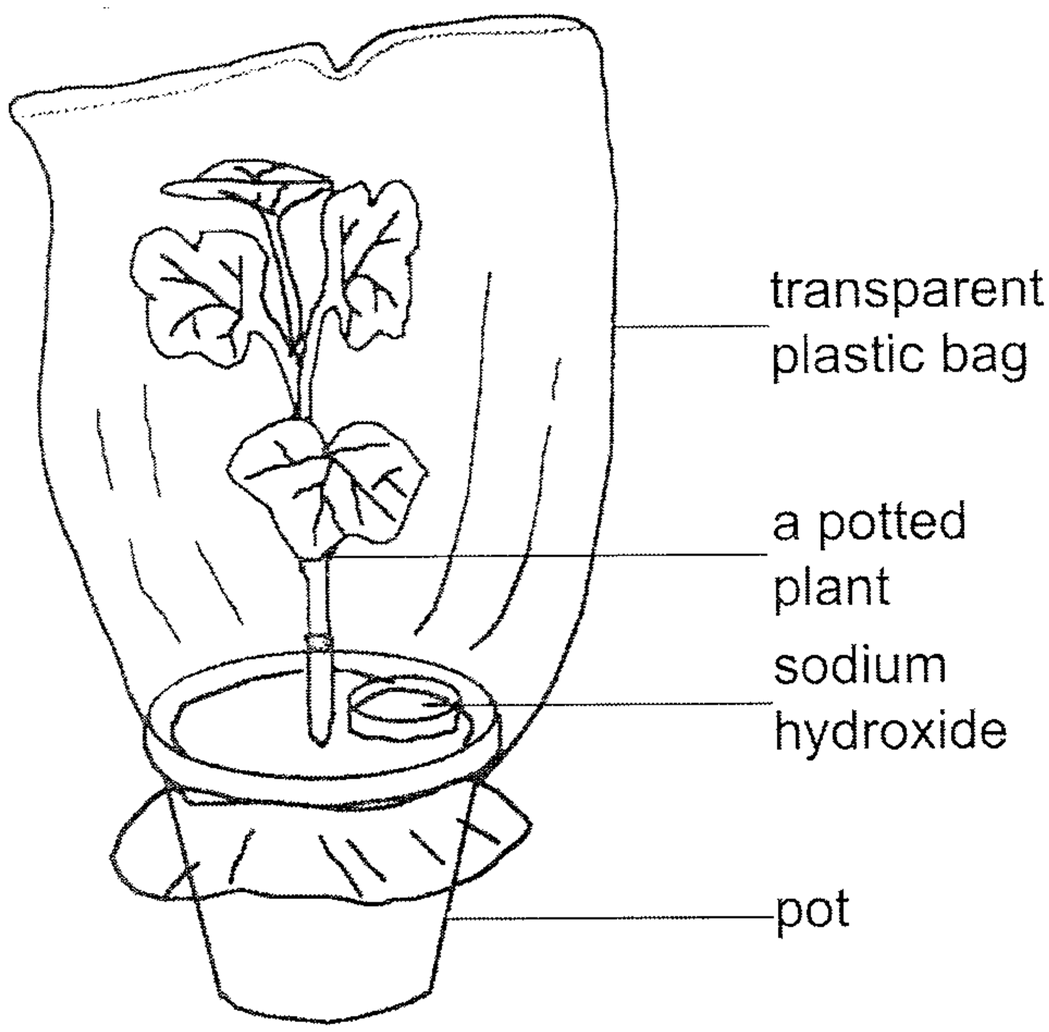


Figure 1

(a) What is the aim of this experiment?

(b) Why is sodium hydroxide used in this experiment?

(c) How would you set up a control for this experiment?

(d) i. State how the plant was destarched.

ii. Suggest *one* reason a potted plant is suitable for this experiment.

2. **Figure 2** is a diagram of a longitudinal section of a human kidney.

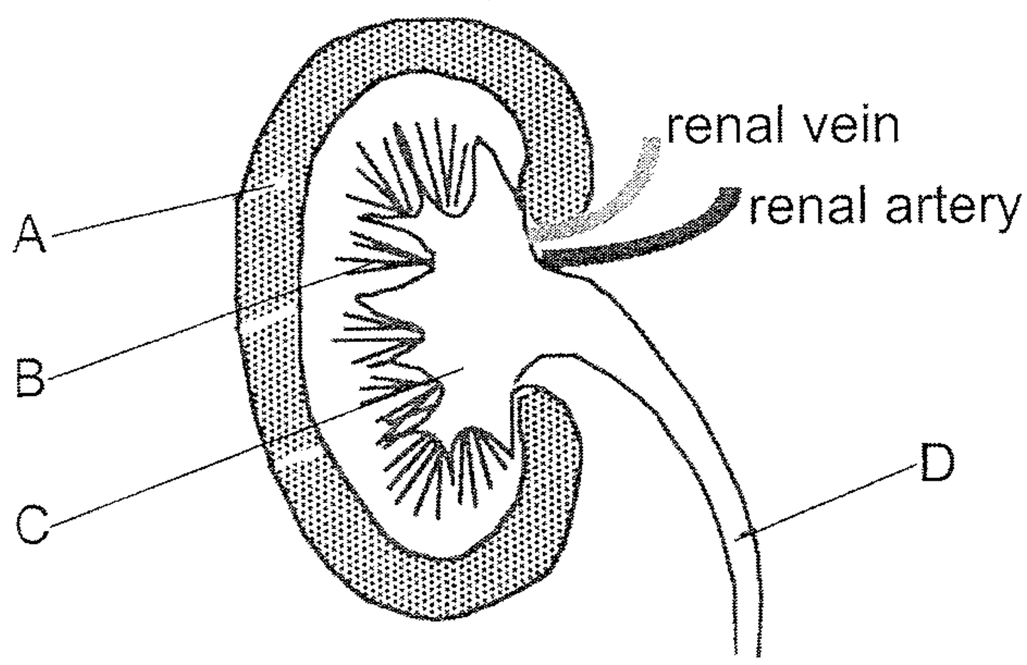


Figure 2

(a) Name the parts labelled A, B, and C.

(b) In which region of the kidney as shown in figure 2, does filtration take place?

(c) Give the function of structure labelled D.

(d) i. Which of the renal vessels has a higher concentration of urea?

ii. Explain your answer to (d)i.

(e) Useful substances such as glucose are in higher concentration in the blood than in the kidney tubules. Suggest how these substances are reabsorbed from the tubules.

3. Dichlorophenol indophenol (DCPIP) is an indicator which can show the presence of vitamin C. DCPIP changes colour from blue to colourless in the presence of vitamin C.

Table 1 shows results of an experiment on some foodstuffs carried out by a class.

Table 1

Food substance	Treatment	Results
Milk	a few drops of DCPIP added	blue
Guava juice	a few drops of DCPIP added	colourless
Tamarind juice (*bwemba*)	a few drops of DCPIP added	colourless

(a) What do the results in table 1 indicate?

(b) Each of the three samples of foodstuffs was boiled for 10 minutes and then a few drops of DCPIP added.

i. What results would you except?

ii. Suggest a reason for your answer.

(c) What disease does vitamin C prevent?

(d) Name a vitamin which must be present in the body for the body to use calcium.

(e) Give *one* vitamin which is commonly found in butter.

4. White flowers (genotype **WW**) and red flowers (genotype **RR**) of pure bred balsam plants were cross-pollinated. The resulting flowers were all pink.

(a) What is the genotype of the pink flowers?

(b) If the pink flowers were self-pollinated, what would be the ratio of white, pink, and red flowers? Show your working.

(c) Suggest a possible explanation for the ratio you have obtained in (b) above.

5. **Figure 3** is a diagram of a root tip.

