

Answer all the questions.

1 (a) Fig. 1.1 represents a sensory neurone connected to its associated receptor cells.

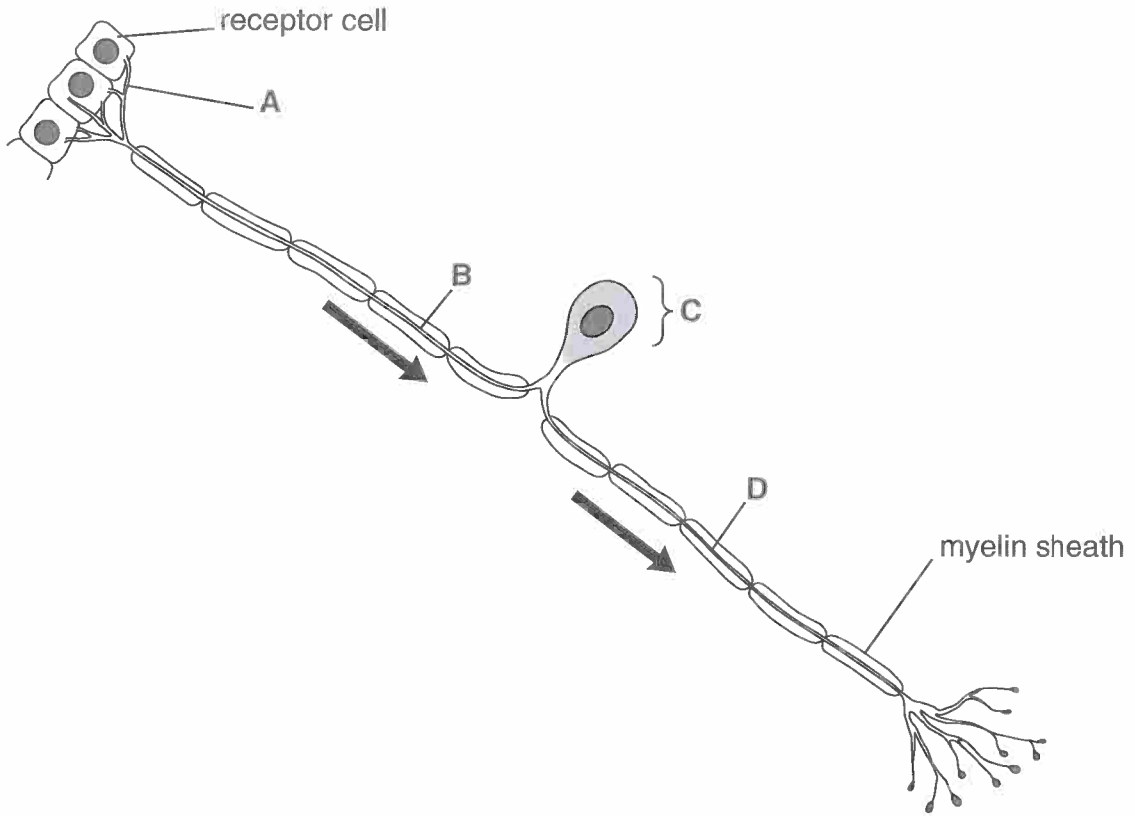


Fig. 1.1

(i) Identify the parts of the neurone labelled A to D.

A

B

C

D

[4]

(ii) What is represented by the arrows on Fig. 1.1?

.....

..... [1]

(c) Fig. 1.2 shows the changes in the membrane potential of a sensory neurone when the receptor cells are stimulated.

Fig. 1.3 indicates the strength of the stimuli that results in the corresponding changes in membrane potential.

