

Past-paper walk-through

Control and coordination in mammals ■ 15.1

eXercise

Questions in this set

- 9700/41 N25 Q5 ■ 13 marks
- 9700/42 N25 Q10 ■ 10 marks
- 9700/44 N25 Q1 ■ 8 marks
- 9700/41 J25 Q10 ■ 6 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 5

9700/41 N25 ■ Q5 ■ 13 marks

5 The endocrine system and the nervous system both coordinate responses in mammals.

- (a)** Complete Table 5.1 to show the features of three cell-signalling molecules of the endocrine system: antidiuretic hormone (ADH), glucagon and insulin.

Use a tick (✓) if the molecule has the feature and a cross (✗) if the molecule does **not** have the feature.

Put a tick (✓) or a cross (✗) in every box.

Table 5.1

feature	ADH	glucagon	insulin
binds to receptors on cell surface membranes			
results in molecules			

Question 5

results in molecules moving from cells into the blood			
is secreted as a result of detection by osmoreceptors			

[3]

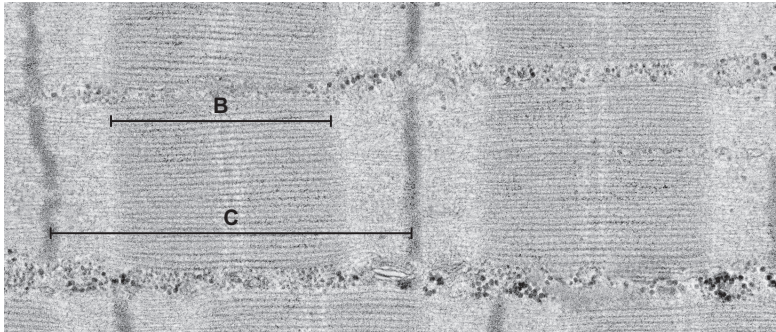
- (b) The endocrine system has a slower transmission speed than the nervous system.

Describe **other** ways in which the endocrine system and the nervous system differ.

Question 5

- (c) The endocrine system and the nervous system can affect muscle function.

Fig. 5.1 shows a transmission electron micrograph of a longitudinal section of striated muscle tissue that is in a relaxed state.



Question 5



Question 5

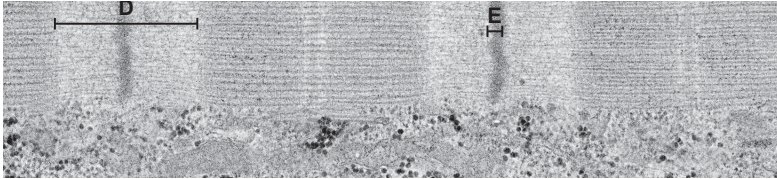


Fig. 5.1

- (i) State the letter on Fig. 5.1 that indicates the length of a sarcomere.

Question 5

- (ii) State the letter on Fig. 5.1 that indicates a region where actin and myosin overlap.

Question 5

- (iii) Describe **and** explain how the region labelled **D** on Fig. 5.1 changes during muscle contraction.

Question 5

[Total: 13]

Solution 5

(a) Mark scheme

- feature
- ADH
- glucagon
- insulin
- binds to receptors on cell surface
- membranes
-
-

Solution 5

-
- ;
- results in molecules moving from
- cells into the blood
-
-
-]
- ;
- is secreted as a result of detection by
- osmoreceptors

Solution 5

-
-]
-]
- ;
- 3

Solution 5

(b) Mark scheme

- any four from:
- 1
- impulses / action potentials / neurotransmitters, in nervous system and hormones in endocrine system ;
- 2
- electrical in nervous system and chemical in endocrine system ;
- 3
- neurones / nerve cells, in nervous system and blood in endocrine system ;

Solution 5

- 4
- effects are / target is, specific / localised, in nervous system and (can be) widespread in endocrine system ;
- 5
- effect / response, happens quickly in nervous system and slowly in endocrine system ;
- 6
- effect / response, lasts a short time in nervous system and long time in endocrine system ;
- 7
- AVP ;

