

Question: 1

(a) The control of blood glucose is a very important aspect of homeostasis.

(i) Explain what is meant by the term *homeostasis*.

[2]

(ii) Describe how negative feedback is used to control blood glucose concentration.



In your answer, you should use appropriate technical terms, spelt correctly.

[6]

(b) A 55 year old man visited the doctor and was newly diagnosed with diabetes.

- The doctor initially recommended to the man that he should change his diet to cut out excess carbohydrate, including sugars such as glucose and make a further appointment to check on his progress.
- At this second appointment, however, it was discovered that the dietary changes had not been effective, which was unexpected.
- It turned out that the man had a form of diabetes that required daily hormone injections to control his blood sugar concentration.

Using only the information given above, state how this man's form of diabetes is similar to:

(i) Type 1 diabetes

[1]

(ii) Type 2 diabetes.

[1]

[Total: 10]

Question: 2

In order to survive, animals need to be able to respond to changes in the internal and external environment.

(a) Complete the following passage by using the most appropriate word(s) or term(s).

Specialised cells that are able to detect stimuli can be found both within and at the surface of an animal's body. These specialised cells can be found singly or in groups and are known as sensory .

Each cell is specialised to respond to a particular type of stimulus. Some specialised cells in the retina of the eye respond to the and wavelength of light. Groups of specialised cells in the nose and on the tongue detect stimuli and this results in the ability to smell and taste.

When specialised cells receive an appropriate stimulus which is above the threshold , the cells are able to convert this energy into a nerve .

[5]

(b) Following the detection of a stimulus, sensory and motor neurones co-ordinate the body's response to this stimulus.

State one way in which:

(i) the structure of a motor neurone differs from that of a sensory neurone

[1]

(ii) the function of a motor neurone differs from that of a sensory neurone.

[1]

[Total: 7]

Question: 3

(a) Fig. 3.1 is an electron micrograph of a chloroplast from a tobacco leaf.

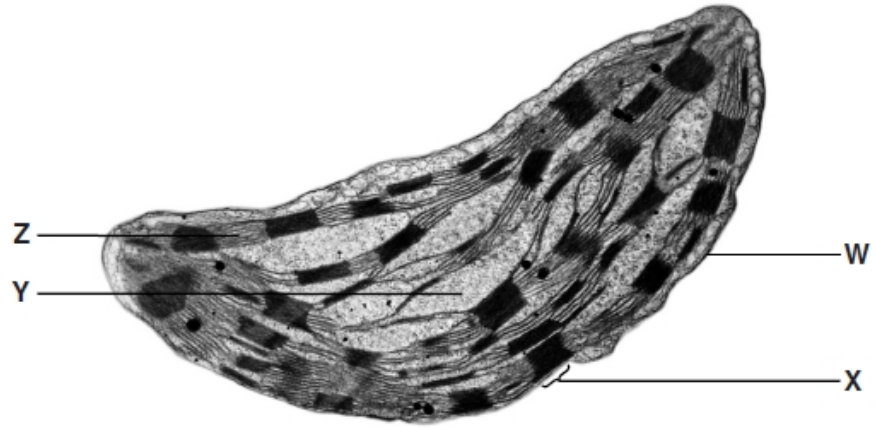


Fig. 3.1

(i) Identify the structures labelled W to Z.

W

X

Y

Z

(ii) In addition to the structures seen in Fig. 3.1, a chloroplast also contains DNA and ribosomes.

Suggest the role of DNA and ribosomes in this organelle.

(b) The table below contains statements that refer to the light-dependent stage of photosynthesis.

Complete the table, indicating with the letters C, N or B, whether each statement applies to:

• cyclic photophosphorylation only (C)

or

• non-cyclic photophosphorylation only (N)

or

• both cyclic and non-cyclic photophosphorylation (B)

The first one has been completed for you.

statement	letter
ATP is produced	B
an electron leaves photosystem I	
electrons are passed along an electron carrier chain	
electrons leave both photosystem I and photosystem II	
an electron from a water molecule replaces the electron lost from the photosystem	
the same electron returns to the photosystem	

[
[Total: 1

Question: 4

Urine is a liquid that is composed of a number of different substances.