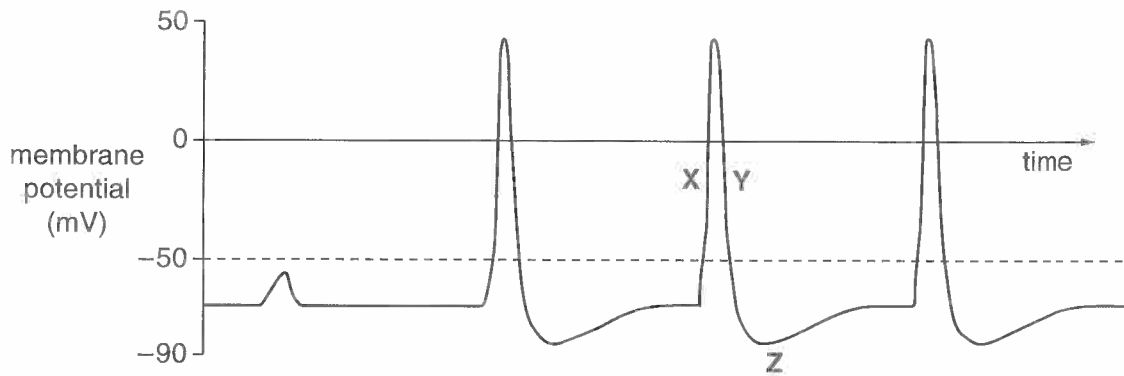


Fig. 1.2

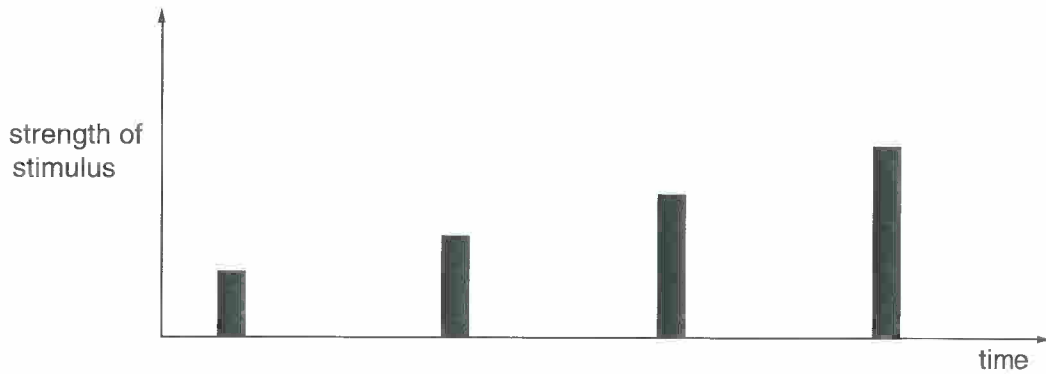


Fig. 1.3

(i) State the term used to describe what is happening at each of the points X, Y and Z on Fig. 1.2.

X

Y

Z

[3]

(ii) What term is used to refer to the value of -50 mV on Fig. 1.2?

..... [1]

(iii) Comment on the relationship between the strength of a stimulus, as shown in Fig. 1.3, and the resulting action potential, as shown in Fig 1.2.

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..... [2]

[Total: 15]

(c) The presence of a pathogen in the body can cause a fever. During a fever, the body's thermoregulatory set-point (normal body temperature) rises.

(i) Fever is accompanied by sweating.

Explain the effect that this sweating will have on the body.

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..... [2]

(ii) Another feature of fever may be uncontrollable shivering.

Suggest why shivering occurs during fever.

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..... [1]

(d) Hypothermia is a condition in which the body's core temperature is lowered. Hypothermia can affect people who take part in outdoor activities in winter without wearing suitable clothing.

Some people think that alcohol should be given to those who have hypothermia, as it makes them feel warmer. Alcohol causes vasodilation.

Explain why it is **not** a good idea to give alcohol to someone with hypothermia.

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..... [2]

[Total : 12]

END OF QUESTION PAPER

- 2 The skin is important in enabling the body to detect changes in the environment. This allows the body to respond to these changes.

(a) Various types of sensory receptor are located in the skin.

Fig. 2.1 is a photomicrograph of a **transverse section** through a pressure receptor known as a Pacinian corpuscle.