Solution 5

■ 4

Solution 5

(c)(i)

Mark scheme

- C ;
- 1

Solution 5

(c)(ii)

Mark scheme

- B ;
- 1
- 9700/41
- October/November 2025

Solution 5

(c)(iii) Mark scheme

- 1
- (D / it), shortens / contracts / decreases ;
- and any three from:
- 2
- calcium ions / Ca^{2+} , bind to troponin ;
- 3
- tropomyosin, moves / shifts position / exposes binding sites on actin ;
- 4

Solution 5

- myosin (head) binds to actin / myosin-actin cross-bridges form ;
- 5
- power stroke / myosin head, pulls actin ;
- 6
- more actin, enters / overlaps with, A band / B
- or
- more overlap between actin and myosin ;
- 4

Question 10

9700/42 N25 ■ Q10 ■ 10 marks

Nerve impulses can be transmitted along a myelinated motor neurone to a neuromuscular junction at fast speeds of up to 100 m s^{-1} .

(a) Outline how a transmission speed of 100 m s^{-1} is achieved by the neurone. [3]

(b) When a nerve impulse reaches the neuromuscular junction, acetylcholine is released and diffuses to the sarcolemma.

Describe how the release of acetylcholine can result in the binding of calcium ions to troponin in the sarcomere. [4]

(c) Muscle contraction can be affected by a low blood glucose concentration. Suggest how a low blood glucose concentration would affect the functioning of the sarcomere. [3]

Solution 10

(a)

Mark scheme

any three from :

- 1 myelin sheath / Schwann cells, acts as an insulator / prevents movement of ions ;
- 2 depolarisation / action potential, **only** occurs at the nodes ; I impulses
- 3 action potentials jump from node to node / saltatory conduction ; I impulses
- 4 long(er) local circuits ;
- 5 AVP ; e.g. wide axon diameter

Solution 10

(b) Mark scheme

any four from :

- 1 ACh binds to receptors on sarcolemma ;
- 2 (ligand-gated) Na^+ channels open **or** Na^+ enters, muscle cell / sarcoplasm ;
- 3 sarcolemma depolarised ;
- 4 depolarisation / action potential, spreads, to / down, T-tubules ;
- 5 **voltage-gated** Ca^{2+} channels open ;
- 6 Ca^{2+} , diffuse / move, out of sarcoplasmic reticulum (and bind to troponin) ;

Solution 10

(c) Mark scheme

any three from :

- 1 (decreased rate of respiration so), no / less, ATP produced ;
- 2 no / less, Ca^{2+} pumped back into sarcoplasmic reticulum ;
- 3 no / less, release of myosin heads from actin / cross bridges broken **or** no / less, hydrolysis of ATP by myosin head / return of myosin head to original position ;
AW
- 4 sarcomere, permanently contracted / cannot relax ; **A** paralysis
- 5 slower sarcomere contraction / less sarcomere shortening / weaker power stroke ;

Question 1

9700/44 N25 ■ Q1 ■ 8 marks

- 1 (a) Fig. 1.1 is a diagram of a sensory neurone.

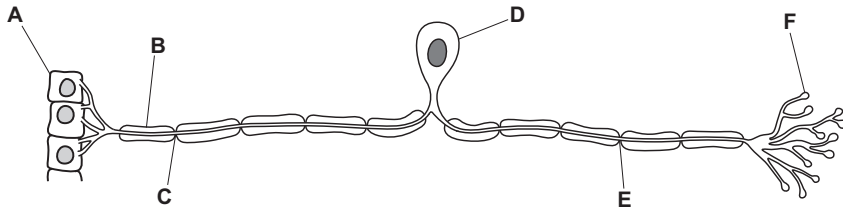


Fig. 1.1

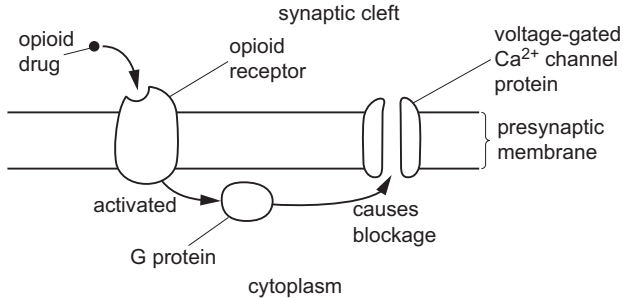
Use the letters **A–F** in Fig. 1.1 to identify:

Question 1

[4]

- (b) Opioid drugs can bind to opioid receptors in the presynaptic membrane of a cholinergic synapse.