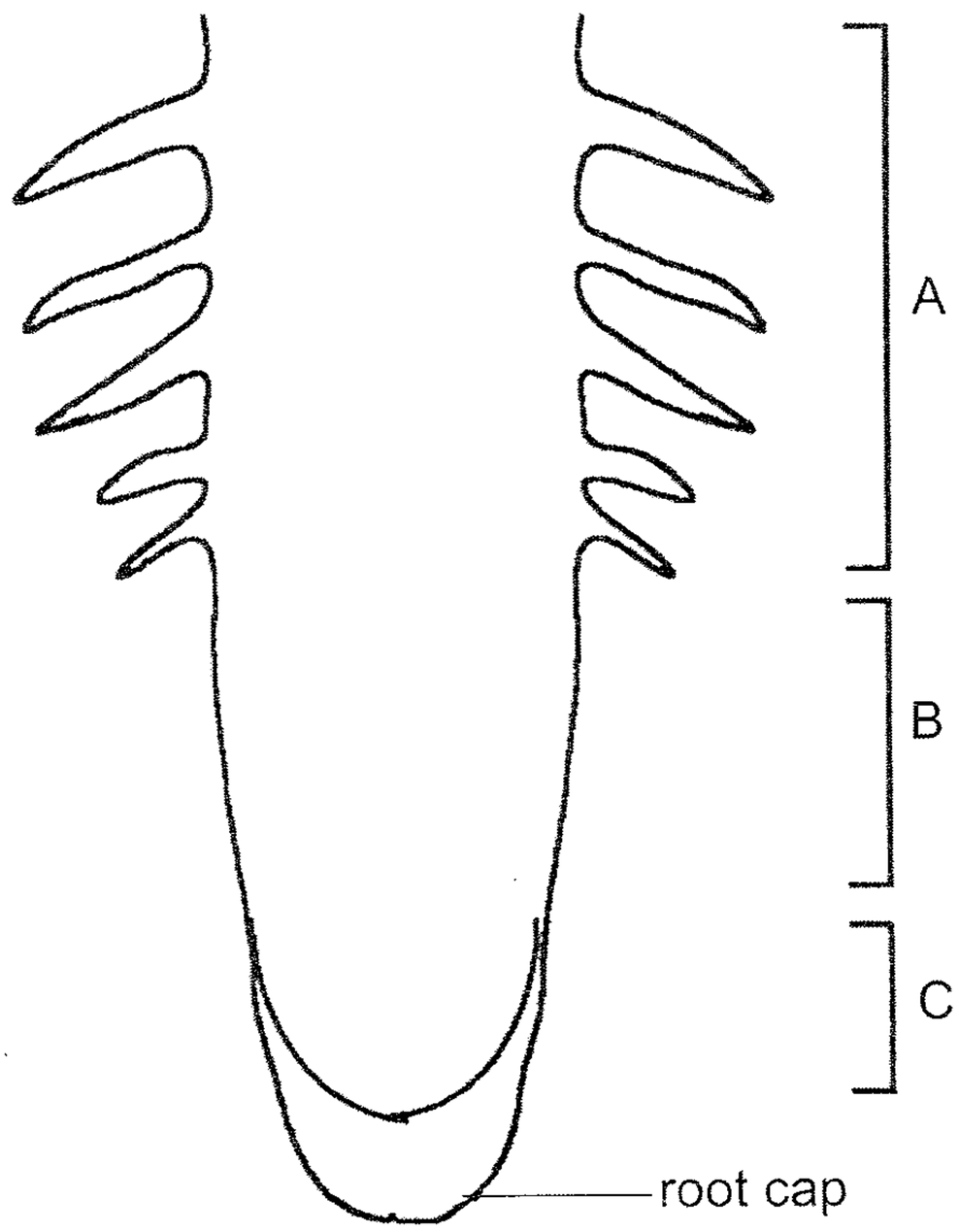


Figure 3

(a) Name the zones labelled A, B, and C.

(b) Why are there many root hairs in zone A?

(c) Name a water conducting vessel in a flowering plant.

6. (a) In each case state *two* ways in which micro-organisms are (i) helpful and (ii) harmful to humans.

i. Helpful ways:
ii. Harmful ways:

(b) Explain how some bacteria such as Clostridium may cause food poisoning

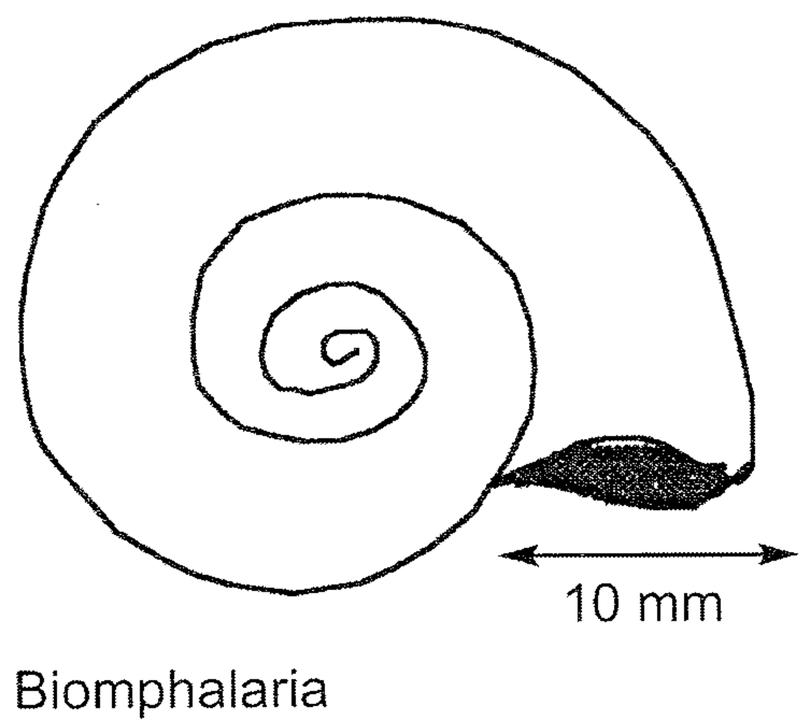
(c) Name *two* human diseases which are caused by parasitic fungi.

7. A student found many caterpillars feeding on mango leaves in a school fruit garden. Some birds were picking up the caterpillars.

(a) Draw a labelled diagram of a pyramid of numbers to show this relationship.

(b) i. What type of data would you use to get a differently shaped pyramid?
ii. How would you obtain the information (data) named in (b)i?
iii. What name is given to the pyramid drawn from the data collected in (b)ii ?

8. **Figure 4** shows snail vectors of the bilharzia worm.



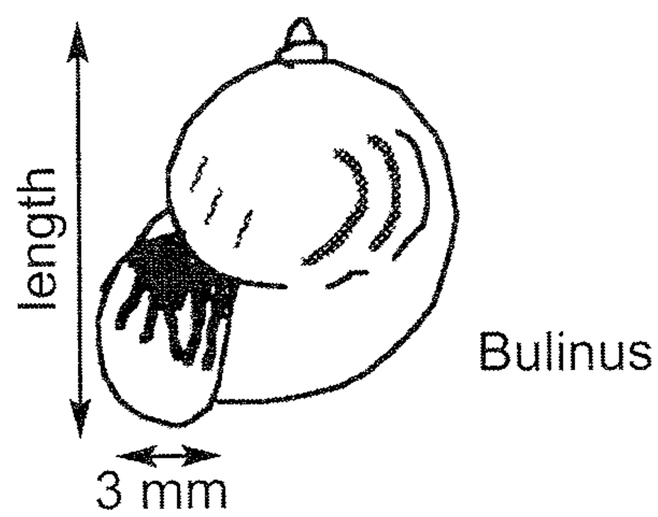


Figure 4

(a) What name is given to the larvae which leave the body of a snail and swim in water?

(b) Name the type of bilharzia transmitted by each of the two vector snails.

Biomphalaria:
Bulinus:

(c) Calculate the actual length of the Bulinus snail.

(d) Give *one* way through which bilharzia can be transmitted.

(e) Suggest *two* ways of controlling the population of the snail vectors.

(f) Give *one* way by which you could tell that a person has bilharzia.

9. **Table 2** shows the estimated numbers of organisms recorded per m^2 in a fish pond of total surface area of 400 m^2.

Table 2

Organism	Estimated number
Small fish	20
Microscopic algae	900
Snails	10
Carnivorous large fish	5
Mosquito larvae	200

(a) From table 2 above,

i. which organism has the least population density?

ii. calculate the total estimated population of small fish for the whole pond. Show your working.

(b) Construct a food web consisting of *three* organisms from the fish pond mentioned above.

(c) What name is given to:

i. the pond together with all the organisms it contains?

ii. all the organisms found in the pond?

10. Ten maize seedlings were grown and their tips cut off. The lengths of the seedlings were then measured. A mixture of Vaseline and auxin was applied to the cut surface of five of the seedlings, and Vaseline only to the remaining five. After three days the seedlings were measured again. The results are summarised in table 3.

Table 3 (length in mm)

Vaseline		Vaseline with auxin	
Initial length	Final length	Initial length	Final length
22	29	22	36
20	26	23	37
26	33	18	34
23	29	26	40
21	25	20	35

(a) Calculate the average increase in length of the seedlings for each treatment. Show your working.

(b) What is the aim of this experiment?

(c) Explain the results in the two treatments. Assuming that the results of this experiment are valid and reliable, suggest how a farmer could use this knowledge.

(e) Which is the control in this experiment?

11. Explain the importance of water to living things.

12. Discuss the dependence of humans on forests.

1. **Figure 1** is a diagram of a human alimentary canal.

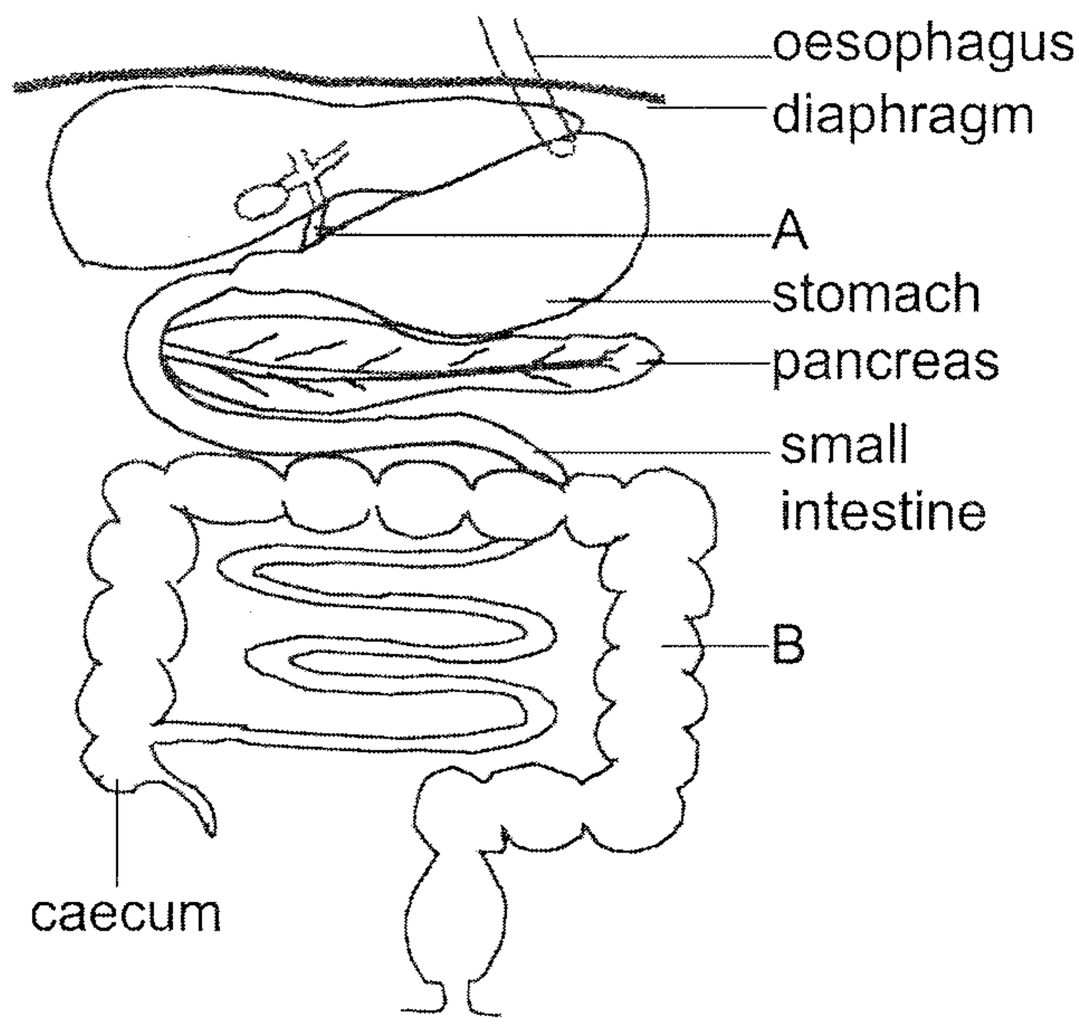


Figure 1

(a) Name the parts labelled A, B, and C.

