



ANSWER BOOK

Brain imaging, development and learning

Nervous coordination, receptors and muscles · Unit B14

Edexcel A 8.9, 8.10, 8.11, 8.12, 8.13, 8.19

12 questions · 46 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

A1 **B1** CT, which uses X-rays passed through the head. **B1** PET, which uses a radioactive tracer injected into the blood. [2]
BI-Q1

SECTION B · Standard, 3 to 5 marks

B1 the sensory neurone still sends impulses to its presynaptic terminal with each touch. **B1** with repeated stimulation the calcium ion channels in the presynaptic membrane become less responsive, so fewer open. **B1** fewer calcium ions enter the presynaptic terminal, so fewer vesicles fuse with the membrane and less neurotransmitter is released. **B1** less neurotransmitter binds to receptors on the motor neurone, so its depolarisation is smaller and reaches threshold less often. **B1** so fewer impulses reach the gill muscles and the withdrawal is weaker. [5]
BI-Q9

B2 **B1** place the snail on a clean, damp surface and wait until it has emerged fully with its tentacles extended. **B1** touch it gently between the tentacles with a damp cotton bud and time how long the tentacles take to extend fully again. **B1** repeat the touch at a fixed interval after each re-emergence, ten times or more, recording the time each time. **B1** control the place touched, the pressure of the touch and the person applying it, and keep temperature, light and vibration constant. **B1** repeat with several snails to check the trend is repeatable, and handle them gently, keep them moist and return them unharmed. [5]
BI-Q11

B3 **B1** neurones in an active region respire faster and use more oxygen. **B1** blood flow to the active region increases, bringing more oxygenated blood. **B1** oxyhaemoglobin and deoxyhaemoglobin behave differently in the magnetic field, so the scanner detects the rise in oxygenated blood. **B1** scans are taken every few seconds during the reading and compared with scans at rest, and the regions where oxygenated blood has increased are the ones the task uses. [4]
BI-Q2

B4 **B1** CT detects the absorption of X-rays by tissues, whereas MRI detects radio signals from hydrogen nuclei in a strong magnetic field. **B1** both produce cross-sectional images of brain structure rather than of activity. **B1** MRI shows soft tissue in finer detail, such as grey against white matter, whereas CT gives poorer soft-tissue resolution. **B1** CT exposes the patient to ionising radiation but is quicker, whereas MRI uses no ionising radiation but is slower and unsuitable for some people with metal implants. [4]
BI-Q3

- B5** BI-Q13 **B1** new-born babies have had very little experience of the world, so a preference present at birth is likely to be innate, which supports the conclusion. **B1** learning begins in the womb, so some experience has already occurred before birth. **B1** the preference is inferred from eye and head movements, because babies cannot report what they perceive, so the interpretation may be wrong. **B1** a judgement: the evidence supports a large genetic contribution to a basic preference, but cannot show that later face recognition owes nothing to experience. [4]
- B6** BI-Q14 **B1** when damage to one region causes a particular ability to be lost, that region is linked to the ability, as Broca linked speech production to an area of the left frontal lobe. **B1** recovery of an ability after damage, which is often greater in children than in adults, shows other regions can take over, so development is shaped by experience as well as genes. **B1** one limitation: the damage is rarely confined to one region, so the lost ability may depend on another region that was also damaged. **B1** another limitation: abilities before the damage are seldom known exactly, and every case differs, so samples are small. [4]
- B7** BI-Q4 **B1** glucose labelled with a positron-emitting isotope is injected into the blood. **B1** the most active brain cells take up the most glucose, so the tracer collects in the most active regions. **B1** the radiation produced when the positrons meet electrons is detected by detectors round the head, and a computer locates where it came from to build the image. [3]
- B8** BI-Q7 **B1** they have forward-facing eyes and binocular vision, with a visual cortex organised much like the human one, so results are likely to apply to humans. **B1** the experiments required procedures that would not be allowed on humans, such as depriving an eye of light and recording from single neurones in the cortex with electrodes. **B1** they develop faster than humans, so the critical period can be studied in months, and their rearing conditions can be controlled exactly. [3]
- B9** BI-Q12 **B1** the muscles that withdraw the tentacles are not fatigued, because they can still produce a full response. **B1** the receptors and sensory neurones still work, so the reduced response is not sensory adaptation. **B1** the change is specific to the repeated, harmless stimulus and lies in the nervous system, at the synapses of the withdrawal pathway. [3]
- B10** BI-Q15 **B1** the two populations differ genetically as well as in their surroundings, so the difference could be partly genetic. **B1** the test was devised in one culture and may be understood or answered differently in another. **B1** many other environmental factors also differ between the two groups, such as schooling and experience of pictures, so the cause cannot be pinned to the surroundings alone. [3]

SECTION C · Long, 6 marks or more**C1**

BI-Q8

BI a utilitarian standpoint judges the research by its consequences: it is right if it produces the greatest overall good or the least overall harm. **BI** a utilitarian may support it when the suffering of a limited number of animals is outweighed by the benefits, such as treatments for large numbers of patients or new understanding of disease. **BI** a utilitarian may oppose it when the benefits are small or uncertain, when the results may not apply to humans, or when the same results could be obtained without animals. **BI** a rights-based standpoint holds that some actions are wrong whatever their consequences, because they violate a right or break a duty. **BI** if animals have a right not to be harmed or used as a means to an end, the research is wrong however great the benefits. **BI** alternatively, if rights belong only to beings that can reason and accept duties, animals have none and regulated research is permissible, though there is still a duty to avoid cruelty, as in the three Rs.

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