

# Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCE  
in Biology (6BI05) Paper 01  
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 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
1(a)	D - stays the same;	(1)

Question Number	Answer	Mark
1(b)(i)	D ;	(1)

Question Number	Answer	Mark
1(b)(ii)	A - 1 ;	(1)

Question Number	Answer	Mark
1(b)(iii)	B - myosin binding sites to be exposed ;	(1)

Question Number	Answer	Mark
1(b)(iv)	B - myosin ;	(1)

Question Number	Answer	Mark
1(b)(v)	A - more mitochondria than fast twitch fibres ;	(1)

Question Number	Answer	Additional Guidance	Mark
1(c)	1. {extensor muscles / eq} {contract / shorten / eq} ; 2. leg is straightened / eq ; 3. flexor muscle relaxes / eq ; 4. description of antagonistic action e.g. these muscles working in opposition, when one contracts the other relaxes ; 5. flexor is stretched / eq ; 6. tendons attach muscles to bones / eq ;	<b>1 ACCEPT</b> correctly named muscle e.g. quads/quadriceps  <b>3 ACCEPT</b> correctly named muscle e.g. hamstrings  <b>4 IGNORE</b> work together, in pairs	(4)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	Two from: 1. idea of size of cube ; 2. same {species / eq} of carrot ; 3. same {age / source / eq} of carrot ;	<b>1 ACCEPT</b> surface area / volume IGNORE mass	(2)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	1. (oxygen is) electron acceptor / eq ; 2. (also oxygen) binds with protons / H <sup>+</sup> /hydrogens ; 3. Idea of electrons from {electron transport chain / ETC} ; 4. to form (metabolic) water ;	<b>3 ACCEPT</b> from cytochromes	(3)

Question	Answer	Additional Guidance	Mark
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Number			
2(b)	1. aerobic respiration ; 2. ref. to decarboxylation ; 3. (when) pyruvate broken down / eq ; 4. (decarboxylation occurs) in Krebs cycle ; 5. details of where in Krebs cycle e.g. removed from { C6 / C5 / eq } compound ;	<b>4 ACCEPT</b> link reaction  <b>5 ACCEPT</b> C3 to C2 if refer to link reaction	(4)

Question Number	Answer	Additional Guidance	Mark
2(c)	1. as temperature increases, percentage of CO <sub>2</sub> in bag {increases / eq} ; 2. (as temperature increase) {reactants /named / eq} {gain more kinetic energy / collide more often} ; 3. increased enzyme activity / more E-S complexes form / eq ; 4. smaller increase between 5 and 10 because {more active sites occupied / some other factor is limiting / eq} ;	<b>1 ACCEPT</b> rises <b>IGNORE</b> change unqualified  <b>4 ACCEPT e.g.</b> O <sub>2</sub> concentration could be limiting, high CO <sub>2</sub> levels inhibit enzymes	(3)

Question Number	Answer	Additional Guidance	Mark
2(d)	anaerobic respiration ;	<b>ACCEPT</b> fermentation but not lactic acid fermentation <b>IGNORE:</b> respiration unqualified	(1)





Question Number	Answer	Additional Guidance	Mark
3(a)	<ol style="list-style-type: none"> <li>1. idea that stimulation generated from within (muscle) ;</li> <li>2. idea that this results in depolarisation ;</li> </ol>		(2)

Question Number	Answer	Additional Guidance	Mark
3(b)	<ol style="list-style-type: none"> <li>1. idea that it shows electrical activity of the heart ;</li> <li>2. idea of how to identify {one heart beat / time for one heart beat} ;</li> <li>3. count the number of { these / peaks / eq } in a {set time / stated time} or how long from one set of electrical activity to the next ;</li> <li>4. description of how to obtain heart rate e.g. beats divided by time ;</li> </ol>	<p><b>ACCEPT for 2:</b> from one {P wave / QRS complex / T wave } to the next</p>	(3)

Question Number	Answer	Additional Guidance	Mark
3(c)	<p><b>QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence</b></p> <ol style="list-style-type: none"> <li>1. the concentration of carbon dioxide in the <i>alveoli</i> is higher / eq ;</li> <li>2. the concentration of carbon dioxide in the blood is higher / pH of blood is lower / eq ;</li> <li>3. detected by <i>chemoreceptors</i> in { <i>medulla</i> / <i>carotid artery</i> / <i>aorta</i> } ;</li> <li>4. reference to { <i>cardiovascular</i> / <i>cardiac</i> } control centre in <i>medulla</i> ;</li> <li>5. reference to <i>autonomic</i> nervous system / <i>sympathetic</i> nerve ;</li> <li>6. more impulses to <i>SAN</i> / eq ;</li> <li>7. { <i>noradrenalin(e)</i> / <i>norepinephrine</i> } released onto <i>SAN</i> ;</li> <li>8. <i>SAN</i> (excitation) rate increased / eq ;</li> <li>9. heart rate will increase / eq ;</li> </ol>	<p><b>QWC Emphasis is on spelling of technical terms</b></p> <p><b>1 ACCEPT</b> { diffusion / concentration } gradient increased</p>	(5)

