CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



EXAM QUESTION PACK

15 CONTROL AND COORDINATION

SCORE	PERCENTAGE
/	%

STEMUP

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Q1.

3 Fig. 3.1 is a diagram that shows the events that occur between two neurones at a synapse.

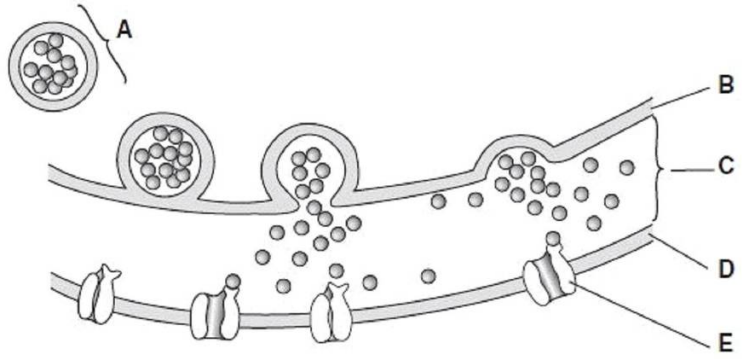


Fig. 3.1

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

A .....

B .....

C .....

D .....

E .....

[5]

(b) Draw a large arrow on the diagram to indicate the direction of the impulse across the synapse. [1]

(c) Describe the role of calcium ions in synaptic transmission.

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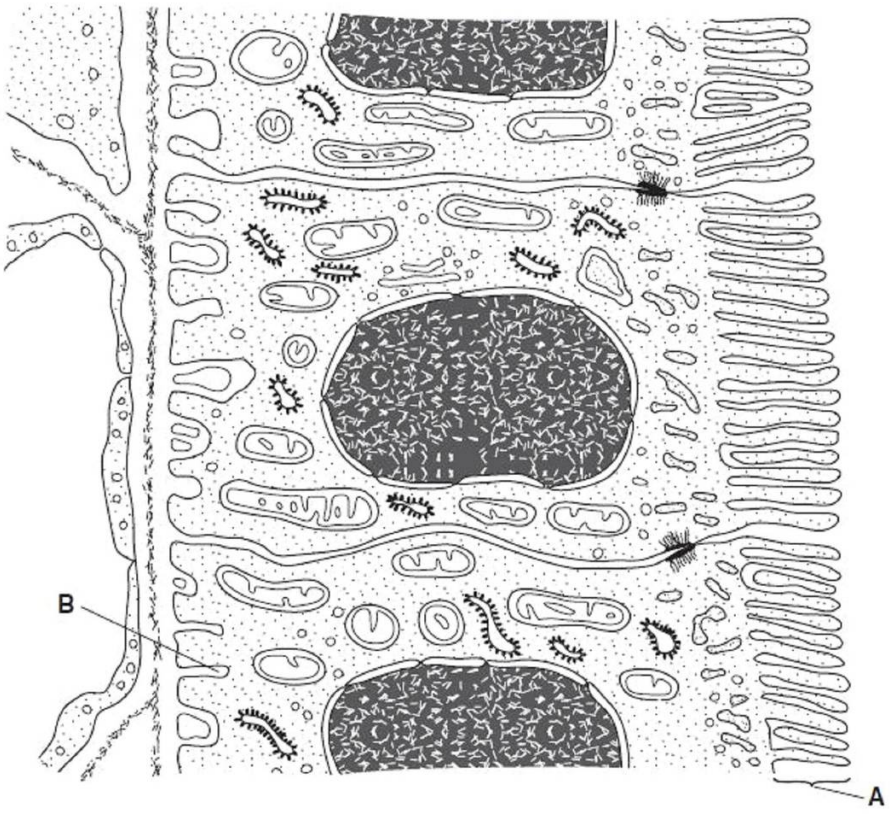
.....[3]

[Total : 9]

Q2.

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3 Fig. 3.1 is a diagram of a section through the proximal convoluted tubule of a kidney nephron showing details of cell structure, as seen with the electron microscope.



(a) Name the structures **A** and **B**.

A .....

B .....[2]

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(b) Explain three ways in which the cells of the proximal convoluted tubule are adapted for selective reabsorption.

1. .....

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2. .....

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3. .....

.....[3]

(c) Describe the mechanism of glucose reabsorption into the blood from the lumen of the proximal convoluted tubule of the kidney.

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.....[3]

(d) Outline, in terms of water potential, how water is reabsorbed by the cells of the **proximal convoluted tubule**.

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.....[2]

[Total: 10]

Q3.

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3 Fig. 3.1 is a diagram of a reflex arc.

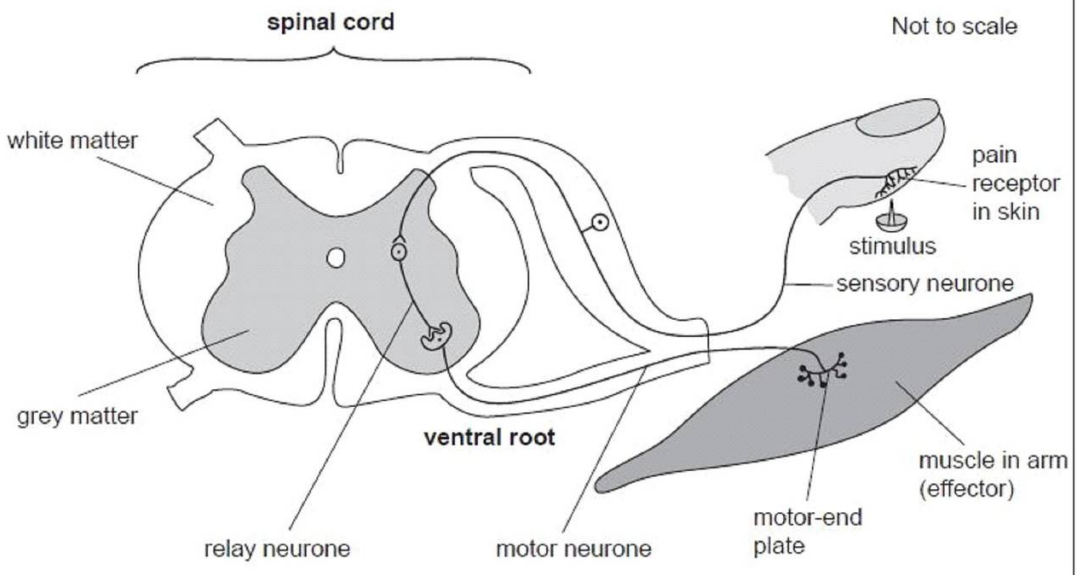


Fig. 3.1

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(a) Explain **briefly** how the stimulus at the finger produces an impulse in the sensory neurone.

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.....[3]

(b) Describe the role of the motor neurone in the reflex arc.

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.....[3]

(c) Suggest why nerve impulses can only travel in one direction through the reflex arc.

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.....[2]

[Total: 8]

Q4.

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3 During the process of the excretion of nitrogenous waste in mammals, blood passes from the renal artery into networks of capillaries called glomeruli.
Fig. 3.1 is an electronmicrograph showing the relationship between the capillaries and the renal capsule cells, called podocytes.

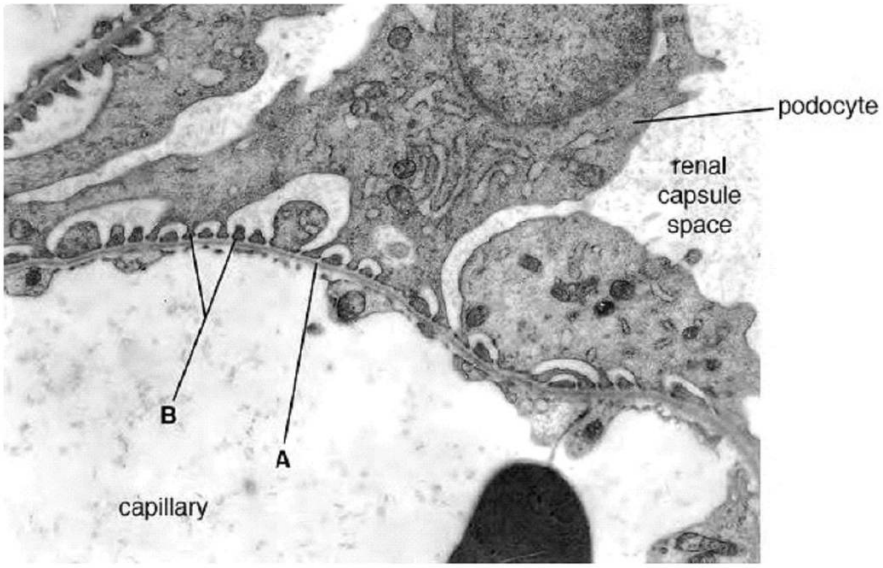


Fig. 3.1

(a) Name structures **A** and **B**.

A .....

B ..... [2]

(b) Draw an arrow, on Fig. 3.1, to show the passage of fluid out of the capillary. [2]

(c) **(i)** Name the fluid that collects in the capsular space.

.....

.....[1]

(ii) Describe how the composition of this fluid differs from blood plasma.

.....

.....

.....

.....[2]

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(d) Ultrafiltration involves the removal of small molecules, including urea, from the blood into the renal capsule. Explain what is required for ultrafiltration to occur.

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.....[3]

[Total: 10]

Q5.

4 **(a)** Name the transmitter which is responsible for the transmission of nerve impulses across a cholinergic synapse.

.....[1]

(b) Outline the role of calcium ions in synaptic transmission.

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.....[4]

(c) Explain how a synapse ensures one-way transmission of nerve impulses.

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.....[2]

[Total: 7]

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Q6.

4 **(a)** Describe the role of insulin in the regulation of blood glucose concentration.

Use

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.....[4]

Q7.

2 Fig. 2.1 is a light micrograph of a small part of the pancreas.

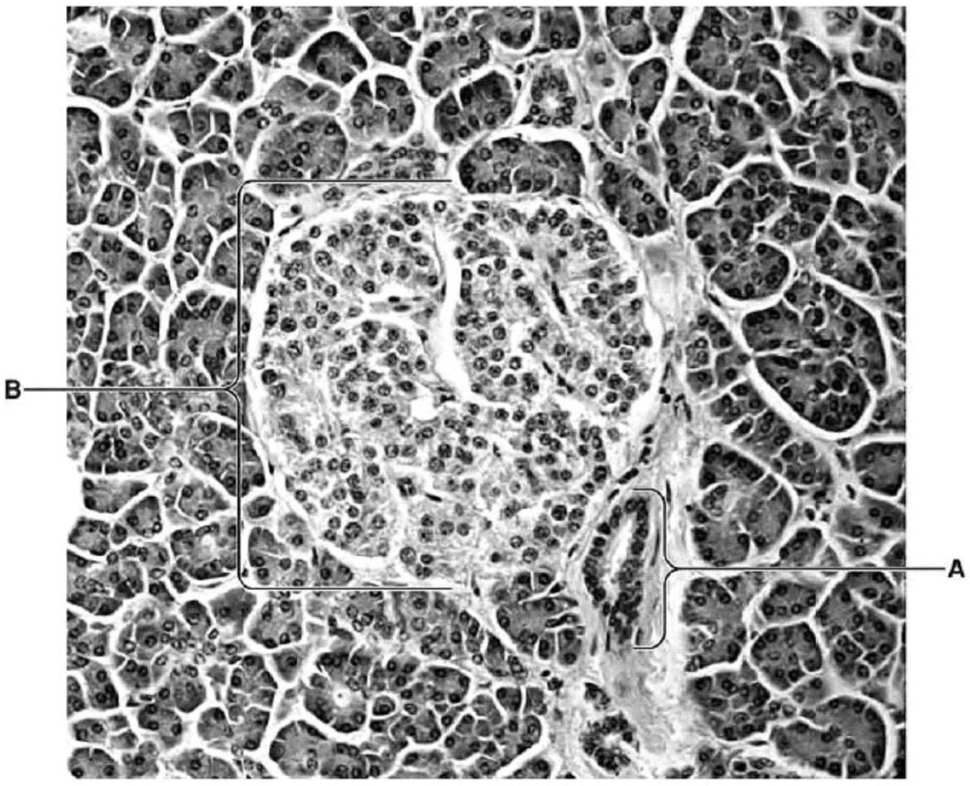


Fig. 2.1

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(a) Name structures **A** and **B**.

A .....

B .....[2]

(b) With reference to Fig. 2.1, explain why the pancreas is an *endocrine gland*.

.....

.....

.....[2]

(c) Insulin and glucagon are involved in the control of blood glucose concentration. When blood glucose concentration rises, secretion of insulin increases.

Outline two ways in which insulin affects the activity of cells in the liver.

1. .....

.....

2. .....

.....[2]

(d) Some forms of diabetes are caused by an inability to secrete insulin and can be controlled by regular injections of insulin. Most of this insulin is now produced using genetically modified *Escherichia coli*.

Explain the advantages of using this type of insulin, rather than insulin obtained from animal sources.

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.....[2]

[Total: 8]

Q8.

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4 Almost 40% of adults with cystic fibrosis (CF) develop a form of diabetes known as cystic fibrosis-related diabetes (CFRD). This is thought to happen because the build-up of thick secretions in the pancreas destroys β cells.

For Examin Use

(a) Explain how the destruction of β cells causes diabetes.

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..... [4]

(b) The bacterium *Pseudomonas aeruginosa* can cause chronic (long-lasting) lung infections. A person with CFRD is likely to have poorer lung function and a greater likelihood of having a chronic lung infection than a person who has CF but does **not** have CFRD.

An investigation was carried out to find out if the severity of damage to lung function in a person with CFRD is affected by

- their gender
- whether or not they have a chronic *P. aeruginosa* infection.

The investigators measured lung function by recording the maximum volume of air that can be expelled from the lungs in the first one second of a forced expiration. This is known as FEV_1. The lower the median FEV_1, the poorer the lung function.

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	without chronic *P. aeruginosa* infection				with chronic *P. aeruginosa* infection			
	male		female		male		female	
	with CFRD	without CFRD	with CFRD	without CFRD	with CFRD	without CFRD	with CRFD	without CFRD
number of people	44	110	52	93	106	166	121	120
FEV_1	71.1	71.4	53.6	73.6	49.0	59.0	42.0	61.0

With reference to Table 4.1

(i) discuss whether or not there appears to be a positive correlation between having a chronic *P. aeruginosa* infection and having CFRD

.....

.....

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.....

.....

..... [2]

(ii) calculate the percentage difference between the FEV_1 of males and females without CFRD and without *P. aeruginosa* infection.

Show your working

answer ..... % [2]

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(iii) outline the conclusions that can be drawn concerning the relationship between gender and the severity of lung damage in a person with CFRD and with *P. aeruginosa* infection.

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..... [3]

(c) In a person with CF, damage to lung function and the increased likelihood of chronic infections are the result of the secretion of thick mucus.

Explain why thick mucus is secreted in the lungs of a person with CF.

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..... [4]

[Total: 15]

Q9.

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6 **(a)** Fig. 6.1 outlines how a cholinergic synapse works.

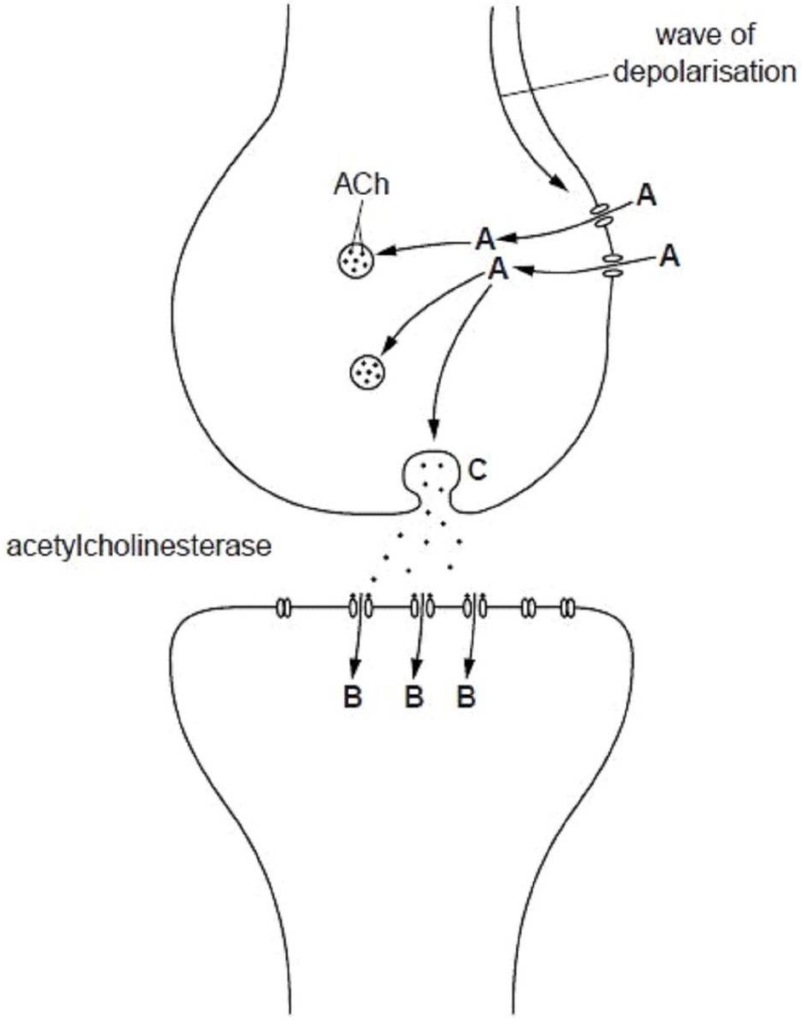


Fig. 6.1

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With reference to Fig. 6.1:

(i) name **A** and **B**

A .....

B ..... [2]

(ii) name the process occurring at **C**

..... [1]

(iii) state the effect of **B** entering the post-synaptic neurone

..... [1]

(iv) explain the role of acetylcholinesterase in the synapse.

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..... [3]

(b) Some synapses in the brain use the neurotransmitter dopamine. After the postsynaptic membrane has been depolarised, dopamine leaves the receptor proteins and moves back into the presynaptic neurone through specific transporter proteins.

Schizophrenia is a condition in which there is a higher than usual concentration of dopamine in certain areas of the brain. The drug phenothiazine has a similar shape to dopamine and is used to treat schizophrenia.

Suggest and explain what occurs at the synapse when phenothiazine is used in the treatment of schizophrenia.

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.....

..... [2]

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(c) DRD4 is a dopamine receptor in humans. The gene coding for the DRD4 receptor has a large number of alleles, of which an individual can have only two.

Three alleles of the DRD4 receptor gene have the following mutations:

- a single base substitution
- a 21 base-pair deletion
- a 13 base-pair deletion.

The 13 base-pair deletion has the most serious consequences for the structure of the DRD4 receptor protein. Suggest why this is so.

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..... [3]

(d) One allele of the DRD4 gene has been found more frequently amongst individuals whose personality is described as 'impulsive and exploratory'.

Describe the mechanism whereby an allele such as this could have become common in the human population.

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..... [3]

[Total: 15]

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Q10.

6 **(a)** The human kidneys process 1200 cm^3 of blood every minute. This 1200 cm^3 of blood contains 700 cm^3 of plasma. As blood passes through the glomeruli of the kidneys, 125 cm^3 of fluid passes into the renal capsules (Bowman's capsules). This fluid is called the glomerular filtrate and is produced by a process called ultrafiltration.

For Examiner Use

(i) Calculate the percentage of plasma that passes into the renal capsules.

Show your working and **give your answer to one decimal place**.

answer .....% [2]

(ii) Explain how the **structures** of the glomerular capillaries and the podocytes are adapted for ultrafiltration.

glomerular capillaries .....

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.....

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.....

podocytes .....

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..... [4]

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(b) The glomerular filtrate then passes through the proximal convoluted tubule.

Fig. 6.1 is a transverse section through part of the proximal convoluted tubule.

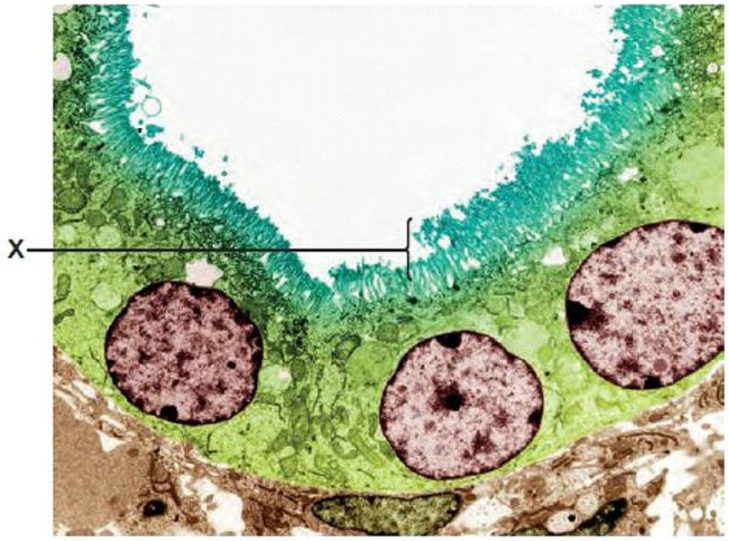


Fig. 6.1

(i) Name the structures labelled **X**.