(b) What is the function of the part labelled B?

(c) State the effect of reducing the length of the small intestine.

(d) State *two* functions of the pancreas.

2. (a) State *three* ways in which trees prevent soil erosion.

(b) Apart from vegetation give *two* soil conditions which are likely to result in sheet erosion.

(c) Explain how the following soil properties are determined by the size of the soil particles:

i. water retention;
ii. capillarity.

3. **Figure 2** is a diagram of a variegated leaf on a plant which had been left in the dark for 24 hours. The leaf was then partly covered with a piece of light-proof paper which had a hole in the middle. The plant was placed in the sun for 4 hours. The leaf was then tested for starch.

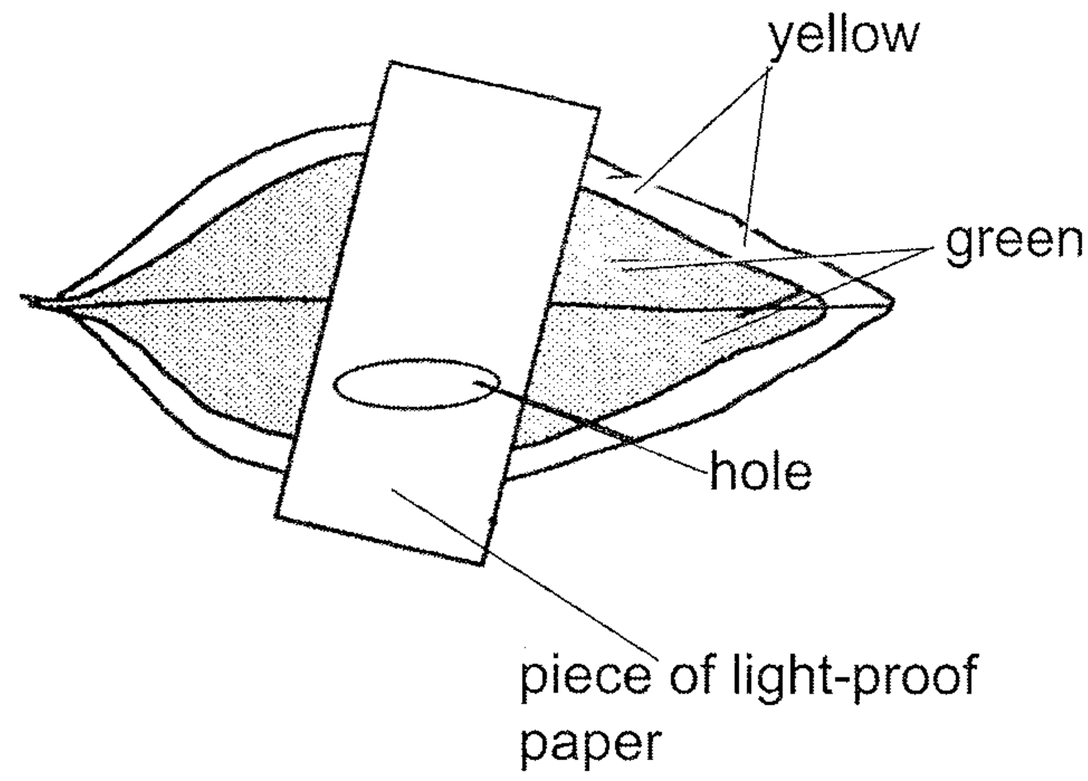


Figure 2

(a) Why was the plant left in the dark for 24 hours?

(b) Draw a labelled diagram of the leaf after the starch test.

(c) What conditions necessary for photosynthesis are being investigated in this set-up?

(d) The process of photosynthesis occurs in *two* main stages. What are these stages?

4. Acquired Immune Deficiency Syndrome (AIDS) is a disease caused by the Human Immuno deficiency Virus (HIV).

(a) Which part of the blood is attacked by HIV?

(b) Name any *two* symptoms of AIDS.

(c) Why is a person infected with HIV more liable to catch other diseases?

5. An experiment was carried out to study the growth rate of a population of bacteria. Bacteria were introduced into a 2 litre flask containing 500 m*l* of sterile nutrient both and then incubated at 35°C. Every two hours a 1 m*l* sample was extracted from the flask using a sterile pipette. The number of live bacteria in the sample was determined. The results are shown in table 1 below.

Table 1

Time from start (hours)	2	4	6	8	10
Number of live bacteria in 1 cm^3 (millions)	10	25	205	220	230

Time from start (hours)	12	14	16	18	20
Number of live bacteria in 1 cm^3 (millions)	225	210	100	40	10

(a) State how nutrient broth is sterilised.

(b) Draw a graph of the number of live bacteria against time on graph paper.

(c) From the graph find the population growth rate of bacteria between 5 and 6 hours. Show your working.

(d) Suggest *two* possible reasons why the population fell between 10 and 20 hours.

6. **Figure 3** is a diagram of part of a human forearm.

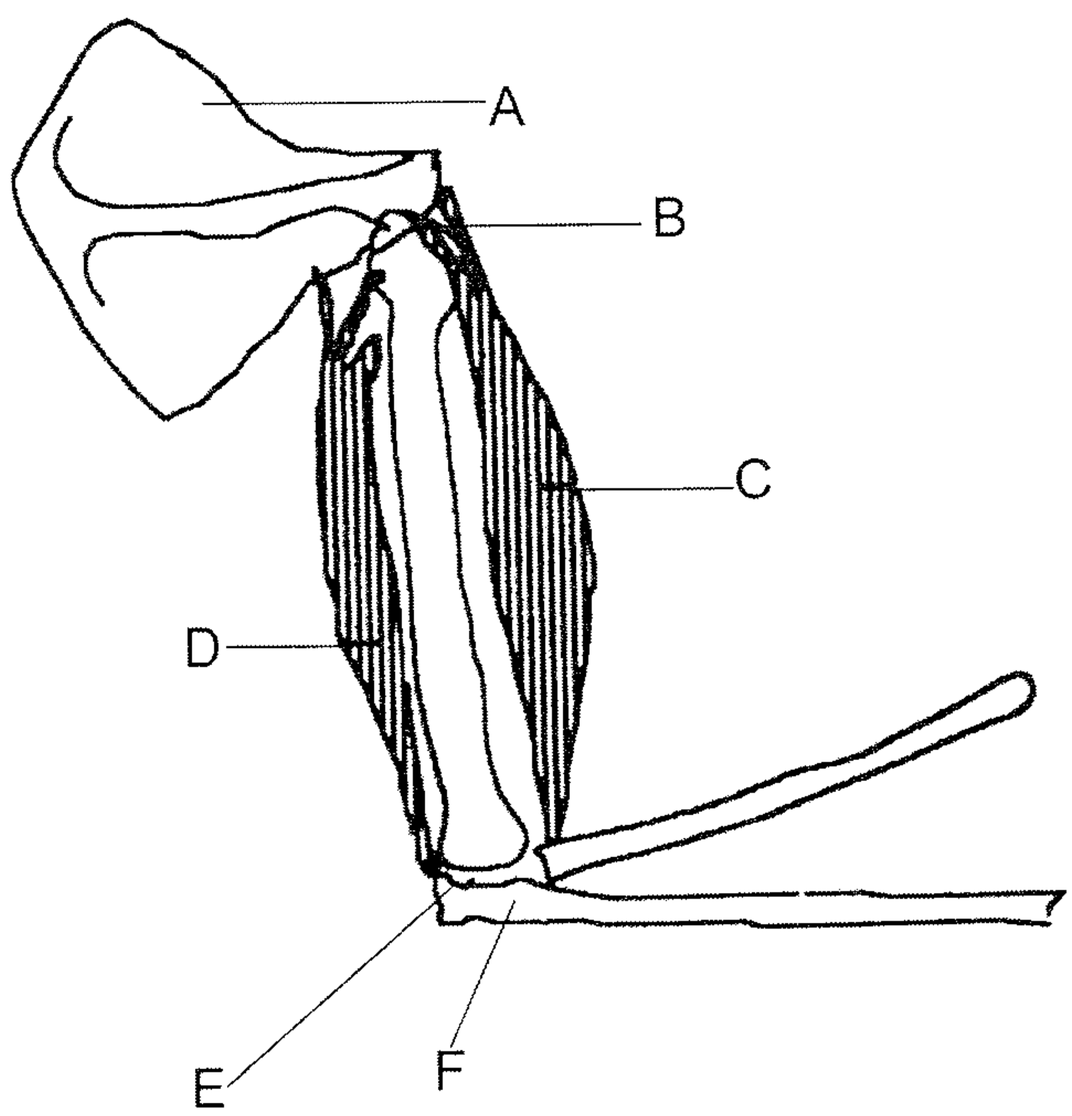


Figure 3

(a) Name the parts labelled A, C, and F.