(a) Urea is one compound that is excreted from the mammalian body in urine.

(i) Name the organ that produces urea.

[1]

(ii) It has been observed that the urea content of urine is relatively high when a person eats an excessive amount of protein in their diet.

Suggest why a high intake of protein in the diet will be likely to result in a high concentration of urea in urine.

[3]

(b) Suggest what condition is indicated by the presence of glucose in a person's urine.

[1]

(c) (i) Pregnancy may be detected by testing a woman's urine.

State the substance that is being tested for in urine when a pregnancy test is carried out.

[1]

(ii) Ovulation is the release of an egg cell from the ovary. In order for pregnancy to occur, the egg cell must be fertilised within 24 hours of its release from the ovary.

Immediately before ovulation, the body produces a large amount of luteinising hormone (LH). This is known as the LH surge and triggers ovulation. It is during this time that fertilisation is most likely to occur.

- If a woman is trying to get pregnant, it can be useful to know when ovulation has occurred.
- It is possible to identify the LH surge by using a test stick to detect LH in urine.
- The test stick for LH works in a similar way to the test stick used for detecting pregnancy.

Fig. 2.1 shows the features of a test stick that can be used to test for LH in urine. region containing:

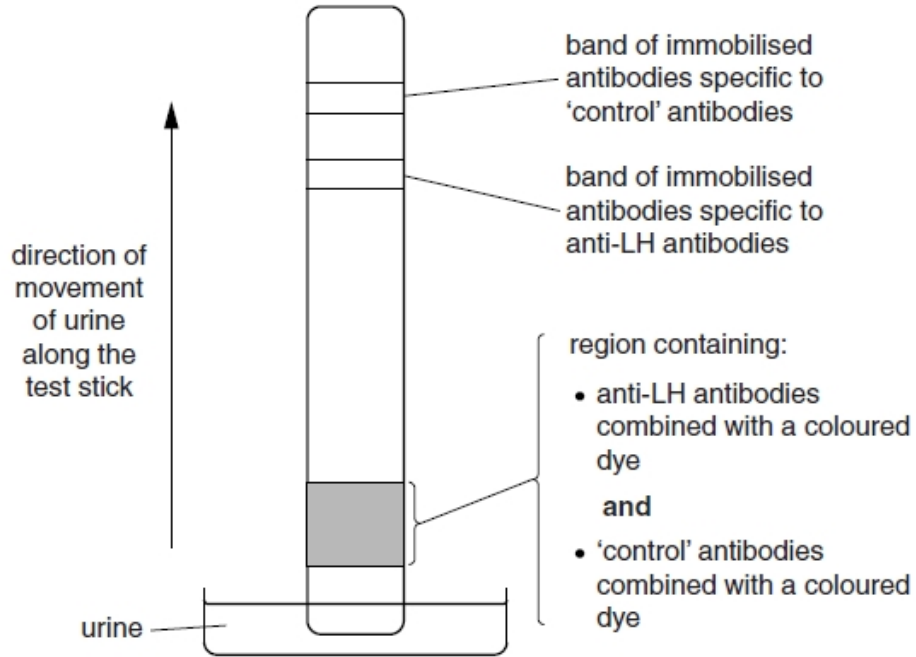


Fig. 2.1

Using your knowledge of how a test stick works, suggest how the test stick in Fig. 2.1 can be used to indicate a positive result for LH in urine.

[3]

[Total: 9]

Question: 5

Fig. 5.1 is a photomicrograph of a horizontal section through the cortex of a mammalian kidney.