..... [1]

(ii) Explain why the epithelial cells of the proximal convoluted tubule have many mitochondria in them.

.....

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..... [2]

(iii) Of the 125 cm^3 of glomerular filtrate that enters the renal capsules each minute, only 45 cm^3 reaches the loops of Henlé.

Name **two** substances that are reabsorbed into the blood from the proximal convoluted tubule, **apart from water**.

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..... [2]

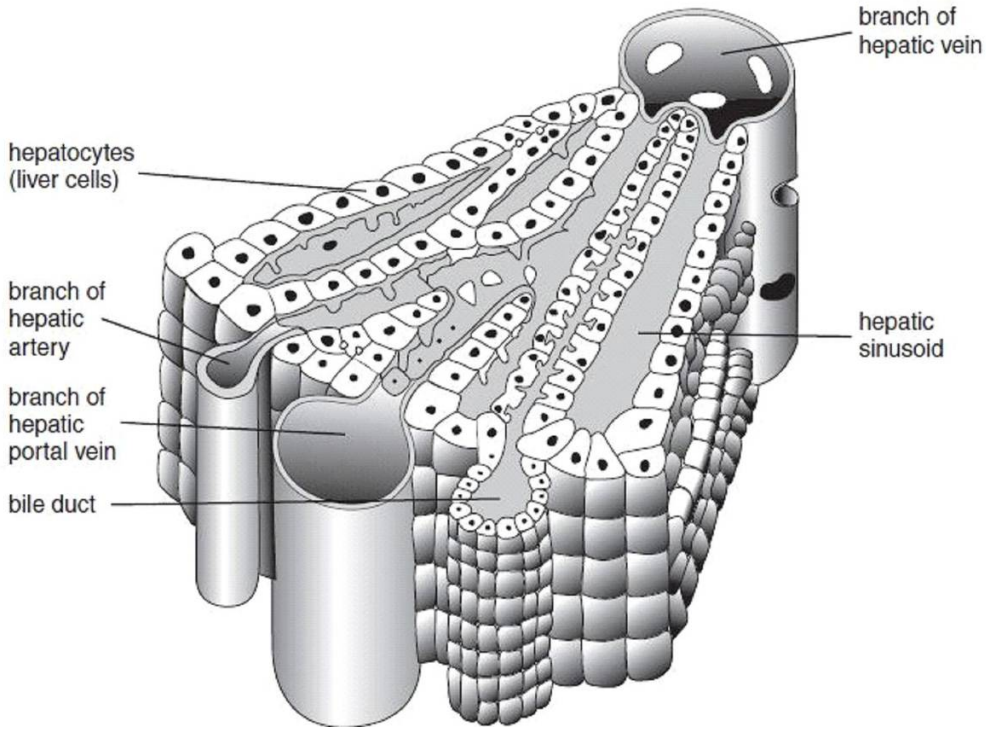
[Total: 11]

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Q11.

Use

3 The mammalian liver is made up of lobules that consist of liver cells (hepatocytes) arranged in plates.
Between these plates of cells are enlarged leaky capillaries called sinusoids.
Blood from both the hepatic portal vein and the hepatic artery flows through these sinusoids to the central vein and eventually into the hepatic vein.
Inside the sinusoids are Kupffer cells.
Fig. 3.1 shows a section of a liver lobule and its associated blood vessels.



(a) Describe the role of the Kupffer cells in the homeostatic function of the liver.

.....

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.....

.....[4]

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Use

(b) State how liver cells are involved in fat metabolism.

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.....[3]

(c) Explain how urea produced by liver cells from the deamination of excess amino acids is transported to the kidney for excretion.

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.....[2]

(d) State how blood in the hepatic vein will differ after a heavy meal from blood in

(i) the hepatic portal vein;

.....

.....[1]

(ii) the hepatic artery.

.....

.....[1]

[Total : 11]

Q12.

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3 Figs 3.1 and 3.2 show the concentration of glucose and insulin in blood plasma before and after a glucose drink.

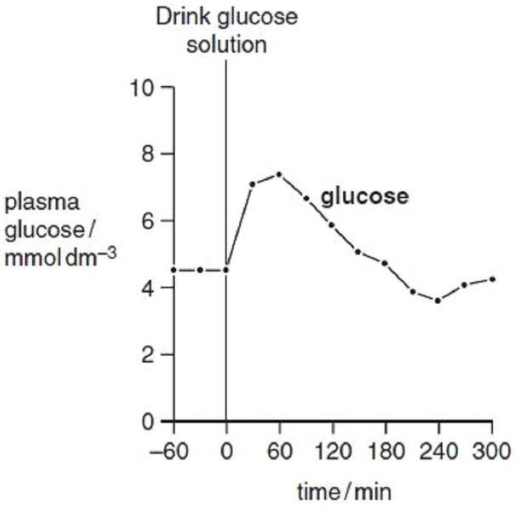


Fig. 3.1

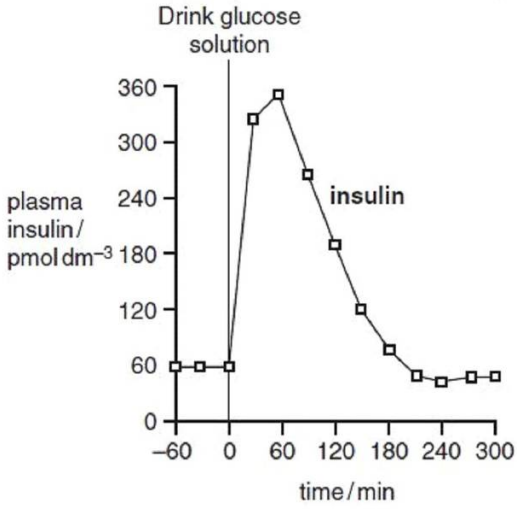


Fig. 3.2

(a) With reference to Fig. 3.1, describe the changes in blood glucose concentration after the glucose drink.

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.....[3]

(b) With reference to Fig. 3.1 and Fig. 3.2, explain how the changes in blood glucose cause:

(i) an increase in the concentration of insulin in the plasma;

.....

.....

.....[2]

(ii) a subsequent fall in the concentration of insulin in the plasma.

.....

.....

.....[2]

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(c) Describe the role of the hormone glucagon in maintaining the concentration of blood glucose.

.....

.....

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.....[3]

[Total : 10]

Q13.

5 Fig. 5.1 is a drawing of a section of a liver lobule that has been injected with ink. The Kupffer cells are clearly visible as a result of taking up carbon particles from the ink by phagocytosis.

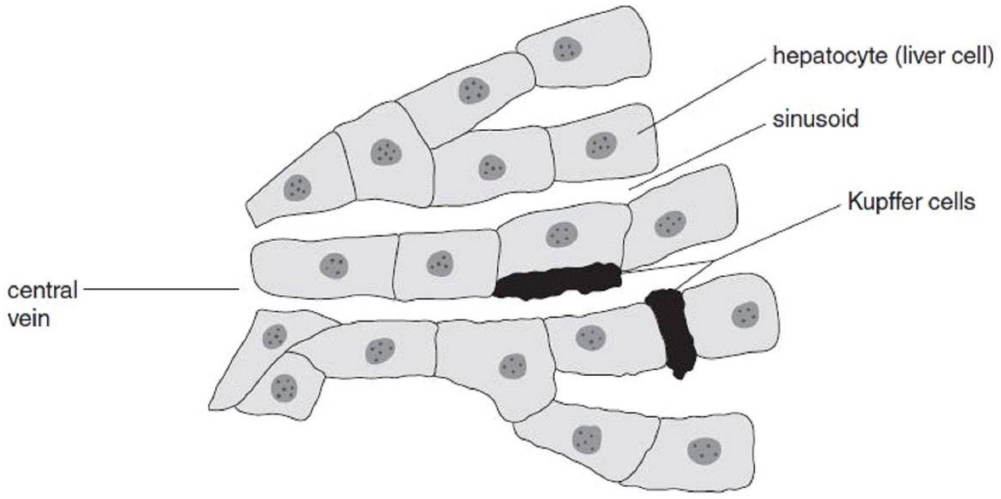


Fig. 5.1

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(a) The Kupffer cells remove damaged red blood cells from the blood in the sinusoids. Explain what happens to the haemoglobin.

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.....[4]

(b) Describe how excess amino acids are deaminated by the hepatocytes.

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.....[3]

(c) Outline the function of the hepatocytes in detoxification of a **named** toxic compound.

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.....

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.....[3]

[Total : 10]

Q14.

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2 Fig. 2.1 shows the changes in membrane potential in an axon during the passage of a single impulse.

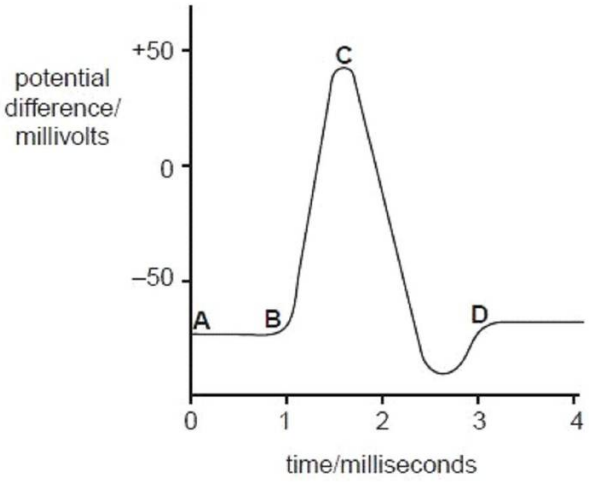


Fig. 2.1

(a) Outline how the resting potential from **A** to **B** is maintained.

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.....[3]

(b) Describe how the changes in the membrane bring about depolarization from B to C.

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.....[3]

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(c) Explain how the membrane is repolarised from C to D.

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.....[3]

(d) State three differences between nervous and hormonal communication in mammals.

1. .....

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2. .....

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3. .....

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[3]

[Total : 12]

Q15.

3 In mammalian kidneys, the loop of Henle is closely associated with the process of osmoregulation.

(a) Explain what is meant by osmoregulation.

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..... [2]

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Fig. 3.1 shows the water potential of renal fluid as it passes through the loop of Henle.

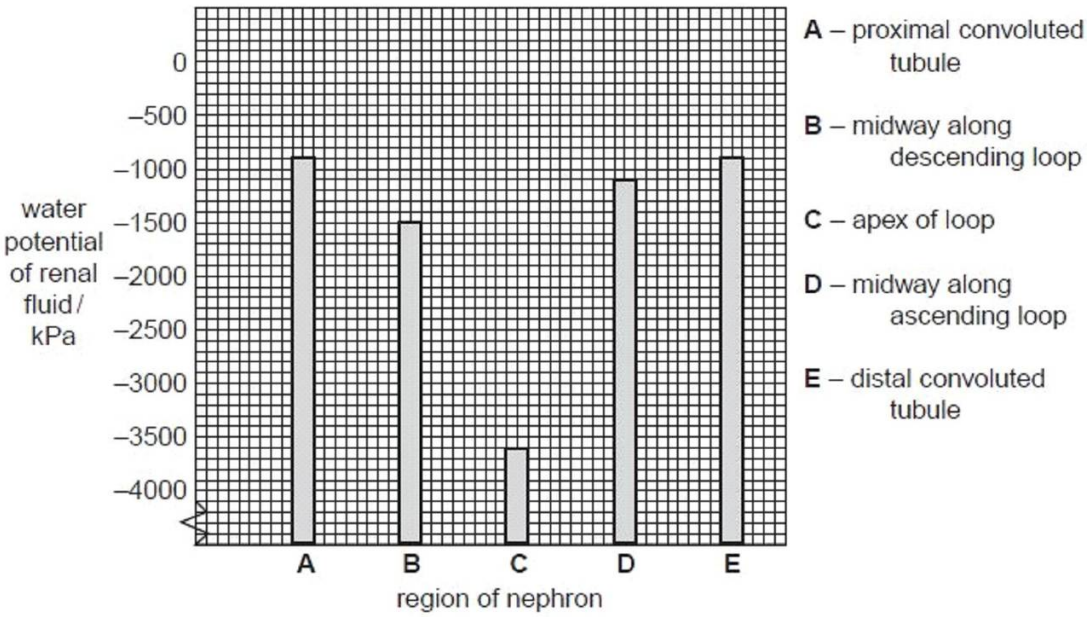


Fig. 3.1

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(b) Using the information given in Fig. 3.1, describe and explain what happens to the renal fluid as it passes through the loop of Henle.

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..... [5]

(c) Control systems often work by using negative feedback. These systems require a receptor and an effector. In the process of osmoregulation name the receptor and effector involved.

Receptor .....

Effector ..... [2]

[Total: 9]

Q16.

5 The lower epidermis of a dicotyledonous leaf is perforated with stomata. Each stoma is bounded by two guard cells which control the size of the pore.

Fig. 5.1 shows a scanning electron microscope photograph of an open and a closed stoma.

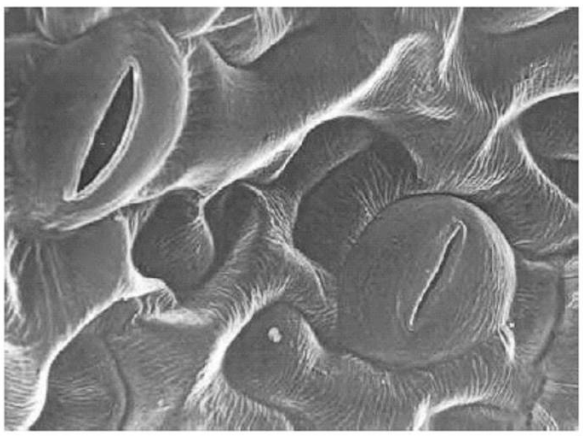


Fig. 5.1 **X4000**

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(a) Calculate the length of the pore of the open stoma in Fig. 5.1.

Show your working.

Answer ..... [2]

(b) Explain the importance of abscisic acid, ABA, in causing stomatal closure.

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..... [4]

(c) Under conditions of low wind speed, the rate of transpiration decreases, even though the stomata of the leaves are open.

Explain why this is so.

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.....

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..... [2]

[Total: 8]

Q17.

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4 **(a)** Explain the role of negative feedback in homeostasis in mammals.

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..... [4]

(b) The enzyme glucose oxidase catalyses the conversion of glucose to gluconic acid.

$$\text{glucose} + O_2 + H_2O \longrightarrow \text{gluconic acid} + H_2O_2$$

Describe how glucose oxidase in a biosensor can give warning of low blood glucose concentration (hypoglycaemia).

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..... [4]

[Total: 8]

Q18.

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Examiner's Use

8 Fig. 8.1 shows the changes in potential difference (p.d.) across the membrane of a neurone over a period of time. The membrane was stimulated at time **A** and time **B** with stimuli of different intensities.

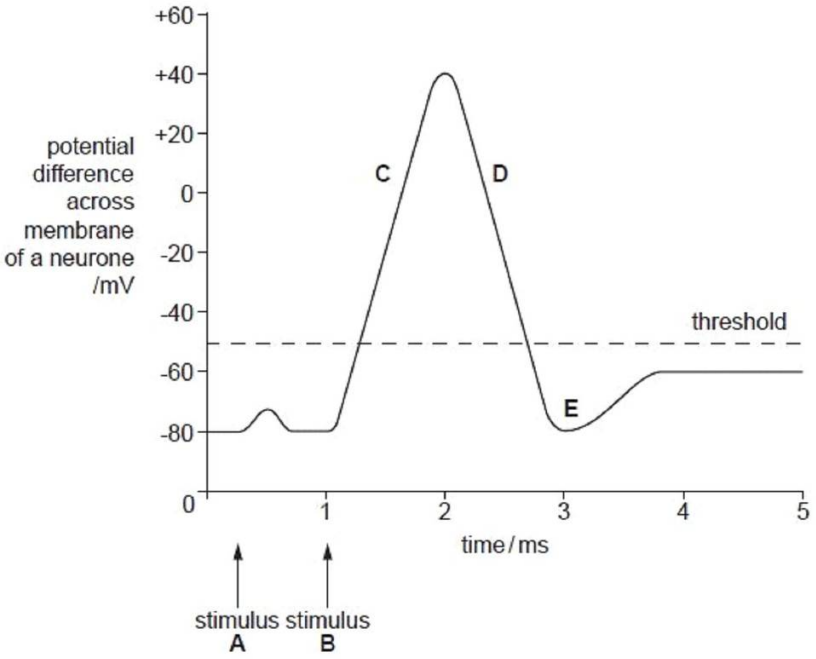


Fig. 8.1

(a) Stimulus **B** resulted in an action potential. Describe what is occurring at **C**, **D** and **E**.

C .....

.....

.....

D .....

.....

.....

E .....

.....

..... [6]

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(b) Suggest why stimulus **A** did not result in an action potential being produced whereas stimulus **B** did.

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..... [2]

[Total: 8]

Q19.

7 Fig. 7.1 shows a section through part of the cortex of a kidney.

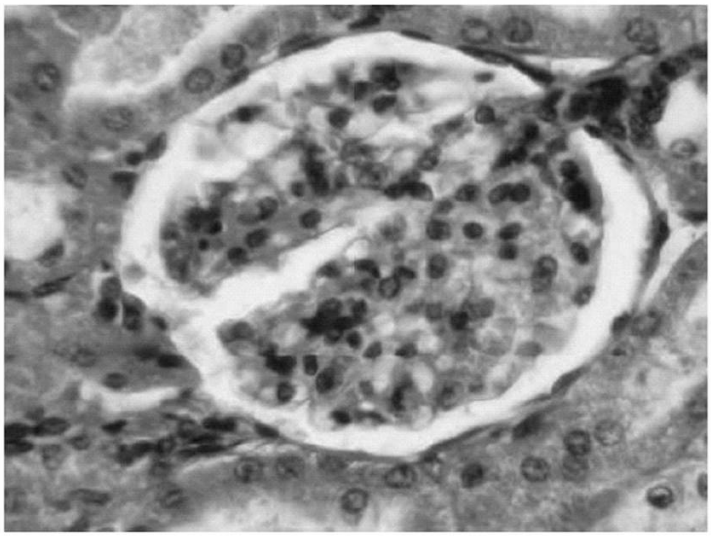


Fig. 7.1

(a) On Fig. 7.1, draw label lines and use the letters **G** and **R** to identify :

- a glomerulus with the letter **G**.
- a renal capsule with the letter **R**. [2]

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(b) State the name of the hormone that is involved in the control of the water potential of the blood.

.....[1]

(c) Table 7.1 shows the concentration of some compounds in the fluids of a glomerulus, a renal capsule and a collecting duct of the kidney.

Table 7.1

compound	concentration / g 100 cm^{-3}		
	blood plasma entering glomerulus	filtrate in renal capsule	urine in collecting duct
water	90	90	96
proteins	8.0	0.0	0.0
glucose	0.1	0.1	0.0
urea	0.03	0.03	2.0

With reference to Table 7.1,

(i) explain why proteins occur in the blood entering the glomerulus but not in the filtrate in the renal capsule

.....

.....

.....[2]

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(ii) explain why there is glucose present in the filtrate but not in the urine

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.....[2]

(iii) explain the difference in the concentration of urea between the filtrate and urine.

.....

.....

.....[2]

[Total: 9]

Q20.

6 (a) The pancreas acts both as an exocrine and an endocrine gland.

(i) Describe the parts of the pancreas involved in its **endocrine** function.

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.....

.....[3]

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(ii) State precisely the group of compounds to which the pancreatic hormone insulin belongs.

.....[1]

(b) People with insulin-dependent (type 1) diabetes require regular injections of insulin. In the past the insulin used came from animal sources such as pigs. Diabetics now use human insulin that has been manufactured using gene technology.

Describe the advantages of treating diabetics with insulin produced by gene technology.

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.....[3]

[Total: 7]

Q21.