(b) What type of joint is found at B?

(c) How do parts labelled C and D bring about movement of the arm?

(d) Name the fluid found at E.

(e) State the function of the fluid found at E.

(f) Name a disease that affects joints.

7. **Figure 4** is a diagram of a nephron with its blood supply.

(a) Name the parts labelled A and B.

(b) Indicate using arrows how the filtrate flows in the nephron.

(c) Explain how pressure is built up in the structure marked A.

(d) The concentration of urea in the urine excreted from the human body is about 60 times greater than the concentration in blood plasma. Name *two* processes that bring about this difference in concentration.

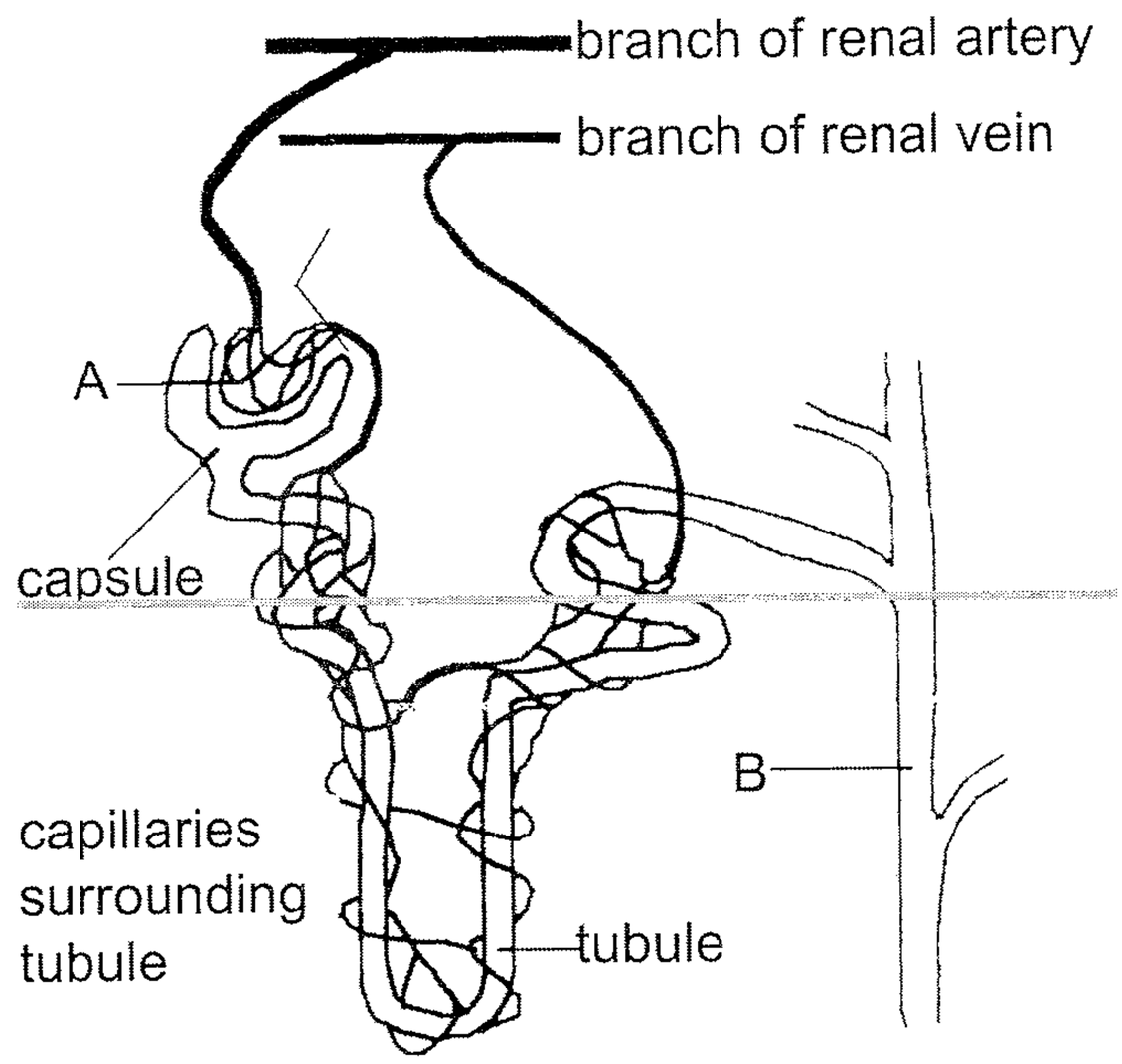


Figure 4

8. **Figure 5** is a diagram showing the general structure of a sperm cell.

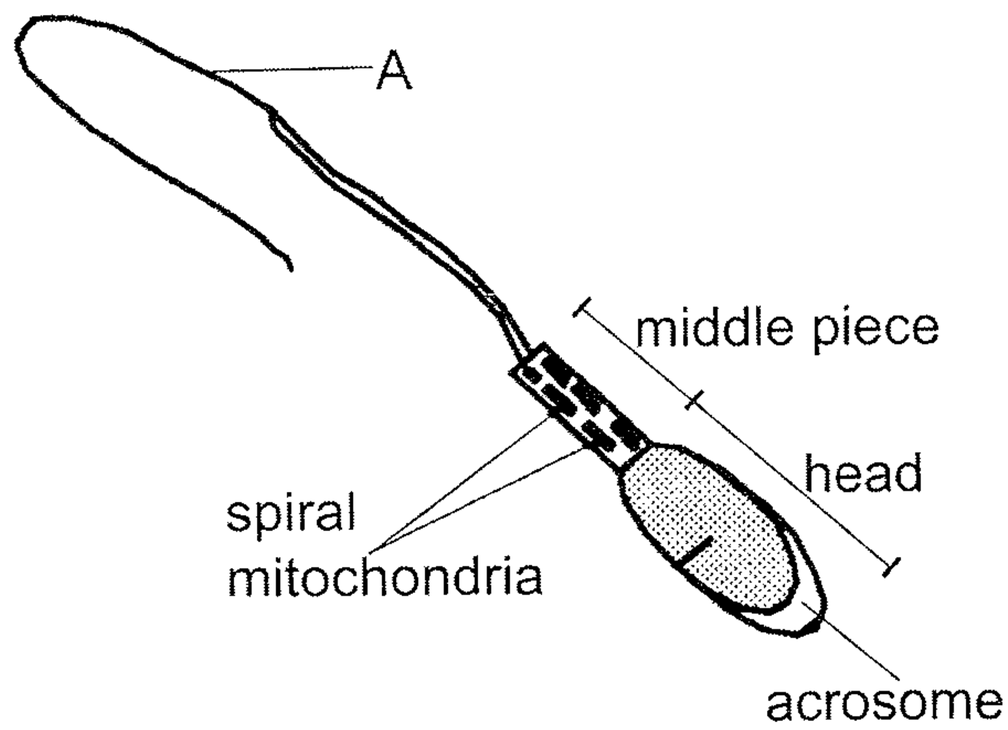


Figure 5

(a) Name the parts labelled A and B.

(b) What is the function of:

i. enzymes found in the acrosome;
ii. mitochondria in the middle piece ?

(c) State *two* ways in which a mammalian sperm differs from a mammalian egg.

Sperm	Egg

(d) Where in the maize plant would you find a male gamete?

9. **Figure 6** is a graph showing corresponding changes in the amount of lactic acid, the rate of oxygen supply and the rate of energy use, during and after exercise.

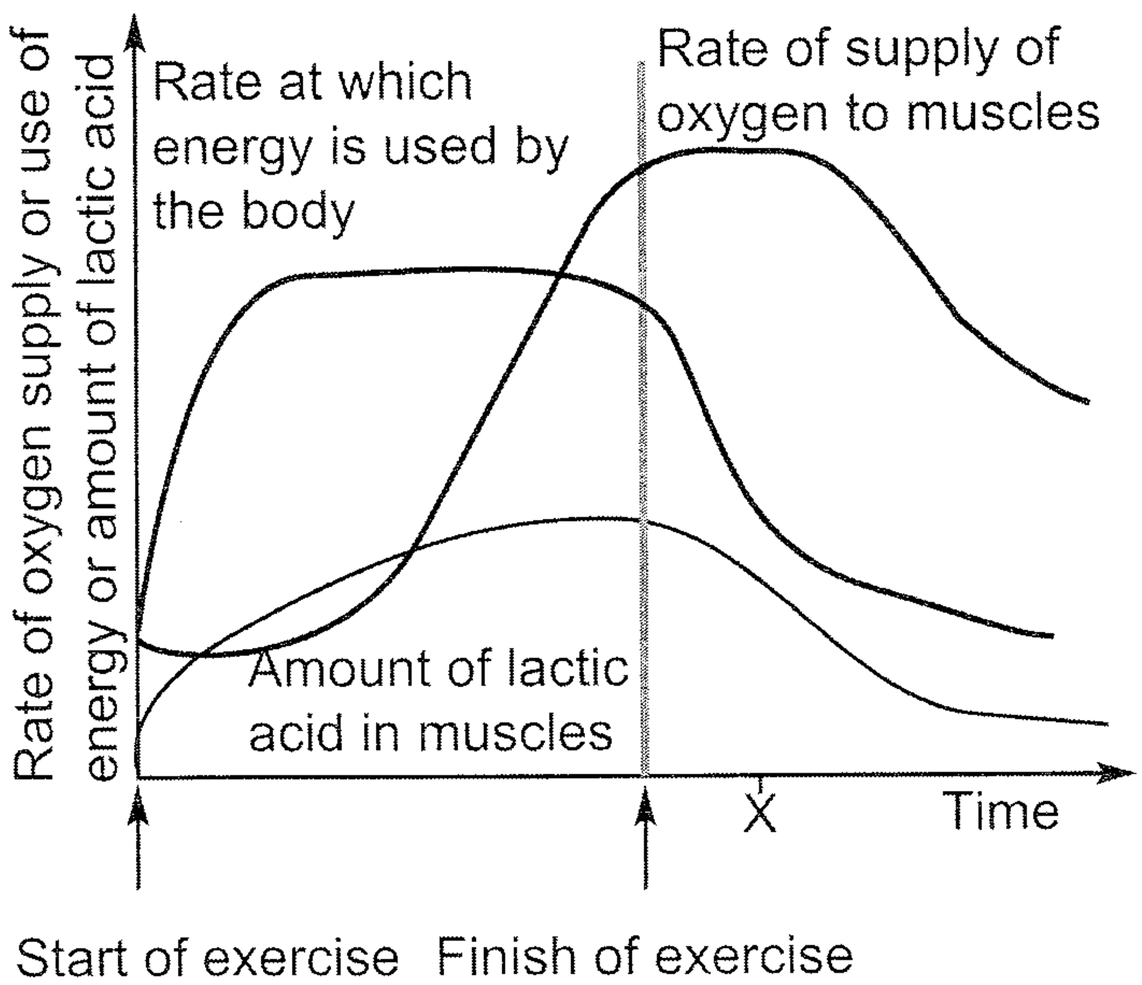


Figure 6

(a) Describe the rate at which energy is used by the body from the start of the exercise to the point marked X.