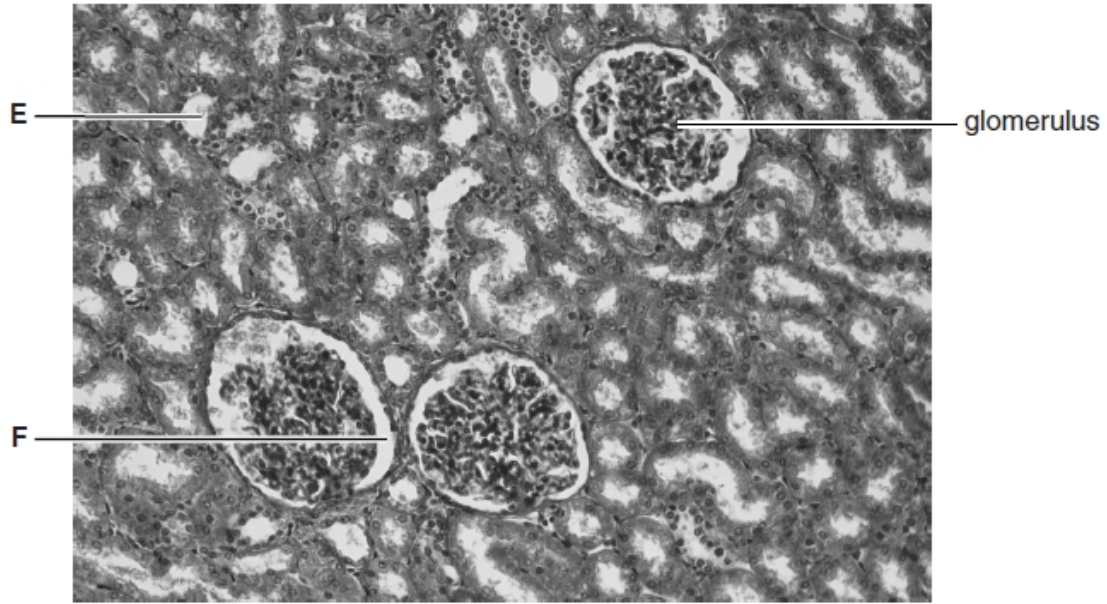


Fig. 5.1

(a) Identify the structures labelled E and F in Fig. 5.1.

E

F

[2]

(b) (i) Explain how the glomerulus is able to perform its function.



In your answer, you should use appropriate technical terms, spelt correctly.

[3]

(ii) Name the specialised cells present in structure F that assist in the function you described in (b)(i).

[1]

(c) Kidney failure has serious consequences for the individual.

(i) Suggest the effects of complete kidney failure on the composition of the blood.

[2]

(ii) One way of treating a person with kidney failure is by giving them a kidney transplant.

Explain the need for close matching of the donated kidney to the recipient.

[3]

[Total: 11]

Question: 6

A student carried out an experiment to investigate the effect of light intensity on the rate of photosynthesis in an aquatic plant, using the apparatus shown in Fig. 2.1.

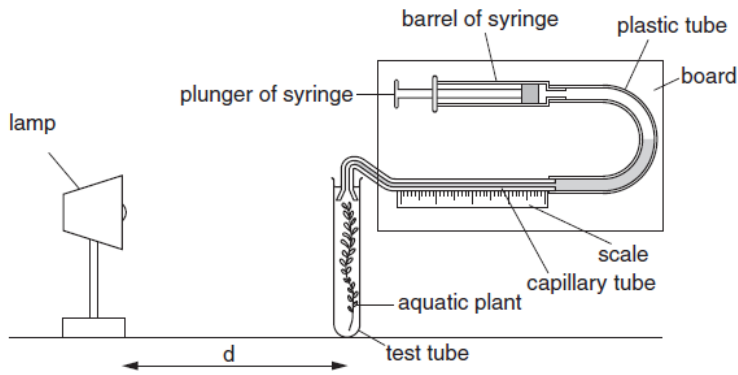


Fig. 2.1

The student decided to measure the rate of photosynthesis by measuring the gas produced over a five minute period. The gas collected in the capillary tube.

After five minutes, the length of the bubble was measured along the scale.

The light intensity was varied by altering the distance (d) between the lamp and the photosynthesising plant.

The student prepared Table 2.1 to calculate the light intensity.

Table 2.1

distance (d) from lamp to plant (cm)	light intensity $\left(\frac{1}{d^2}\right)$
4	0.0625
8	0.0156
12	0.0069
16	0.0039
20	0.0025
24	
60	0.0003

(a) (i) Calculate the light intensity when the lamp was 24 cm from the plant.