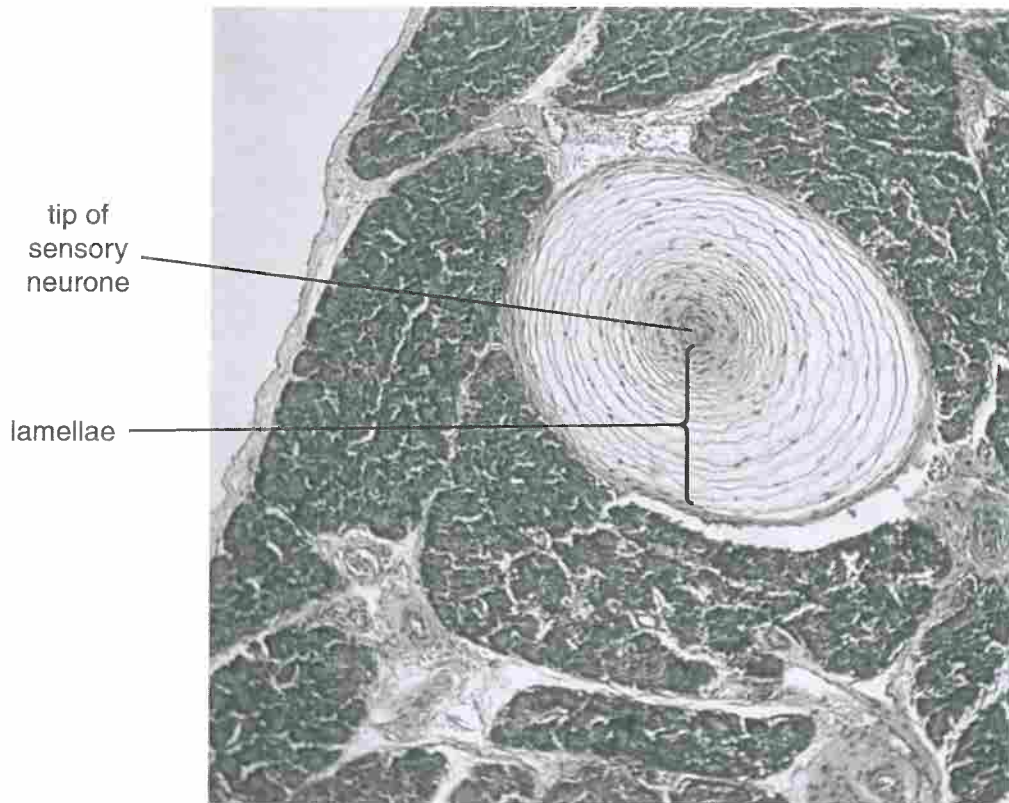


Fig. 2.1

Fig. 2.2 is a diagram of a **longitudinal section** through a Pacinian corpuscle. The tip of the sensory neurone is not covered by the myelin sheath.

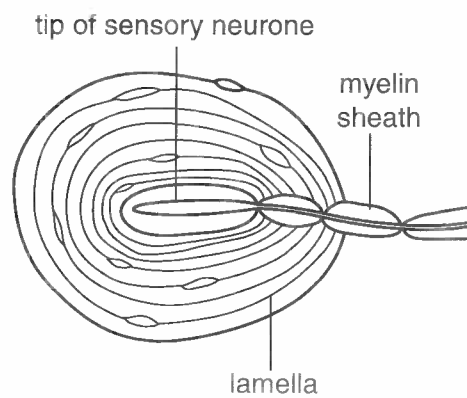


Fig. 2.2

The Pacinian corpuscle is a type of biological transducer.

- As a pressure stimulus is exerted on the corpuscle, the lamellae are compressed and exert pressure on the tip of the sensory neurone.
- The plasma (cell surface) membrane of the tip of the neurone becomes deformed and more permeable to sodium ions (Na^+).
- This region of the neurone becomes depolarised, reaching the threshold potential, and an action potential is generated.

(i) Why is the Pacinian corpuscle described as a transducer?

