1.21 The Nervous System and Reflexes: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Table 3 lists three main regions of the brain.

Brain region	Main function
Cerebrum (cerebral cortex)	?
Cerebellum	?
Medulla oblongata	?

(a) Complete Table 3 to give the main function of each brain region. **(3)**

(b) Explain why it can be difficult for surgeons to safely repair damage inside the brain. **(2)**

(Total for Question 1 is 5 marks)

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2 Higher tier only. In addition to studying patients with brain damage, scientists use other techniques to map regions of the brain to their functions.

(a) Name two techniques, other than studying patients with brain damage, that can be used to investigate brain function. **(2)**

(b) Suggest why electrically stimulating a region of a patient's brain during surgery does not cause the patient pain. **(1)**

(Total for Question 2 is 3 marks)

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3 Figure 4 shows a cross-section of the human eye with five structures labelled A to E, which are described below.

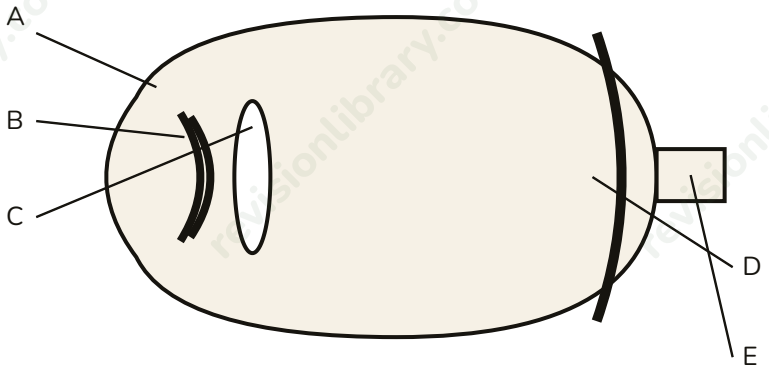
A: refracts most of the light entering the eye

B: contains muscles that control the diameter of the pupil

C: changes shape to fine-focus light onto the retina

D: contains the light receptor cells (rods and cones)

E: carries electrical impulses from the eye to the brain



(a) Name structures A to E. **(5)**

(b) State the function of the pupil. **(1)**

(Total for Question 3 is 6 marks)

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4 Higher tier only. The diameter of the pupil is controlled by two sets of antagonistic muscles in the iris: circular muscles and radial muscles.

(a) Explain how these muscles act together in bright light to protect the retina from damage. **(2)**

(b) Predict what happens to these two muscles, and to the pupil, in dim light. **(2)**

(Total for Question 4 is 4 marks)

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5 Aoife steps barefoot onto a drawing pin that has been left point-up on the carpet. Her foot lifts away from the pin before she consciously feels any pain. Explain, in as much detail as you can, how the structures of the nervous system work together to produce this reflex response, and why this reflex response is more effective than a voluntary response would be in this situation.

(Total for Question 5 is 6 marks)

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Mark scheme · 1.21 The Nervous System and Reflexes: 30-minute Pack

Question 1

(a) cerebrum (cerebral cortex): controls complex behaviour, conscious thought, memory, personality, language and intelligence, oe **B1**

(a) cerebellum: controls muscular coordination, balance and posture (fine control of movement), oe **B1**

(a) medulla oblongata: controls unconscious/involuntary activities, e.g. heart rate and breathing rate, oe **B1**

(a) Answer: Cerebrum: complex behaviour, conscious thought, memory and language. Cerebellum: muscular coordination and balance. Medulla oblongata: unconscious activities such as heart rate and breathing rate.

(b) the brain contains billions of interconnected neurones controlling many different functions packed into a small space, so damaging healthy tissue during surgery could cause loss of an unrelated function, oe **B1**

(b) the brain is soft/delicate tissue enclosed within the skull, making it difficult to access without a high risk of causing further damage, oe **B1**

(b) Answer: The brain is extremely complex, with many functions controlled in a small space, so surgery risks damaging healthy tissue; it is also delicate and enclosed by the skull, making safe access difficult.

Question 2

(a) any one of: MRI scanning (or CT/PET scanning), producing a detailed image of brain structure or activity **B1**

(a) a second, different technique: electrically stimulating an exposed region of the brain during surgery and observing the patient's response **B1**

(a) Answer: E.g. MRI (or CT/PET) scanning, and electrically stimulating an exposed region of the brain during surgery.

(b) brain tissue itself contains no pain receptors, oe **B1**

(b) Answer: Brain tissue has no pain receptors.

Question 3

(a) A: cornea **B1**

(a) B: iris **B1**

(a) C: lens **B1**

(a) D: retina **B1**

(a) E: optic nerve **B1**

(a) Answer: A: cornea. B: iris. C: lens. D: retina. E: optic nerve.

(b) the hole in the centre of the iris through which light passes/enters the eye, oe **B1**

(b) Answer: It is the opening through which light enters the eye.

Question 4

(a) the circular muscles contract and the radial muscles relax, oe **B1**

(a) this causes the pupil to constrict (get smaller), reducing the amount of light entering the eye and reaching the retina, oe **B1**

(a) Answer: The circular muscles contract while the radial muscles relax, making the pupil constrict, which reduces the amount of light reaching the retina.

(b) the radial muscles contract and the circular muscles relax, oe **B1**

(b) causing the pupil to dilate (get bigger), allowing more light to enter the eye, oe **B1**

(b) Answer: The radial muscles contract and the circular muscles relax, causing the pupil to dilate and let more light enter the eye.

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Question 5

Level 1 Simple, isolated statements are made, for example naming one or two structures (e.g. receptor, effector) or simply stating that reflexes are fast, with little linking of ideas and no clear logical sequence. **1-2**

Level 2 A description of most stages of the reflex arc pathway in a broadly logical order, with some reference to synapses, and some explanation of why the response is fast, but the answer may lack full detail on synaptic transmission or the comparison with a voluntary response. **3-4**

Level 3 A detailed, logically sequenced explanation of the full reflex arc pathway (receptor, sensory neurone, relay neurone, motor neurone, effector), including the role of synapses (neurotransmitter release, diffusion and binding to receptors), together with a clear explanation of why bypassing conscious processing in the brain makes the response faster, linked to the survival benefit of minimising harm from the drawing pin. **5-6**

Indicative content:

- A (pain/pressure) receptor in the skin of Aoife's foot detects the stimulus, the sharp point of the drawing pin
- An electrical impulse passes along a sensory neurone to the spinal cord
- At a synapse, the impulse triggers release of a neurotransmitter, which diffuses across the gap and binds to receptors on a relay neurone, generating a new impulse
- The impulse passes along the relay neurone (in the spinal cord) and, at another synapse, triggers an impulse in a motor neurone
- The motor neurone carries the impulse to an effector: a muscle in the leg or foot
- The muscle contracts, lifting the foot away from the pin, the response
- This pathway does not involve conscious processing in the brain, unlike a voluntary response, which would require impulses to travel to the cerebral cortex, be processed, and a decision sent back to the muscle
- Because the reflex pathway is shorter and involves fewer synapses than a pathway via the brain, the response happens automatically and much faster
- This is more effective for survival because it minimises the time the foot is in contact with the pin, reducing the injury caused

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