Show your working.

Answer =

[2]

(ii) The length of the gas bubble was measured (in mm).

State what additional information would be required to calculate the volume of gas produced.

[1]

(iii) Suggest how the student supplied the aquatic plant with a source of carbon dioxide.

[1]

(b) Certain assumptions are made when using the apparatus shown in Fig. 2.1 to measure the rate of photosynthesis.

(i) One of these assumptions is that all of the oxygen produced by the plant during photosynthesis is collected.

Suggest why not all of the oxygen produced by the plant is collected.

[2]

(ii) Another assumption is that all of the gas collected is oxygen.

Analysis of the gas collected reveals that it has the following composition:

- oxygen 50%
- nitrogen 44%
- carbon dioxide 6%

Suggest a reason for the presence of nitrogen in the gas collected.

[1]

(iii) Comment on the percentage of carbon dioxide present in the gas collected and give reasons for this figure.

[3]

(c) Some aquatic photosynthetic organisms, for example seaweeds, contain pigments such as fucoxanthin and phycoerythrin, in addition to chlorophyll. These pigments give seaweeds a brown or red colour and are produced in larger quantities in those seaweeds that live in deeper water.

Suggest why the presence of these pigments is an advantage to seaweeds that live in deeper water.

[2]

[Total: 12]

Question: 7

Fatigue is a symptom of some medical conditions. One feature of fatigue is extreme tiredness, due to a lack of energy.

Medical conditions that have fatigue as a characteristic symptom include Type 2 diabetes, certain heart conditions, chronic fatigue syndrome (CFS) and emphysema.

(a) Explain how emphysema could result in fatigue.

[2]

(b) In Type 2 diabetes, the target cells do not respond correctly to the insulin produced when there is an increase in blood glucose concentration.

Suggest why fatigue may occur in a person with Type 2 diabetes who is not taking medication.

[2]

(c) Certain heart conditions result in a weak and irregular heart beat.

Suggest how a weak and irregular heart beat could result in fatigue.

[2]

(d) Chronic fatigue syndrome (CFS) is a condition in which symptoms vary from individual to individual.

It is thought that a number of different malfunctioning processes can contribute to this condition in an individual.

CFS can affect every system in the body and is identified by symptoms that include fatigue, muscle weakness and aching muscles.

(i) It has been suggested that, in the cells of people with CFS, pyruvate may not be transferred into the mitochondria efficiently.

Outline the consequences of an inefficient transfer of pyruvate into mitochondria and link this to the symptoms of CFS stated above.

[3]

(ii) Some people with CFS overproduce T lymphocytes and associated cytokines. Despite this, the specific immune response is poor in these people, resulting in an increased susceptibility to infection.

Suggest a reason for the poor specific immune response in people with CFS.

[1]

[Total: 10]

Question: 8

(a) Fig. 5.1 is a drawing representing a vertical section through a mammalian kidney.

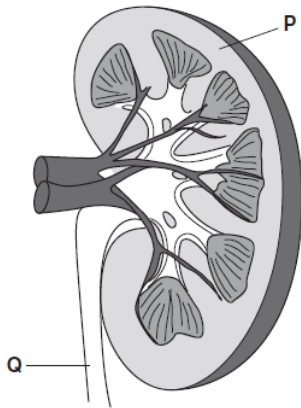


Fig. 5.1

Name the region P and the structure Q.

P

Q

[2]

(b) (i) Each kidney contains approximately one million nephrons. Each section of a kidney nephron is adapted to perform its function effectively.

Describe the features of the glomerulus and Bowman's capsule that allow them to perform their function effectively.



In your answer, you should use appropriate technical terms, spelt correctly.

[4]

(ii) Nephritis is a condition in which the tissue of the glomerulus and proximal convoluted tubule becomes inflamed and damaged.

Suggest two differences in the composition of the urine of a person with nephritis when compared to the urine of a person with healthy kidneys.

[2]

(c) Caffeine is a mild diuretic. Caffeine prevents the introduction of additional aquaporins into the wall of the collecting duct of the nephron and therefore additional water is not removed from the urine.