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

(ii) Deformation of the plasma membrane of the tip of the neurone causes the membrane to become more permeable to Na^+ .

Suggest why.

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

(iii) The generation of an action potential follows the 'All-or-Nothing' law.

Explain what this means.

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

(iv) Describe how information about the strength and intensity of a stimulus is communicated to the brain.

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

- (b) When clothes are first put on the body, a constant gentle pressure is applied to the pressure receptors in the skin. After a short time, action potentials are no longer generated unless there is a change in pressure as the clothes move over the surface of the skin.

Suggest an explanation for the fact that action potentials are not generated constantly whilst wearing clothes.

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..... [1]

- (c) Synapses are an integral part of the nervous system.

Outline the roles of synapses in the nervous system.

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..... [3]

[Total: 9]

Answer all the questions.

1 (a) Fig. 1.1 represents a cross section through a myelinated neurone.

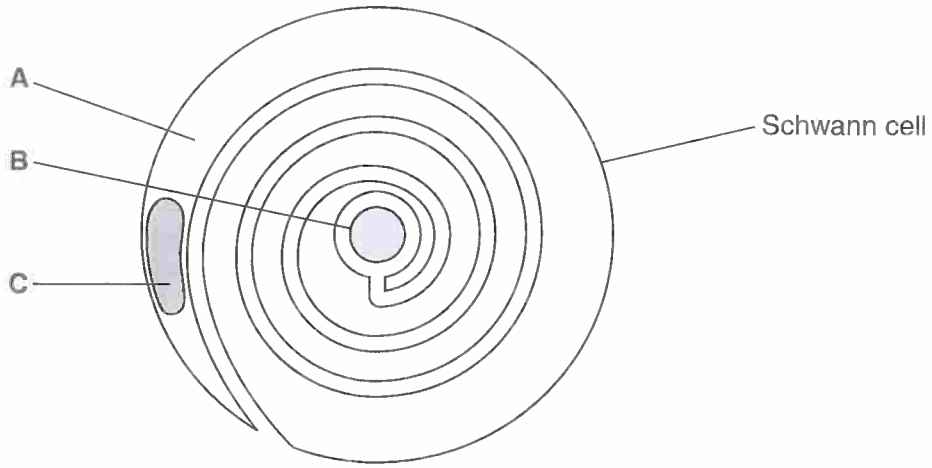


Fig. 1.1

(i) Identify A to C.

- A
- B
- C [3]

(ii) Name the gap between two adjacent Schwann cells along the length of the neurone.

..... [1]

- (c) A family of membrane proteins known as SNARE proteins are attached to vesicle membranes and cell surface membranes.

Fig. 1.2 summarises the mechanism by which vesicles secrete acetylcholine from a neurone.

