

Mark Scheme (SAM)

Pearson Edexcel International Advanced Level in Biology

Unit 5: Energy, Exercise and Coordination

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General marking guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of Quality of Written Communication, are being assessed. The strands are as follows:
 - i. ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
 - ii. select and use a form and style of writing appropriate to purpose and to complex subject matter
 - iii. organise information clearly and coherently, using specialist vocabulary when appropriate.

Using the Mark Scheme

Examiners should NOT give credit for incorrect or inadequate answers, but allow candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected, it may still be creditworthy.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/	Means that the responses are alternatives and either answer should receive full credit.
()	Means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Bold	Phrases/words in bold indicate that the meaning of the phrase or the actual word is essential to the answer.
ecf/TE/cq	(error carried forward)(transfer error)(consequential) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions that involve the writing of continuous prose require candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities. Questions where Quality of Written Communication is likely to be particularly important are indicated (Quality of Written Communication) in the mark scheme, but this does not preclude others.

Question Number	Answer	Mark
1(a)(i)	B	(1)

Question Number	Answer	Mark
1(a)(ii)	D	(1)

Question Number	Answer	Mark
1(a)(iii)	A	(1)

Question Number	Answer	Mark
1(a)(iv)	D	(1)

Question Number	Answer	Mark
1(a)(v)	A	(1)

Question Number	Answer	Additional guidance	Mark
1(b)	1. Ideas of (muscles) work antagonistically 2. Circular muscle relaxes 3. Radial muscle contracts	ACCEPT stretched. IGNORE for mp3 constrict.	(2)

Total for Question 1 = 7 Marks

Question Number	Answer	Additional guidance	Mark
2(a)	1. CT therefore can only identify {larger/main} structures/MRI can identify smaller structures/eq 2. Reference to tissue identified/eq 3. MRI uses {radio waves/magnetic field}, CT uses X-rays/eq 4. Idea of both give {2D/3D} images 5. Limitation of MRI or CT 6. Idea of images for both are at one point in time 7. Reference to comparative cost of use	ACCEPT both identify soft tissue, MRI better for soft tissue, CT for bone/tissues of different density, both for tumours. ACCEPT aligning hydrogen atoms for MRI. ACCEPT easier to get 3D from MRI. ACCEPT MRI – noisy, need to keep still, not so good for people with metal implants, pacemakers. CT reference to safety aspects of X-rays. ACCEPT MRI more expensive than CT.	(3)

Question Number	Answer	Additional guidance	Mark
2(b)	1. View brain activity directly/eq 2. Idea of seeing brain activity over a period of time 3. Safer as does not use X rays 4. No need to use special dyes	ACCEPT MRI identifies active areas by greater blood flow, greater oxygen uptake, presence of more oxyhaemoglobin in these areas. ACCEPT see in real time, quotes figures such as fMRI takes up to 4 frames a second or moving image, CT is still image.	(2)

Question Number	Answer	Additional guidance	Mark
2(c)(i)	1. Idea that tumour tissue differs from brain tissue 2. Detail of effect on scan, e.g. {energy source/magnetic field/radio waves/eq} {absorbed/blocked/eq} 3. Reference to difference in blood supply	ACCEPT1 reference to relative densities, tumour growing/dividing/mutated cells. ACCEPT reference to oxygen presence.	(2)

Question Number	Answer	Additional guidance	Mark
2(c)(ii)	1. Idea that (treatment) has been partially successful 2. Tumour reduced/eq 3. Reduction qualified, e.g. in contact with less brain tissue or size reduction quoted	ACCEPT affecting less brain tissue. Halved in size.	(2)

Question Number	Answer	Additional guidance	Mark
2(c)(iii)	1. and 2. Two appropriate functions given, e.g. think, learn, show emotions, memory, personality, reasoning, eq	ACCEPT decision making, problem solving, planning, intelligence, controls voluntary behaviour, forming associations (combining information from rest of cortex), ability to carry out different movements IGNORE control/coordinates movement.	(3)
	3. Because tumour is situated in the frontal lobe/cerebral hemispheres/cerebrum	ACCEPT frontal cortex.	

