



## Mark Scheme (Results)

January 2019

Pearson Edexcel International Advanced Level  
in Biology (WBI05)  
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.

Question Number	Answer	Mark
<b>1(a)(i)</b>	<p><b>C</b> – myosin only</p> <p>The only correct answer is C</p> <p><i>A is not correct because R identifies a region of myosin only</i></p> <p><i>B is not correct because R identifies a region of myosin only</i></p> <p><i>D is not correct because R identifies a region of myosin only</i></p>	<p><b>Computer</b></p> <p><b>(1)</b></p>

Question Number	Answer	Mark
<b>1(a)(ii)</b>	<p><b>A</b> – P and Q</p> <p>The only correct is A</p> <p><i>B is not correct because R does not move when a sarcomere contracts</i></p> <p><i>C is not correct because R does not move when a sarcomere contracts</i></p> <p><i>D is not correct because R and S do not move when a sarcomere contracts</i></p>	<p><b>Computer</b></p> <p><b>(1)</b></p>

Question Number	Answer	Additional Guidance	Mark
<b>1(b)</b>	<ol style="list-style-type: none"> <li>1. binds to troponin ;</li> <li>2. changes the shape of the troponin ;</li> <li>3. moves tropomyosin (away from actin) ;</li> <li>4. allows the myosin head to bind to actin / eq ;</li> </ol>	<b>MP4 ALLOW</b> exposing myosin binding site (on actin)	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(c)</b>	<ol style="list-style-type: none"> <li>1. attaches muscle to bone ;</li> <li>2. tendon is {non elastic / eq } ;</li> <li>3. when muscle contracts bones move ;</li> </ol>	<p><b>MP2 ALLOW</b> tendon does not have elastic fibres</p> <p><b>MP3 ALLOW</b> when muscles contract joints move</p>	<b>(2)</b>

Question Number	Answer	Mark
<b>2(a)(i)</b>	<p><b>D</b> – medulla oblongata</p> <p>The only correct answer is D</p> <p><i>A is not correct because the cerebellum is not involved in the reflex control of the heart rate</i></p> <p><i>B is not correct because the cerebral hemisphere is not involved in the reflex control of the heart rate</i></p> <p><i>C is not correct because the hypothalamus is not involved in the reflex control of the heart rate</i></p>	<b>(1)</b>

Question Number	Answer	Mark
<b>2(a)(ii)</b>	<p><b>B</b> - medulla oblongata</p> <p>The only correct answer is B</p> <p><i>A is not correct because pH receptors are not found in the coronary arteries</i></p> <p><i>C is not correct because pH receptors are not found in the skin</i></p> <p><i>D is not correct because pH receptors are not found in the vena cava</i></p>	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(i)</b>	<ol style="list-style-type: none"> <li>1. as altitude increases breathing rate <b>and</b> tidal volume both increase ;</li> <li>2. little change in { breathing rate / tidal volume } from 0 m to 4000 m / greatest change in { breathing rate / tidal volume } from 4000 m to 6000 m</li> <li>3. manipulation of data to show change in breathing rate or tidal volume;</li> </ol>	<p><b>MP1</b> Need to refer to both breathing rate and tidal volume</p> <p><b>MP3</b> e.g. breathing rate increases by 11 % or tidal volume increases by 40 %</p> <p><b>ALLOW</b> 9.9% or 29.6% if comparing effects from 4000 to 6000m</p>	<b>(2)</b>