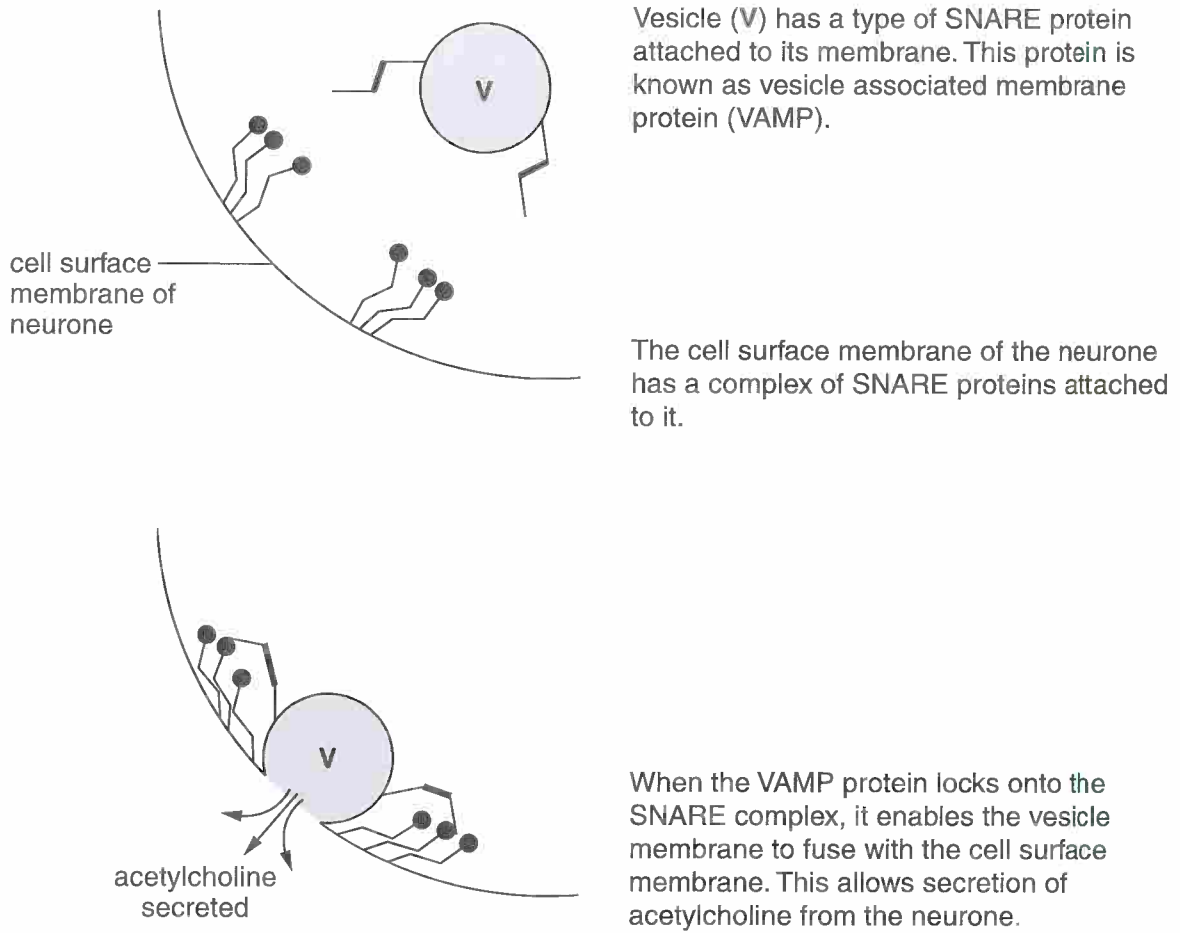


Fig. 1.2

- (i) Name the process by which the acetylcholine is secreted.
..... [1]
- (ii) Name the part of a neurone from which acetylcholine is secreted.
..... [1]

(iii) Botulinum toxin is a protease that is produced by the bacterium, *Clostridium botulinum*.

If this toxin is present in the body, for example as a result of eating contaminated food, the toxin enters neurones.

With reference to Fig. 1.2, suggest, with reasons, the effects that botulinum toxin may have once it has entered a neurone.

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..... [2]

[Total: 12]

2 (a) Fig. 2.1 represents the end region of a neurone at a cholinergic synapse.