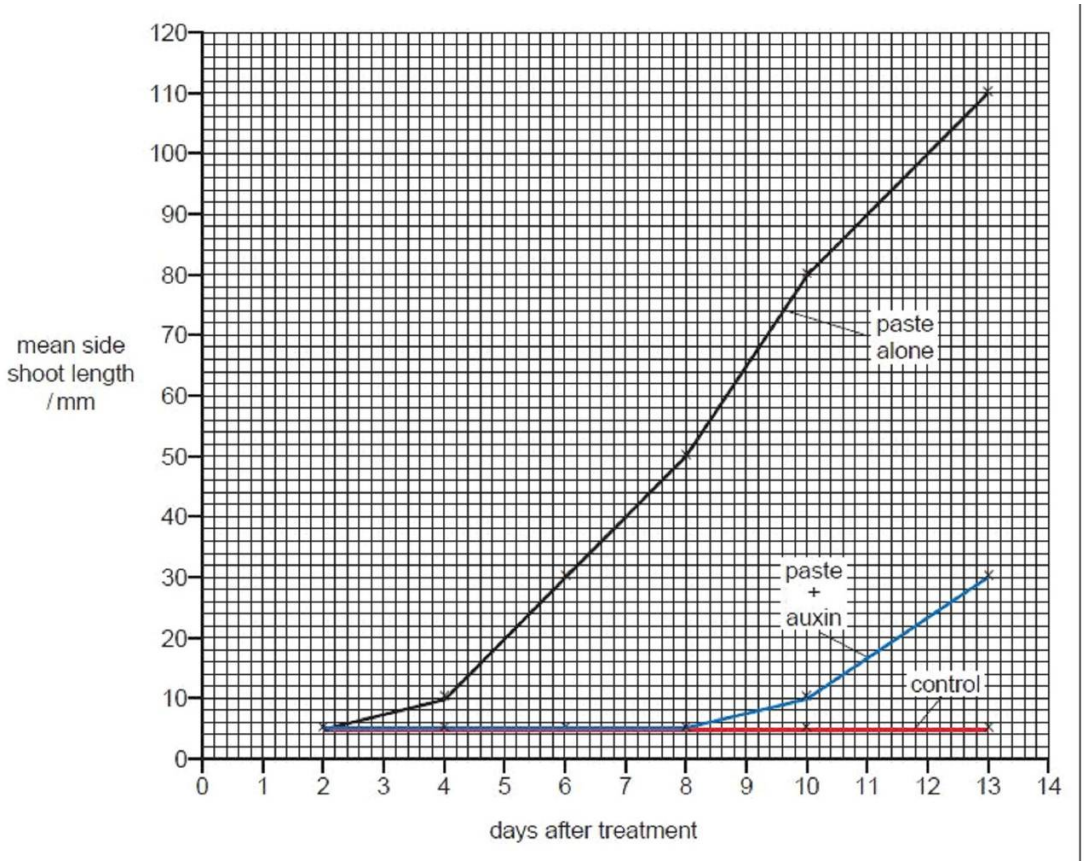
7 An investigation was carried out into the effects of a plant growth regulator, auxin (IAA), on apical dominance.

- The apical buds of 20 pea plants were cut off and discarded.
- The cut surfaces of 10 pea plants were coated with an inert paste containing auxin.
- The cut surfaces of the other group of 10 pea plants were coated with the inert paste alone.
- A further group of 10 pea plants did not have their apical buds removed and were not coated with paste. This was a control group.

The lengths of the side shoots of plants in each of the three groups were measured at regular time intervals and mean values calculated.

The results are shown in Fig. 7.1.

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mean side shoot length / mm
120
110
100
90
80
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
days after treatment
paste alone
paste + auxin
control

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(a) Explain why the side shoots increase in length when the terminal buds are removed.

.....

.....

.....

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.....

..... [3]

(b) Calculate the percentage difference, at 13 days, in the mean length of side shoots of plants treated with paste alone compared with the plants treated with paste and auxin.

Give your answer to the nearest whole number.

Show your working.

Answer .....% [2]

(c) Using data from Fig. 7.1, describe **and** explain the effect of auxin on the growth of side shoots.

.....

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..... [3]

[Total: 8]

Q22.

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7 Urea is the main nitrogenous waste product in humans. It is made in the liver and excreted by the kidneys in urine.

(a) Define the term *excretion*.

.....

.....

.....

..... [2]

(b) The kidneys regulate the water potential of body fluids. This is known as osmoregulation and involves a negative feedback system.

Outline the role of negative feedback in osmoregulation.

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..... [4]

(c) Investigations have shown that when a person remains in a cold environment for more than 15 minutes there is increased urine production. This is called cold diuresis.

Suggest how exposure to cold can lead to cold diuresis.

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.....

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..... [2]

[Total: 8]

Q23.

STEMUP.CO.UK

2 **(a)** The first diagnostic test strip using immobilised enzymes was a dip stick to estimate the concentration of glucose in urine.

For Examin Use

The dip stick is a thin strip of plastic with a cellulose pad containing two enzymes and a colour reagent (chromogen) at one end. The pad responds with a colour change after being dipped into a sample of urine that contains glucose. The colour can be matched against a graded colour chart to give a 'semi-quantitative' estimate of the concentration of glucose in the sample, as shown in Fig. 2.1. The chart shows the colours of a negative reaction (–) and three increasingly positive reactions (+, ++ and +++).

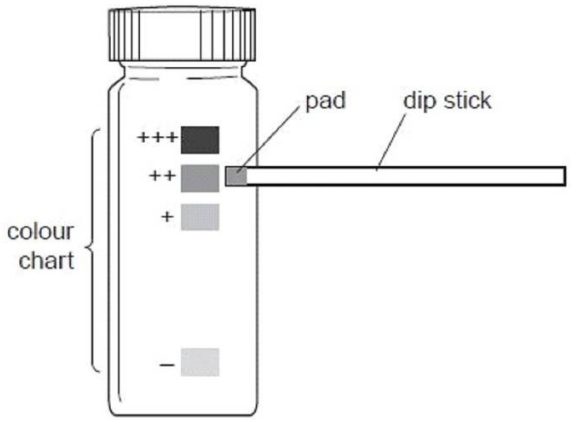


Fig. 2.1

Explain why the estimate of glucose concentration achieved by this method is only 'semi-quantitative'.

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.....

.....[2]

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(b) One of the two enzymes immobilised in the cellulose pad on the test strip is glucose oxidase, which catalyses the following reaction:

$$\text{glucose} + \text{oxygen} \xrightarrow{\text{glucose oxidase}} \text{gluconic acid} + \text{hydrogen peroxide}$$

This reaction does **not** result in the development of colour by the chromogen. This is achieved by the activity of the second immobilised enzyme in the pad.

(i) Name the second immobilised enzyme in the pad.

.....[1]

(ii) Explain how the reaction catalysed by this enzyme results in the chromogen changing colour.

.....

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.....

.....[2]

(iii) The cellulose pad on the test strip is covered by a layer of cellulose acetate, which is permeable to glucose molecules, but not to larger molecules.

Suggest why the layer of cellulose acetate is present.

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.....[2]

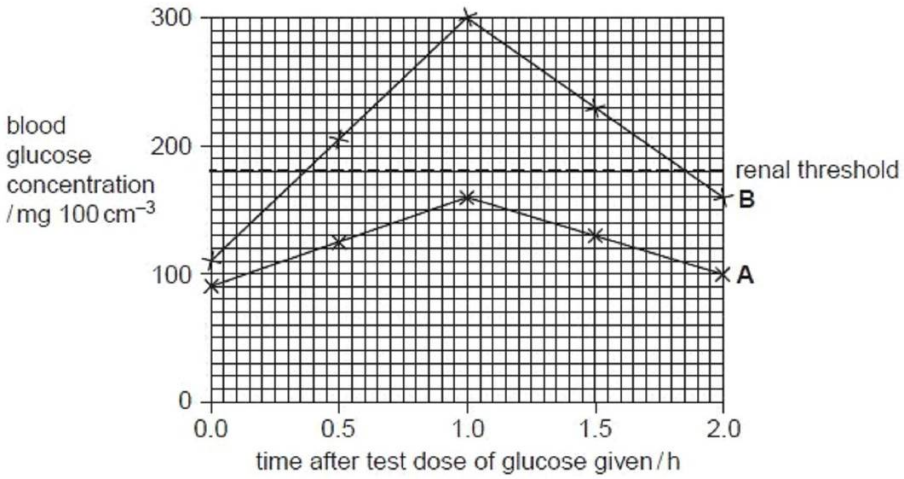
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(c) Two young men, subjects **A** and **B**, were each given a standardised test dose of glucose after fasting.

For Examiner Use

- The blood glucose concentration of each subject was then measured immediately and at 30 minute intervals for two hours.
- Samples of their urine were taken and tested at the same time intervals. The colour change of each test strip was compared with the colour chart and recorded as **–**, **+**, **++** or **+++**.

The results of the investigation are shown in Fig. 2.2.



Results of urine tests:

	time after test dose of glucose given / h				
subject	0.0	0.5	1.0	1.5	2.0
A	–	–	–	–	–
B	–	+	++	++	+++

Fig. 2.2

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With reference to Fig. 2.2:

Ex

(i) explain the differences between the **blood glucose** concentrations of **A** and **B**

.....

.....

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.....[4]

(ii) suggest what is meant by the term 'renal threshold'

.....

.....[1]

(iii) describe the events in the kidneys, after ultrafiltration, that result in the increasing quantity of glucose in **B**'s urine.

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.....[3]

[Total: 15]

Q24.

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7 **(a)** Table 7.1 shows the effect of several events on the blood concentration of glucose, insulin and glucagon in a healthy person.

Complete the table using the words **increase**, **decrease** or **no effect**.

The first row has been done for you.

Table 7.1

	initial effect of event on blood concentration of		
event	**glucose**	**insulin**	**glucagon**
meal containing sucrose	increase	increase	decrease
meal containing only protein			
fasting			
exercising			
meal containing starch			

[4]

(b) The concentration of glucose in the blood is controlled by the hormones insulin and glucagon.

Describe the part played by **glucagon** in the control of glucose in the blood.

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.....[3]

[Total: 7]

Q25.

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9 **(a)** When a part of the body is damaged or injured, action potentials are sent to the areas of the brain responsible for the perception of pain.

Explain how the structure of a sensory neurone can enable the action potentials to reach the brain very quickly.

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.....[2]

(b) The pain associated with osteoarthritis can be relieved using transcutaneous electrical nerve stimulation (TENS). It uses electrical impulses to stimulate the nerve endings at, or near, the site of the pain. Self-adhesive electrodes are stuck on the skin and attached to a small, portable power unit.

Fig. 9.1 shows a TENS machine in use.



Fig. 9.1

It is thought that TENS triggers the release of natural painkillers called endorphins, which are similar in shape to painkilling drugs such as morphine.

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Fig. 9.2 shows synapses in a pain pathway from a damaged joint to the brain.

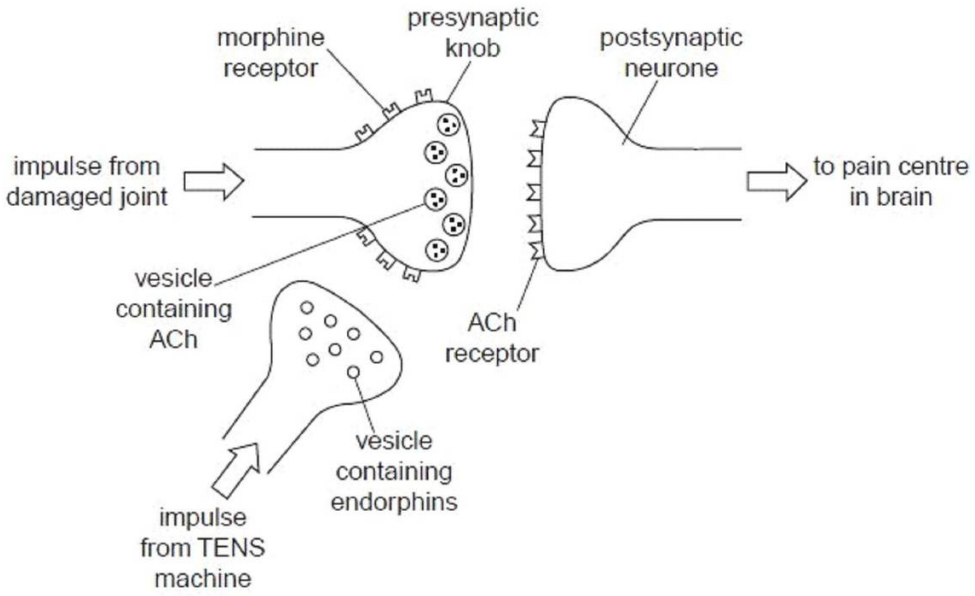


Fig. 9.2

STEMUP.CO.UK

(i) Suggest how endorphins may act to reduce pain.

.....

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.....[4]

(ii) Suggest advantages of using TENS for pain relief instead of more conventional treatment.

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.....[2]

[Total: 8]

Q26.

1 (a) Nerve impulses have to cross synapses. The events that enable a nerve impulse to cross a cholinergic synapse are listed in Table 1.1.

The events are **not** listed in the correct order.

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Table 1.1

event	description of event
A	Calcium ions enter presynaptic neurone knob.
B	Acetylcholine binds to receptor proteins on postsynaptic membrane.
C	Vesicles fuse with presynaptic membrane and release acetylcholine into synaptic cleft.
D	Postsynaptic membrane becomes depolarised.
E	Nerve impulse reaches presynaptic membrane.
F	Acetylcholine diffuses across cleft.
G	Receptor proteins change shape, channels open and sodium ions enter postsynaptic neurone.
H	Calcium ion channels open in presynaptic membrane.
I	Nerve impulse generated in postsynaptic neurone.
J	Vesicles of acetylcholine move towards presynaptic membrane.

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Complete Table 1.2 to show the events in the correct order.

Two of the events have been done for you.

Table 1.2

correct order	letter of stage
1	**E**
2	
3	
4	
5	
6	**F**
7	
8	
9	
10	

[4]

(b) Synapses have many roles in nervous coordination in mammals.

(i) Explain how synapses ensure one-way transmission of nerve impulses.

.....

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.....

.....

.....[2]

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(ii) In a learning activity, it is believed that the number of synapses between brain neurones increases.
Suggest the advantages of this increased number of synapses.

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.....[2]

[Total: 8]

Q27.

1 **(a)** Fig. 1.1 shows a neurone forming three synapses with adjacent neurones.

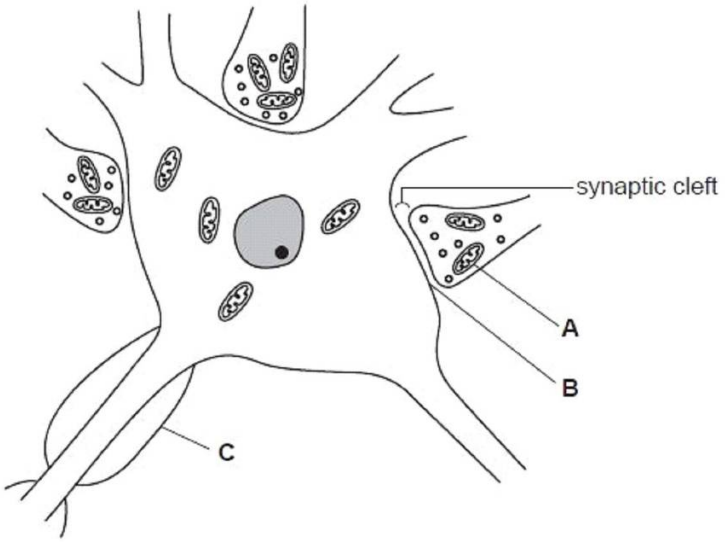


Fig. 1.1

Name **A**, **B** and **C**.

A.....

B.....

C.....[3]

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(b) Outline the role of structure **A** in synaptic transmission.

.....

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.....[3]

(c) The drug nicotine has a similar structure to acetylcholine.

Suggest the effects on brain neurones of inhaling nicotine from a cigarette.

E

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.....[2]

[Total: 8]

Q28.

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6 **(a)** Table 6.1 shows the mean axon diameter and mean speed of conduction of nerve impulses for four different animals.

Table 6.1

animal	type of neurone	axon diameter / μm	mean speed of conduction / ms^{-1}
A – mammal	myelinated	4	25
B – mammal	unmyelinated	5	3
C – amphibian	myelinated	14	35
D – amphibian	myelinated	10	30

With reference to Table 6.1, describe:

(i) the effect of myelination on the speed of conduction of impulses in mammals

.....

.....

.....

.....[2]

(ii) the effect of axon diameter on the speed of conduction of impulses in amphibians.

.....

.....

.....

.....[2]

(b) Explain how myelination affects the speed of conduction of impulses.

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.....[3]

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(c) Multiple sclerosis (MS) is an auto-immune condition of humans in which the body's immune system attacks the myelin sheaths which are then damaged. This leads to a decrease in information reaching the brain from sensory receptors.

(i) Suggest how the myelin sheaths may be attacked.

.....

.....

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.....[2]

(ii) Explain why this damage leads to a decrease in information reaching the brain from sensory receptors.

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.....[2]

[Total: 11]

Q29.

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9 The passage below summarises the effects of gibberellins on seed germination.

Complete the passage by using the most appropriate scientific term(s).

When a seed is shed from the parent plant, it is in a state of ..... , which means it is metabolically inactive.

When water is absorbed by a seed, it stimulates the production of gibberellin by the ..... within the seed. The gibberellin stimulates the synthesis of amylase by cells in the ..... layer.

Amylase hydrolyses starch molecules in the ..... converting them to soluble ..... molecules. These molecules are converted to glucose which is transported to the embryo, providing a source of carbohydrate that can be respired to provide ..... as the embryo begins to grow.

Gibberellin causes these effects by regulating genes that are involved in the synthesis of amylase. It has been shown that application of gibberellin to seeds can cause an increase in the ..... of the DNA coding for amylase.

[Total: 7]

Q30.

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6 Fig. 6.1 is a trace that shows the changes that occur in the membrane potential of a neurone during an action potential.

E

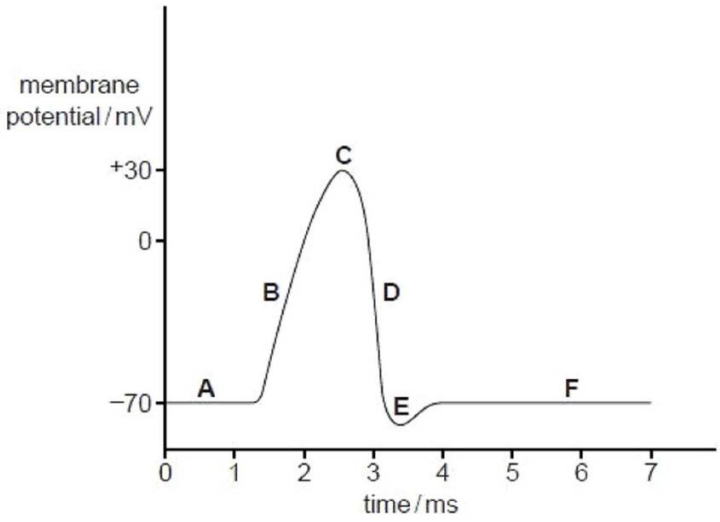


Fig. 6.1

(a) Using the letter(s) **A** to **F** from Fig. 6.1, state which letter(s) corresponds to the following:

(i) depolarisation .....

(ii) hyperpolarisation .....

(iii) the membrane is most permeable to potassium ions .....

(iv) resting potential ..... [4]

(b) Saxitoxin is a powerful poison produced naturally by single-celled, eukaryotic, photosynthetic, marine organisms. Shellfish may consume organisms containing saxitoxin but are unaffected. If humans were to eat shellfish containing saxitoxin they would become very ill and may die.

(i) State the kingdom to which the organisms that produce saxitoxin belong.

.....[1]

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(ii) Saxitoxin blocks sodium ion channels in the cell surface membranes of neurones.

Describe the role of sodium ion channels in the transmission of a nerve impulse.

B

.....

.....

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.....[3]

(iii) Suggest why saxitoxin may be fatal to humans.

.....

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.....[2]

[Total: 10]

Q31.

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9 The passage below summarises the effects of auxin on the growth of a shoot.

Complete the passage by using the most appropriate scientific term(s).

Auxin is synthesised in the growing tips of shoots (apical buds). It is transported from here down the shoot by ..... from cell to cell and also to a lesser extent by ..... flow in the ..... .

Auxin seems to be involved in determining whether a plant grows upwards or whether it branches sideways. When the apical bud is actively growing, it tends to stop lateral buds from growing. This is called apical ..... . The plant grows upwards rather than branching out sideways.

However, if the apical bud is cut off, the lateral buds start to grow. It is thought that removal of the apical bud causes the concentration of auxin in lateral buds to ..... so the buds can now grow by cell ..... and cell ..... .

[Total: 7]

Q32.

6 (a) The passage below outlines how sensory receptors work.

Complete the passage by using the most appropriate scientific term(s).

A sensory receptor cell responds to a stimulus by opening ion ..... in its cell surface membrane. Sodium ions flood into the cell causing the membrane to become ..... . This is called the ..... potential. If this potential is large enough to reach a ..... then an action potential is transmitted to the central nervous system. An increase in the strength of the stimulus will result in an increase in the ..... of action potentials transmitted. [5]

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(b) Describe how an action potential is **transmitted** along a sensory neurone in a mammal.

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.....[5]

Q33.

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6 (a) In mammals, the water potential of the blood is constantly monitored by osmoreceptor cells in the hypothalamus of the brain. When the water potential of the blood decreases, ADH (antidiuretic hormone) is produced by cells in the hypothalamus and released into the blood via an endocrine gland.

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

.....

.....

.....[1]

(ii) Describe the effect on water potential of adding solute to a solution.

.....

.....[1]

(iii) State precisely where ADH is released into the blood.