Aquaporins are channels in the cell surface membrane that allow water molecules to pass through.

Fig. 5.2 represents an aquaporin.

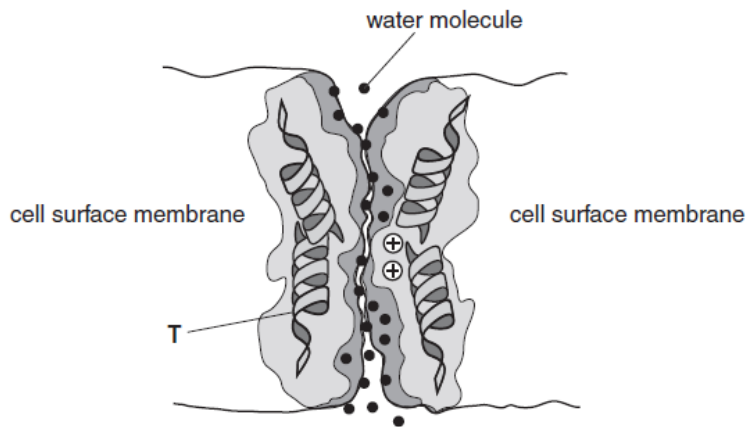


Fig. 5.2

(i) Identify the type of molecule labelled T.

[1]

(ii) The aquaporin allows water to travel from the collecting duct into the surrounding tissues but prevents the passage of ions such as sodium ions and potassium ions.

With reference to Fig. 5.2, suggest two ways in which the structure of this aquaporin prevents the passage of ions.

[2]
[Total: 11]

Question: 9

(a) State the precise location where each of the following biochemical processes take place:

(i) the production of glucocorticoids in the body

[1]

(ii) chemiosmosis within an animal cell.

[1]

(b) Name the mechanism or process that is being described in each of the following statements.

(i)

A person breathes in air that is high in carbon dioxide. This produces a high concentration of carbon dioxide in the blood. This increased concentration is detected by receptors, resulting in the person breathing more rapidly. In turn, more carbon dioxide enters the blood causing the breathing to be even more rapid.

The mechanism being described is:

[1]

(ii)

Light strikes a molecule of chlorophyll a in photosystem I, providing it with enough energy so that it loses an electron. This electron is passed along a series of electron carriers and then returns to a molecule of chlorophyll a in photosystem I. As the electron loses energy, ATP is formed.

The process being described is:

[1]

(iii)

As an animal needs to respond to changes in the external and internal environment, communication between cells takes place within the body to coordinate the activities of different organs.

The mechanism being described is:

[1]
[Total: 5]

Question: 10

(a) The cells of the body need to communicate with one another.

State the name given to this process of communication.

[1]

(b) Fig. 1.1 is an electron micrograph of the junction between two neurones.

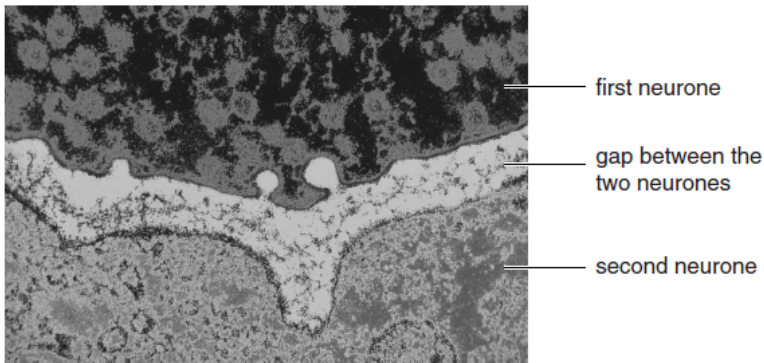


Fig. 1.1

(i) State the name given to the gap between the two neurones at this junction.

[1]

(ii) Outline how the first neurone communicates with the second neurone across the gap.



In your answer, you should use appropriate technical terms, spelt correctly.

[3]

(iii) Outline the importance of the junctions between neurones in the functioning of the nervous system.