(b) What is the source of energy released during muscular activity?

(c) What causes muscle fatigue during strenuous exercise?

(d) Describe what happens to the rate of supply of oxygen to muscles after the exercise has finished.

(e) Explain why the amount of lactic acid in the muscles decreases after the exercise has finished.

10. **Figure 7** is a diagram of a longitudinal section of a sieve tube.

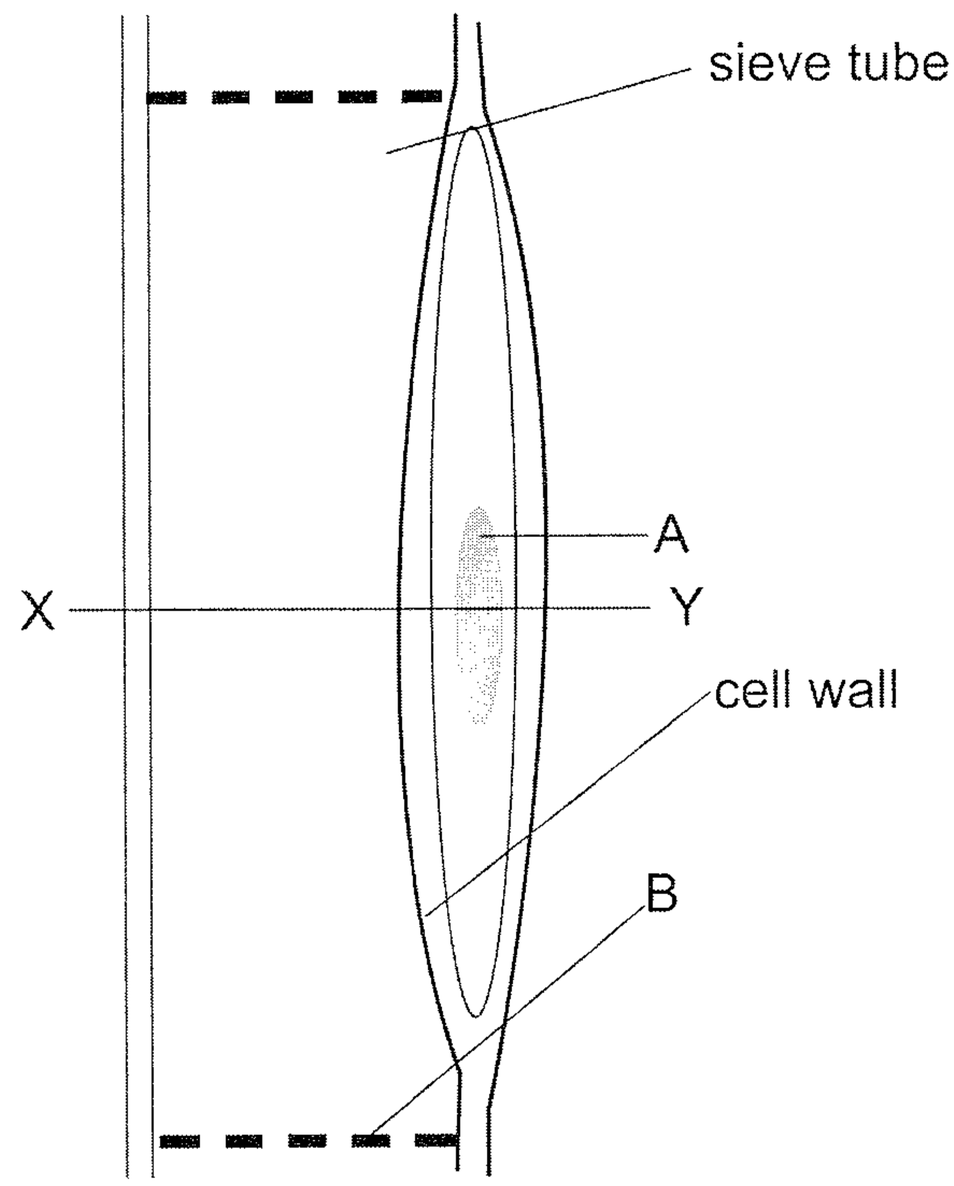


Figure 7

(a) Name the parts labelled A and B.

(b) Draw a labelled diagram of the cross section of the sieve tube and the adjacent cell along line XY.

(c) Name *one* substance that is transported by the sieve tube.

(d) State *two* structural differences between a phloem tube and a xylem vessel.

Sieve tube	Xylem vessel

11. **Figure 8** shows a diagram of a simple reflex arc.

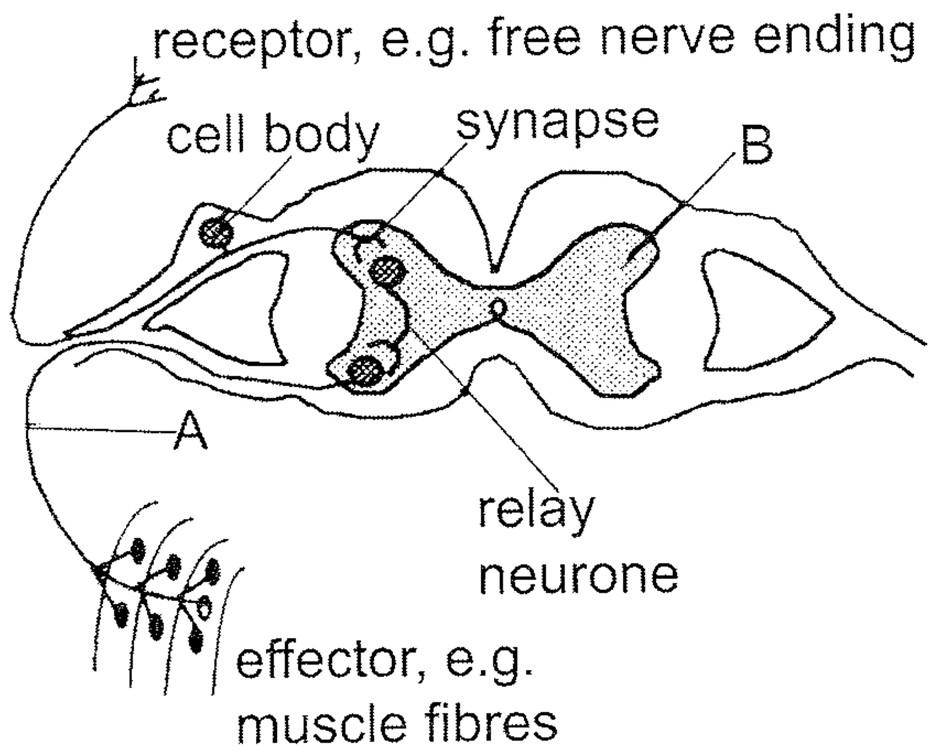


Figure 8

(a) Name the parts labelled A and B.

(b) i. Give an example of a reflex action.
ii. State the importance of the reflex action named in 11(b)i.

(c) How are the impulses transmitted across the synapses?

(d) On the diagram, mark with an X the part affected by leprosy.

12. **Figure 9** is a diagram of a section through a blood capillary.

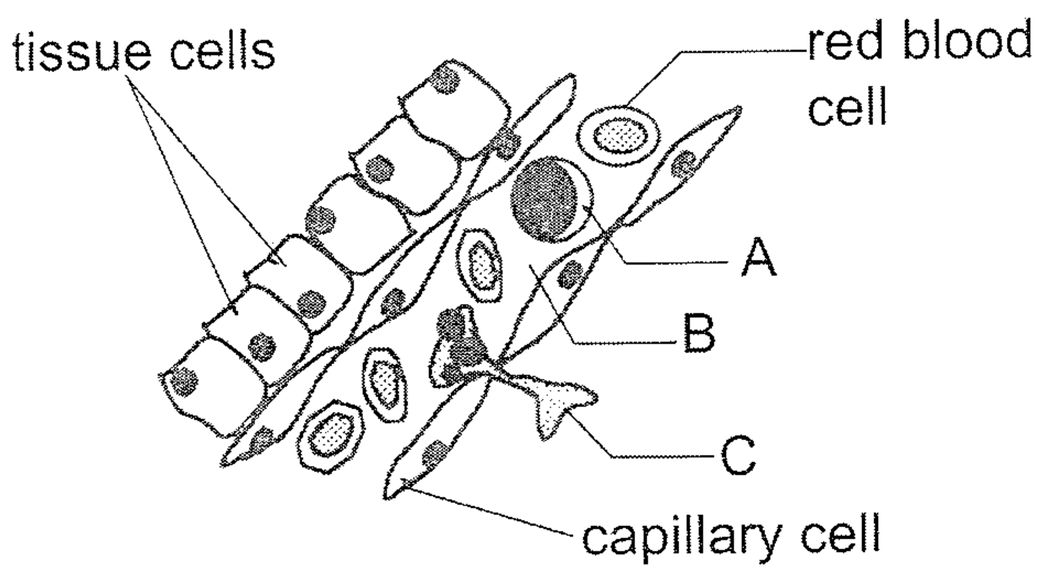


Figure 9

(a) Name the parts of the blood labelled A and B.