Fig. 1.2 is a diagram of a presynaptic membrane with an opioid receptor.



Question 1

Fig. 1.2

Opioid drugs have an effect on the normal events that occur at a cholinergic synapse.

Suggest **and** explain the effect that an opioid drug will have on the normal events that occur at a cholinergic synapse.

Question 1

[Total: 8]

Solution 1

(a) Mark scheme

- 1
- A ;
- 2
- C ;
- 3
- F ;
- 4
- B ;

Solution 1

■ 4

Solution 1

(b) Mark scheme

- any four from:
- 1
- no / less, Ca^{2+} / calcium ions, enter (synaptic knob / presynaptic neurone) ;
- 2
- no / less, vesicles of acetylcholine, move towards / fuse with / do exocytosis at, presynaptic membrane ;
- 3
- no / less, acetylcholine / ACh, binds to receptors (on postsynaptic membrane) ;

Solution 1

- 4
- no / less, Na^+ / sodium ions, enter (postsynaptic neurone)
- or
- no / less, depolarisation of postsynaptic membrane ;
- 5
- no / fewer, actions potentials ;
- 4

Question 10

9700/41 J25 ■ Q10 ■ 6 marks

- 10** During the course of an action potential, the potential difference across a neurone membrane changes.

Table 10.1 shows the potential difference across the neurone membrane at three sequential time points, **X**, **Y** and **Z**, just before and during an action potential.

Table 10.1

time point	potential difference /mV
X	–70
Y	+40
Z	–90

- (a)** Describe the events that cause each of the potential differences at points **X**, **Y** and **Z**.

Question 10

- (b)** Suggest how one action potential causes an action potential in an adjacent section of the axon of an unmyelinated neurone.

Question 10

- (c) Vertebrate animals generally have a myelin sheath around the axons of motor neurones.

Explain why the presence of a myelin sheath around a motor neurone axon is an advantage.

Question 10

[Total: 12]

Solution 10

(a) Mark scheme

- causing X / -70 (mV) any three from:
 - 1
 - active transport / sodium-potassium pump ;
 - 2
 - moves three Na^+ out of and two K^+ in (to neurone) ;
 - 3
 - more K^+ diffuses out than Na^+ diffuses in ;
 - 4

Solution 10

- makes outside of membrane (relatively) more positive ;
- 5
- maintaining / establishing, resting potential ;
- causing Y / +40 (mV) any two from:
 - 6
 - depolarisation ;
 - 7
 - Na^+ / sodium ion, channels open ;
 - 8
 - Na^+ , moves / diffuses, in (to neurone) ;

Solution 10

- causing Z / -90 (mV) any two from:
 - 9
 - hyperpolarisation ;
 - 10 (voltage-gated) K^+ / potassium ion, channels open ;
 - 11 K^+ , moves / diffuses, out (of neurone) ;
 - 7

Solution 10

(b)

Mark scheme

- 1
- local, circuit / current ;
- 2
- from, depolarised / positive, area to, resting / negative, area ;
- 2

Solution 10

(c) Mark scheme

- any three from:
- 1
- speeds up (nerve) impulse / impulse transmission faster ;
- 2
- (as) myelin sheath / Schwann cells, act(s) as an insulator ;
- 3
- (as) local circuits flow between, nodes of Ranvier / gaps in sheath ;
- 4

Solution 10

- saltatory conduction ;
- 5
- fast(er), (described) response / muscle contraction ;
- 3