[3]

The nervous system and the hormonal system are involved in the maintenance of core body temperature.

(c) Give the most suitable word or term that has the same meaning as each of the following descriptions:

(i) animals that are able to regulate and maintain their core body temperature within narrow limits;

[1]

(ii) the increase in the diameter of the lumen of an arteriole to allow more blood to flow through.

[1]

(d) (i) Name a hormone that increases the metabolic rate and so generates heat.

[1]

(ii) Name the part of the brain where the thermoregulatory centre is located.

[1]
[Total: 12]

Question: 11

The kidney is composed of many nephrons.

Fig. 2.1 is a diagrammatic representation of a nephron. The numbers represent the relative concentrations of solutes in the tubule and the tissue fluid surrounding the tubule.

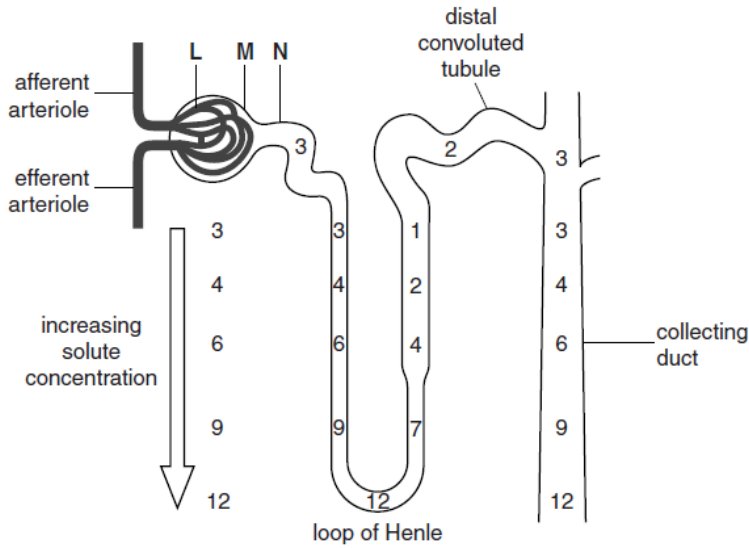


Fig. 2.1

(a) Name the parts of the nephron labelled L, M and N.

L

M

N

(b) Which part(s) of the nephron corresponds to each of the statements in the table below?

statement	part(s) of the nephron
walls are impermeable to water	
glucose is reabsorbed into the blood	
ADH acts on the walls	
contains podocytes	
most of the water is reabsorbed into the blood	

[5]

(c) With reference to Fig. 2.1, explain the role of the loop of Henle in the production of urine.



In your answer, you should use appropriate technical terms, spelt correctly.

[5]
[Total: 13]

Question: 12

The compound 2,3,5-triphenyl-tetrazolium chloride (TTC) is an electron acceptor. TTC will diffuse into actively respiring cells and accept electrons from the electron transport chain.

When TTC accepts electrons and becomes reduced, it changes from colourless to pink. The tissues in which this reaction takes place will be stained a pink colour.

(a) State the precise location of the electron transport chain in the cell.

[1]

(b) A student carried out an investigation into the respiratory activity of plant tissue. She used three groups of germinating broad bean seeds. These were first treated as shown in Table 3.1.

Table 3.1

seed	treatment
group A	kept at 22 °C for 24 hours before the investigation
group B	kept at 6 °C for 24 hours before the investigation
group C	kept at 22 °C for 24 hours and then placed in water at 90 °C for 5 minutes before the investigation

The groups of seeds were then sliced longitudinally and placed, cut surface down, in a shallow dish containing a small volume of TTC solution. The cut surfaces remained in contact with the solution for 10 minutes.

The seeds were then removed from the dish. The excess TTC solution was wiped off and the cut surfaces of the seeds in each group were observed.

The appearance of the seeds in each group is shown in Fig. 3.1. The shaded areas are the regions where the tissues have stained a pink colour.