.....[1]

(iv) The decrease in the water potential of the blood is sometimes due to the loss of water from the body of a mammal.

List **two** ways by which water may be lost from the body.

.....

.....[1]

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(b) Describe the action of ADH on the kidney.

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.....

.....

.....

.....

.....

.....

.....[5]

(c) Diabetes insipidus is a condition caused by an inability to produce ADH or by the kidneys being unable to respond to ADH.

Suggest symptoms that may be experienced by a person who has diabetes insipidus.

.....

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.....

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.....[2]

[Total: 11]

Q34.

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6 (a) Neurones transmit impulses from one part of a mammal's body to another.

The table contains statements that refer to motor and sensory neurones.

Complete the table, indicating with the letters **M**, **S** or **B**, whether each statement applies to:

- motor neurones only (**M**)
- sensory neurones only (**S**)
- both motor and sensory neurones (**B**).

The first one has been done for you.

statement	letter
is myelinated	**B**
may form a synapse with an intermediate (relay) neurone	.....
cell body lies within the CNS	.....
dendron is usually longer than axon	.....
cell body lies within spinal nerve	.....
has many dendrites	.....

[3]

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(b) A synapse is a junction between two or more neurones.

Describe how an action potential arriving at a presynaptic membrane of a neurone can result in the depolarisation of the membrane of a post-synaptic neurone.

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.....[5]

(c) Acetylcholinesterase is an enzyme found in the synaptic cleft.

Outline the role of acetylcholinesterase.

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.....[2]

[Total: 10]

Q35.

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6 Asparagus, *Asparagus officinalis*, is a green vegetable plant grown in many parts of the world.

Fig. 6.1 shows some asparagus shoots.



Fig. 6.1

(a) The shoots are usually cooked and then eaten hot or cold. Asparagus contains many mineral ions which have important roles in the bodies of mammals.

Complete Table 6.1 to summarise some of these roles.

Table 6.1

ion	role	type of cell
Fe^{2+}	....	red blood cell
Na^{+}	co-transport in the kidney	....
Ca^{+}	....	neurone

[3]

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(b) When asparagus is digested, some of the compounds produced pass quickly into the urine to give a characteristic odour that only 22% of people can detect. The compounds bind to specific chemoreceptors in the nasal cavities of these people.

Complete the sentence below by using the most appropriate scientific term.

The chemoreceptors will send impulses to the brain only if the ..... potential is reached. [1]

(c) Outline how molecules, such as the compounds from the digestion of asparagus, pass from the blood to become part of the glomerular filtrate.

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.....[4]

[Total: 8]

Section-B

1.

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6 (a) Explain how a synapse functions. [9]

(b) Describe the role of glucagon in regulating blood glucose. [6]

[Total: 15]

2.

6 (a) Describe the role of auxins in apical dominance. [6]

(b) Explain the role of gibberellins in the germination of wheat or barley. [9]

[Total: 15]

3.

6 (a) Explain the meaning of the term **homeostasis** with specific reference to the control of **raised** blood glucose concentration in mammals. [8]

(b) Describe the role played by ADH in osmoregulation in mammals. [7]

[Total: 15]

4.

9 (a) Describe how a nerve impulse crosses a cholinergic synapse. [9]

(b) Explain the roles of synapses in the nervous system. [6]

[Total: 15]

5.

10 (a) Compare the roles of the endocrine **and** nervous systems in control and coordination in animals. [8]

(b) Describe the part played by auxins in apical dominance in a plant shoot. [7]

[Total: 15]

6.

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10 **(a)** Describe the part played by the proximal convoluted tubules in the functioning of the kidneys. [8]

(b) Explain how the collecting ducts in the kidneys may reduce the loss of water from the body. [7]

[Total: 15]

7.

10 **(a)** Describe the structure of a kidney nephron and its associated blood vessels. [7]

(b) Explain how glomerular filtrate is formed. [8]

[Total: 15]

8.

10 **(a)** Describe the structure of a myelinated sensory neurone. [7]

(b) Explain how an action potential is transmitted along a sensory neurone. [8]

[Total: 15]

9.

9 **(a)** Outline the ways in which the endocrine **and** nervous systems carry out their roles in control and coordination in animals. [8]

(b) Describe the part played by auxins in apical dominance in a plant shoot. [7]

[Total: 15]

10.

11 **(a)** Describe the role of abscisic acid (ABA) in the closure of a stoma. [8]

(b) Describe the role of gibberellins in the germination of barley seeds. [7]

[Total: 15]

11.

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10 (a) Describe the structure of a kidney, including its associated blood vessels. [6]

(b) Describe the mechanisms involved in reabsorption in the proximal convoluted tubule **and** describe how the epithelial cells of the proximal convoluted tubule are adapted to carry out this process. [9]

[Total: 15]

12.

10 (a) Outline, with reference to blood glucose concentration, the principles of homeostasis in mammals. [6]

(b) Describe the roles of the endocrine and nervous systems in control and coordination in mammals. [9]

[Total: 15]

13.

7 (a) Describe how nitrogenous waste products are formed and explain why they need to be removed from the body. [6]

(b) Describe how the kidney removes metabolic wastes from the body. [9]

14.

6 (a) Describe how the structure of neurones speeds up the transmission of action potentials. [6]

(b) Explain, using a named example, how sensory receptors in mammals convert energy into action potentials. [9]

[Total: 15]

15.

10 (a) Describe the structure of a motor neurone. [7]

(b) Explain how an action potential is transmitted along a motor neurone. [8]

[Total: 15]

16.

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10 **(a)** Describe a reflex arc **and** explain why such reflex arcs are important. [7]

(b) Describe the structure of a myelin sheath **and** explain its role in the speed of transmission of a nerve impulse. [8]

[Total: 15]

17.

10 **(a)** Describe how a nerve impulse crosses a cholinergic synapse. [9]

(b) Explain the roles of synapses in the nervous system. [6]

[Total: 15]

18.

11 **(a)** Describe how a resting potential is maintained in an axon. [9]

(b) Describe, using named examples, how sensory receptors in mammals generate action potentials. [6]

[Total: 15]

19.

10 **(a)** Outline the process of the photolysis of water **and** describe what happens to the products of photolysis. [10]

(b) Describe the roles of gibberellins in stem elongation. [5]

[Total: 15]

20.

9 **(a)** Describe the action of glucagon on liver cells in the regulation of blood glucose concentration. [9]

(b) Outline how a dip stick can measure the concentration of glucose **and** suggest advantages of using an electronic biosensor instead of a dip stick. [6]

[Total: 15]

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1. Nov/2018/Paper_41/No.8

(a) Outline the roles of sensory receptor cells in the mammalian nervous system.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Fig. 8.1 shows the changes in potential difference (p.d.) across the membrane of a receptor cell over a period of time. The membrane was stimulated at time **A** and at time **B** with stimuli of different intensities.

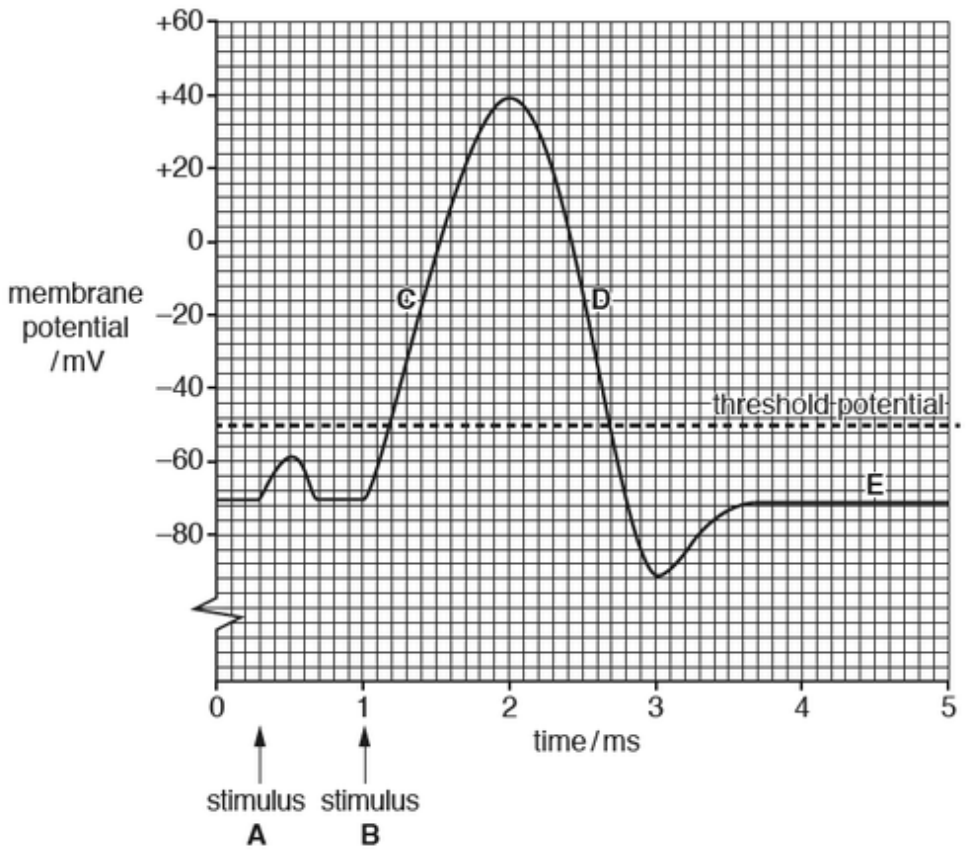


Fig. 8.1

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(i) State which of the letters **C**, **D** and **E** on Fig. 8.1 correspond to each of these events. You may use each of the letters **C**, **D** or **E** once, more than once or not at all.

The Na^+/K^+ pump is operating .....

The voltage-gated Na^+ channels are open .....

The voltage-gated K^+ channels are open .....

[3]

(ii) Explain why stimulus **A** did not result in an action potential being produced whereas stimulus **B** did.

.....

.....

.....

..... [2]

(iii) Describe the importance of the refractory period in the transmission of action potentials.

.....

.....

.....

..... [2]

(iv) Describe how action potentials are transmitted along a myelinated axon.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 14]

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2. Nov/2018/Paper_43/No.8

(a) Outline the roles of sensory receptor cells in the mammalian nervous system.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Fig. 8.1 shows the changes in potential difference (p.d.) across the membrane of a receptor cell over a period of time. The membrane was stimulated at time **A** and at time **B** with stimuli of different intensities.

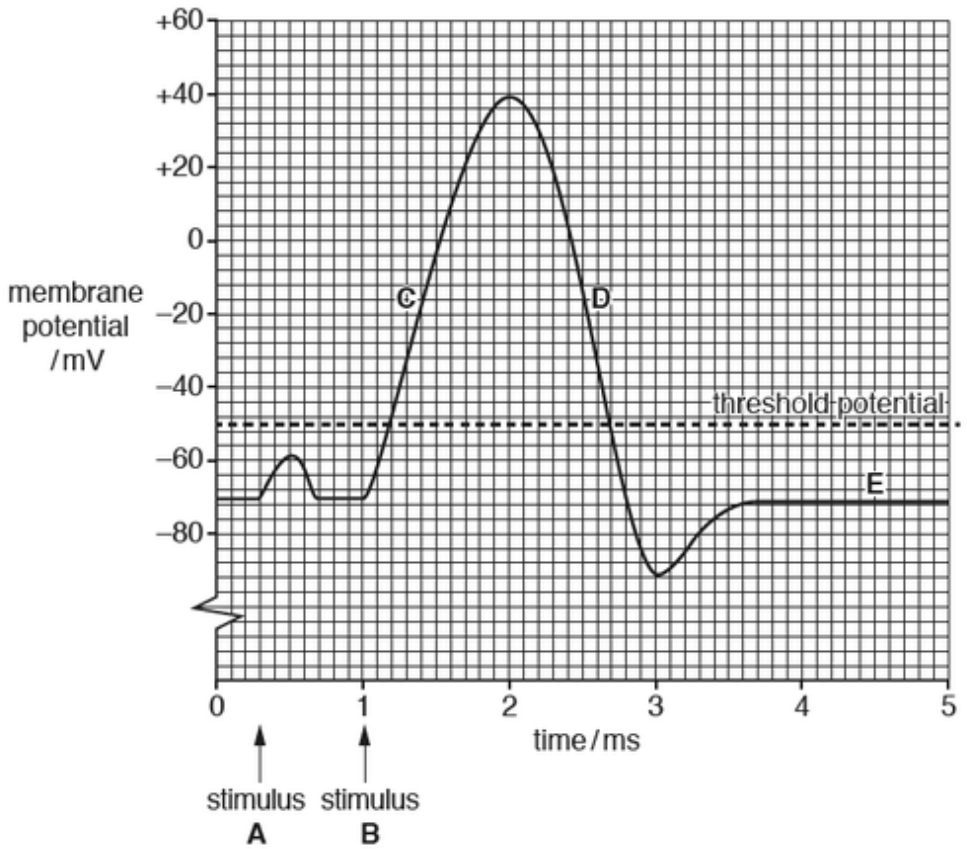


Fig. 8.1

STEMUP.CO.UK

(i) State which of the letters **C**, **D** and **E** on Fig. 8.1 correspond to each of these events. You may use each of the letters **C**, **D** or **E** once, more than once or not at all.

The Na^+/K^+ pump is operating .....

The voltage-gated Na^+ channels are open .....

The voltage-gated K^+ channels are open .....

[3]

(ii) Explain why stimulus **A** did not result in an action potential being produced whereas stimulus **B** did.

.....

.....

.....

..... [2]

(iii) Describe the importance of the refractory period in the transmission of action potentials.

.....

.....

.....

..... [2]

(iv) Describe how action potentials are transmitted along a myelinated axon.

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.....

.....

..... [4]

[Total: 14]

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1. Nov/2019/Paper_41/No.7

The Venus fly trap, *Dionaea muscipula*, is a carnivorous plant, native to wetlands of the East Coast of the USA. Mineral ions from decayed organisms are often washed away in these wetlands.

Fig. 7.1 shows a Venus fly trap leaf.

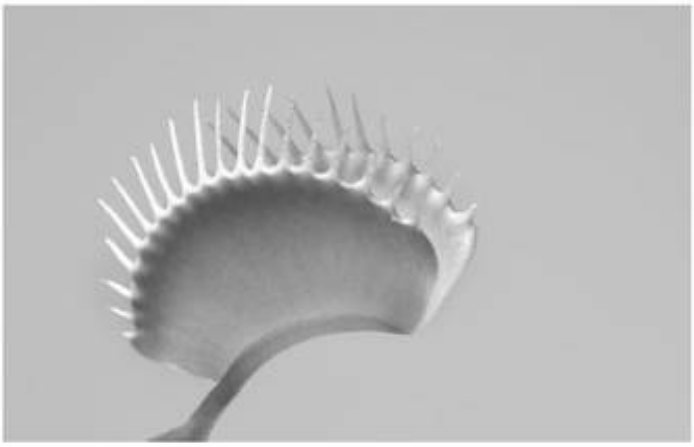


Fig. 7.1

(a) Suggest why a Venus fly trap benefits from catching insects in these wetlands.

.....

.....

.....

..... [2]

(b) **(i)** The leaves of the Venus fly trap will close if stimulated by an insect.

State which part of the leaf detects the stimulus.

..... [1]

(ii) Explain how the plant does not waste energy by closing when it does not need to, such as when a large drop of rain touches the receptor.

.....

..... [1]

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(c) Fig. 7.2 is a graph of an action potential in a human neurone.

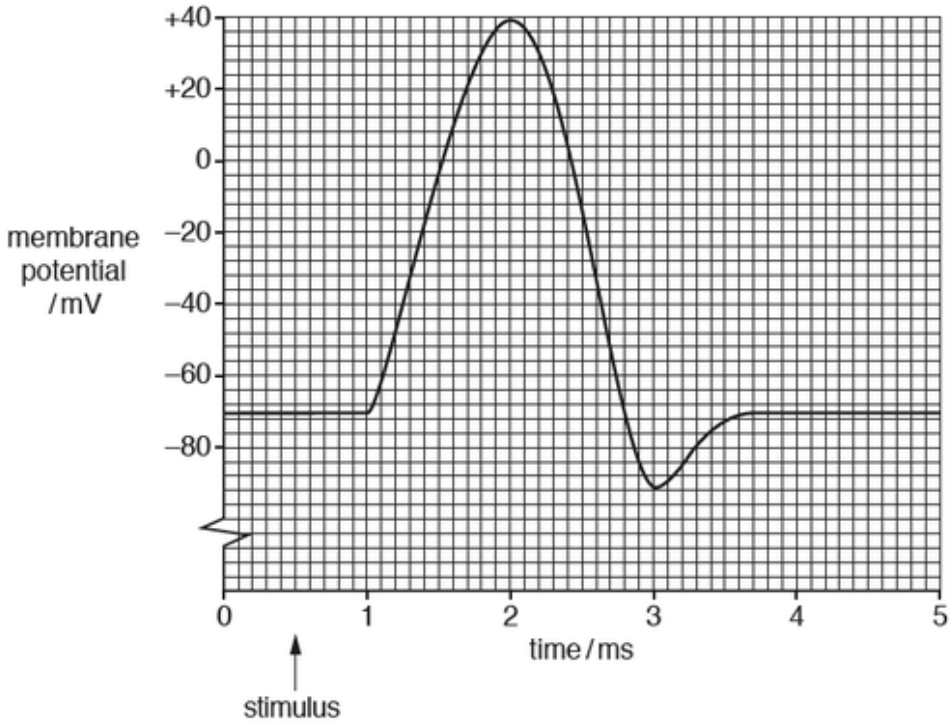


Fig. 7.2

Fig. 7.3 is a graph of an action potential in leaf cells of a Venus fly trap.

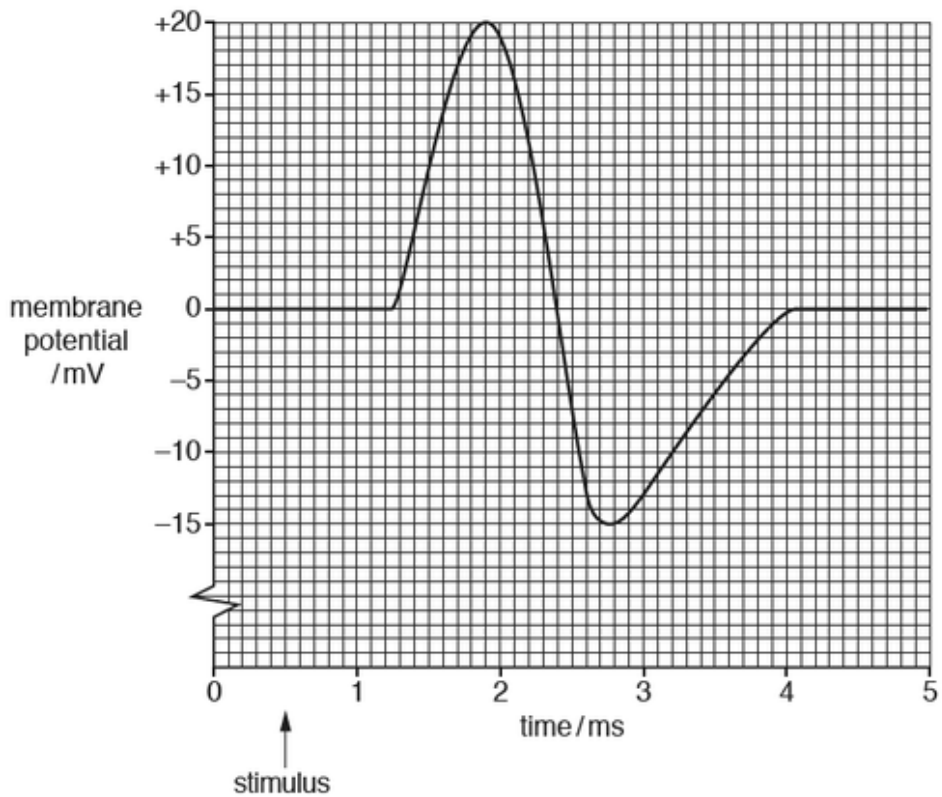


Fig. 7.3

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With reference to Fig. 7.2 and Fig. 7.3, describe how the action potential of the Venus fly trap differs from that of a human.

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..... [3]

(d) Describe how the production of action potentials in the leaf cells of the Venus fly trap can result in the leaves closing and trapping an insect.

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..... [5]

[Total: 12]

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2. Nov/2019/Paper_42/No.7

The Venus fly trap, *Dionaea muscipula*, is a carnivorous plant, native to wetlands of the East Coast of the USA. Mineral ions from decayed organisms are often washed away in these wetlands.

Fig. 7.1 shows a Venus fly trap leaf.