(b) How does the function of the cell labelled A differ from that of the cell labelled C?

(c) The red blood cells are biconcave in shape. What is the functional advantage of this shape?

(d) Substances diffuse into and out of the capillary through the capillary wall.

i. Name *three* substances that pass from the tissue cells into the blood capillary.

ii. From the diagram, name *two* features of the capillary wall which help the movement of these substances.

13. **Figure 10** is a diagram showing a cell undergoing cell division.

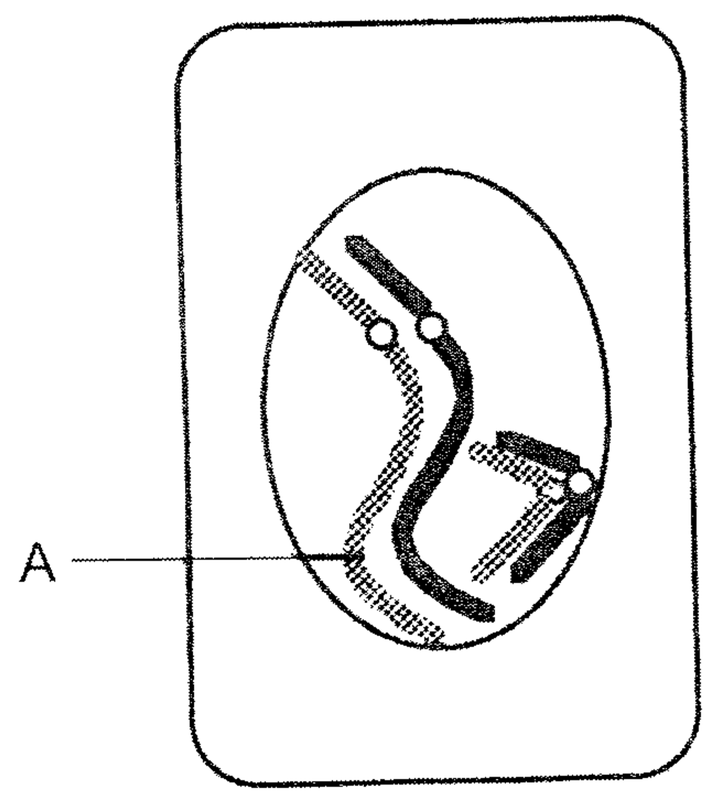


Figure 10

(a) i. What type of cell division is taking place in this cell?
ii. Give a reason for your answer to 13(a) i.

(b) Draw *one* daughter cell which would result from this cell division.

(c) What important molecule is found in the structure labelled A?

1. **Figure 1** is a diagram showing an orchid growing on a branch of a tree high off the ground.

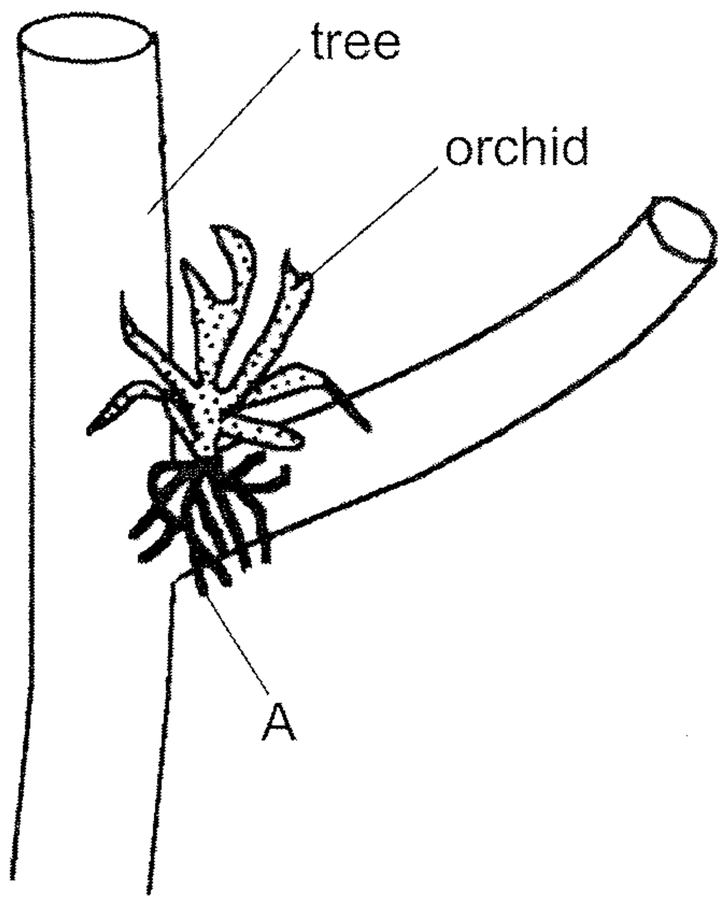


Figure 1

(a) i. Name the part labelled A.
ii. State the function of the part labelled A.

(b) What type of symbiotic relationship exists between the orchid and the tree as shown in figure 1?

(c) Why is it advantageous for orchids to grow on trees?

2. As blood circulates in the capillaries some of the plasma filters through the capillary walls to form tissue fluid.

(a) State *two* differences in composition between blood and tissue fluid.

Blood	Tissue fluid
1.	
2.	

(b) Explain how water from the tissue fluid returns to the venous end of the capillary.

(c) In what *two* ways do lymphatic vessels resemble most veins in their structures?

(d) In addition to the lymphatic vessels, lymph is also found in the pleural cavity and in the cavity enclosed by the pericardium.
State *two* functions of lymph in these places.

3. **Figure 2** is a diagram of the apparatus used in an experiment on soil. Two soil samples were tied in muslin bags. The levels of water, X and Y in both sides of the glass tube were the same at the beginning of the experiment.

(a) What results would be obtained in X and Y after two days?
Explain the results obtained in X.

(b) Suggest the effect of opening both taps.

(c) What is the aim of this experiment?

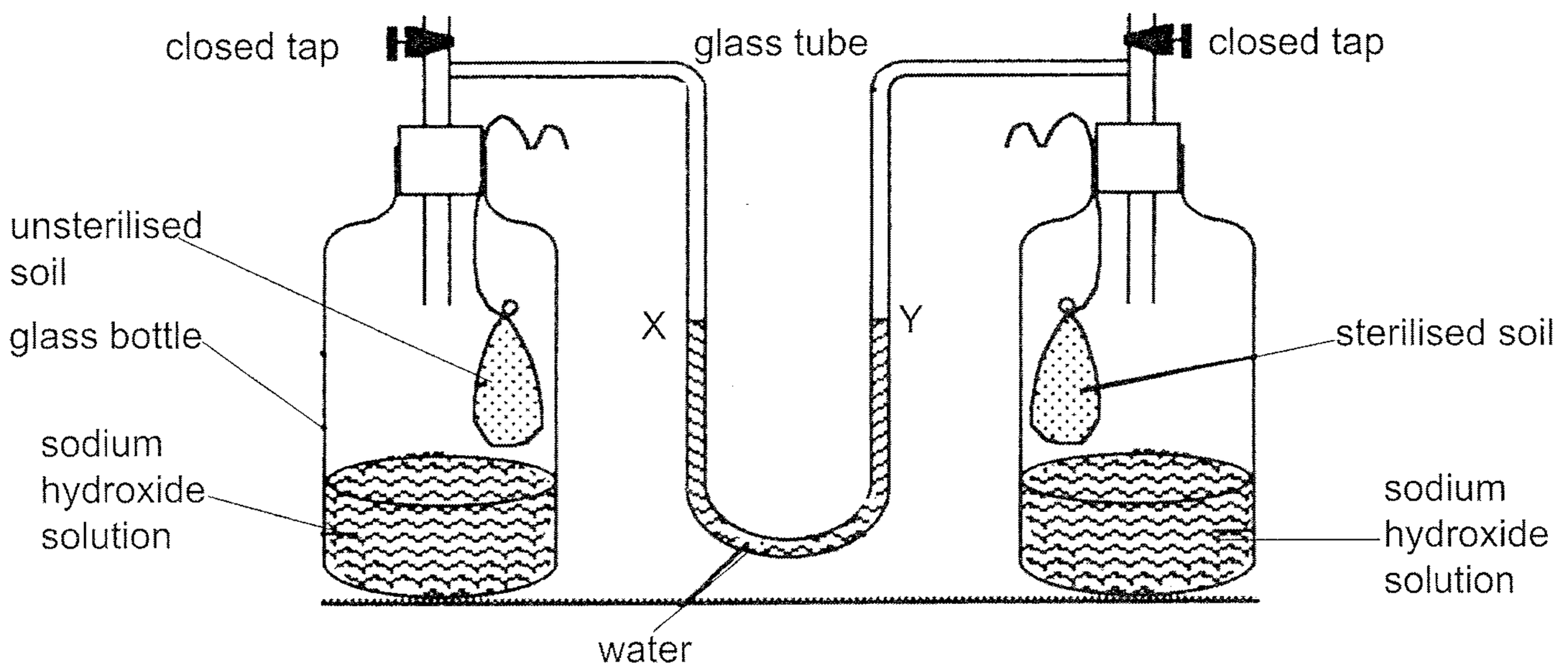


Figure 2

4. **Figure 3** shows graphs of the effect of exercise on breathing rate and pulse rate of a 16 year old athlete.