Question Number	Answer	Additional Guidance	Mark
<b>2(b)(ii)</b>	<ol style="list-style-type: none"> <li>1. lower availability of oxygen at higher altitudes ;</li> <li>2. (increased) anaerobic respiration / (more) lactic acid produced ;</li> <li>3. idea that {increase in CO<sub>2</sub> / decrease in pH} stimulates the {respiratory centre / ventilation centre / medulla} ;</li> <li>4. which sends (more) impulses to {intercostal muscles / diaphragm} ;</li> <li>5. the {diaphragm / intercostal muscles} contract more { frequently / strongly }</li> </ol>	<p><b>MP1 ALLOW</b> lack of oxygen at high altitude</p> <p><b>MP3 ALLOW</b> decrease in blood oxygen concentration / increase in H<sup>+</sup> detected by the respiratory centre</p> <p><b>MP5 IGNORE</b> increasing breathing rate / depth of breath</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>2(c)(i)</b>	<ol style="list-style-type: none"> <li>change in heart rate 15 (beats min<sup>-1</sup>) ;</li> <li>0.0075 beats min<sup>-1</sup> m<sup>-1</sup> ;</li> </ol>	<p><b>ALLOW</b> 95 - 80</p> <p><b>ALLOW</b> 7.5 x 10<sup>-3</sup> beats min<sup>-1</sup> m<sup>-1</sup></p> <p>ALLOW beats per minute per meter for units</p> <p>Correct answer with no working shown gains both marks</p> <p>Correct answer with no units gains one mark</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>2(c)(ii)</b>	<ol style="list-style-type: none"> <li>lower availability of oxygen (at higher altitudes) ;</li> <li>oxygen concentration of the blood will fall ;</li> <li>reference to the {<b>cardiac centre</b> / <b>medulla</b>} ;</li> <li>increase in {heart rate / cardiac output} required to provide tissues with sufficient oxygen ;</li> </ol>	<p><b>MP1 ALLOW</b> lack of oxygen at high altitude</p> <p><b>MP2 ALLOW</b> causing oxygen debt</p> <p><b>MP3 ALLOW</b> cardiovascular centre</p> <p><b>MP4 ALLOW</b> increase in {heart rate / cardiac output} to supply enough or more oxygen</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>3(a)(i)</b>	<ol style="list-style-type: none"> <li>1. 91 and 26 from the graphs ;</li> <li>2. 3.5:1 / 7:2 ;</li> </ol>	<p><b>MP1 ALLOW</b> 90 / 27</p> <p><b>MP2 ALLOW</b> 3.33:1 to 3.5:1</p> <p><b>IGNORE</b> 3.33 to 3.5</p> <p>Correct answer with no working gains both marks</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>3(a)(ii)</b>	<ol style="list-style-type: none"> <li>1. more (worms with) adp-1 mutants swim backwards following tapping than wt (worms) ;</li> <li>2. fewer (worms with) tom-1 mutations swim backwards following tapping than wt (worms) ;</li> <li>3. idea that adp-1 mutation slows habituation / tom-1 mutation speeds up habituation ;</li> <li>4. credit appropriate use of data to support MP1 or 2 ;</li> </ol>	<p><b>ALLOW</b> response of adp-1 is higher than wt / for adp-1 the decrease was less than for wt</p> <p><b>ALLOW</b> response of tom-1 is lower than wt / for tom-1 the decrease was more than for the wt</p> <p>e.g. comparing difference in percentage from wt for one or both mutant strains</p>	<b>(3)</b>

Question	Answer	Additional Guidance	Mark
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Number			
<b>3(b)</b>	<ol style="list-style-type: none"> <li>1. sensible function of tom-1 protein ;</li> <li>2. (mutation) results in less neurotransmitter being released ;</li> <li>3. from the sensory neurone ;</li> <li>4. idea that fewer action potentials are stimulated in post synaptic {membrane / neurone} ;</li> <li>5. of motor neurones ;</li> </ol>	<p><b>MP1 e.g.</b> reduced fusion of vesicles with pre-synaptic membrane / reduced activity of calcium channels / reduced influx of calcium ions</p> <p><b>MP4 ALLOW</b> less depolarisation of post-synaptic membrane / impulse is not produced in the post-synaptic neurone</p> <p><b>MP5 ALLOW</b> to the effector / to the muscle</p>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
<b>3(c)</b>	<p>1. calcium channels remain responsive / more neurotransmitter is released / slower re-uptake of neurotransmitter ;</p> <p>2. idea of neurotransmitter remaining in synapse longer ;</p> <p>3. resulting in { prolonged / more extensive depolarisation } of the post-synaptic membrane ;</p> <p>OR</p> <p>1. adp-1 codes for inhibitory {neurotransmitter / receptor} ;</p> <p>2. (neurotransmitter / receptor) no longer functions ;</p>	<p><b>MP3 ALLOW</b> more action potentials in post-synaptic neurones</p>	<p><b>(2)</b></p>

Question Number	Answer	Mark
<b>4(a)(i)</b>	<p><b>C</b> - formation of synaptic connections in the cortex</p> <p>The only correct answer is C</p> <p><i>A is not correct because exposure to light does not stimulate division of optic nerve cells</i></p> <p><i>B is not correct because exposure to light does not stimulate formation of rhodopsin</i></p> <p><i>D is not correct because exposure to light does not stimulate growth of rod cells</i></p>	<b>(1)</b>