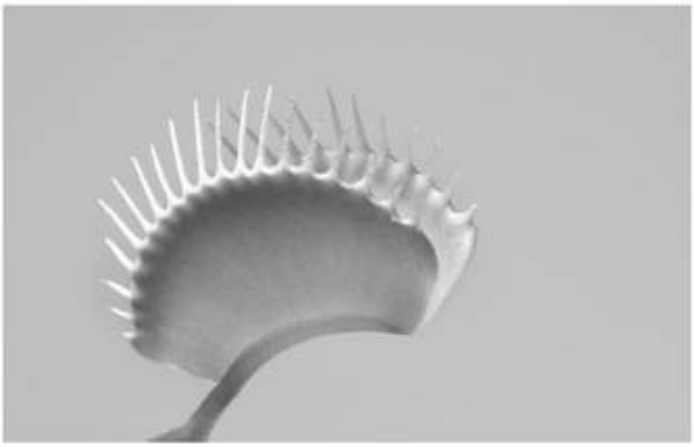


Fig. 7.1

(a) Suggest why a Venus fly trap benefits from catching insects in these wetlands.

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..... [2]

(b) **(i)** The leaves of the Venus fly trap will close if stimulated by an insect.

State which part of the leaf detects the stimulus.

..... [1]

(ii) Explain how the plant does not waste energy by closing when it does not need to, such as when a large drop of rain touches the receptor.

.....

..... [1]

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(c) Fig. 7.2 is a graph of an action potential in a human neurone.

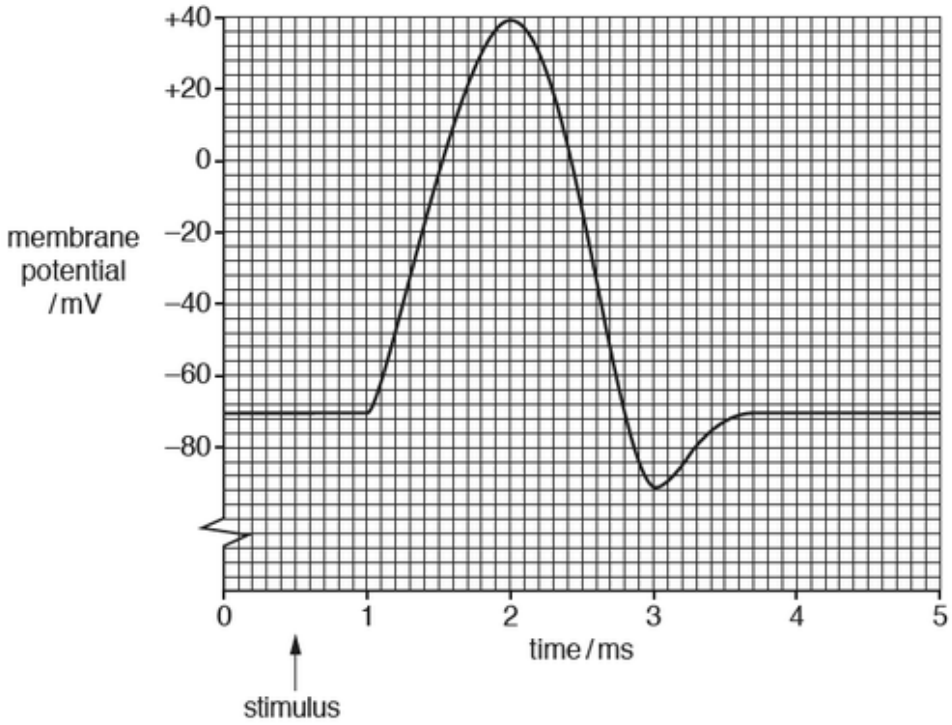


Fig. 7.2

Fig. 7.3 is a graph of an action potential in leaf cells of a Venus fly trap.

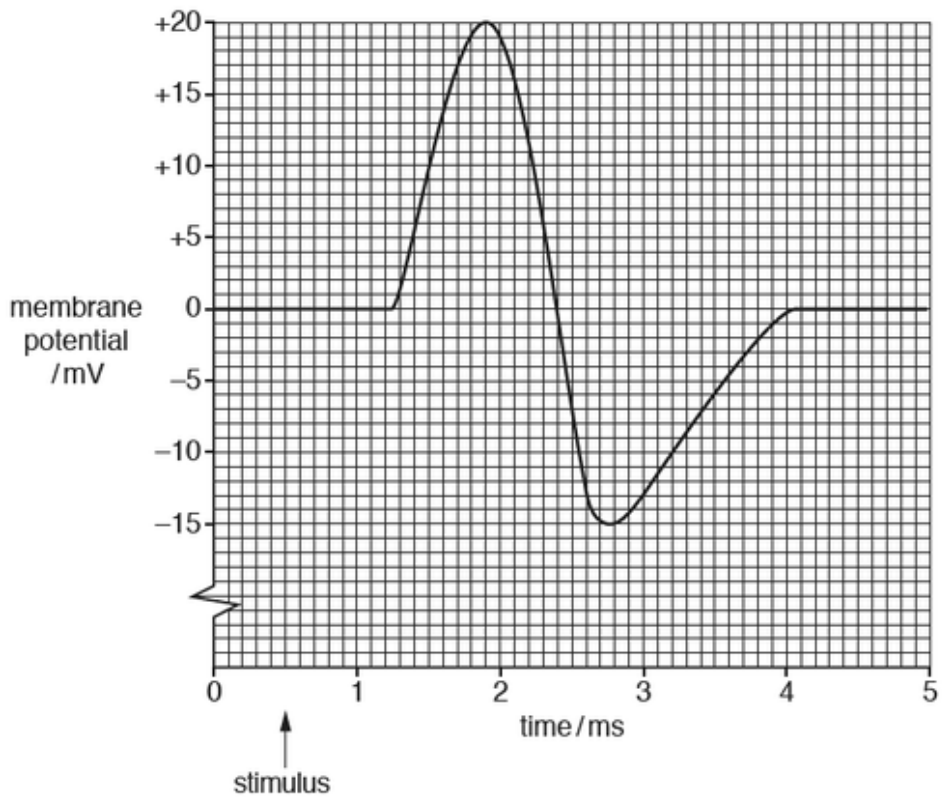


Fig. 7.3

STEMUP.CO.UK

With reference to Fig. 7.2 and Fig. 7.3, describe how the action potential of the Venus fly trap differs from that of a human.

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..... [3]

(d) Describe how the production of action potentials in the leaf cells of the Venus fly trap can result in the leaves closing and trapping an insect.

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..... [5]

[Total: 12]

STEMUP.CO.UK

3. Nov/2019/Paper_43/No.10(a)

(a) Describe the roles of the neuromuscular junction, transverse system tubules (T-tubules) and the sarcoplasmic reticulum in stimulating contraction in striated muscle. [7]

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4. June/2019/Paper_41/No.1

(a) Fig. 1.1 shows part of a cell in a growing region of a plant.

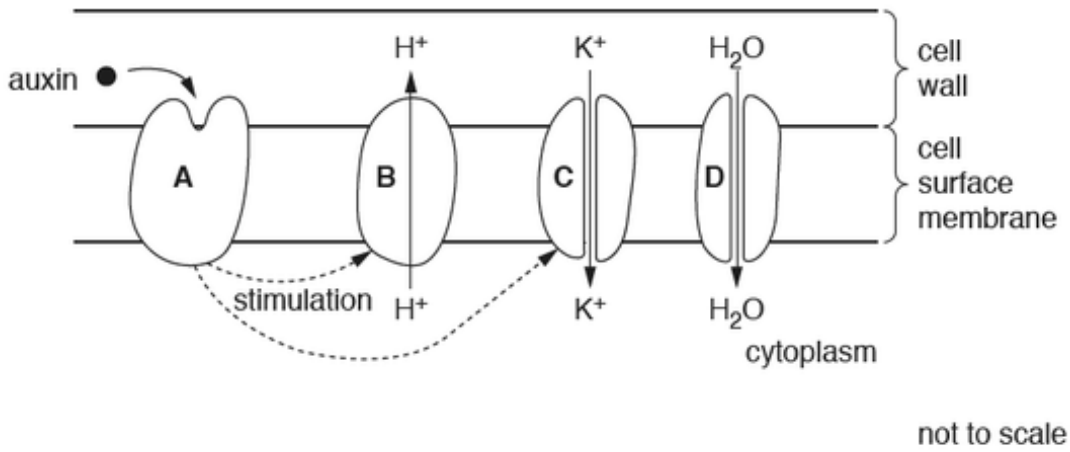


Fig. 1.1

(i) State the **type** of protein represented by **A**.

..... [1]

(ii) Proteins **B**, **C** and **D** are transport proteins.

Identify proteins **B**, **C** and **D**.

B .....

C .....

D .....

[3]

(b) Describe the effects on the cell wall of many hydrogen ions moving into the cell wall.

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..... [3]

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(c) Explain the consequences of an influx of potassium ions into the cell.

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..... [2]

[Total: 9]

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5. June/2019/Paper_41/No.10(a)

(a) Explain how a cholinergic synapse functions. [7]

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6. June/2019/Paper_42/No.1

(a) Fig. 1.1 is an electron micrograph showing a cross-section of a myelinated neurone.

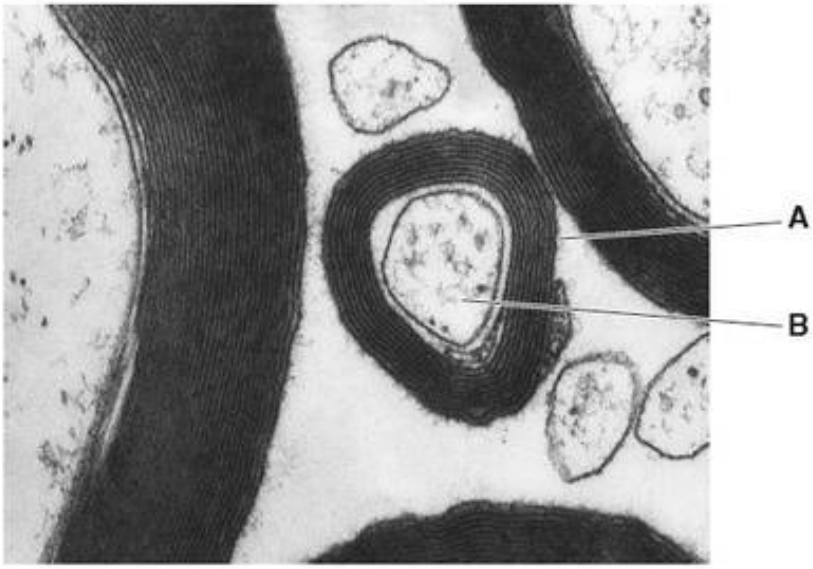


Fig. 1.1

Name **A** and **B**.

A .....

B .....

[2]

(b) Explain what is meant by saltatory conduction **and** describe its effect on the transmission of a nerve impulse.

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..... [3]

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(c) A type of sea snail, *Conus purpurascens*, produces a toxin that blocks calcium ion channels in the presynaptic knob of a cholinergic synapse. The presence of this toxin results in no action potentials in the postsynaptic neurone.

Explain why the presence of this toxin results in **no** action potentials in the postsynaptic neurone.

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..... [5]

[Total: 10]

STEMUP.CO.UK

7. June/2019/Paper_42/No.10(a)

(a) Outline the biological basis of contraceptive pills containing oestrogen and progesterone. [8]

STEMUP.CO.UK

8. June/2019/Paper_43/No.1

(a) Fig. 1.1 shows a cholinergic synapse.

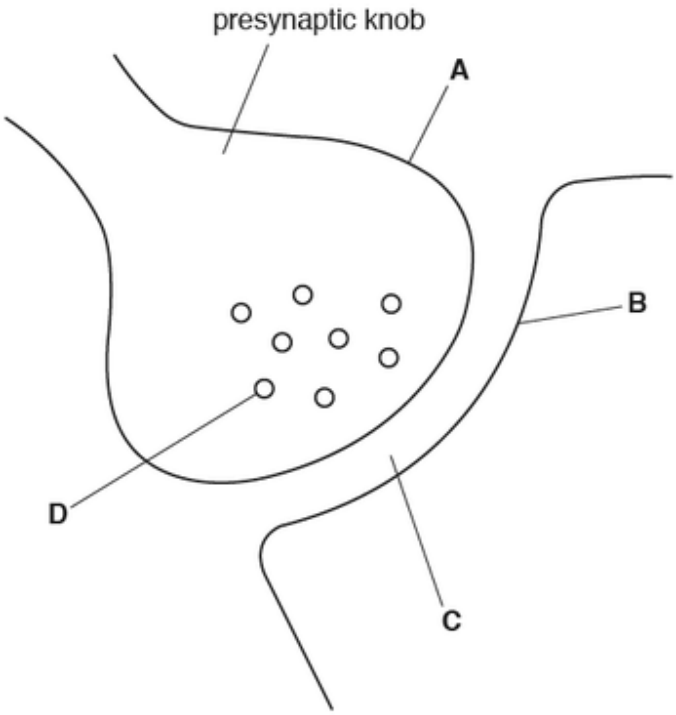


Fig. 1.1

Complete Table 1.1, using the letters **A**, **B**, **C** or **D** from Fig. 1.1, to show the location of compounds and structures associated with a cholinergic synapse.

You may use **A**, **B**, **C** and **D** once, more than once, or not at all.

Table 1.1

compound or structure	location
acetylcholine	.....
voltage-gated channel	.....
receptor protein	.....
acetylcholinesterase	.....

[4]

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(b) Explain what is meant by a voltage-gated channel.

.....

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..... [2]

(c) Explain the role of acetylcholinesterase in a synapse.

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..... [3]

(d) Outline the roles of synapses in the nervous system.

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..... [2]

[Total: 11]

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9. Feb/2019/Paper_42/No.7

(a) Isolated mitochondria were used to investigate respiration.

- Mitochondria were extracted from respiring mammalian cells and incubated in a buffer solution.
- Pyruvate and inorganic phosphate (Pi) were added at time zero.
- ADP was added one minute later.
- The oxygen concentration of the buffer solution containing mitochondria was monitored throughout the investigation.

The results of the investigation are shown in Fig. 7.1.

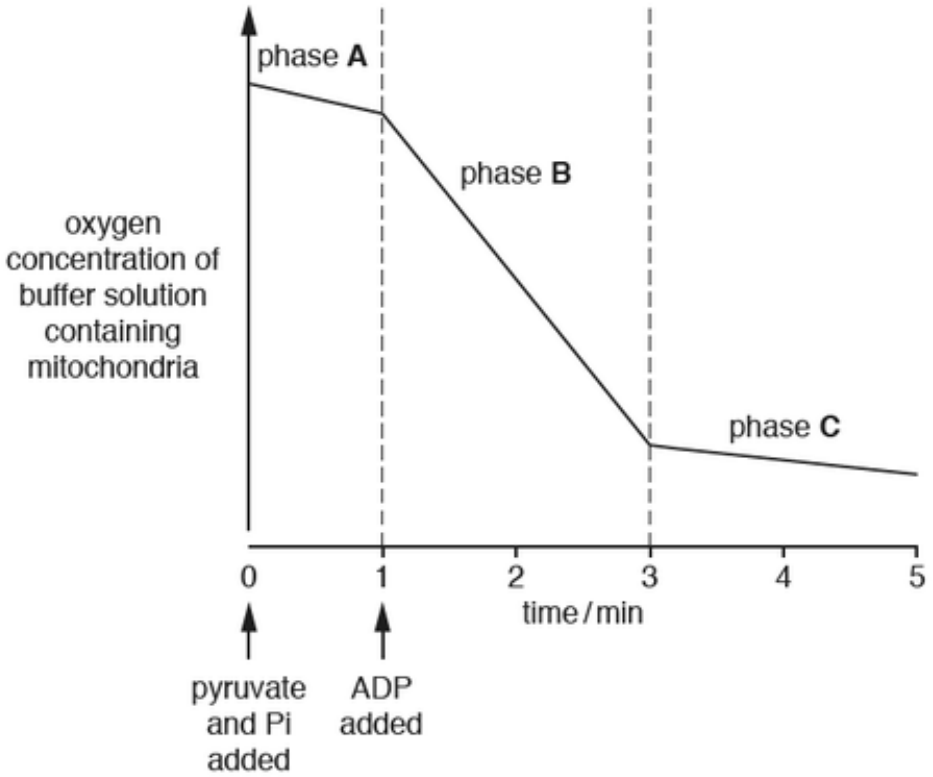


Fig. 7.1

(i) Suggest why the line of the graph in Fig. 7.1 is steeper during phase **B** than during phase **A**.

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..... [3]

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(ii) Suggest why the line of the graph starts to level out in phase **C**.

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..... [1]

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(b) Some plants, such as rice, grow with their roots submerged in water.

Fig. 7.2 shows a group of rice plants.



Fig. 7.2

Explain how rice is adapted to grow with its roots submerged in water.

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..... [5]

STEMUP.CO.UK

10. Feb/2019/Paper_42/No.9(a, b)

(a) Describe the sliding filament model of muscular contraction. [7]

(b) Explain the roles of the hormones FSH, LH, oestrogen and progesterone in the human menstrual cycle. [8]

[Total: 15]

STEMUP.CO.UK

1. Nov/2021/Paper_41/No.5

(a) Gibberellin is a plant growth regulator involved in barley seed germination. Production of gibberellin is stimulated by the uptake of water.

State the location of gibberellin synthesis in a barley seed during germination.

..... [1]

(b) Barley seeds germinate when placed on blotting (absorbent) paper soaked in water.

The germination of barley seeds placed on blotting paper soaked in solutions of different water potential was investigated.

The success of germination was measured as a germination index for:

- barley seeds placed on blotting paper soaked in water
- barley seeds placed on blotting paper soaked in 5 solutions of different water potential.

The results are shown in Fig. 5.1.

The higher the germination index value, the more successful the germination of the barley seeds.

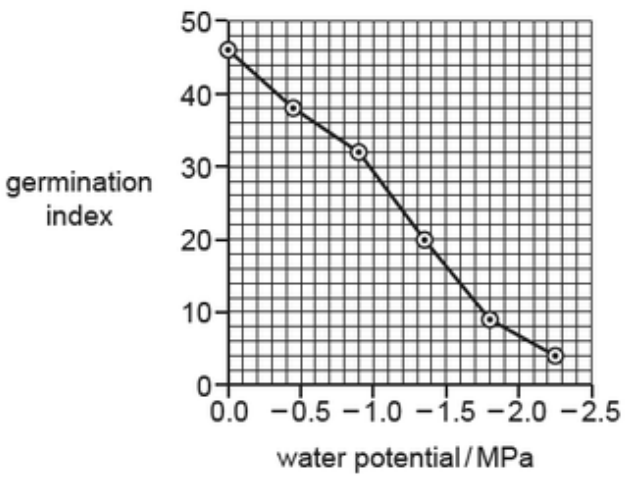


Fig. 5.1

(i) With reference to Fig. 5.1, describe the relationship between the germination index of barley seeds and water potential.

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..... [2]

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(ii) Suggest explanations for the relationship shown in Fig. 5.1.

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..... [3]

(c) During barley seed germination, gibberellin stimulates the synthesis of enzymes.

State the name of one of these enzymes **and** the precise location of its synthesis.

enzyme .....

location .....
[2]

(d) Some plants are grown commercially for their flowers. Many of these plants are varieties that have short stems.

Two factors that affect the height of stems are:

- gibberellin
- the *Le*/*le* gene.

The *Le*/*le* gene has two alleles, Le and le.

(i) Suggest an advantage of growing a short-stemmed variety of a flowering plant.

.....

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..... [1]

(ii) Explain how the *Le*/*le* gene and gibberellin are involved in affecting the height of plant stems.

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..... [3]

[Total: 12]

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2. Nov/2021/Paper_41/No.10

(a) Describe **and** explain the transmission of an action potential in a myelinated neurone. [9]

(b) Explain what is meant by homeostasis in a mammal **and** explain why it is important to maintain body temperature, blood glucose concentration and the water potential of blood. [6]

[Total: 15]

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3. Nov/2021/Paper_42/No.3

During the germination of barley seeds, amylase is produced.

(a) Describe the sequence of events that lead to the production of amylase during germination of barley seeds.

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..... [3]

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(b) Malting is a process involved in the production of a drink called beer. During malting, barley seed germination is controlled so that the sugars produced during germination can be used in the production of beer.

Fig. 3.1 shows two features of a germinating barley seed during the first five days of malting:

- activity of the amylase enzyme
- the percentage of starch reserves remaining in the barley seed.