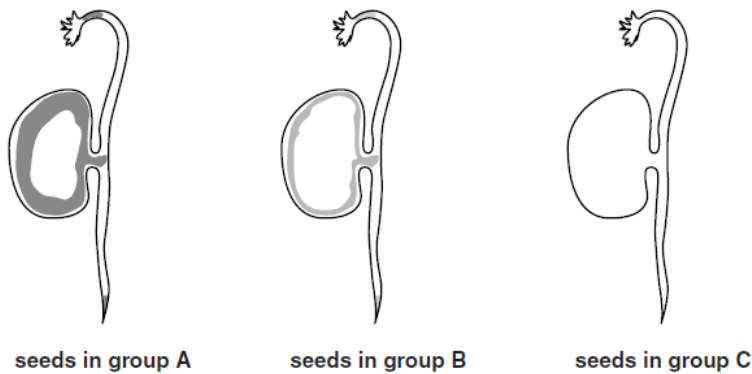


Fig. 3.1

(i) Describe the differences observed in the seeds in groups A, B and C.

[1]

(ii) Suggest reasons for the results observed in the seeds in group A.

[2]

(iii) Suggest reasons for the difference in the amount of staining observed in the seeds in groups B and C when compared to those in group A .

[2]

(c) If oxygen is not present or is in short supply, respiration can take an anaerobic pathway after glycolysis. In plant cells, this pathway is the same as the one used in yeast cells.

(i) Name the hydrogen acceptor in this pathway.

[1]

(ii) Name the intermediate compound in this pathway.

[1]

(iii) Name the products of this pathway.

[1]

(iv) Explain why this pathway is important for the plant cell.

[2]
[Total: 11]

Question: 13

One way to determine the rate of photosynthesis is to measure the uptake of carbon dioxide.

(a) Discuss why measuring carbon dioxide uptake may or may not give a better indication of photosynthetic activity than measuring oxygen production.

[2]

(b) Fig. 4.1 shows the relationship between light intensity and the relative carbon dioxide uptake and production in a plant.

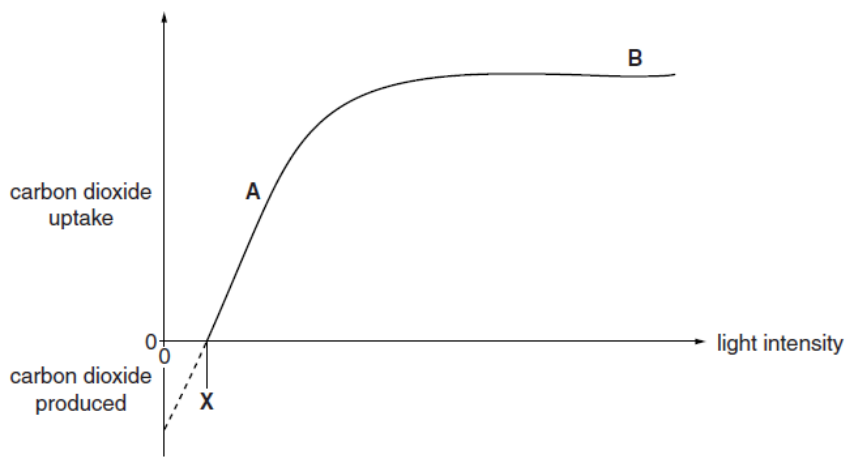


Fig. 4.1

(i) State the factor that is limiting the rate of photosynthesis at A on the graph.

[1]

(ii) Suggest one factor that may limit the rate of photosynthesis at B.

[1]

(iii) Carbon dioxide is given off by the plant when the light intensity is lower than X.

Name the process that produces carbon dioxide in the plant.

[1]

(iv) With reference to Fig. 4.1, explain the biochemical processes that are occurring in the plant:

- as light intensity increases from 0 (zero) to X.
- at light intensity X.
- at light intensities greater than X.

[3]

(c) (i) Name the products of the light-dependent stage of photosynthesis.

[3]

(ii) Paraquat is a weedkiller. It binds with electrons in photosystem I.

Suggest how paraquat results in the death of a plant.

[2]
[Total: 13]

Question: 14

The regulation of blood glucose concentration is important for homeostasis and involves hormonal control.

(a) (i) Name the endocrine tissue in the pancreas that is responsible for secretion of hormones.