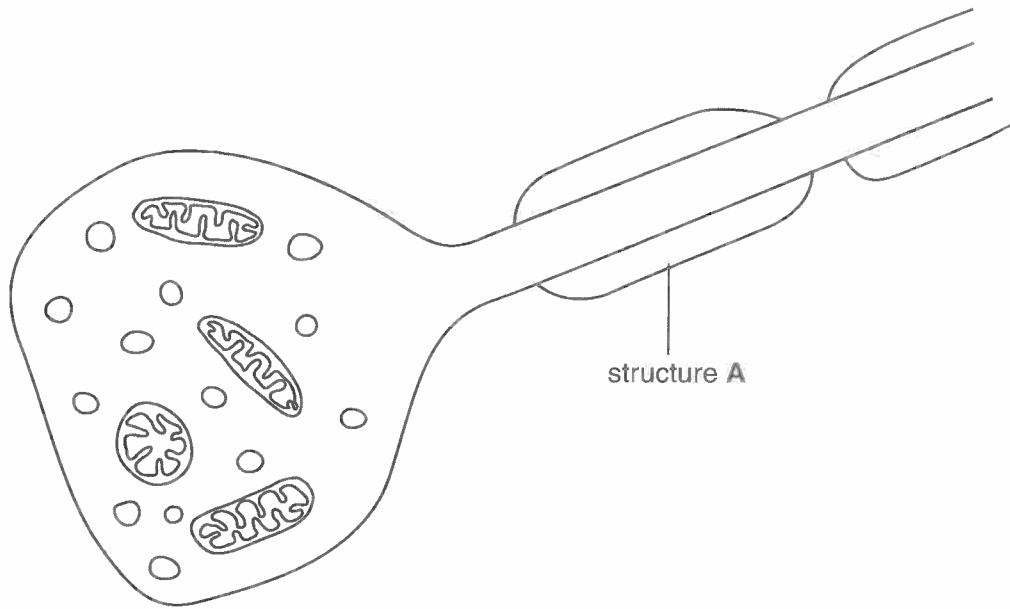


Fig. 2.1

(i) Describe the function of **structure A**.



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

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..... [4]

(ii) Name the process by which acetylcholine leaves the neurone shown in Fig. 2.1.

..... [1]

(iii) Name the process by which acetylcholine travels across the synaptic cleft.

..... [1]

(iv) A feature of synapses is that they allow transmission in only one direction.

State how this is achieved.

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

(b) The chemical nature of synaptic transmission makes it susceptible to disruption by toxins.

(i) Atropine is a toxin produced by the deadly nightshade plant, *Atropa belladonna*.

Atropine is a similar shape to acetylcholine. The presence of atropine prevents the initiation of an action potential in the post-synaptic neurone.

Explain how the presence of atropine in the synapse will prevent the initiation of an action potential.

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..... [3]

(ii) Nerve gases have been used as chemical weapons. Some nerve gases act by inhibiting acetylcholinesterase, prolonging the effect of acetylcholine.

Suggest how atropine could act as an antidote to nerve gas.

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..... [2]

[Total: 12]

6 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]

END OF QUESTION PAPER

Answer **all** the questions.

- 1 (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.

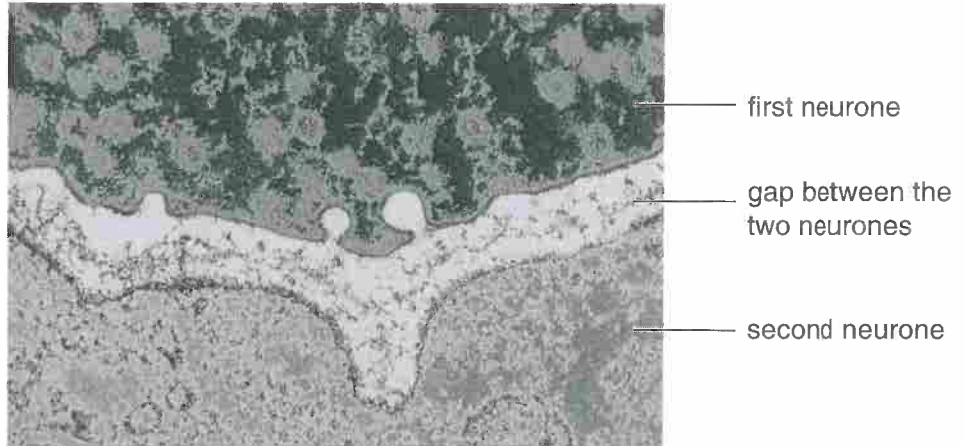


Fig. 1.1

- (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.

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..... [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]

Answer **all** the questions.

- 1 (a) The nervous system is made up of a number of different types of neurone, which transmit electrical impulses.

Complete the table below by stating **three** differences in the structure of motor and sensory neurones.

motor neurone	sensory neurone

[3]

- (b) Complete the following passage, using the most appropriate term(s) in each case.

