Unit 5 - Mark scheme

Question number	Answer	Mark
1(a)	B inner mitochondrial membrane	(1)

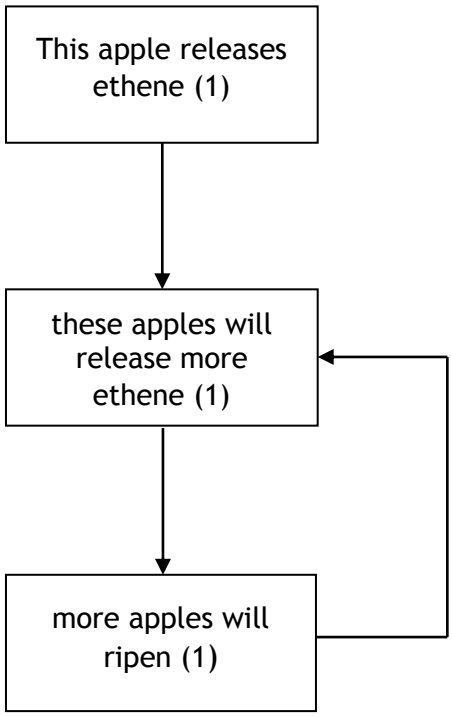
Question number	Answer	Mark
1(b)(i)	An explanation that includes any two of the following points: • no ATP will be produced by the electron transport chain (1) • because electrons will not be passed onto the oxygen (1) • therefore {reduced NAD will not be reoxidised / the electron transport chain will stop} (1)	(2)

Question number	Answer	Mark
1(b)(ii)	An explanation that includes the following points: • there will be no ATP production from reduced NAD (1) • there will be some ATP produced from reduced FAD because electrons from reduced FAD enter the electron transport chain after the site of inhibition of rotenone (1)	(2)

Question number	Answer	Mark
1(b)(iii)	An explanation that includes the following points: • because the inhibitors affect the ETC, which is not used in anaerobic respiration (1) • therefore the same quantity of ATP will be produced from substrate level phosphorylation in glycolysis (1)	(2)

Question number	Answer	Mark
2(a)(i)	D chemoreceptor, medulla oblongata	(1)

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that includes any four of the following points: • an increase in blood carbon dioxide decreases the pH of the blood (1) • the pH of the blood needs to be kept within narrow limits (1) • therefore the ventilation rate has to increase (1) • nerve impulse sent from {respiratory centre / medulla} to intercostal muscles (1) • when inspiratory centre is stimulated, the expiratory centre is inhibited (1)	Accept cells have to be supplied with sufficient oxygen / carbon dioxide has to be removed Accept converse	(4)

Question number	Answer	Mark
2(b)	An answer that includes the following points:  	(3)

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Question number	Answer	Mark
3(a)	• x values read from the graph and subtracted (1) • mean percentage drop calculated (1) • mean percentage of insects calculated (1) Example of calculation: 58 − 1 = 57 100 ÷ 57 = 1.75 350 × 1.75 ÷ 100 = 6	(3)

Question number	Answer	Mark
3(b)	An explanation that includes the following points: • investigation demonstrates habituation (1) • because the {response / number of insects showing PER} decreased each time the stimulus was repeated (1) • because they learned that the heat pad was not a source of blood (1)	(3)

Question number	Answer	Mark
3(c)	An answer that includes the following points: • energy saved by not extending proboscis (1) • less likely to damage the proboscis (1)	(2)

Question number	Answer	Mark
4(a)	B flexible, non-elastic tissue connecting muscle to bone flexible tissue connecting bone to bone	(1)

Question number	Answer	Mark
4(b)(i)	A P to T	(1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An answer that includes three of the following points: similarities: • contain {actin / myosin / tropomyosin / troponin} (1) • consist of {sarcoplasm / sarcolemma / sarcomeres} (1) differences: • slow-twitch muscle fibres have more mitochondria (1) • slow-twitch muscle fibres have more myoglobin (1) • slow-twitch muscle fibres have less glycogen (1) • slow-twitch muscle fibres have less creatine phosphate (1)	To gain maximum marks, at least one similarity must be included in the answer Accept the converse points for fast-twitch fibres	**(4)**