Total for Question 2 = 12 Marks

Question Number	Answer	Additional guidance	Mark
3(a)	1. Idea an enzyme converts a named substrate into named product, e.g. enzyme 1 converts P to Q 2. Idea that this product becomes the substrate of next step 3. Idea of specificity 4. {Controls/eq} the conversion/eq 5. Speeds up the conversion/eq 6. By reducing activation energy/eq 7. Credit reference to control of whole process	ACCEPT answers in context of respiration. ACCEPT reference to an enzyme converting one named intermediate to the next, e.g. {named enzyme/enzyme} used to convert hexose to phosphorylated hexose or enzyme converts 6C compound to 5C compound (in Krebs cycle) ACCEPT respiration example given, e.g. pyruvate from glycolysis is substrate/intermediate for lactate formation. ACCEPT this product can be used by the next enzyme. ACCEPT description of specificity, e.g. active site of enzyme 1 only accepts substance P or in context of named respiratory intermediate. ACCEPT regulates, one enzyme may limit the rate of process. ACCEPT catalysis/enzyme acts as a catalyst. ACCEPT end product inhibition or description.	(4)

Question Number	Answer	Additional guidance	Mark
3(b)(i)	1. $W = \{NAD/NAD^+/NAD_{ox}/eq\}$ Any two of the following: 2. (Due to) reduced NAD {releasing/eq} {electrons/eq} 3. Idea of electrons go to {carrier A/ETC/eq} 4. Idea of H^+ moved into inter-membranal space	ACCEPT being oxidized. Releasing hydrogen (atoms), H^+/protons⁻ ACCEPT 1st electron carrier/correctly named carrier, e.g. FAD, flavoprotein, ETC. ACCEPT released to matrix, pumped through the inner membrane.	(3)

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	1. Substance X is ATP Any two of the following: 2. Due to H^+ pass through {stalked particle/ATPase} 3. (H^+ passes) down an electrochemical gradient 4. (Sufficient) energy is {released/eq} 5. To join ADP and {Pi/eq} 6. Reference to chemiosmosis	ACCEPT ATP synthase. ACCEPT 3 description of electrochemical gradient/reference to electromotive force NOT 4 produced. ACCEPT phosphorylation of ADP but not reference to phosphorus (P).	(3)

Question Number	Answer	Mark																			
3(c)	<table><thead><tr><th rowspan="2">Situation</th><th colspan="3">Movement of coloured liquid</th></tr><tr><th>towards A</th><th>towards B</th><th>does not move</th></tr></thead><tbody><tr><td>Screw clip is open</td><td></td><td></td><td>☒</td></tr><tr><td>Screw clip is closed</td><td>☒</td><td></td><td></td></tr><tr><td>Potassium hydroxide is replaced with water and screw clip is closed</td><td></td><td></td><td>☒</td></tr></tbody></table>	Situation	Movement of coloured liquid			towards A	towards B	does not move	Screw clip is open			☒	Screw clip is closed	☒			Potassium hydroxide is replaced with water and screw clip is closed			☒	(3)
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Potassium hydroxide is replaced with water and screw clip is closed			☒																		

Total for Question 3 = 13 Marks

Question Number	Answer	Mark
4(a)(i)	1. (protein in thin filament) - actin/G actin 2. (protein in thick filament) - myosin	(2)

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	1. {Ca ²⁺ / calcium ions} bind to troponin 2. Troponin {changes shape/moves/moves/eq} 3. This displaces tropomyosin (away from myosin)/eq	ACCEPT pulls/shifts/moves tropomyosin.	(2)

Question Number	Answer	Additional guidance	Mark
4(a)(iii)	Acetylcholine/{noradrenaline/eq }	Accept ACh, noradrenalin, norepinephrine. IGNORE reference to adrenaline, epinephrine.	(1)

Question Number	Answer	Additional guidance	Mark
4(b)	1. The higher troponin T, the longer the stay/eq 2. Reliability of prediction decreases as troponin T concentration increases 3. Because {range/eq} increases 4. Least reliable for 6.0+ as range is largest 5. One range stated, e.g. for 6.0+ it is 7 to 11 days 6. Reference to range overlapping between 4.0-5.9 and 6.0+ 7. Idea that 6.0+ is too wide a category for concentration of troponin T 8. Idea that the higher the troponin T, the greater the damage to the heart	ACCEPT 1 converse. ACCEPT 2 converse, less reliable at high troponin T. ACCEPT 3 range of the length of stay, range of data. ACCEPT 4 converse for 1.0-3.9/4.0-5.9.	(3)

Total for Question 4 = 8 Marks

Question Number	Answer	Additional guidance	Mark
5(a)	A - cell body B - axon	Accept axoplasm.	(2)

Question Number	Answer	Additional guidance	Mark
5(b)(i)	1. Increasing Eugenol concentration increases percentage inhibition /positive correlation 2. Description of non-linear correlation 3. Credit correct manipulation of the data, e.g. between 0.1 and 1.0 mmol dm ³ percentage inhibition to increase by 55%	IGNORE any references to rate. ACCEPT for example greatest increase in inhibition is between eugenol concentration of 0.2 and 0.4 mmol dm ⁻³ , least increase in inhibition/inhibition plateaus above 0.8 eugenol concentration.	(2)

