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.

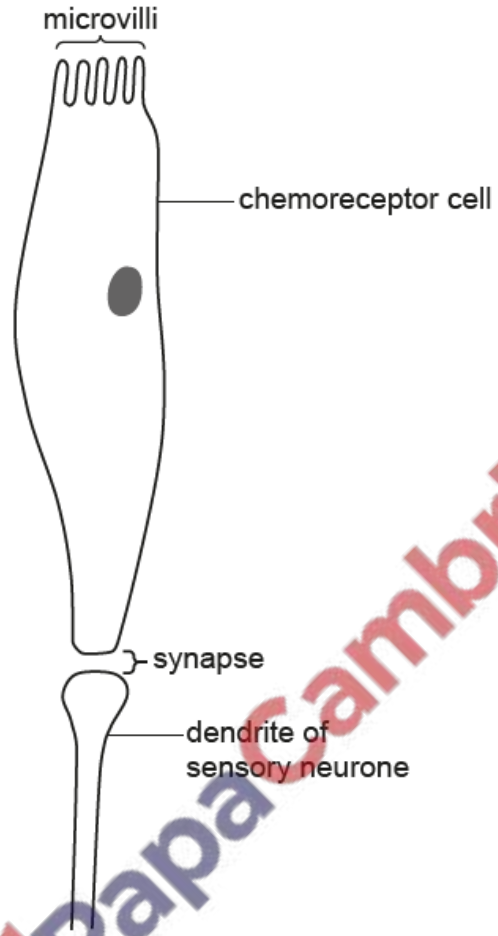

Fig. 7.1

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

Explain the results shown in Table 7.1.

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

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[Total: 7]

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

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

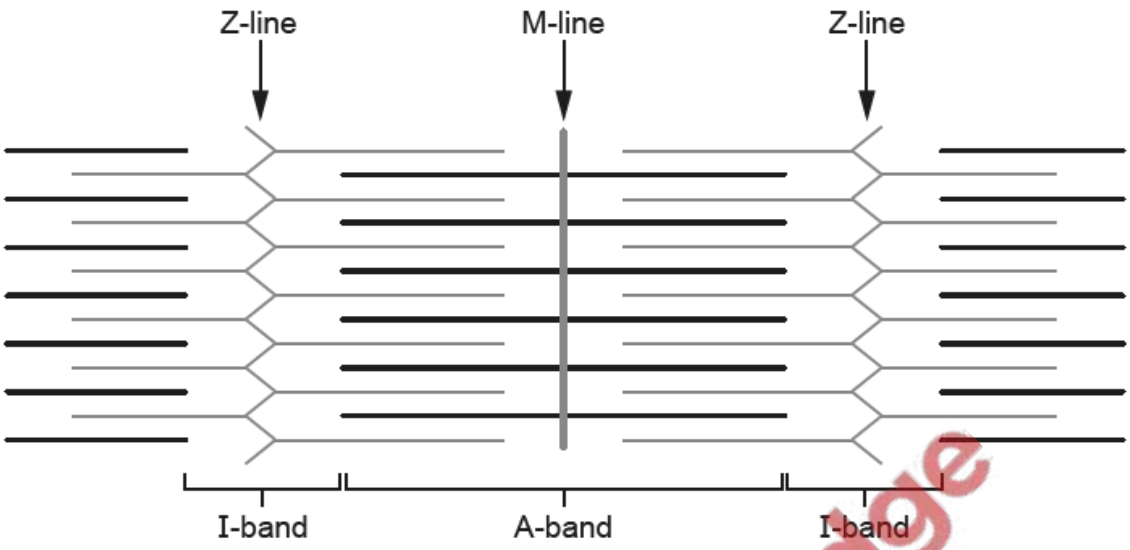

Fig. 9.1

(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]

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

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[Total: 10]

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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(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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[Total: 7]

(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.