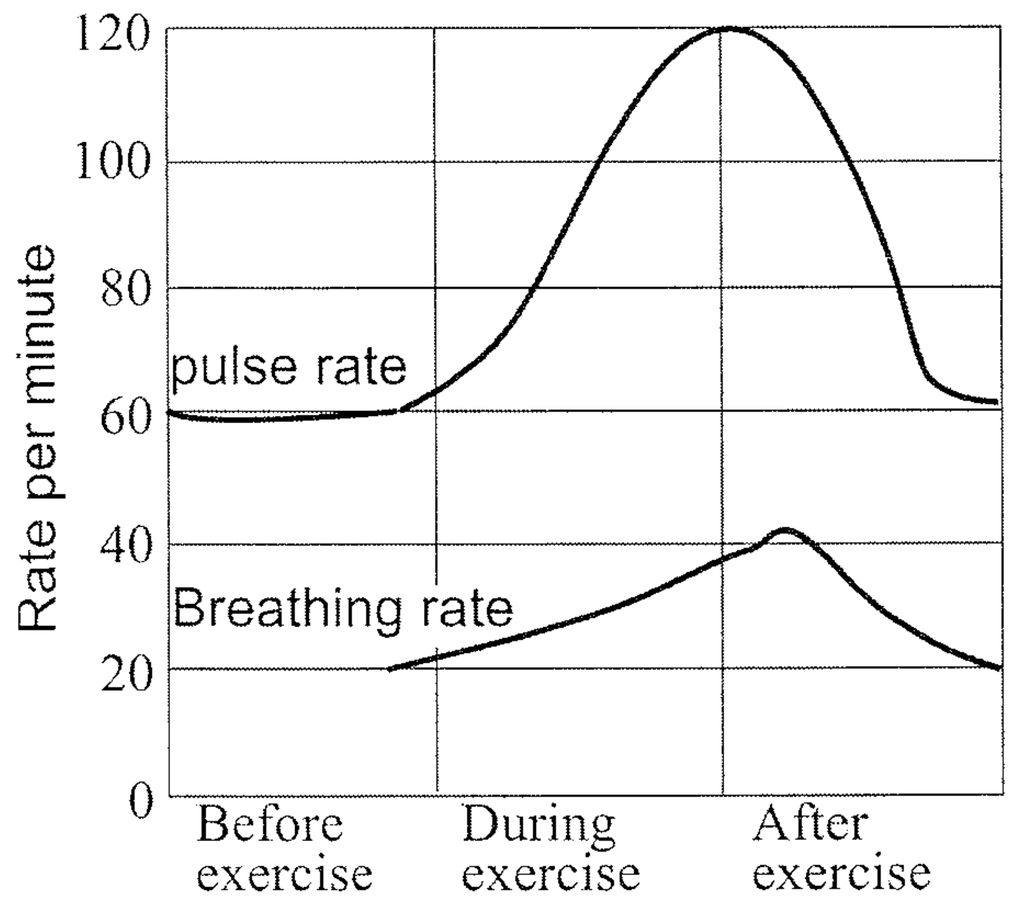


Figure 3

(a) From the graph,

i. What is the maximum breathing rate?

ii. How many times is the maximum pulse rate greater than the pulse rate before the exercise?

(b) How is pulse rate measured?

(c) Why does the pulse rate increase with exercise?

(d) In addition to exercise, state *two* other factors which affect pulse rate.

5. (a) Give *two* reasons why movement from one place to another is an advantage to an organism.

(b) How does *Paramecium* move?

(c) What are the functions of the following structures in fish:

i. tail;
ii. swim bladder;
iii. pectoral fins ?

6. **Figures 4A, 4B** and **4C** show structures of the fossil hind feet of three extinct horses. (**A**) is a diagram of the oldest fossil, (**B**) is the next and **C** is the most recent one. **Figure 4D** shows the hind foot of the modern horse. All the diagrams are drawn to scale.

(a) i. What are fossils?
ii. State *two* condition under which fossils are formed.

(b) From **figure 4**, list *two* ways in which the hind foot of **B** differs from that of **D**.

Hind foot of B	Hind foot of D

(c) How did the changes in the horse's foot come about?

(d) i. Suggest what happened to the horse's size over time.
ii. Give a reason for your answer to 6(d)i.

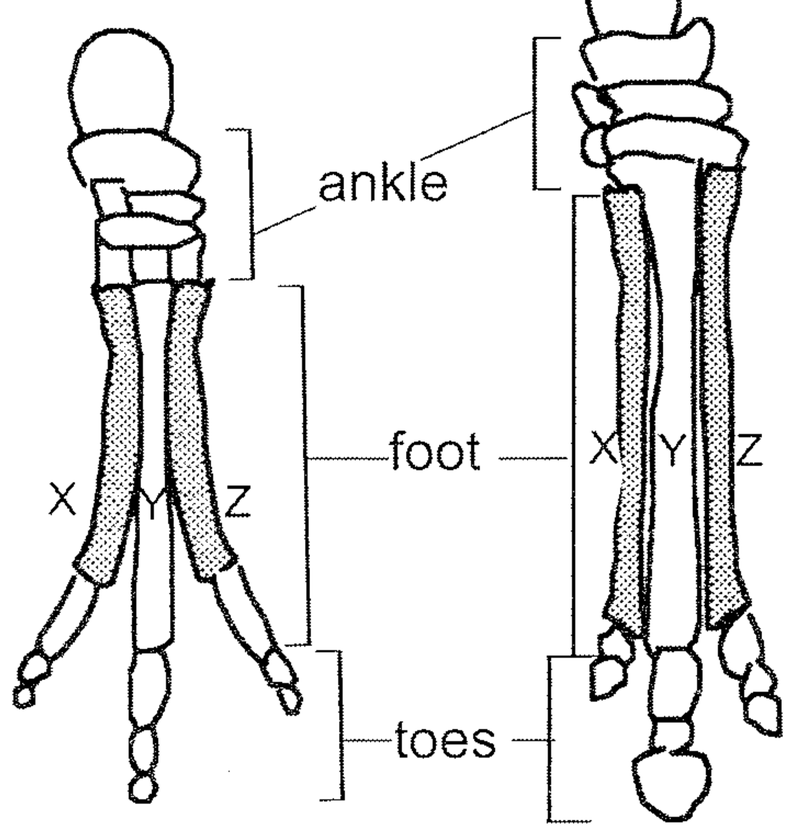


Figure 4A

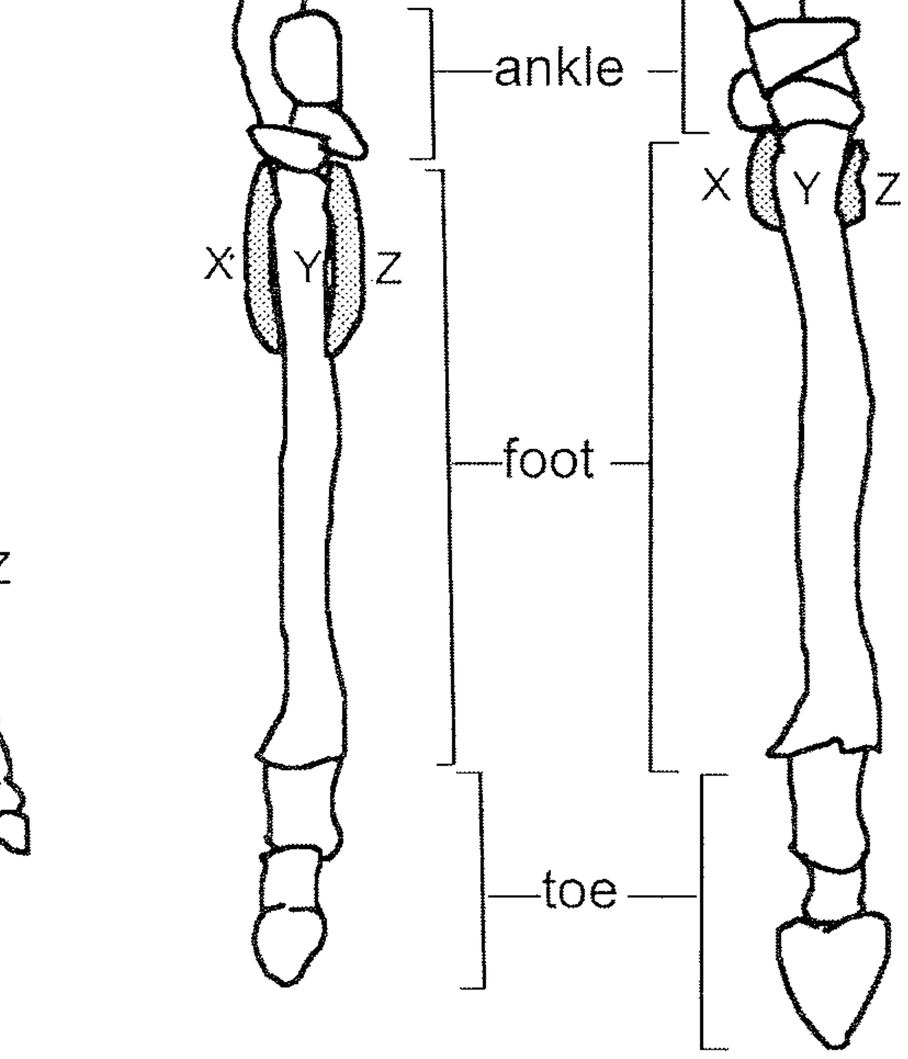


Figure 4B **Figure 4C** **Figure 4D**

7. **Figure 5** is a diagram of a bean seedling which was placed horizontally. The bean seedling was then left in the dark for two days.