Question Number	Answer	Additional guidance	Mark
*5(b)(ii) Quality of Written Communication	(Quality of Written Communication – Spelling of technical terms must be correct and the answer must be organised in a logical sequence.) 1. {reduced/eq} Ca^{2+} enters {presynaptic membrane/into sensory neurone} 2. Due to Ca^{2+} channel not opening/decreased sensitivity of membrane to Ca^{2+} 3. Fewer vesicles {move towards/fuse} with presynaptic membrane 4. Less neurotransmitter {released into/less diffuses across} {synaptic gap/eq} 5. Less neurotransmitter binds to receptors on {post-synaptic membrane/adjacent neurone} 6. Idea of reduced depolarisation/less Na^+ or cation channels open 7. Idea of {threshold intensity/action potential/impulse} less likely to occur 8. Idea of pain not being sensed as impulse {stopped before entering CNS/leaving the sensory neurone}	ACCEPT into synaptic knob/pre-synaptic neurone Allow reference to no calcium ions also calcium . ACCEPT (and for 4 and 5) none as alternative to less. ACCEPT named neurotransmitter example. ACCEPT no diffusion of neurotransmitter. ACCEPT so less neurotransmitter to allow receptors on post-synaptic membrane to be stimulated. ACCEPT not reached as alternative to less likely to be reached.	(6)

Total for Question 5 = 10 Marks

Question Number	Answer	Additional guidance	Mark
6(a) (i)	(Cut shoot) without IAA present/without agar blocks	ACCEPT agar block with no IAA, empty agar block, agar block with water. ACCEPT auxin(s) as alternative to IAA.	(1)

Question Number	Answer	Additional guidance	Mark
6(a) (ii)	1. (Both sides of) shoot taller/eq 2. Than the control/eq 3. Both IAA's diffuse {down/out of agar/to zone of elongation}/eq 4. Reference to cell elongation/eq 5. Details of cell elongation/eq 6. Shoot bends to the right/eq 7. (Due to) more growth on {left side of shoot/side with artificial IAA}/eq	ACCEPT auxin as alternative to IAA throughout. ACCEPT grow {taller/faster /higher/up/ towards the light}. ACCEPT away from the light/agar block. ACCEPT bends away from side with artificial IAA.	(5)

Question Number	Answer	Additional guidance	Mark
6(b)	- Idea that IAA enters the cell - Reference to movement within cell/IAA in cytoplasm to nucleus - Effect when binds to transcription factor, e.g. forms a transcription initiation complex or countering an inhibitor - Reference to switching on gene - Activity at promoter region/eq - Allows formation of (m)RNA/eq - Idea of translation produces protein	ACCEPT auxin as alternative to IAA throughout. ACCEPT joins to promoter region or activates transcription factor. ACCEPT reference to RNA polymerase activity. ACCEPT RNA/preRNA for Mrna. IGNORE reference to tRNA.	(4)

Total for Question 6 = 10 Marks

Question Number	Answer	Additional guidance	Mark
7(a)	1. Alpha glucose in starch and beta glucose in cellulose 2. Only {starch/amylopectin} can be branched/cellulose only a linear molecule 3. Starch contains two types of molecule, cellulose only one 4. Alternate monomers rotated through 180° in cellulose only 5. Only {amylopectin/starch} can have 1–6 glycosidic bonds/cellulose has 1–4 glycosidic bonds only	ACCEPT symbols for alpha and beta. ACCEPT starch can be spiralled. ACCEPT 3 the two named molecules of starch – amylose and amylopectin. ACCEPT starch can have 1–6 and 1–4 glycosidic bonds but cellulose only 1–4. ACCEPT starch has alpha 1–4 glycosidic bonds and cellulose beta 1–4.	(2)

Question Number	Answer	Additional guidance	Mark
7(b)(i)	1. Thermoreceptors in hypothalamus/eq 2. Detect the increase in (core) blood temperature/eq 3. Reference to heat loss centre activated 4. Reference to autonomic nervous system 5. Reference to impulses down motor neurones 6. To {effectors/named effector}/eq 7. Detail of method of heat loss/eq	ACCEPT receptors in hypothalamus. ACCEPT sympathetic. ACCEPT effector neurone for motor neurone. ACCEPT vasodilation of blood vessels, sweat released, heat loss from blood through radiation. IGNORE – reference to hair erector muscles.	(4)

Question Number	Answer	Additional guidance	Mark
7(b) (ii)	1. (Shivering) is muscle contraction 2. Which uses {respiration/ATP/eq} 3. Which release heat (to warm body)/eq	IGNORE movement. ACCEPT oxidative phosphorylation, ATP being converted to ADP and Pi.	(2)