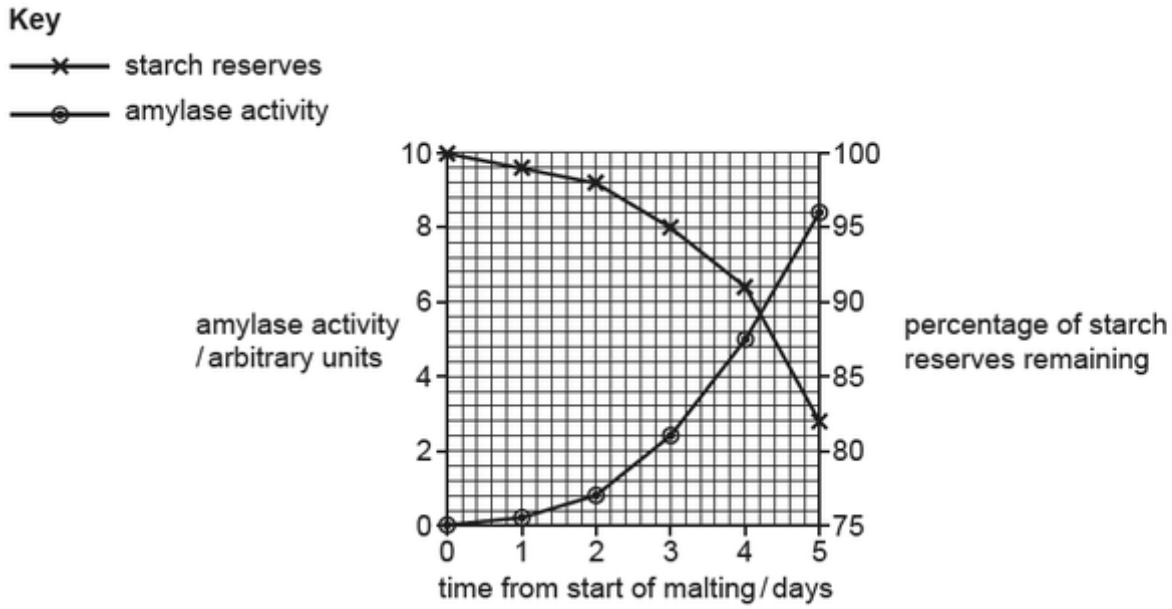


Fig. 3.1

(i) State the precise location of the starch reserves in the barley seed.

..... [1]

(ii) With reference to Fig. 3.1, describe **and** explain the effect of malting on amylase activity and the percentage of starch reserves remaining in the germinated barley seed.

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..... [4]

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(c) In the malting process, germination is stopped before the concentration of sugars in the germinating barley seeds exceeds a concentration that causes shoot or root growth.

Drying the germinating barley seeds at 50 °C is one method used to stop malting.

(i) Explain how this method would stop malting.

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..... [3]

(ii) Suggest why malting is stopped before shoot or root growth occurs.

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..... [1]

[Total: 12]

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4. Nov/2021/Paper_42/No.9(b)

(b) Describe the structure of a motor neurone. [6]

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5. Nov/2021/Paper_42/No.(a, b)

(a) Explain how dip sticks function to test for glucose in a sample of urine. [7]

(b) Explain the control of gibberellin synthesis **and** outline how gibberellin stimulates stem elongation. [8]

[Total: 15]

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1. June/2022/Paper_41/No.1(b, c)

(b) The toxin in the skin of the golden mantella affects the action of the sarcomeres in muscle fibres (muscle cells) of mammalian striated muscle. The toxin inhibits a protein, Ca^{2+}ATPase, found in the membrane of the sarcoplasmic reticulum.

Ca^{2+}ATPase pumps calcium ions from the cytoplasm into the sarcoplasmic reticulum when the fibre is no longer stimulated.

Suggest the consequences to the sarcomere of the action of the golden mantella toxin.

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..... [3]

(c) Describe the role of calcium ions in a cholinergic synapse.

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..... [3]

2. June/2022/Paper_41/No.10

(a) Motor neurones and sensory neurones have different roles in nervous coordination.

Contrast the structure **and** function of sensory neurones and motor neurones.

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..... [3]

(b) Mammals have many types of neurones, which vary in axon diameter and myelination.

Table 10.1 shows the axon diameter and mean impulse transmission speed of four different types of mammalian neurone.

Table 10.1

neurone type	myelination	mean axon diameter /μm	mean impulse transmission speed / $m s^{-1}$
motor α	✓	13.0–20.0	80–120
motor β	✓	6.0–12.0	35–75
motor δ	✓	1.0–5.0	5–35
motor C	✗	0.2–1.5	0.5–2.0

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Using the data shown in Table 10.1, comment on the relationship between:

- myelination and mean impulse transmission speed
- axon diameter and mean impulse transmission speed.

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..... [3]

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(c) Fig. 10.1 is a graph of an action potential in a mammalian neurone.

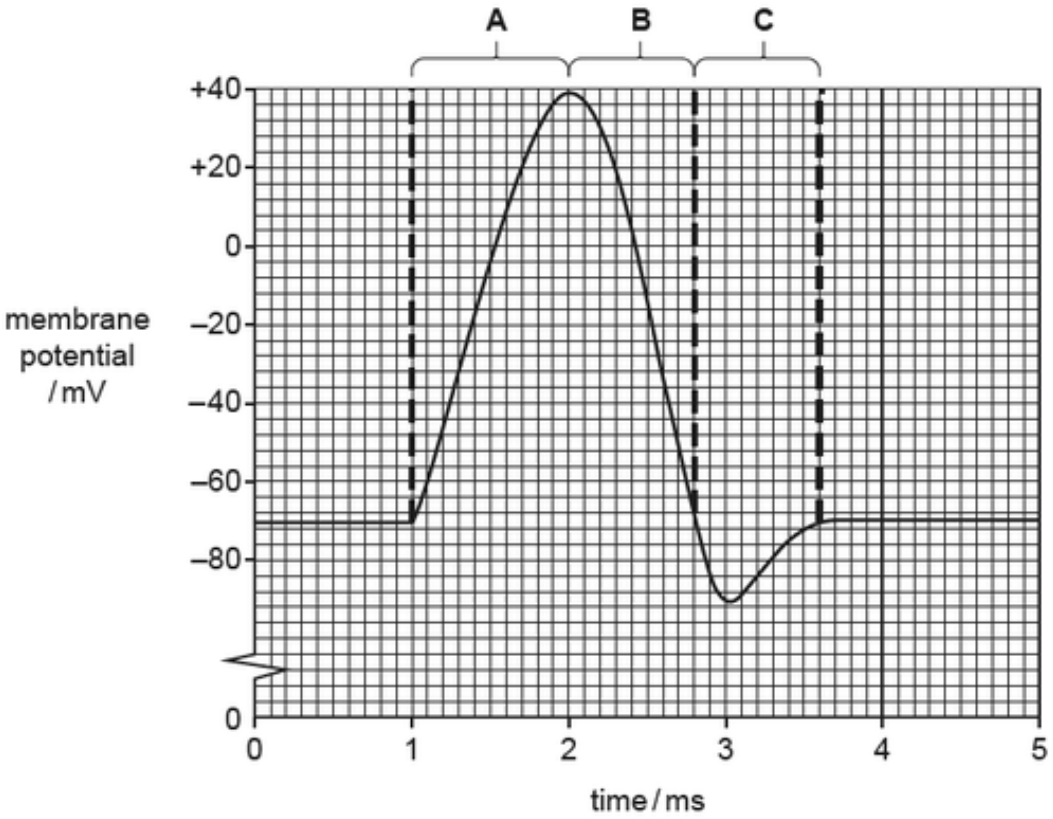


Fig. 10.1

With reference to Fig. 10.1 suggest why:

- no further action potential can occur during **A** and **B**
- it is difficult for a further action potential to occur during **C**.

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..... [3]

[Total: 9]

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3. June/2022/Paper_42/No.6

(a) Gibberellin is a plant hormone that has an important role in seed germination.

Fig. 6.1 is a diagram of a section through a barley seed (grain).

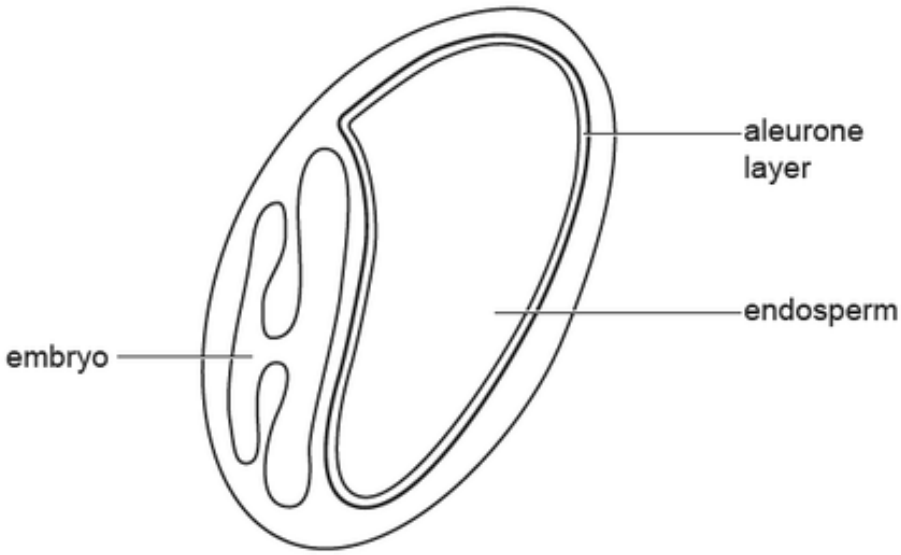


Fig. 6.1

On Fig. 6.1:

- Draw **one** arrow, labelled **G**, to show the movement of gibberellin during germination.
- Draw **one** arrow, labelled **A**, to show the movement of amylase during germination.

[2]

(b) Outline the role of amylase in seed germination.

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..... [3]

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(c) The germination of three groups of seeds of the plant *Penstemon digitalis* was investigated.

The seeds were soaked for 24 hours in distilled water or in a solution of gibberellin. The were then sown on filter paper in dishes and kept moist for 10 days.

Fig. 6.2 shows the results for each group.

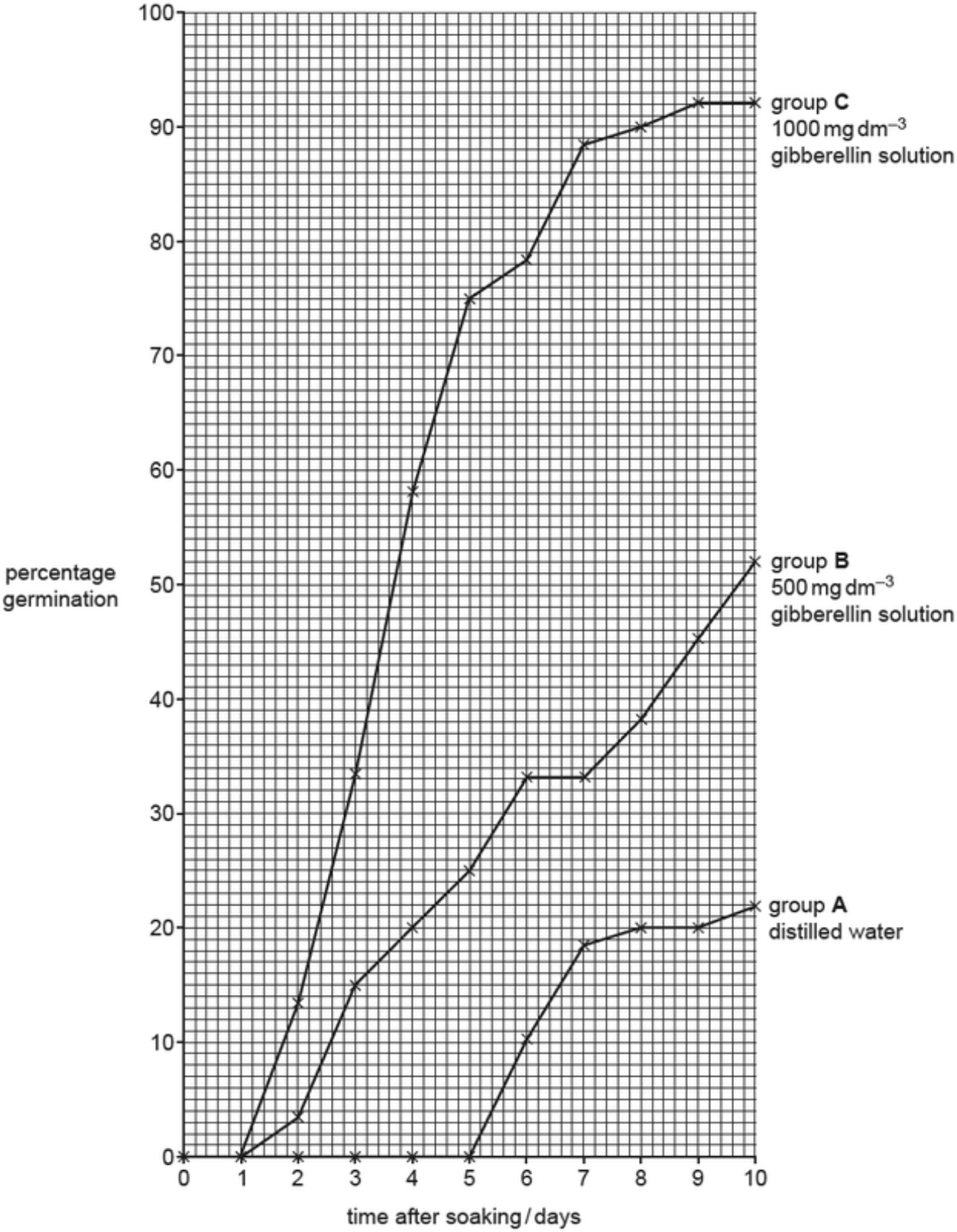


Fig. 6.2

[6]

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Describe the results shown in Fig. 6.2.

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..... [4]

[Total: 9]

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4. June/2022/Paper_42/No.8

The role of sensory receptor cells in mammals is to detect stimuli and generate action potentials in sensory neurones.

Human taste buds on the tongue contain chemoreceptor cells. Different chemoreceptor cells respond to different chemical stimuli.

Fig. 8.1 is a diagram of chemoreceptor cells in a taste bud.

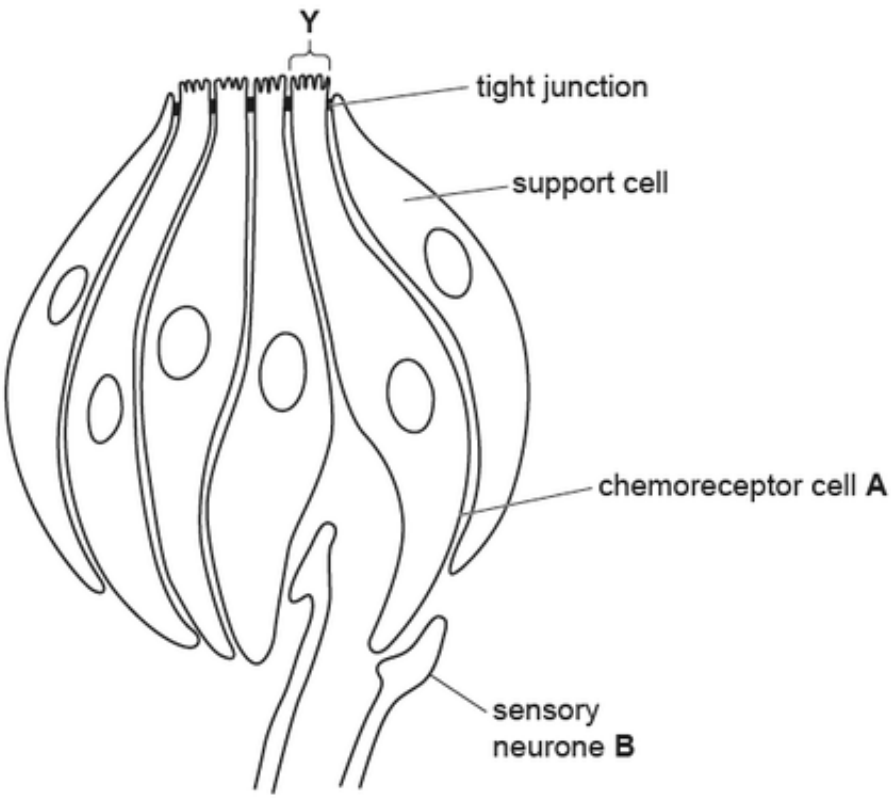


Fig. 8.1

(a) Name the structures in the region **Y**.

..... [1]

(b) Suggest a reason for the tight junctions between the chemoreceptor cells.

.....

.....

..... [1]

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(c) Chemoreceptor cell **A** responds to sodium ions (Na^+) in salt.

Describe how the contact of cell **A** with Na^+ can result in an action potential in sensory neurone **B**.

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..... [7]

[Total: 9]

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5. June/2022/Paper_43/No.6

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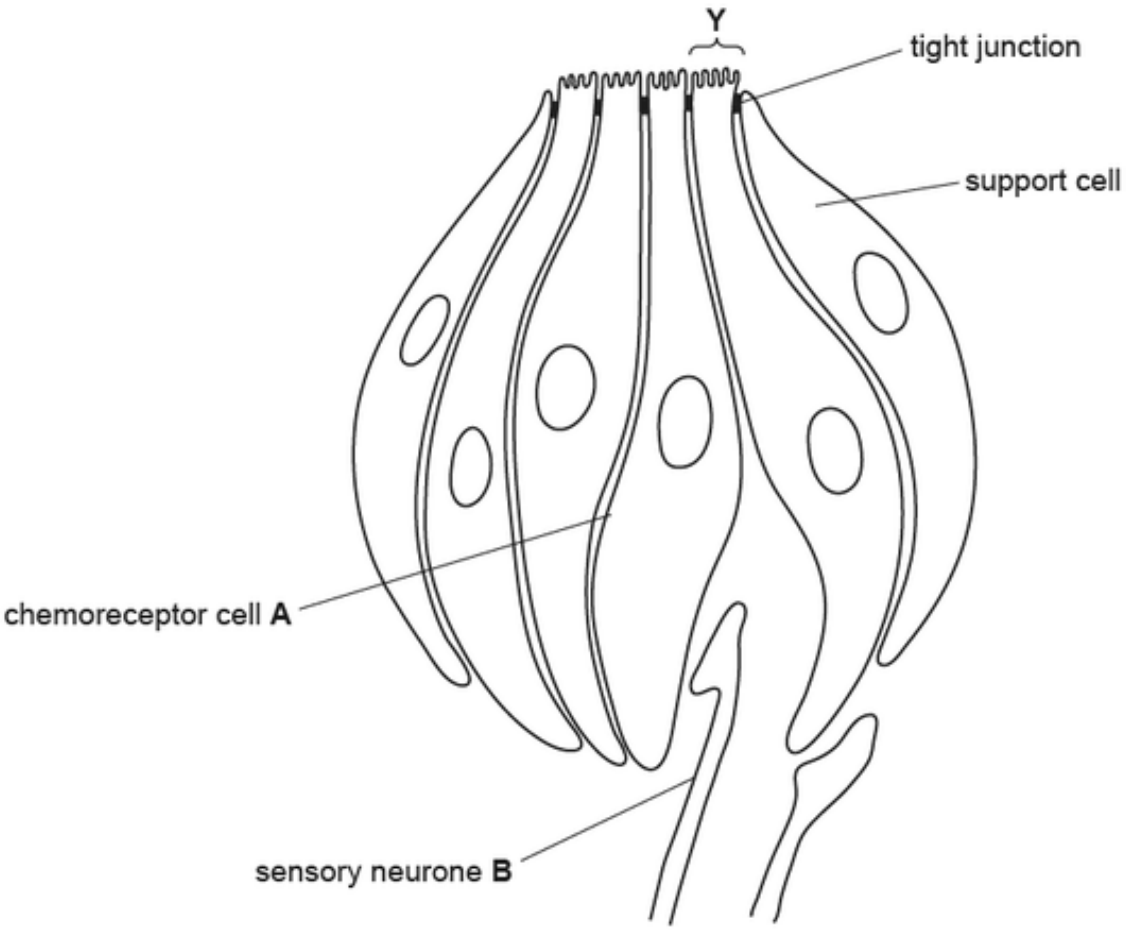


Fig. 6.1

(a) Name the structures in the region **Y and** describe their function in a chemoreceptor cell.

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..... [3]

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(b) When a sugar molecule binds to a receptor protein on the cell surface membrane of cell **A**, calcium ions are released into the cytoplasm of the cell by the endoplasmic reticulum.

Explain how the release of calcium ions will lead to an action potential being generated in sensory neurone **B**.

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..... [6]

[Total: 9]

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6. June/2022/Paper_43/No.9

(a) Fig. 9.1 shows a cross-section through a myelinated neurone.

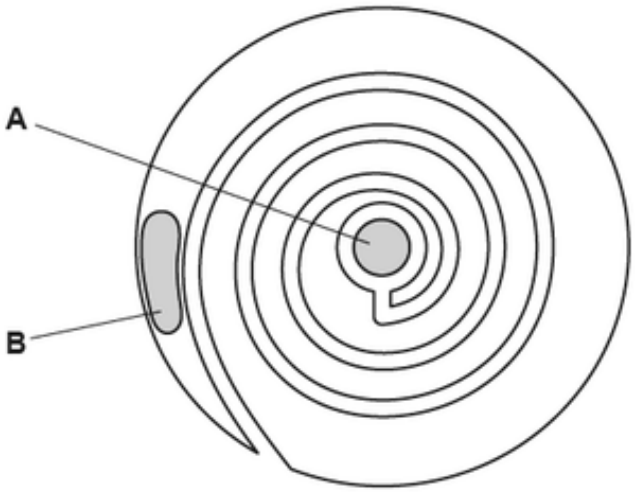


Fig. 9.1

Identify structures **A** and **B**.