Question number	Answer	Mark
4(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant. **Indicative content** • power output is (always) greater in muscles containing more than 50% fast-twitch muscle fibres • power output in muscles containing more than 50% fast-twitch muscle fibres increases with speed of contraction. • power output in muscles containing less than 50% fast-twitch muscle fibres decreases with higher speeds of contraction. • fast-twitch muscles are designed for rapid short bursts of energy. • therefore power output will increase with speed of contraction. • because they are adapted for anaerobic respiration. • example of adaptation described • muscles with low content of fast-twitch muscles cannot sustain aerobic respiration for long periods of time	**(6)**

Level	Marks	Descriptor
	0	No awardable content.
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
3	5-6	An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.

Question number	Answer	Mark
5(a)	• diameter of lesion and length of brain measured (1) • diameter of lesion multiplied by the magnification (1) Example of calculation: 6 mm and 63 mm 6 × (150 ÷ 63) = 14 / 14.3 / 14.29	(2)

Question number	Answer	Mark
5(b)(i)	• mean increase in conduction per 1 μm increase in diameter for each type of neurone calculated (1) • value for myelinated neurone divided by value for non-myelinated to give an answer that is at least 1 SF more (1) Example of calculation: myelinated = (8.5 − 2.6) ÷ 2 = 2.95 non-myelinated = (4.2 − 2.3) ÷ 4 = 0.475 2.95 ÷ 0.475 = 6.2 / 6.21	(2)

Question number	Answer	Mark
5(b)(ii)	An explanation that includes the following points: • both an increase in diameter and the presence of a myelin sheath increase speed of transmission (1) • myelin insulates the axon because it is hydrophobic (1) • therefore {nerve impulses jump from node to node / action potentials only occur at the nodes of Ranvier / saltatory conduction occurs} (1) • as diameter increases the resistance to flow decreases (1)	(4)

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An answer that includes any three of the following points: • demyelination in a person with MS will result in impulses travelling slower (1) • blindness in one eye will result from demyelination of {nerve from eye to brain / one side of the brain} (1) • lack of coordination will result from sensory neurones and motor neurones transmitting nerve impulses at different speeds (1) • {blindness in one eye / lack of coordination} will result if demyelination occurs in the part of the brain associated with {vision / coordination} (1)	Accept occipital lobe	**(3)**

Question number	Answer	Mark
6(a)(i)	C glucose and urea	**(1)**

Question number	Answer	Mark
6(a)(ii)	A basement membrane	**(1)**

Question number	Answer	Mark
6(a)(iii)	C sodium co-transport	**(1)**

Question number	Answer	Mark
6(a)(iv)	An explanation that includes any two of the following points: • because the concentration of urea is greater in the filtrate than in the blood (1) • so urea will diffuse down its concentration gradient (1) • because the walls of the proximal tubule and capillaries are permeable to urea (1)	**(2)**

Question number	Answer	Mark
6(b)(i)	• correct figures selected from the table and subtracted (1) • percentage decrease calculated (1) Example of calculation: 7.0 − 0.6 = 6.4 (6.4 ÷ 7) × 100 = 91.43	(2)

Question number	Answer	Mark
6(b)(ii)	B at 1-minute intervals between 5 minutes and 15 minutes	(1)

Question number	Answer	Mark
6(b)(iii)	An explanation that includes any four of the following points: • because the carotid artery will carry the blood straight up to the hypothalamus (1) • which will detect the lower solute potential of the blood (1) • as a result, the (posterior) pituitary gland will release ADH (1) • ADH will result in more reabsorption of water from the {distal tubules / collecting ducts} so less urine produced (1) • because when solute potential returns to normal, ADH will no longer be released and urine production will increase again (1)	(4)

Question number	Answer	Mark
7(a)	A bioinformatics	(1)