Question Number	Answer	Additional guidance	Mark
7(c)	1. (Cancer causing) gene identified/eq 2. Gene {cut/isolated/eq} from DNA/eq 3. Using a {restriction/eq} enzyme/eq 4. Gene in {vector/named vector} 5. Mechanism for getting {gene/vector} into host cells (of naked mole rats)/eq	ACCEPT screen for the gene. ACCEPT named examples – retrovirus, virus, liposome, plasmid, bacteria. ACCEPT reference to (micro)injection, microprojectiles, electroporation, gene gun, inhaler.	(3)

Question Number	Answer	Additional guidance	Mark
*7(d) Quality of Written Communication	(Quality of Written Communication – Spelling of technical terms must be correct and the answer must be organised in a logical sequence.) 1. Idea that this air has higher CO₂ content 2. {CO₂ level in blood increases/pH of blood falls/eq} 3. Change detected by chemoreceptors in {carotid body/carotid artery/aortic body/aorta/medulla} 4. Reference to {ventilation centre/eq} (in medulla) 5. Sends more impulses along neurones/eq 6. To intercostal muscles/diaphragm/eq 7. Causing an increased {ventilation rate/rate of breathing/depth of breathing}/eq	Quality of Written Communication to emphasis logical sequence. ACCEPT high, higher. ACCEPT respiratory centre, inspiratory centre for ventilation centre. ACCEPT impulses sent more often. ACCEPT reference to phrenic nerve. IGNORE reference to faster.	(5)

Question Number	Answer	Additional guidance	Mark
7(e)	1. Naked mole rat's {incisors/eq} grow through {skin/lip} without {damage/eq} 2. Lead to new {coatings/permanent seal /eq} at {skin/bone/metal} interface 3. So soft tissue is {not damaged/eq}{by the prosthetic}/eq}	ACCEPT chance of infection reduced.	(2)

Question Number	Answer	Additional guidance	Mark
7(f)	Gonadotrophin-releasing (hormone) and anterior pituitary/gonadotrophins and {ovaries/testes}	ACCEPT testosterone and testes. ACCEPT gonads for testes or ovaries.	(1)

Question Number	Answer	Additional guidance	Mark
7(g)	1. Idea of irregularity of flagellum 2. Idea of irregularity associated with mid-region	Context is structural. ACCEPT no or more than one flagellum. ACCEPT tail for flagellum. ACCEPT mitochondria non-functional, less effective, not enough mitochondria.	(2)

Question Number	Answer	Additional guidance	Mark
7(h)	1. Idea of high levels of inbreeding 2. Low level of genetic diversity/eq 3. Idea that there is some variation because more than one male is involved in 4. Unfamiliar males used as mates (by queen)/eq 5. Fusion of colonies/eq 6. Arrival of a dispersal phenotype (from a different colony) 7. Mutations/eq	ACCEPT accept idea in context of only one queen/female breeds. ACCEPT restricted gene pool, low genetic variation Ignore reference to biodiversity for Mp2.	(3)

Question Number	Answer	Additional guidance	Mark
7(i)	1. Reduces inbreeding (depression)/eq 2. Increases outbreeding/outbreeding qualified 3. (Leading to) increase in genetic diversity 4. Idea of colony size regulation 5. Idea of increase in fecundity 6. Idea of increased chance of survival	ACCEPT less genetic drift. ACCEPT disperser/new comer more likely to breed. ACCEPT increased genetic variation, increase in variety of alleles etc. ACCEPT appropriate reference to natural selection, due to environmental changes.	(2)

Question Number	Answer	Additional guidance	Mark
7(j)	Paired responses: 1. Reduced sensitivity to chemical pain/disconnection of 'pain nerves' 2. High CO₂ in air (of tunnels) 3. Haemoglobin has higher affinity for oxygen/brain can tolerate eq 4. Low O₂ levels (in tunnels)/eq 5. Increased number of oxytocin receptors in brain 6. Overcrowding/eq 7. Non-pigmented 8. Lack of UV light 9. Outbreeding mechanisms such as dispersal phenotype 10. Low genetic diversity 11. Hairless/naked/reduction of sweat gland/loose skin/no insulating layer/poikilothermic 12. Due to nature of its temperature environment/eq	ACCEPT lack or receptor for chemical pain. ACCEPT reference to brain's hypoxia response, neurones or brain resistance to hypoxia. ACCEPT hairless, naked. ACCEPT size of colony. ACCEPT ectothermic for poikilothermic, or a description.	

Question Number	Answer	Additional guidance	Mark
7(j) continued	13. teeth arrangement/eq: a) for digging underground b) keen sense of smell/reduce eyesight/reference to circadian rhythms dark conditions.	ACCEPT forward of lips or long.	(4)

Total for Question 7 = 30 Marks

Total for Paper = 90 Marks