A .....

B .....

[2]

(b) With reference to voltage-gated sodium ion channels, explain the difference in speed of transmission of an action potential along a myelinated neurone and a non-myelinated neurone.

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..... [4]

[Total: 6]

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1. Nov/2022/Paper_41/No.9

(a) A neuromuscular junction allows the transmission of an action potential from a motor neurone to a striated muscle fibre, causing it to contract.

Fig. 9.1 is a graph of an action potential in a motor neurone.

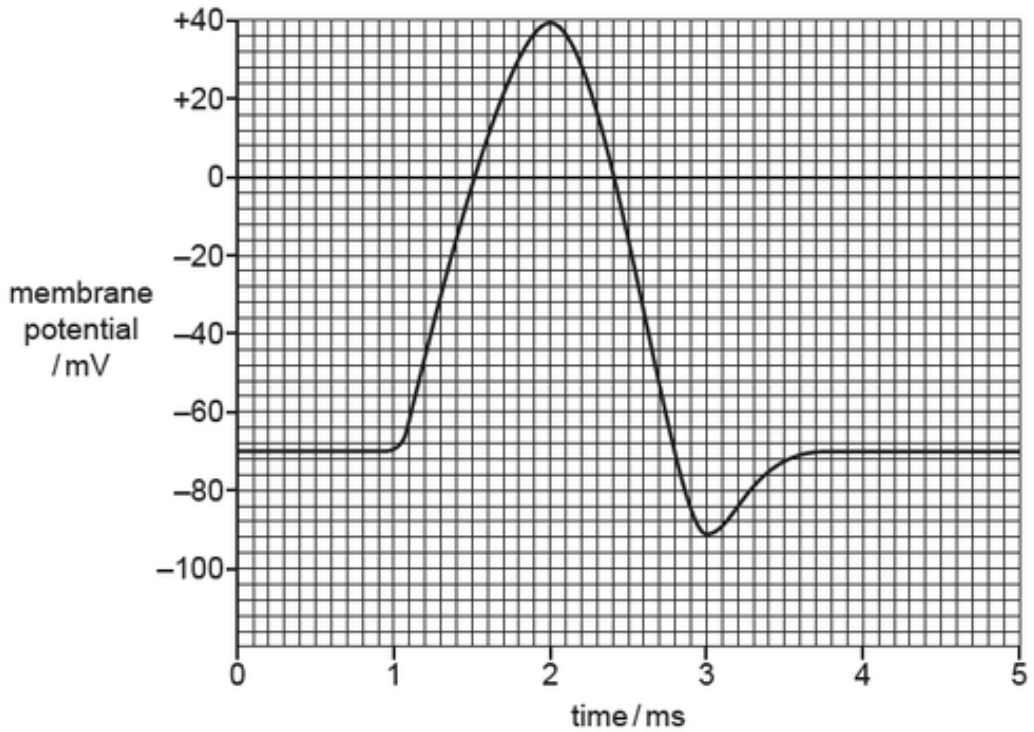


Fig. 9.1

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Fig. 9.2 is a graph of an action potential in a striated muscle fibre.

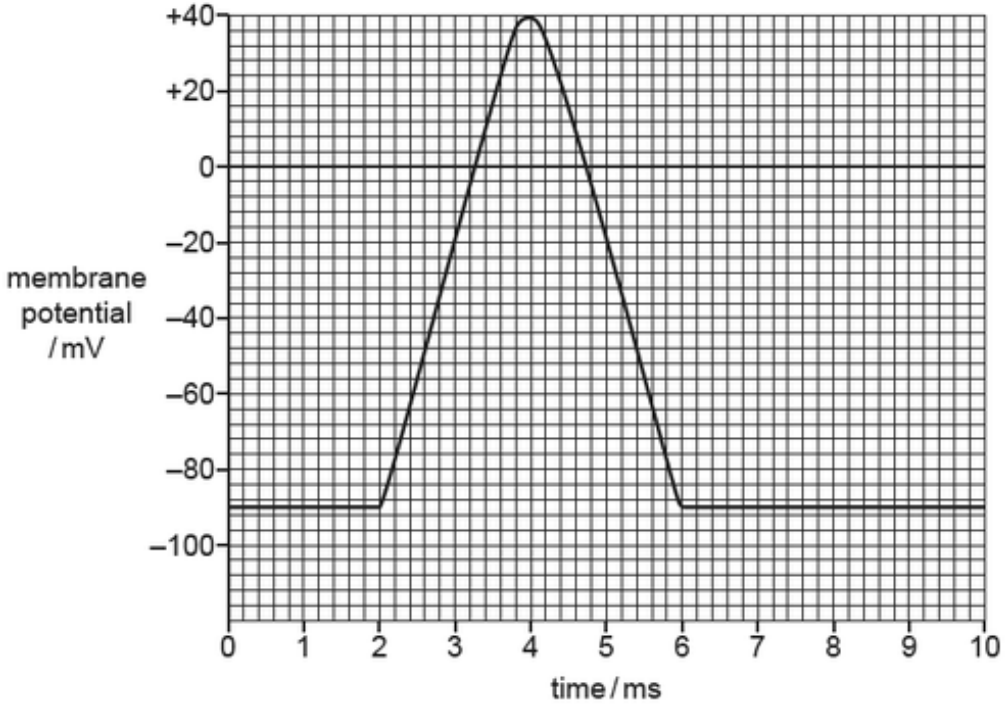


Fig. 9.2

With reference to Fig. 9.1 and Fig. 9.2, describe the differences between the action potential in a motor neurone and the action potential in a striated muscle fibre.

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..... [4]

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(b) There are three phases in the contraction of a striated muscle: latent phase, contraction phase and relaxation phase.

The tension in a muscle represents the degree of contraction of its fibres.

Fig. 9.3 is a graph of the tension in a striated muscle during the three phases of contraction.

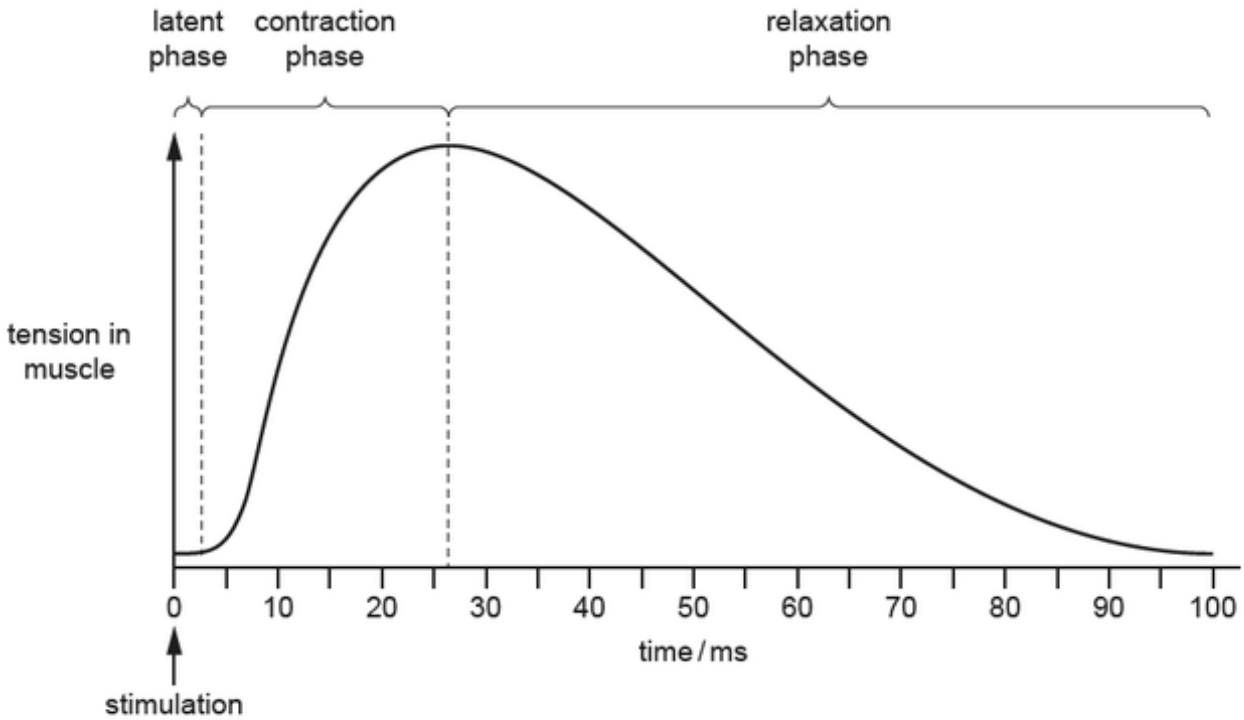


Fig. 9.3

(i) With reference to Fig. 9.3, explain what is happening in the striated muscle fibre during the latent phase.

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..... [3]

(ii) Suggest why the relaxation phase shows a gradual decrease in muscle tension.

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..... [1]

[Total: 8]

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2. Nov/2022/Paper_42/No.9

(a) Voltage-gated channels are involved in the generation of an action potential.

Fig. 9.1 is a diagram of the voltage-gated channels of sodium ions and potassium ions in the membrane of an axon. The channels are shown in three different states, **1**, **2** and **3**.

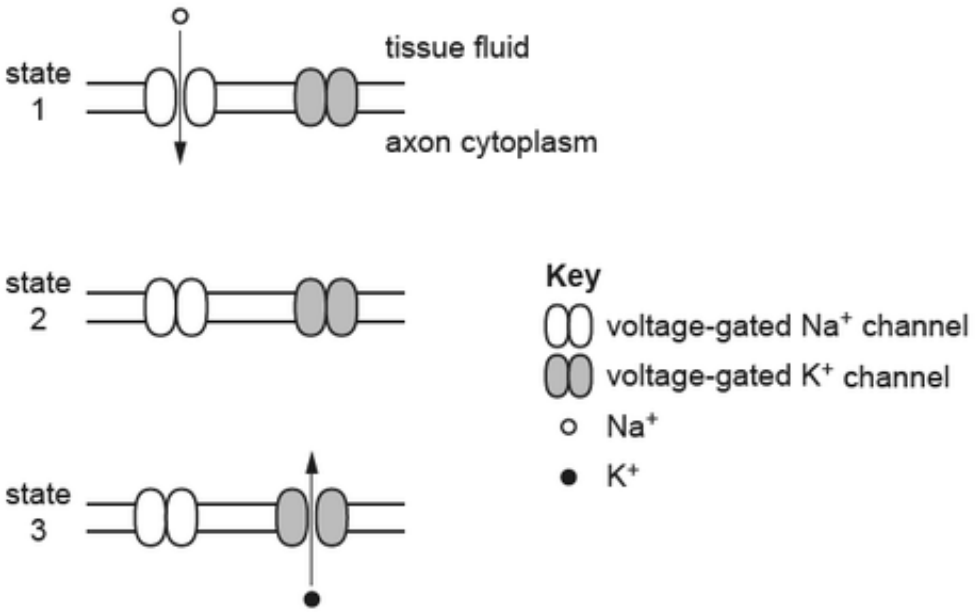


Fig. 9.1

Fig. 9.2 is a diagram of different phases of an action potential in an axon. The phases are labelled **A**, **B**, **C**, **D**, **E**, **F** and **G**.

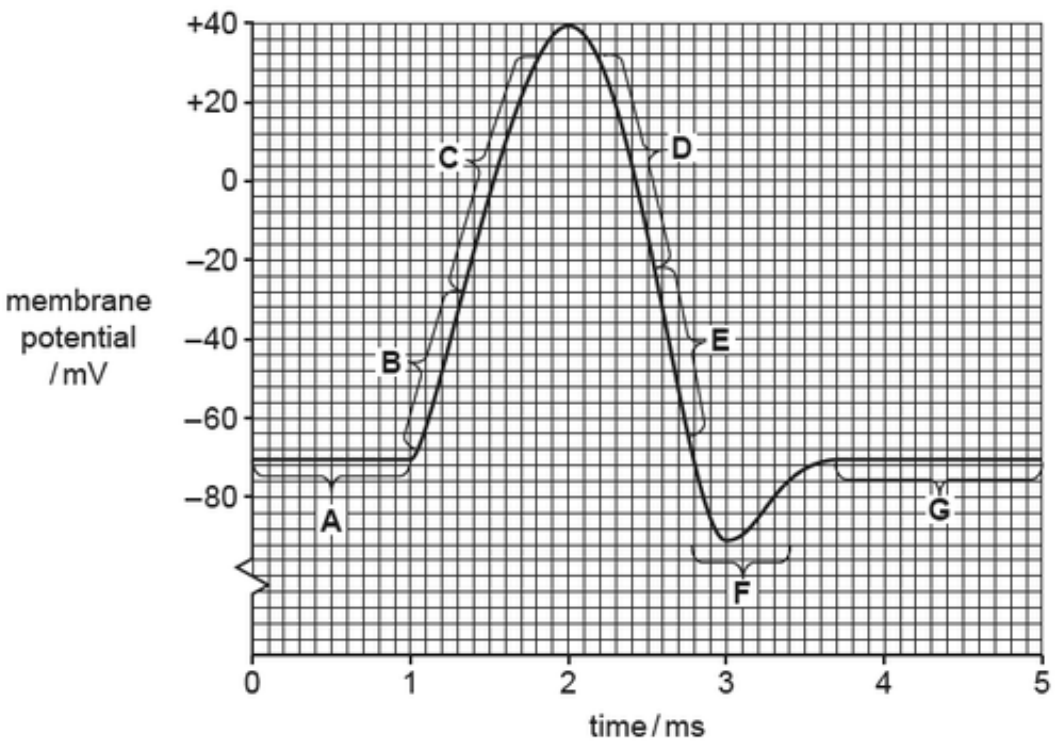


Fig. 9.2

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Complete Table 9.1 to match each of the listed phases of the action potential with the appropriate state of the voltage-gated channels: **1**, **2** or **3**.

Table 9.1

phase of action potential	state of voltage-gated channels
A	.....
C	.....
E	.....
F	.....
G	.....

[3]

(b) Many neurones are surrounded by myelin sheaths.

Describe **and** explain the role of the myelin sheath in the transmission of an action potential.

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..... [3]

[Total: 6]

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1. March/2023/Paper_ 9700/42/No.7

(a) Fig. 7.1 is a diagram representing a synapse between a chemoreceptor cell from a human taste bud and a dendrite of a sensory neurone.

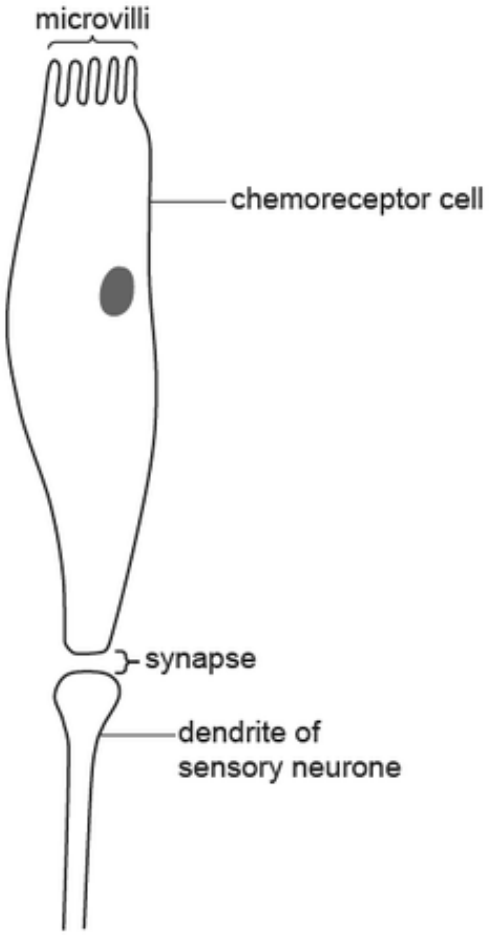


Fig. 7.1

In an experiment, different concentrations of sodium chloride solution were applied to the microvilli of the chemoreceptor cell. The membrane potential of the chemoreceptor cell and the membrane potential of the dendrite of the sensory neurone were recorded for each concentration.

The resting potential of this chemoreceptor cell is –50 mV and the resting potential of the dendrite of this sensory neurone is –70 mV.

The results are shown in Table 7.1.

Table 7.1

concentration of sodium chloride solution / g dm^{-3}	membrane potential / mV	
	chemoreceptor cell	dendrite of sensory neurone
0.1	–50	–70
1.0	+30	+40
10.0	+30	+40

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Explain the results shown in Table 7.1.

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.....[4]

(b) Describe the differences in structure **and** function between sensory neurones and motor neurones.

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..... [3]

[Total: 7]

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2. March/2023/Paper_ 9700/42/No.9

(a) Fig. 9.1 is a diagram of a relaxed sarcomere in striated muscle.

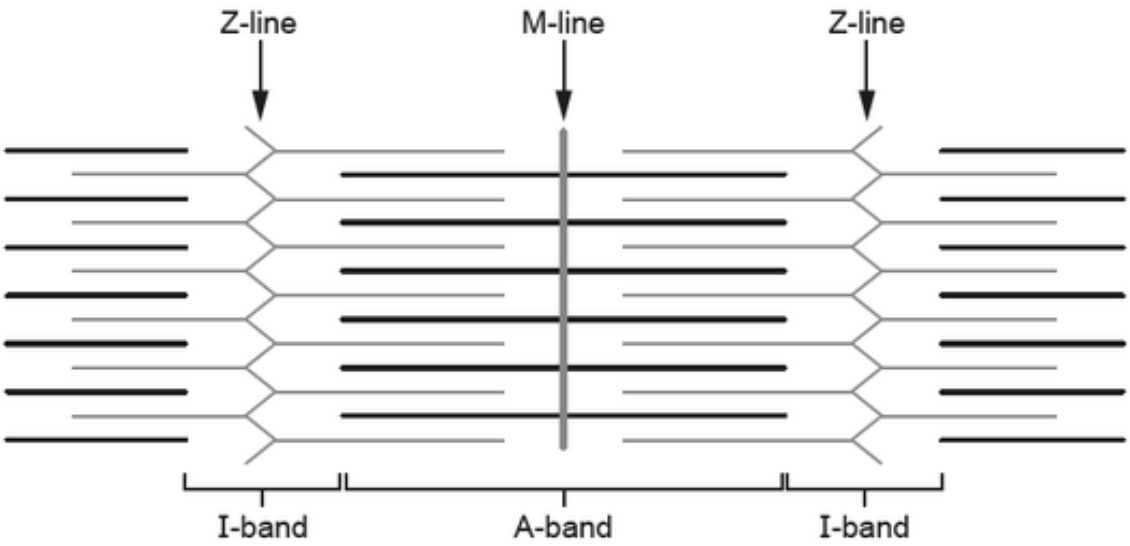


Fig. 9.1

(i) On Fig. 9.1, use label lines and letters to label:

- an actin filament with the letter **P**
- a myosin filament with the letter **R**.

[2]

(ii) State what happens to the A-band and the I-band when the sarcomere contracts.

A-band .....

I-band .....

[2]

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(b) The plant *Strychnos toxifera* produces the toxin curare, which can cause muscle paralysis in mammals.

The toxin acts by binding to receptors on the cell surface membranes (sarcolemma) of muscle cells at neuromuscular junctions.

(i) Suggest how binding of curare to receptors may cause muscle paralysis.

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..... [4]

(ii) Suggest why the action of curare may lead to the death of a mammal.

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..... [2]

[Total: 10]

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3. June/2023/Paper_ 9700/42/No.7

(a) A striated muscle cell (muscle fibre) will contract when stimulated by a motor neurone at a neuromuscular junction.

Air temperature can affect the temperature of striated muscle cells.

Investigations have shown that the efficiency of contraction of striated muscle cells decreases when the air temperature decreases.

Suggest reasons why a reduction in temperature can decrease the efficiency of contraction of striated muscle cells.

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..... [4]

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(b) The greater blue-ringed octopus, *Hapalochlaena lunulata*, produces tetrodotoxin (TTX). TTX is a neurotoxin. If a mammal is bitten by this octopus, the effect of TTX can cause the death of the mammal.

Fig. 7.1 shows a greater blue-ringed octopus.