Question Number	Answer	Mark
<b>4(a)(ii)</b>	<p><b>D</b> – aspect K and aspect L</p> <p>The only correct answer is D</p> <p><i>A is not correct because J would not be affected at 2 years</i></p> <p><i>B is not correct because J would not be affected at 2 years</i></p> <p><i>C is not correct because, aspect L and aspect M are also affected at two years</i></p>	<b>(1)</b>

Question Number	Answer	Mark
<b>4(a)(iii)</b>	<p><b>B – 1</b></p> <p>The only correct answer is B</p> <p><i>A is not correct because only the second statement is correct</i></p> <p><i>C is not correct because only the second statement is correct</i></p> <p><i>D is not correct because only the second statement is correct</i></p>	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(b)</b>	<ol style="list-style-type: none"> <li>1. (during development) action potentials travel along neurones from the retina to the brain / eq ;</li> <li>2. to the visual cortex / eq ;</li> <li>3. (during the critical period) neurones that transmit impulses form {more / stronger} synapses (with the target cells) ;</li> <li>4. neurones that do not transmit impulses {form weaker synapses / die } ;</li> </ol>	<p><b>ALLOW</b> impulses travel along the optic nerve to the brain</p> <p><b>ALLOW</b> ocular dominance column / occipital lobe / visual centre</p> <p><b>ALLOW</b> neurones are pruned</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(c)</b>	<ol style="list-style-type: none"> <li>1. idea that there are (genetically) identical and non-identical twins ;</li> <li>2. investigate the effect of temporary deprivation of vision in identical twins in different environments ;</li> <li>3. (identical twins) show the effect of {environmental factors / nurture};</li> <li>4. investigate the effect of temporary deprivation of vision in non-identical twins in the same environment ;</li> <li>5. (non-identical twins) show the effect of {genetic factors / nature} ;</li> </ol>	<b>DO NOT ALLOW</b> answers in terms of different / similar genes	<b>(3)</b>



Question Number	Answer	Mark
<b>5(a)(i)</b>	<p><b>B</b> – cell body</p> <p>The only correct answer is B</p> <p><i>A is not correct because T identifies the cell body</i></p> <p><i>C is not correct because T identifies the cell body</i></p> <p><i>D is not correct because T identifies the cell body</i></p>	<b>(1)</b>

Question Number	Answer	Mark
<b>5(a)(ii)</b>	<p><b>D</b> – restoration of the resting potential</p> <p>The only correct answer is D</p> <p><i>A is not correct because it is the restoration of the resting potential that prevents impulses moving in both directions along an axon</i></p> <p><i>B is not correct because it is the restoration of the resting potential that prevents impulses moving in both directions along an axon</i></p> <p><i>C is not correct because it is the restoration of the resting potential that prevents impulses moving in both directions along an axon</i></p>	<b>(1)</b>