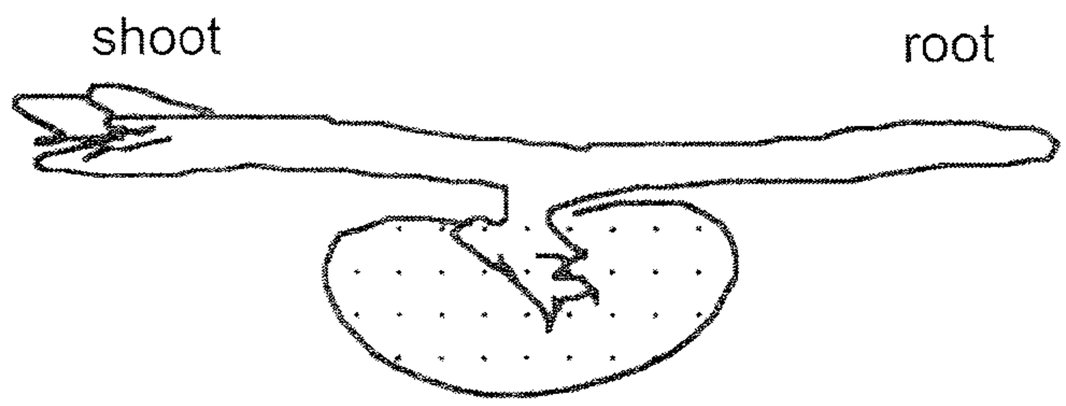


Figure 5

(a) i. Draw a diagram of the seedling to show results after two days.
ii. Give reasons for your answer to 7(a)i.

(b) Explain how auxins make shoots grow towards light.

8. In cattle, the presence or absence of horns is controlled by a single gene which has two forms, one for the presence of horns and the other for the absence of horns. Pure breeding cattle with horns were crossed with pure breeding cattle without horns. All F_1 cattle were hornless.
Use **H** for the dominant form and **h** for the recessive form in answering the questions below.

(a) Give the genotypes of the *two* parents and the F_1 cattle.
Parents with horns:
Parents without horns:
F_1 cattle:

(b) F_1 cattle were mated amongst themselves. Write down the results of such a cross showing the genotypes and phenotypes of the offspring.

(c) The F_1 cattle were crossed with pure breeding cattle with horns. What proportion of the offspring were hornless? Show your working.

9. **Figure 6** is a diagram to show the relationship between the blood supply of embryo, placenta and uterus. The arrows indicate the direction of blood flow.

(a) Name the parts labelled A and B.

(b) Mention *one* substance which passes from the:

i. embryonic blood to maternal blood;
ii. maternal blood to embryonic blood.

(c) Explain how the substance named in 9(b)ii moves from the maternal blood to the embryonic blood.

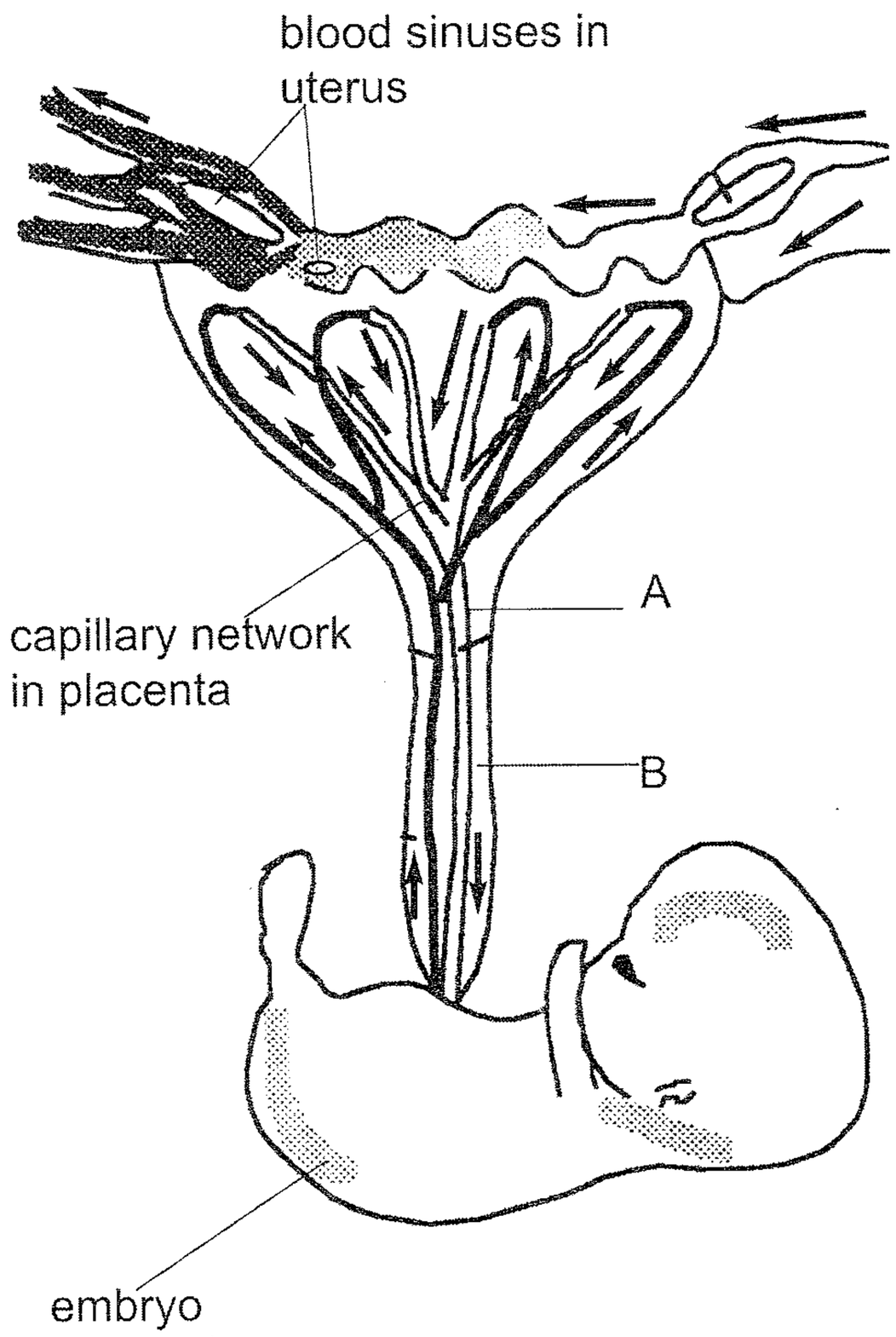


Figure 6

(d) i. State *two* ways in which the placenta is adapted to its function.
ii. Explain how one of the adaptations mentioned in 9(d) i enables the placenta to perform its function efficiently.

10. **Figure 7** is a diagram of a plant cell that was placed in a concentrated solution of sodium chloride.

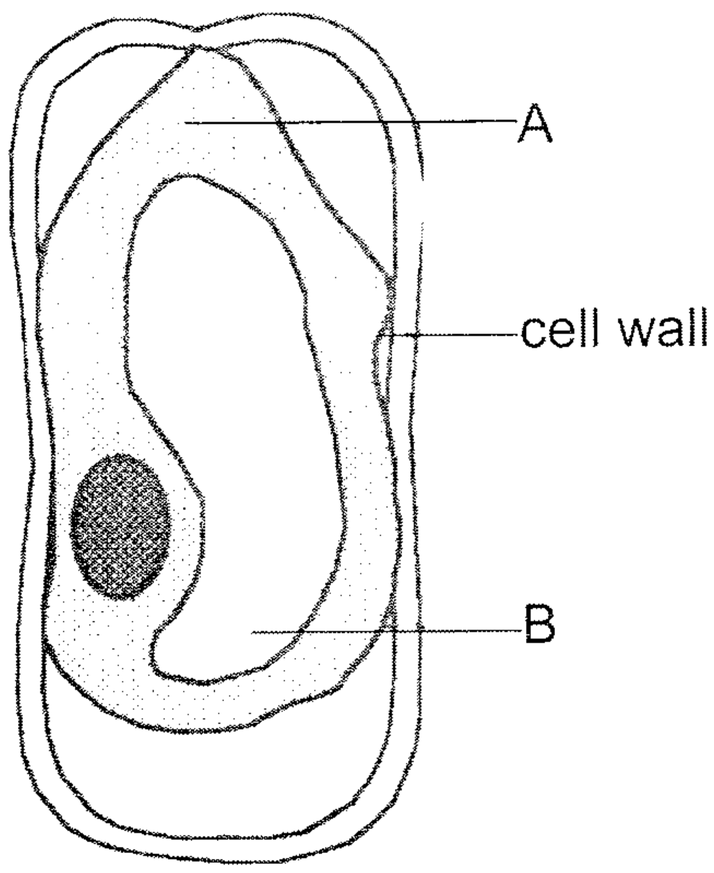


Figure 7

(a) Name the part of a plant cell which is

i. fully permeable:
ii. selectively permeable:

(b) Name the parts labelled A and B.

(c) i. Draw a diagram to show what would happen to the cell in figure 7 if it was placed in pure water.
ii. Explain your answer in 10(c)i.

11. The diagram below is of a food chain found in a lake:

Phytoplankton → Zooplankton → Fish → Fish Eagle
(1 ppm) (10 ppm) (100 ppm) (1000 ppm)

The lake was sprayed with an insecticide in order to kill mosquitoes which breed in it. The numbers indicate the concentration of the insecticide found in the bodies of the organisms. The insecticide is toxic to vertebrates if the concentration is 950 parts per million (ppm) or above.

(a) Name the primary consumer.

(b) State *one* way in which the insecticide may have got into the fish eagle.

(c) Many fish eagles died but fish survived. Explain why fish survived.

(d) Explain what would happen to the numbers of fish and zooplankton as a result of fish eagles dying. Give reasons for your answers.

i. Fish:
Reason:

ii. Zooplankton:
Reason:

(e) Why is the concentration of the insecticide in zooplankton greater than the concentration of insecticide in phytoplankton?

12. The mode of transmission of a disease determines how people try to prevent it. Discuss the above statement by referring to sleeping sickness and cholera.

13. Explain how the stem of a plant is adapted to its functions.