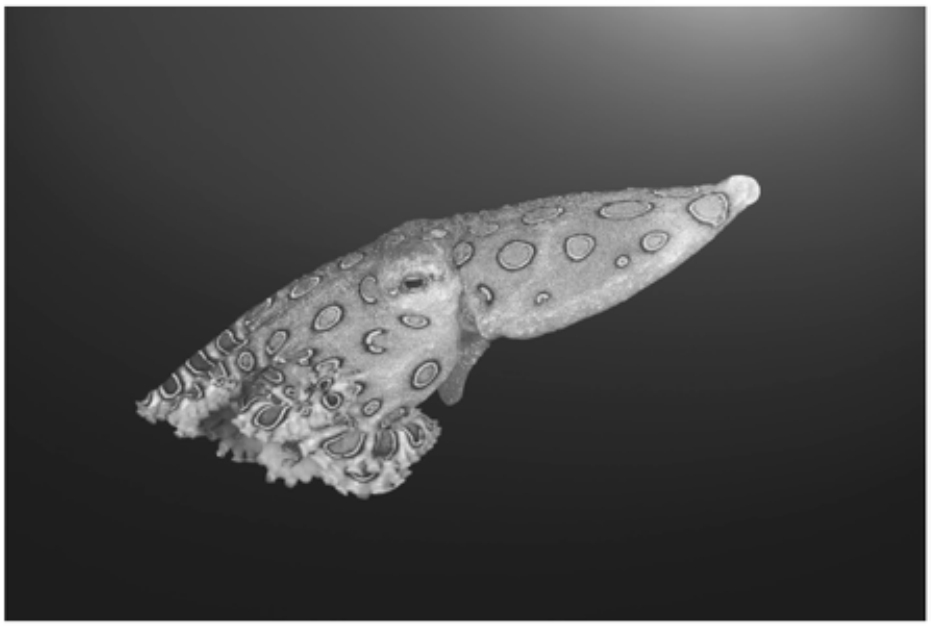


Fig. 7.1

TTX binds to voltage-gated sodium ion channels in the axon of a neurone and changes the tertiary structure of the channel protein.

Suggest how TTX may affect the functioning of a motor neurone.

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..... [3]

[Total: 7]

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4. June/2023/Paper_ 9700/42/No.9

(a) The passage outlines the endocrine system.

Complete the passage by using the most appropriate scientific terms.

The endocrine system consists of tissues and ..... , which secrete hormones such as insulin, glucagon and antidiuretic hormone (ADH). Glucagon only affects target cells that have complementary receptors, which are located on the ..... . Glucagon binds to these receptors and this leads to the production of a ..... , which transfers the signal throughout the cytoplasm. The target cells for insulin are in the liver, ... and adipose tissue. The target cells for ADH are those of the distal convoluted tubule and the ..... of the kidney nephron. These hormones are involved in ..... , which is the maintenance of a constant internal environment. [6]

(b) The blood glucose concentration of a person was measured at regular intervals after the ingestion of a meal rich in glucose.

Fig. 9.1 shows the results of this investigation.

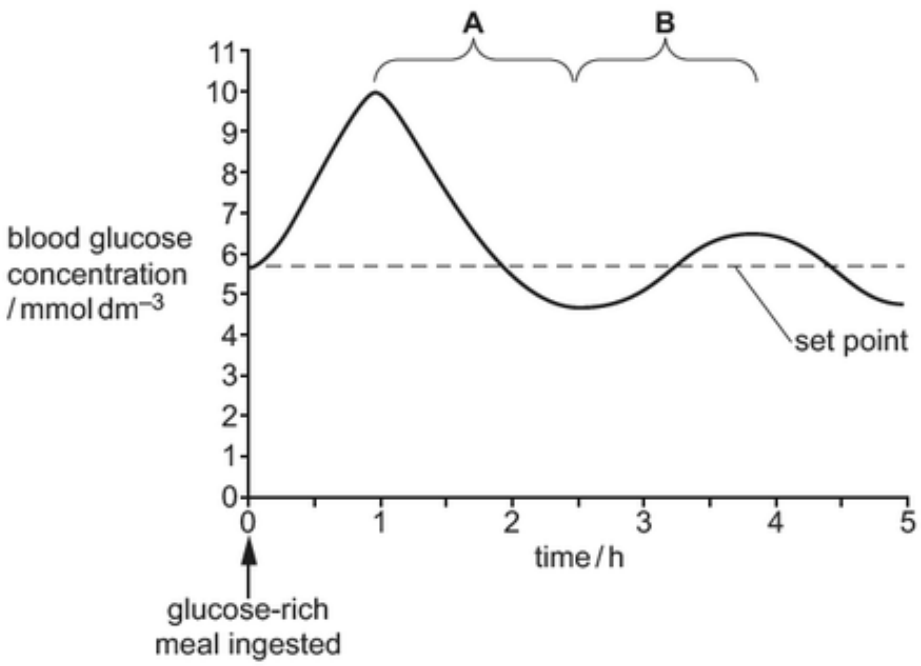


Fig. 9.1

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(i) Explain how the blood glucose concentration is reduced during phase **A** of the curve.

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..... [3]

(ii) Suggest why the blood glucose concentration increases again during phase **B**.

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..... [1]

[Total: 10]

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5. June/2023/Paper_ 9700/43/No.7

(a) Sarcomeres are the functioning units of the myofibrils of the muscle fibres (muscle cells) of striated muscle.

The arrival of an action potential at the sarcoplasmic reticulum of a striated muscle fibre can lead to the shortening of a sarcomere. This shortening occurs by the sliding filament model.

Outline the sequence of events occurring after stimulation of the sarcoplasmic reticulum that results in the shortening of a sarcomere.

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..... [4]

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(b) Scientists compared the diameter of samples of striated muscle fibres taken from young mice and adult mice.

The results are shown in Fig. 7.1.

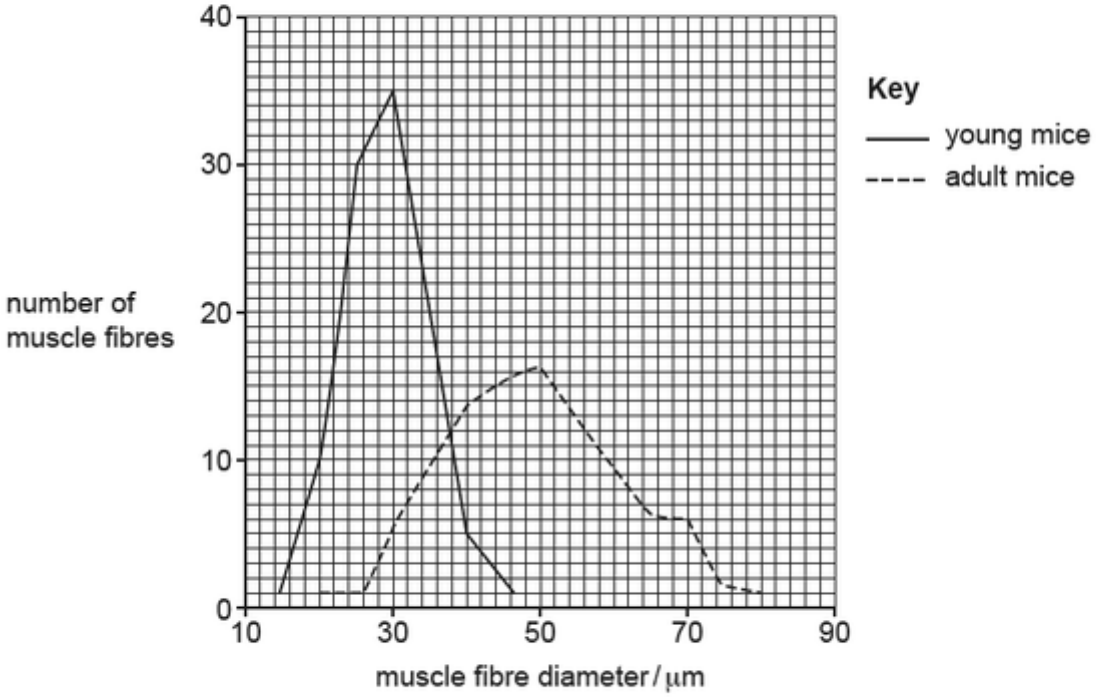


Fig. 7.1

With reference to Fig. 7.1:

- describe **two** differences between the muscle fibres of young mice and adult mice
- suggest how these differences may affect the sliding filament model.

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..... [4]

[Total: 8]

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6. June/2023/Paper_ 9700/43/No.9

(a) Dopamine is a neurotransmitter released in some synapses in the brain. The release and action of dopamine is similar to that of acetylcholine.

Fig. 9.1 is a diagram of a brain synapse where dopamine is the neurotransmitter.

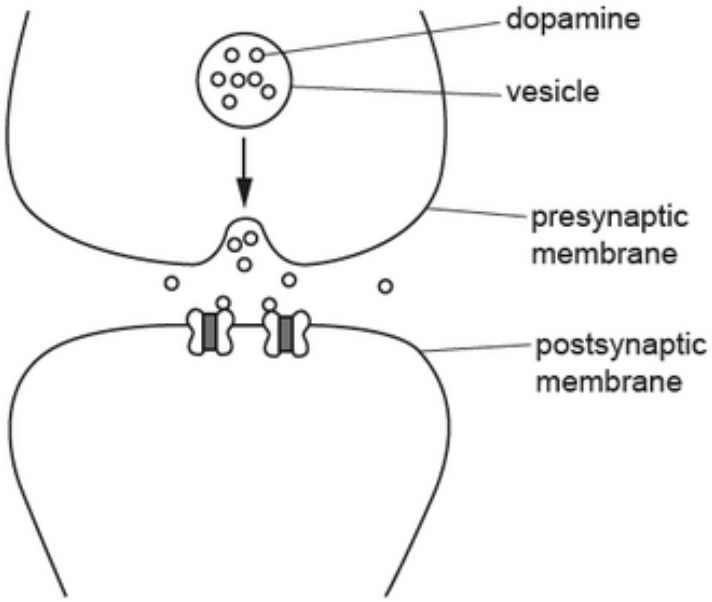


Fig. 9.1

(i) Describe how the release of dopamine from the presynaptic neurone can lead to an action potential in the postsynaptic neurone.

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..... [4]

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(ii) In brain cells, the amino acid tyrosine is changed into DOPA, which then is converted to dopamine.

Name another compound in the body produced from DOPA.

..... [1]

(b) In some brain synapses, the neurotransmitter gamma-aminobutyric acid (GABA) is released. This results in an influx of chloride ions into the postsynaptic neurone.

Suggest **and** explain whether an action potential would be generated in the postsynaptic neurone if GABA is released into a brain synapse.

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..... [3]

[Total: 8]

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1. Nov/2023/Paper_9700/41/No.7

When an impulse arrives at a neuromuscular junction, it stimulates a muscle fibre of striated muscle to contract.

(a) (i) Outline the **similarities** in structure between a neuromuscular junction and a cholinergic synapse.

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..... [4]

(ii) The hydrolysis of ATP during muscle contraction releases inorganic phosphate (P_i).

Calcium ions (Ca^{2+}) can combine with P_i in the sarcoplasmic reticulum to form insoluble calcium phosphate. This may result in fewer power strokes occurring in sarcomeres.

Suggest why calcium phosphate formation in the sarcoplasmic reticulum may result in fewer power strokes occurring in sarcomeres.

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..... [3]

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(b) Adrenaline is a hormone that can affect muscle contraction. Adrenaline binds to G-protein-coupled receptors on T-tubule membranes.

The cell signalling pathway that occurs in response to the binding of adrenaline is similar to the pathway that occurs in liver cells in response to the binding of glucagon.

Fig. 7.1 is an outline of the cell signalling pathway of adrenaline.

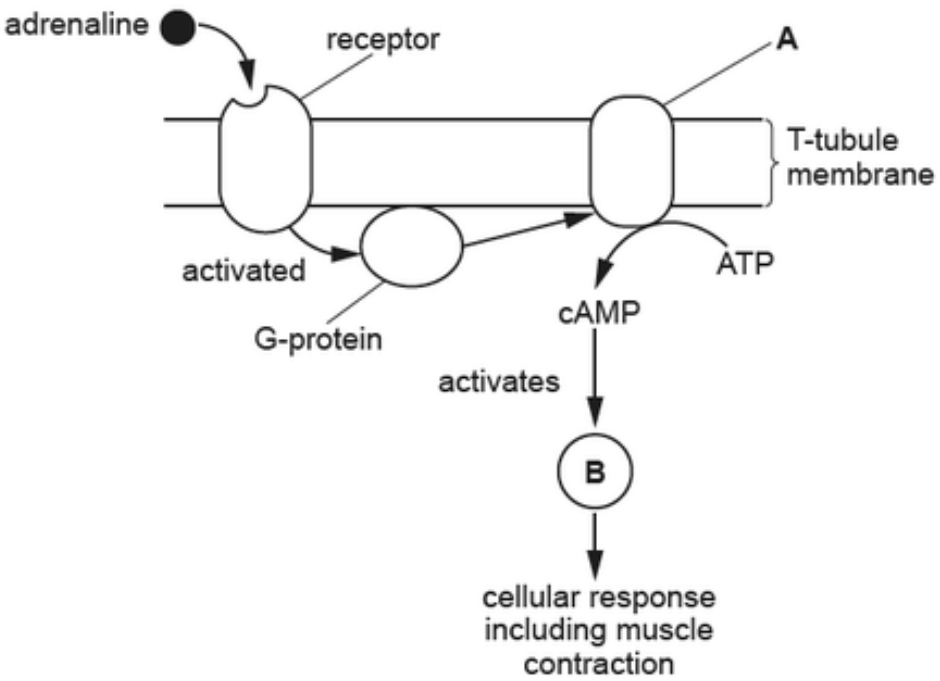


Fig. 7.1

Identify the molecules represented by **A** and **B** in Fig. 7.1.

A .....

B ..... [2]

[Total: 9]

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2. Nov/2023/Paper_9700/42/No.6

(a) (i) When blood glucose concentration decreases, glucagon is released by the pancreas into the blood and is transported to the cells.

Fig. 6.1 outlines the effect of glucagon on liver cells.

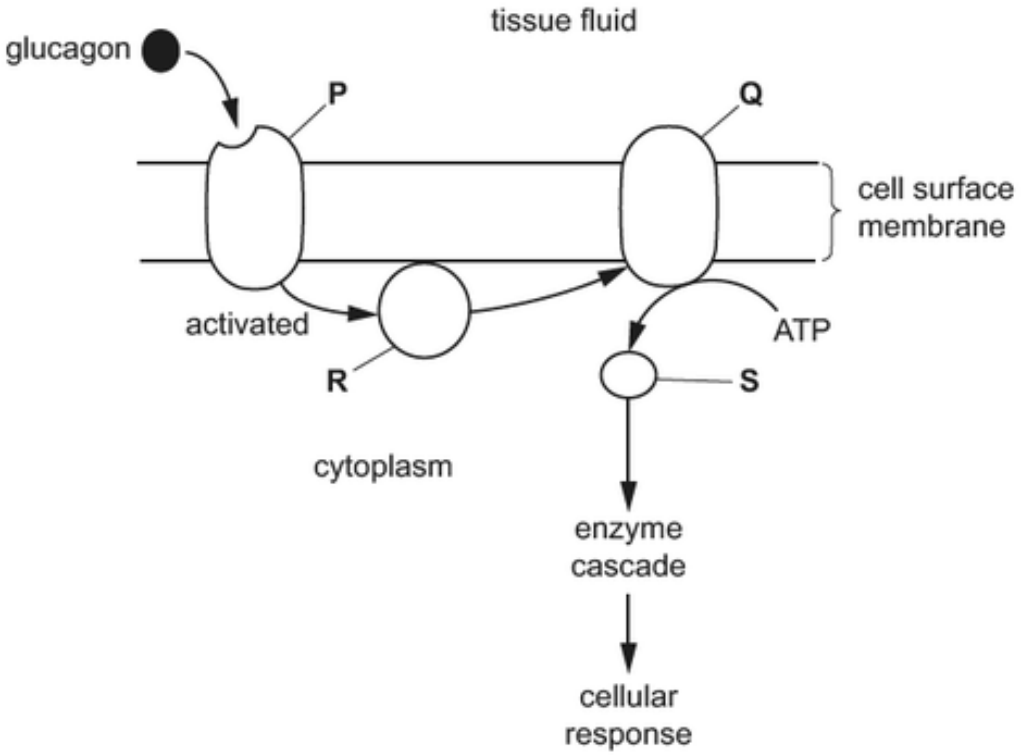


Fig. 6.1

Identify **P**, **Q**, **R** and **S** shown in Fig. 6.1.

P .....

Q .....

R .....

S .....

[4]

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(ii) Table 6.1 shows four processes carried out by liver cells that are affected by a decrease in blood glucose concentration. Some of these are cellular responses from cell signalling by glucagon.

Complete Table 6.1 by stating whether the rate of each process **increases** or **decreases** when blood glucose concentration decreases.

Table 6.1

process	effect on rate of process when blood glucose concentration decreases
glycogenolysis (glycogen breakdown)	.....
glycogenesis (glycogen formation)	.....
glycolysis	.....
fatty acid synthesis	.....

[3]

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(b) Type 2 diabetes is a condition affecting the homeostatic control of blood glucose concentration. In type 2 diabetes, target cells have a much lower response to insulin and some glucose is excreted in the urine.

Test strips can be used to measure the concentration of glucose in a sample of urine, but many people with type 2 diabetes measure blood glucose concentration using a biosensor.

Explain the principles of operation of a test strip for glucose **and** suggest advantages for a person with type 2 diabetes of using a biosensor instead of a test strip.

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..... [7]

[Total: 14]

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3. Nov/2023/Paper_9700/42/No.9

(a) Antidiuretic hormone (ADH) is involved in the maintenance of a constant blood water potential.

A student drank 0.5 dm^3 of water and the concentration of ADH in their blood was measured every 30 minutes for 3 hours.

Fig. 9.1 shows the results of this investigation.

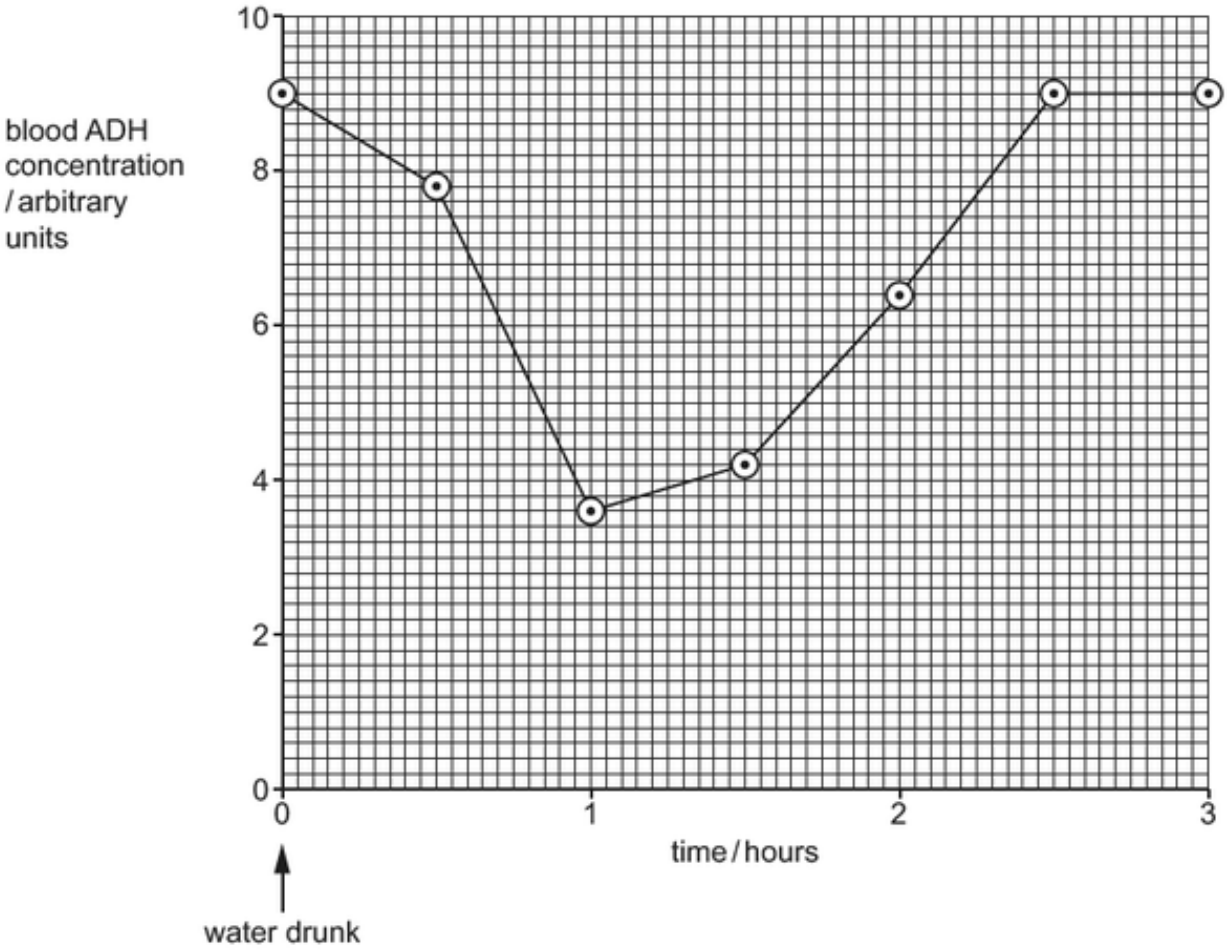


Fig. 9.1

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Explain the results shown in Fig. 9.1.

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..... [4]

(b) Outline the differences between the endocrine system and the nervous system.

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..... [4]

[Total: 8]

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