Question Number	Answer	Additional Guidance	Mark
<b>5(b)</b>	<ol style="list-style-type: none"> <li>reference to the <b>sodium potassium (ion) pump</b> ;</li> <li>moving sodium ions out of the axon and potassium ions into the axon ;</li> <li>(potassium) channels allow potassium ions to diffuse out ;</li> </ol>	<p><b>ALLOW NaK pump</b>  <b>ALLOW</b> active transport of Na<sup>+</sup> and K<sup>+</sup></p> <p><b>IGNORE</b> inside and outside the membrane</p> <p><b>ALLOW</b> potassium ions leave the axon { by facilitated diffusion / because the membrane is more permeable to them than to sodium ions }</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>5(c)(i)</b>	<ol style="list-style-type: none"> <li><math>(-21 - - 32) = 11</math> ;</li> <li>34.4 %</li> </ol> <p>or</p> <p>52.4 %</p>	<p><b>ALLOW</b> 34 (%)</p> <p><b>ALLOW</b> 52 (%)</p> <p>Correct answer with no working gains both marks</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>5(c)(ii)</b>	<ol style="list-style-type: none"> <li>1. idea that more sodium ion channels are open ;</li> <li>2. allows membrane to depolarise ;</li> <li>3. and more easily { reach threshold potential / generate action potentials } ;</li> <li>4. in a large number of neurones ;</li> </ol>	<p><b>ALLOW</b> idea that sodium ion channels are leaky / open early / more of them are open / weak stimulus will open sodium ion channels</p> <p><b>ALLOW</b> increasing frequency of impulses</p> <p><b>IGNORE</b> speeding up transmissions</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>*6(a)</b>	<ol style="list-style-type: none"> <li>1. reference to <b>glycolysis</b> (taking place) ;</li> <li>2. phosphorylation of {6 carbon sugar / hexose / glucose ;</li> <li>3. (phosphorylated hexose) split into two { 3 carbon molecules / GALP / triose phosphates };</li> <li>4. pyruvate is formed ;</li> <li>5. reduced NAD and ATP produced ;</li> <li>6. 2 ATP are produced for each ATP used ;</li> <li>7. pyruvate converted to lactic acid ;</li> <li>8. idea that NAD is regenerated ;</li> </ol>	<p><b>QWC emphasis is logical sequence</b></p> <p><b>MP5 ALLOW</b> NADH/ NADH + H<sup>+</sup>/ NADH<sub>2</sub></p> <p><b>MP5</b> Both required for the mark but can be pieced together</p> <p><b>MP6 ALLOW</b> 4 ATP are produced and 2 used / net yield of two ATP's.</p> <p><b>MP7 ALLOW</b> lactate</p> <p><b>MP8 ALLOW</b> oxidising reduced NAD</p>	<b>(5)</b>

Question Number	Answer	Additional Guidance	Mark
<b>6(b)(i)</b>	<ol style="list-style-type: none"> <li>1. ADP increases the activity (of isocitrate dehydrogenase) / eq ;</li> <li>2. reduced NAD decreases the activity (of isocitrate dehydrogenase) / eq ;</li> </ol>		<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>6(b)(ii)</b>	<ol style="list-style-type: none"> <li>1. during exercise ATP is used (for muscle contraction) ;</li> <li>2. ATP is hydrolysed to ADP ;</li> <li>3. concentration of ADP increases ;</li> <li>4. reduced NAD is used in the electron transport chain / eq ;</li> <li>5. concentration of reduced NAD decreases ;</li> <li>6. (exercise) increases the activity (of isocitrate dehydrogenase) ;</li> </ol>	<p><b>ALLOW</b> broken down / converted</p> <p><b>ALLOW</b> used in oxidative phosphorylation</p>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(a)</b>	<ol style="list-style-type: none"> <li>1. light independent stages of photosynthesis (to form GALP) ;</li> <li>2. GALP converted to glucose ;</li> <li>3. glucose converted to starch ;</li> </ol>	<b>ALLOW</b> Calvin cycle	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(b)</b>	<ol style="list-style-type: none"> <li>1. an oscillator can prepare cells before the light levels change ;</li> <li>2. credit a benefit of being prepared e.g. to maximise photosynthesis / rodents avoid predation ;</li> <li>3. an oscillator will work even if light levels are low ;</li> </ol>	<p>MP1, 2 and 3 ALLOW converse for photoreceptor</p> <p><b>MP1 ALLOW</b> ensures reactions take place at correct time without the need for an external stimulus</p> <p><b>MP1 ALLOW</b> prepares the organism before light levels change /allows the organism to anticipate darkness</p> <p><b>ALLOW</b> an example e.g. oscillator will work on cloudy days</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(c)</b>	<ol style="list-style-type: none"> <li>1. idea that maintaining (core) body temperature is a homeostatic process ;</li> <li>2. body clocks affect the { hypothalamus / thermoregulatory centre } ;</li> <li>3. can change the { set point / target temperature } ;</li> </ol>	<p><b>MP1 ALLOW</b> is a negative feedback process</p> <p><b>MP2 ALLOW</b> body clocks acting on the hypothalamus / thermoregulatory centre</p> <p><b>MP2 ALLOW</b> body clock is in the hyptothalamus</p> <p><b>MP3 ALLOW</b> can alter the temperature that triggers a feedback response</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(d)</b>	<p>1. individuals from different strains of fruit fly can reproduce to produce fertile offspring</p> <p>or</p> <p>individuals from different species cannot reproduce to produce fertile offspring ;</p> <p>2. different strains of fruit fly have the same {genes / genome / eq} <b>whereas</b> different species of fly have different {genes / genome / eq} ;</p>	<p><b>MP2 ALLOW</b> different strains have different alleles whereas different species have different genes</p>	<b>(2)</b>



