Neural Control and Coordination

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. The structural and functional unit of the nervous system is the:
(a) sarcomere **(b)** synapse **(c)** nephron **(d)** neuron

2. An impulse travels 1 m along a nerve fibre at 100 m/s. It takes:
(a) 10 ms **(b)** 100 ms **(c)** 1 ms **(d)** 20 ms

3. The Na^+/K^+ pump uses 17 ATP molecules. How many Na^+ ions does it move, and in which direction?
(a) 51 Na^+ ions moved in **(b)** 34 Na^+ ions moved out
(c) 17 Na^+ ions moved out **(d)** 51 Na^+ ions moved out

4. The cerebellum:
(a) balance and coordination of body movements
(b) fibre tracts that connect different regions of the brain
(c) controls body temperature, hunger and thirst, and makes neurosecretory hormones
(d) four round swellings of the midbrain

5. Which part of a neuron is this: granular bodies in the cell body?
(a) Dendrites **(b)** The myelin sheath
(c) Nissl's granules **(d)** Nodes of Ranvier

6. Multipolar neurons are found mainly in:
(a) the spinal cord only **(b)** the retina of the eye
(c) the cerebral cortex **(d)** usually in the embryonic stage

7. What is the autonomic neural system?
(a) Carry impulses from the CNS to the peripheral tissues and organs
(b) The brain and spinal cord
(c) Carries impulses from the CNS to involuntary organs and smooth muscles
(d) Carry impulses from tissues and organs to the CNS

8. Assertion (A): An impulse covers 2 m of nerve fibre at 100 m/s in 20 ms.
Reason (R): An impulse takes the same time to travel along any length of nerve.
(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. What is the difference between myelinated and non-myelinated nerve fibres?

10. How long does an impulse take to travel 1.5 m along (a) a myelinated fibre at 120 m/s and (b) a non-myelinated fibre at 2 m/s?

11. How many Na^+ and K^+ ions does the Na^+/K^+ pump move using 70 ATP molecules, and what is the net movement of positive charge?

12. Name the part of the brain responsible for this: four round swellings of the midbrain.

13. In a neuron, what are nodes of Ranvier?

14. What term describes this: more K^+ inside, more Na^+ outside, kept by the Na^+/K^+ pump?

15. Name the part of the neural system: the nerves, fibres, ganglia and plexuses to and from the viscera.

16. In a reflex, impulses travel 0.5 m in all at 100 m/s and cross 2 synapses with a delay of 0.5 ms each. How long does the reflex take?

Section C — Word problems — 4 × 4 = 16 marks

17. Describe the structure of a neuron.

18. In a reflex arc the sensory path is 1.2 m and the motor path 0.75 m long; impulses travel at 100 m/s and there is 1 synapse, each with a delay of 0.5 ms. (a) Find the total time from stimulus to response. (b) Name the parts of a reflex arc. (c) Why is a reflex faster than a voluntary action?

19. Give the function of each part of the brain: cerebellum, limbic system, corpus callosum, hypothalamus. Which of them belong to the forebrain?

20. (a) The Na^+/K^+ pump uses 192 ATP molecules. How many Na^+ and K^+ ions does it move? (b) Why does the inside of the axon stay negative at rest? (c) What happens to Na^+ and K^+ during an action potential?

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Answer key

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Q	Answer	Working
1	**(d) neuron**	—
2	**(a) 10 ms**	time = distance ÷ speed = 1 ÷ 100 s
3	**(d) 51 Na^+ ions moved out**	3 Na^+ out and 2 K^+ in for each ATP
4	**(a) balance and coordination of body movements**	—
5	**(c) Nissl's granules**	—
6	**(c) the cerebral cortex**	—
7	**(c) Carries impulses from the CNS to involuntary organs and smooth muscles**	—
8	**(c) A is true, but R is false.**	A is true: 2 ÷ 100 s = 20 ms. R is false.
9	**Myelinated fibres are covered by a myelin sheath formed by Schwann cells, with gaps called nodes of Ranvier, and conduct impulses fast (spinal and cranial nerves). Non-myelinated fibres are enclosed by a Schwann cell without a myelin sheath, found in the autonomic and somatic neural systems.**	—
10	**(a) 12.5 ms; (b) 750 ms**	time = distance ÷ speed
11	**210 Na^+ out and 140 K^+ in; a net 70 positive charges moved out**	3 Na^+ out, 2 K^+ in per ATP
12	**Corpora quadrigemina**	—
13	**Gaps between adjacent myelin sheaths**	—
14	**The resting potential**	—
15	**Visceral nervous system**	—
16	**6 ms**	0.5 ÷ 100 s + 2 × 0.5 ms

Q	Answer	Working
17	**A cell body (cyton) with cytoplasm, organelles and Nissl's granules; short, branched dendrites that carry impulses towards the cell body; and a long axon that carries impulses away, ending in branches with knob-like synaptic knobs containing vesicles of neurotransmitters. Axons may be myelinated (with Schwann cells and nodes of Ranvier) or non-myelinated.**	—
18	**(a) 20 ms; (b) receptor, afferent neuron, CNS (interneuron or direct synapse), efferent neuron, effector; (c) it is handled by the spinal cord without needing the brain to decide**	(1.2 + 0.75) ÷ 100 s + 1 × 0.5 ms
19	**cerebellum: balance and coordination of body movements; limbic system: regulates emotions, motivation and sexual behaviour; corpus callosum: joins the two cerebral hemispheres; hypothalamus: controls body temperature, hunger and thirst, and makes neurosecretory hormones. Forebrain: limbic system, corpus callosum, hypothalamus.**	—
20	**(a) 576 Na^+ out, 384 K^+ in; (b) the pump moves more positive ions out than in, and the membrane is more permeable to K^+, which leaks out, leaving the inside negative; (c) Na^+ rushes in (depolarisation), then K^+ moves out (repolarisation)**	—

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