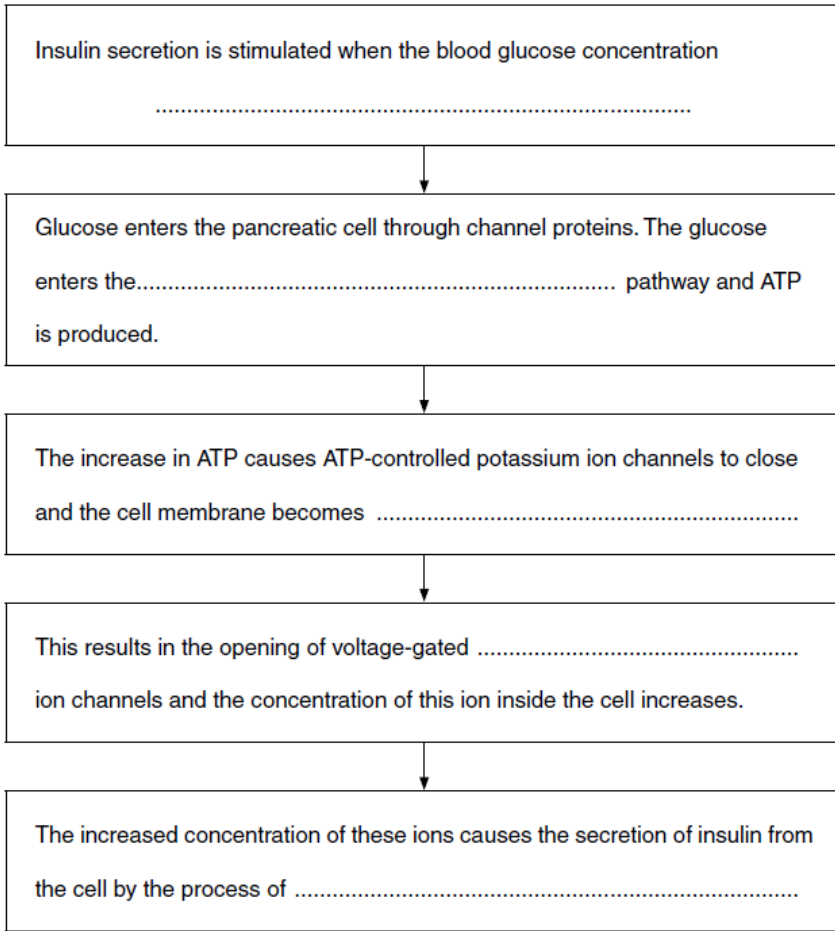
[1]

(ii) Identify the specific cell type in pancreatic tissue that secretes the hormone insulin.

[1]

(b) The incomplete flowchart below outlines the way in which the secretion of insulin from a pancreatic cell is controlled.

Complete the flowchart by inserting the most appropriate word(s) in the spaces provided.



[5]

(c) (i) Insulin is a polypeptide molecule.

State where in a pancreatic cell insulin molecules are synthesised.

[1]

(ii) Outline the events that occur after the synthesis of an insulin molecule until it is ready to be secreted from the pancreatic cell.

[3]
[Total: 11]

Question: 15

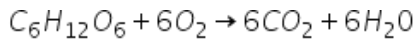
(a) Excretion and secretion are two processes that take place in the body of a mammal.

Complete the table below to compare the processes of excretion and secretion.

	excretion	secretion
one difference	<input type="text"/>	<input type="text"/>
one example of a product	<input type="text"/>	<input type="text"/>
one similarity	<input type="text"/>	

[3]

(b) Aerobic respiration may be summarised by the following equation:



Although carbon dioxide and water are products of aerobic respiration, the equation is an over-simplification of the process.

State and explain one way in which this equation is an over-simplification.

[2]

(c) Over 2.3 million people in the UK are known to have diabetes. It is also estimated that a further 0.5 million people have the condition but are unaware of it.

(i) Explain how Type 1 diabetes is caused.

[2]

(ii) Describe three factors that increase a person's risk of developing Type 2 diabetes.

[3]
[Total: 10]

