B5aD The Nervous System and Reflexes: Exam Drill

AQA 8464 · Calculator allowed · about 90 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Give the name of the cell that transmits electrical impulses away from the central nervous system to effectors such as muscles.

(Total for Question 1 is 1 mark)

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2 State the role of a synapse in nervous transmission.

(Total for Question 2 is 1 mark)

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3 Name the receptor cells that detect change in light intensity in the human eye.

(Total for Question 3 is 1 mark)

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4 Put the following structures of a simple reflex arc in the correct order, starting with the receptor: A receptor, B motor neuron, C sensory neuron, D effector, E spinal cord

- ☐ A -> C -> E -> B -> D
- ☐ A -> E -> C -> B -> D
- ☐ A -> C -> B -> E -> D
- ☐ A -> E -> B -> C -> D

(Total for Question 4 is 2 marks)

5 A student times the reaction of a classmate to a visual stimulus. The student snaps a ruler and the classmate catches it. The student records five reaction times: 0.22 s, 0.25 s, 0.21 s, 0.80 s, 0.24 s.

a) Calculate the mean reaction time excluding the obvious outlier. Show your working. (2 marks)
b) Suggest one procedural change to reduce the effect of random variation when measuring reaction time, and explain why it would help. (1 mark)

(a) Calculate the mean reaction time excluding the obvious outlier. Show your working. **(2)**

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(b) Suggest one procedural change to reduce the effect of random variation when measuring reaction time, and explain why it would help. **(1)**

(Total for Question 5 is 3 marks)

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6 In a nerve conduction practical, students measure the time for an electrical impulse to travel 0.90 m along an isolated nerve bundle. A student measures a time of 0.018 s.

a) Use the data to calculate the speed of the nerve impulse in metres per second. Give your answer to two significant figures. (2 marks)
b) State one biological factor that increases the speed of conduction along a neuron and explain how it increases speed. (1 mark)

(a) Calculate the speed of the nerve impulse in metres per second. Give your answer to two significant figures. **(2)**

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(b) State one biological factor that increases the speed of conduction along a neuron and explain how it increases speed. **(1)**

(Total for Question 6 is 3 marks)

7 Describe one ethical consideration that must be addressed when human volunteers are used to measure reaction time in a class practical, and give one measure a teacher should take to address it.

(Total for Question 7 is 3 marks)

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8 A student uses an online reaction-time test and consistently records values about 0.10 s faster than the class mean. Suggest two possible sources of systematic error in the student's measurements and for each suggest a way to reduce that error. (4 marks)

(a) First source of systematic error and how to reduce it. **(2)**

(b) Second source of systematic error and how to reduce it. **(2)**

(Total for Question 8 is 4 marks)

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9 Explain how myelination and axon diameter affect the speed of nerve impulse conduction. In your answer include the cellular mechanisms responsible and the likely magnitude of the effect. (6 marks)

(Total for Question 9 is 6 marks)

10 An isolated motor nerve is stimulated and an impulse takes 0.024 s to travel 1.20 m along the axon. Use the equation speed = distance / time in your calculation. Show the equation, substitution, and the final answer with correct units and to three significant figures. (4 marks)

(Total for Question 10 is 4 marks)

Mark scheme · B5aD The Nervous System and Reflexes: Exam Drill

Question 1

- **B1** motor neuron (motor neurone) cao
- **Answer: Motor neuron**

Question 2

- **B1** a gap between neurons across which neurotransmitters pass (or where impulse crosses between neurons)
- **Answer: A gap between neurons across which neurotransmitters pass**

Question 3

- **B1** rod cells (rods) cao
- **Answer: Rod cells**

Question 4

- **M1** correct ordering A -> C -> E -> B -> D cao
- **A1** sequence given correctly with arrows or commas cao
- **Answer: A -> C -> E -> B -> D**

Question 5

- (a) **M1** adds the four non-outlier times: 0.22 + 0.25 + 0.21 + 0.24 = 0.92 and divides by 4 (shows calculation)
- (a) **A1** 0.230 s or 0.23 s cao
- **(a) Answer: 0.23 s**
- (b) **B1** any one valid change with explanation e.g. repeat the test more times and take the mean, so random errors average out
- **(b) Answer: Repeat the test more times and use the mean, because random variations will average out and give a more reliable value.**

Question 6

- (a) **M1** substitutes into speed = distance / time: speed = 0.90 / 0.018
- (a) **A1** 50 m/s cao (0.90 / 0.018 = 50.0 m/s, to two significant figures 50 m/s)
- **(a) Answer: 50 m/s**
- (b) **B1** myelination: myelin sheath causes saltatory conduction so impulses jump between nodes, increasing speed, oe
- **(b) Answer: Myelination: the myelin sheath allows saltatory conduction so impulses jump between nodes of Ranvier and travel faster.**

Question 7

- **B1** identifies one ethical consideration e.g. informed consent, risk of distress, or privacy/confidentiality
- **B1** gives a realistic measure to address it e.g. obtain written/verbal consent, allow withdrawal at any time, anonymise results
- **B1** links the measure to the consideration e.g. consent ensures participation is voluntary, anonymising protects privacy
- **Answer: Any one ethical consideration (e.g. informed consent) and a linked measure (e.g. obtain consent and allow participants to withdraw so participation is voluntary and no one is forced to take part).**

Question 8

- (a) **M1** identifies a plausible systematic error e.g. the online test has a calibration offset or different input latency
- (a) **A1** gives an appropriate reduction e.g. use a calibrated timer or the same device as the rest of the class, cao
- **(a) Answer: Possible systematic error: the online test or device introduces a calibration offset (input latency). Reduce by using a calibrated, standardised device or the same hardware and browser as classmates so timings are comparable.**
- (b) **M1** identifies a second plausible systematic error e.g. the student anticipates the stimulus and so reacts faster consistently
- (b) **A1** gives an appropriate reduction e.g. randomise the time between trials or use a practice block to reduce anticipation, cao
- **(b) Answer: Possible systematic error: the student anticipates the stimulus. Reduce by randomising intervals between trials and giving practice trials so anticipation is reduced.**

Question 9

- **Level 3** (5-6): A clear, detailed explanation of both myelination and axon diameter with correct cellular mechanisms and a statement about the magnitude of their effects; logical structure and clear link between cause and effect.
- **Level 2** (3-4): Good explanation of one factor and partial explanation of the other, or reasonable description of both without clear magnitude or mechanism links.
- **Level 1** (1-2): Simple statements e.g. myelin makes conduction faster, larger diameter increases speed, without explanation of mechanism.
- **Indicative content:**
  - Myelination: myelin sheath insulates axon and forces saltatory conduction so action potentials jump between nodes of Ranvier; fewer ion channels open per unit length so conduction is faster and more energy efficient
  - Effect magnitude: myelinated axons conduct much faster than unmyelinated of same diameter (tens of m/s up to 100 m/s compared with a few m/s for unmyelinated), gives idea of order of magnitude
  - Axon diameter: larger diameter reduces internal resistance to ion flow, allowing faster local currents and faster propagation of the action potential
  - Mechanistic link: reduced resistance and increased membrane resistance to current loss both increase length constant so depolarisation spreads further and threshold reached quicker at next node
  - Any reasonable quantitative comment or example values and clear linking phrases

Question 10

- **M1** quotes the equation speed = distance / time or v = d / t
- **M1** substitutes values correctly: v = 1.20 / 0.024
- **A1** 50.0 (correct numerical value to three significant figures)
- **A1** includes correct unit m/s cao
- **Answer: 50.0 m/s**