Question Number	Answer	Additional Guidance	Mark
<b>7(e)</b>	<ol style="list-style-type: none"> <li>1. nonsense mutation introduces a stop codon ;</li> <li>2. results in {a shortened / no} protein ;</li> <li>3. these proteins have no function ;</li> <li>4. missense mutation produces a change in one amino acid ;</li> <li>5. these proteins may { be folded differently / have an altered active site } ;</li> <li>6. these proteins could be less or more active ;</li> </ol>	<p><b>MP3 ALLOW</b> are not expressed in the phenotype</p> <p><b>MP4 ALLOW</b> missense mutation produces a change in a small number of amino acids or primary structure</p> <p><b>MP6 ALLOW</b> that have different functions</p> <p><b>MP6 ALLOW</b> producing proteins that shorten or lengthen circadian cycles</p>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(f)</b>	<p>1. idea of (TIM / PER) acting as a transcription factor ;</p> <p>2. (TIM / PER) binding to the regulatory region of gene(s) to prevent their transcription ;</p> <p>Or</p> <p>1. idea of (TIM / PER) acting on a transcription factor ;</p> <p>2. preventing the transcription factor from binding to the regulatory region of gene(s) and stimulating transcription ;</p>	<p><b>MP2 ALLOW</b> period or timeless genes or genes in general</p> <p><b>MP2 ALLOW</b> (TIM / PER) stops RNA polymerase from binding to the promotor region</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(g)</b>	<ol style="list-style-type: none"> <li>1. idea that changes in day length are detected in the retina ;</li> <li>2. the retina sends nerve impulses to the { SCN / hypothalamus } ;</li> <li>3. { SCN / hypothalamus } release hormones ;</li> <li>4. that act on receptors present on (all) cells ;</li> </ol>	<b>MP2 ALLOW</b> SCN receives day night messages from the retina	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(h)</b>	<ol style="list-style-type: none"> <li>1. depression could be caused by reduced production of neurotransmitters ;</li> <li>2. such as serotonin ;</li> </ol>	<b>IGNORE arrhythmic production</b>	

	<p>3. circadian clock could control the production of neurotransmitters ;</p> <p>4. disruption of circadian clock results in insufficient production of neurotransmitter / production of neurotransmitter at wrong time / eq ;</p>	<p><b>MP3 and 4 ALLOW</b> serotonin</p>	<p><b>(3)</b></p>
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Question Number	Answer	Additional Guidance	Mark
<b>*7(i)</b>	<ol style="list-style-type: none"> <li>1. use a respirometer ;</li> <li>2. named organism ;</li> <li>3. control temperature / other variables that might affect respiration ;</li> <li>4. use of CO<sub>2</sub> absorber ;</li> <li>5. control activity / ensure organism is resting ;</li> <li>6. record volume of oxygen used ;</li> <li>7. description of calculation of a rate ;</li> <li>8. repeat investigation at different times of the 24 hour day night cycle ;</li> </ol>	<p><b>QWC emphasis is clarity of expression</b></p> <p><b>ALLOW</b> spirometer (for humans)</p> <p><b>MP4 ALLOW</b> named example</p> <p><b>MP 6 ALLOW</b> distance moved by drop</p> <p>e.g. volume of oxygen divided by time</p> <p><b>MP8 ALLOW</b> during the day and the night</p>	<b>(6)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(j)</b>	<ol style="list-style-type: none"> <li>1. ATP is <b>hydrolysed</b> ;</li> <li>2. to ADP and phosphate ;</li> <li>3. releasing energy / providing phosphate for phosphorylation of another molecule ;</li> </ol>	<p><b>MP1 IGNORE</b> broken down</p> <p><b>MP3 IGNORE</b> produces energy</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(k)</b>	<ol style="list-style-type: none"> <li>1. active transport of potassium ions into the cell ;</li> <li>2. using ATP ;</li> <li>3. (slow) diffusion of potassium ions out of the cell ;</li> <li>4. movement regulated by membrane potential ;</li> </ol>	<p><b>MP1 ALLOW</b> potassium ions are pumped into the cell / transported into the cell by ion pumps</p> <p><b>IGNORE</b> through protein channels</p>	<b>(2)</b>