Question number	Answer	Mark
7(b)	An explanation that includes the following points: • inhibition of the release of acetylcholine will prevent the generation of a nerve impulse because a chemical is needed to transmit the nerve impulse across the {synapse / gap} (1) • blocking the ion channels will prevent the generation of a nerve impulse because calcium ions will not be able to enter the pre-synaptic bulb and trigger the release of {neurotransmitter / acetylcholine} (1) • blocking the acetylcholine receptors will prevent the generation of a nerve impulse because acetylcholine will not be able to bind to its receptors on the post-synaptic neurone, so {depolarisation of the membrane / initiation of an action potential} will not occur (1)	(3)

Question number	Answer	Mark
7(c)(i)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant. **Indicative content** • neurotoxins have a greater composition of cysteine • non-toxins have a greater composition of glutamine and leucine • the different groups of organisms that produce neurotoxins have similar compositions of leucine • the different groups of organisms that produce neurotoxins have variations in the compositions of cysteine and glutamine • mollusc neurotoxin has the greatest composition of cysteine but bacteria neurotoxin has the least • bacteria neurotoxin has the greatest composition of glutamine and cnidarians the least	(6)

Level	Marks	Descriptor
	0	No awardable content.
1	1-2	Limited number of the most important or relevant scientific factors from the data/information provided are synthesised. No judgement is made.
2	3-4	Some of the most important or relevant scientific factors from the data/information provided are synthesised. A straightforward but accurate judgement is made.
3	5-6	Most of the important or relevant scientific factors from the data/information provided are synthesised. A detailed and accurate judgement is made.

Question number	Answer	Mark
7(c)(ii)	An explanation that includes the following points: • because a different amino acid will have a different R group so different bonds will be formed (1) • therefore the tertiary structure will be different and the neurotoxin will not be able to bind to receptors on the {pre-synaptic membrane / neurotransmitter / post-synaptic membrane} (1)	**(2)**

Question number	Answer	Mark
8(a)	• so other scientists could repeat the study / because different species might respond differently to microgravity	**(1)**

Question number	Answer	Mark
8(b)	• nematodes may be {harmed / killed}	**(1)**

Question number	Answer	Mark
8(c)	A description that includes the following points: • epigenetic changes to {prevent / allow} gene expression (1) • transcription factors to switch {on / off} genes (1) • post-transcriptional modification to determine which protein is produced from a particular gene (1)	**(3)**

Question number	Answer	Mark
8(d)	An answer that includes any three of the following points: • (lower fat accumulation because) the diet that the nematodes were fed did not have an energy content greater than that being used (1) • (lower fat accumulation because) nematodes did not need to store energy as they were not very active (1) • (shorter body length because) diet was low in protein (1) • genes controlling {fat accumulation / body length} had been switched off (1) • microgravity resulted in less protein being synthesised (1)	(3)

Question number	Answer	Mark
8(e)	An explanation that includes any four of the following points: • less muscle {protein / named protein} synthesised because of muscle atrophy (1) • because the microgravity decreases the force that needs to be exerted by the muscles (1) • less muscle activity, therefore less ATP required (1) • therefore fewer {enzymes / named enzyme} needed for respiration (1) • fewer proteins involved in gluconeogenesis because less glucose needed for respiration (1)	(4)

Question number	Answer	Mark
8(f)	An explanation that includes the following points: • microarrays analyse the {active DNA / RNA} of a cell (1) • therefore less {active DNA / RNA} for the electron transport genes and increased {active DNA / RNA} for the sirtuin gene (1) • compared to nematodes, they are not exposed to microgravity (1)	(3)

Question number	Answer	Mark
8(g)	An explanation that includes the following points: • because the scientists wanted to assess the lipid stores of the nematodes (1) • Sudan Black binds specifically to fat (1)	**(2)**

Question number	Answer	Mark
8(h)	An answer that includes three of the following points: • mean values are given throughout (1) • frequency data reliable as the standard deviations do not overlap (1) • frequency and wavelength data reliable as p values are less than {0.01 / 0.05} (1) • they are not very reliable as the sample sizes are very small (1)	**(3)**