When an impulse is not passing along a neurone, a resting potential ofmV is established. When the neurone is stimulated, it causes of the cell surface membrane. This will not generate an action potential unless it is large enough to exceed the

A neurone will either conduct an action potential or not; this is described as the law.

Action potentials all have the same The only way in which the intensity of a stimulus can be interpreted is by the of the action potential.

[6]

[Total: 9]

- 5 Fig. 5.1 is a trace that shows the changes that occur in the membrane potential of a neurone during the generation of an action potential.

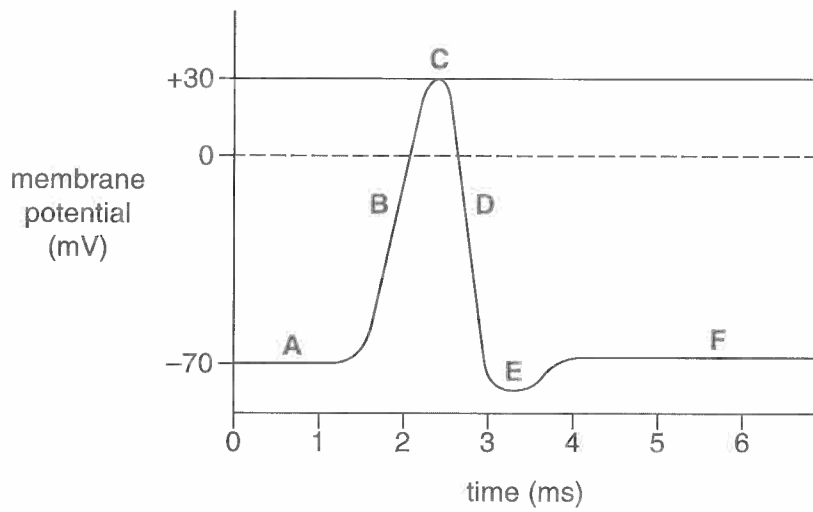


Fig. 5.1

- (a) Using the letters **A** to **F**, indicate the point or points on the trace which correspond to the following:
- (i) hyperpolarisation,
 [1]
 - (ii) resting potential,
 [1]
 - (iii) the membrane is most permeable to potassium ions,
 [1]
 - (iv) depolarisation.
 [1]

- (b) Puffer fish, *Fugu spp.*, produce a powerful poison, tetrodotoxin, and some species store it in high concentrations in their body tissues. Unless these fish are correctly prepared, eating them can be fatal.

Tetrodotoxin is poisonous to humans because it blocks **gated** sodium channels in cell membranes, preventing action potentials. This does not happen in the fish themselves.

- (i) With reference to Fig. 5.1, identify, using the appropriate letter, the part of the action potential trace that will be affected by tetrodotoxin.

..... [1]

- (ii) Suggest why tetrodotoxin is **not** toxic to the puffer fish.

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

QUESTION 5(c) STARTS ON PAGE 16

- (c) Multiple sclerosis (MS) is an auto-immune condition in which the nervous system is damaged. This damage leads to loss of sensation. One form of damage is shown in Fig. 5.2.

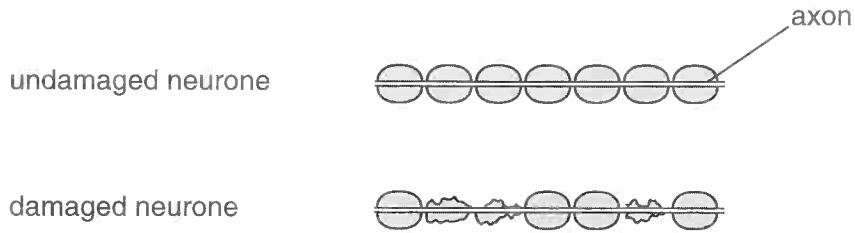


Fig. 5.2

- (i) Suggest why MS is described as an auto-immune condition.

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..... [2]

- (ii) Explain why this damage leads to a loss of sensation.

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..... [2]

[Total: 10]

END OF QUESTION PAPER

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