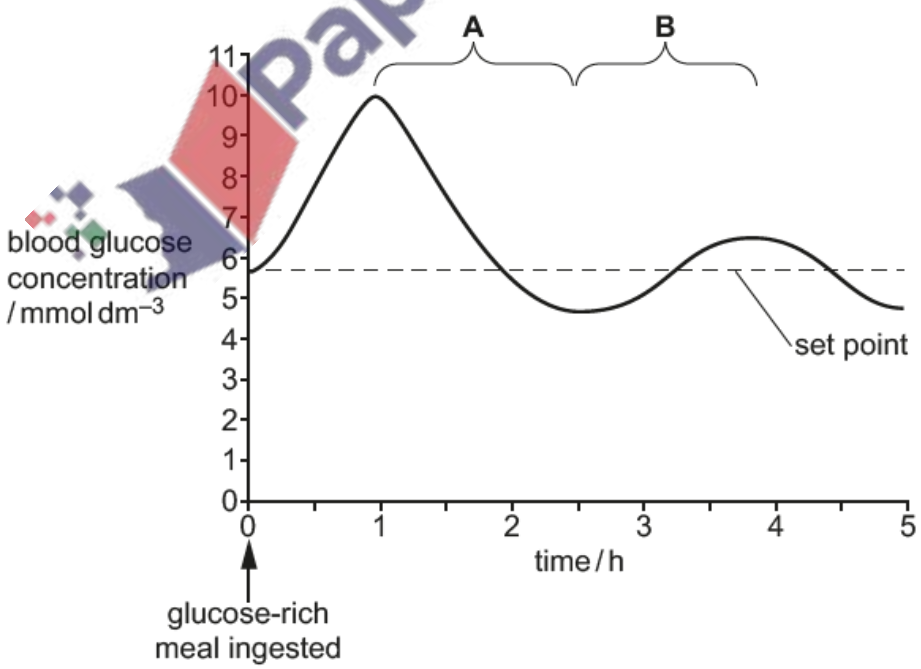

Fig. 9.1

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

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

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[Total: 10]

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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(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.

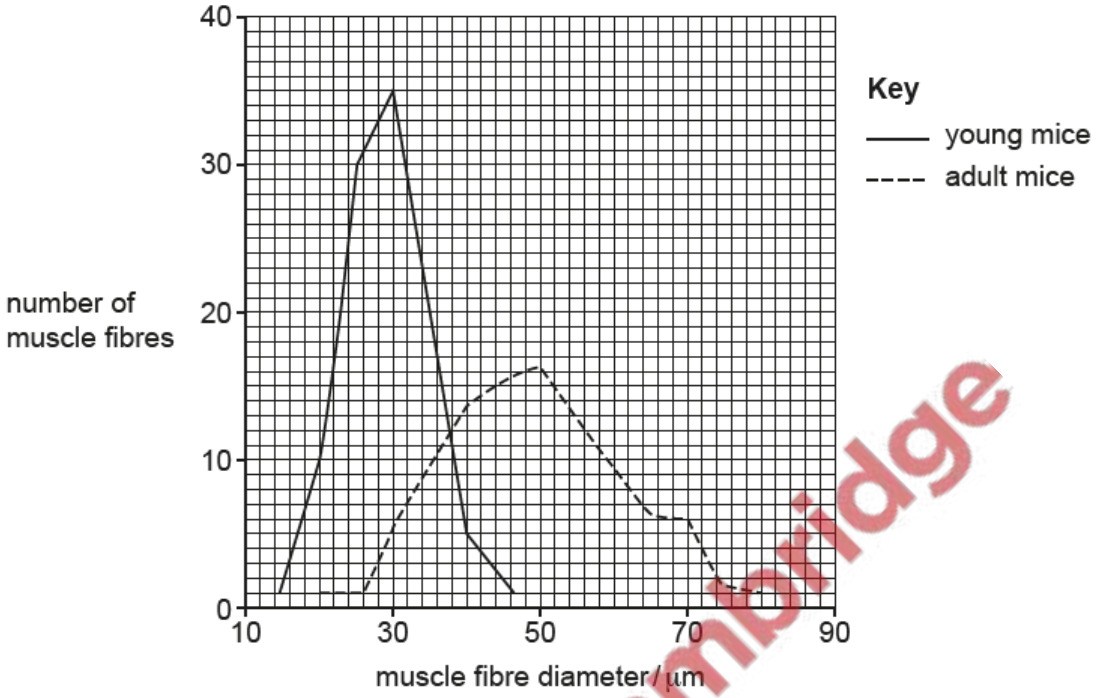

Fig. 7.1

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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[Total: 8]

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.

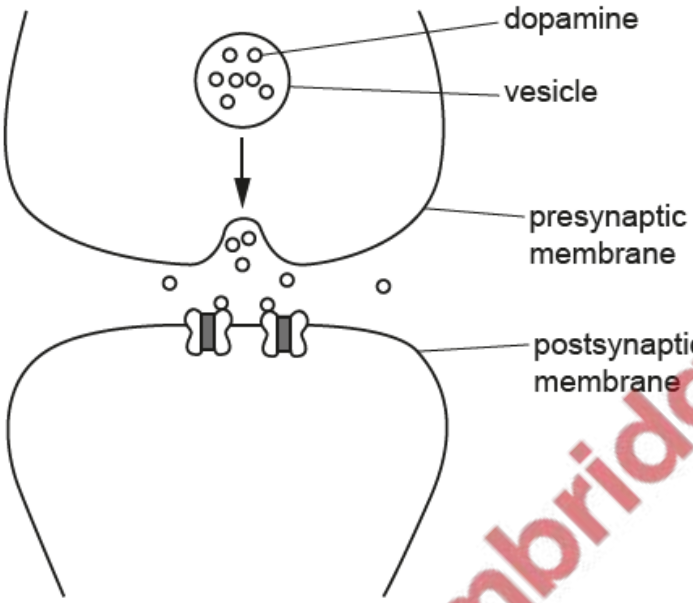

Fig. 9.1

(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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(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.

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(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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[Total: 8]