Question	Answer	Additional Guidance	Mark
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Number			
4(a)	<ol style="list-style-type: none"> <li>1. { identical / monozygotic twins } are genetically identical / eq ;</li> <li>2. derived from one egg and one sperm /one { zygote / embryo / eq } / eq ;</li> <li>3. (so any phenotypic ) difference is due to { nurture / environmental } / eq ;</li> <li>4. { non-identical twins / dizygotic twins} are genetically different ;</li> <li>5. (any phenotype) that is different when the environment is the same is likely to be { nature / genetic / eq } / eq ;</li> </ol>	<p><b>ACCEPT</b> comments on monozygotic twins (MZ) raised apart as a context</p> <p><b>1 ACCEPT</b> same alleles <b>IGNORE:</b> same DNA / genes</p> <p><b>2 ACCEPT</b> one fertilised egg, ball of cells, blastula</p>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	<ol style="list-style-type: none"> <li>1. study groups from different cultures / eq ;</li> <li>2. (if) outcome is the same then (likely to be) nature ;</li> <li>3. (if) outcome is different in the groups then (likely to be) nurture ;</li> </ol>	<p><b>1 IGNORE</b> different countries / environments</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	<p>1. idea of large sample size ;</p> <p>2. idea of standardised sampling technique e.g. age, gender ;</p> <p>3. same (range of) emotions used / eq</p> <p>OR</p> <p>standard methodology e.g. same photos ;</p>		(2)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	<ol style="list-style-type: none"> <li>1. idea that potassium (ion) gradient is greater than sodium (ion) gradient ;</li> <li>2. Credit correct comparative manipulation of the data ;</li> <li>3. idea of concentration gradients act in different directions / eq ;</li> </ol>	<p><b>1 ACCEPT</b> steeper, higher for greater</p> <p><b>2 ACCEPT</b> e.g (K<sup>+</sup> gradient is greater than gradient for Na<sup>+</sup>) by 10 mmol dm<sup>-3</sup>, ratio e.g. 1:10 and 30:1</p>	<p><b>(2)</b></p>

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	<p>1. idea that proteins act as channels ;</p> <p>Repolarising:</p> <p>2. (most voltage-dependent) { sodium / Na<sup>+</sup> } { channels / eq } closed ;</p> <p>3. sodium ions cannot (continue to) enter { neurone / cytoplasm / eq } ;</p> <p>Resetting after hyperpolarisation:</p> <p>4. (voltage-dependent) { potassium / K<sup>+</sup> } { channels / eq } close ;</p> <p>5. sodium-potassium pump imports (two) potassium ions and exports (three) sodium ions / eq ;</p>	<p><b>IGNORE:</b> descriptions of depolarisation/action potentials</p> <p><b>1 ACCEPT</b> gates for channels</p>	<p><b>(4)</b></p>

Question Number	Answer	Additional Guidance	Mark
5(b)	<ol style="list-style-type: none"> <li>1. idea that Ca<sup>2+</sup> enters synaptic bouton ;</li> <li>2. vesicles containing neurotransmitter / eq ;</li> <li>3. { move towards / fuse with presynaptic membrane / eq } / reference to exocytosis (of neurotransmitter) ;</li> </ol>	<p><b>1 ACCEPT for 1:</b> knob, button, presynaptic neurone for bouton, through presynaptic membrane</p> <p><b>3 ACCEPT</b> neurotransmitter released into synaptic {gap / cleft}</p> <p><b>IGNORE:</b> vesicles being released</p>	(3)

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	<p>correct answer with units gains full marks</p> <p>1. <math>5 \div 90</math> ;</p> <p>2. <math>= \{ 0.056 / 0.06 \}</math> au min<sup>-1</sup> ;</p> <p>OR</p> <p>3 <math>[(0.3 \div 30) + (3.7 \div 30) + (1 \div 30) \div 3]</math> ;</p> <p>4 <math>= \{ 0.054 / 0.05 \}</math> au min<sup>-1</sup> ;</p>	<p><b>ACCEPT</b> answer expressed as e.g. 3.6 au per hour</p> <p><b>2 ACCEPT</b> au/min, au per min</p>	(2)

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	<p>1. idea that rate of use is greater than uptake from gut ;</p> <p>2. idea that L-Dopa leaves the blood into tissues ;</p> <p>3. L-Dopa crosses the blood-brain barrier / eq ;</p> <p>4. converted to dopamine / eq ;</p> <p>5. L-Dopa is broken down / eq ;</p>	<p><b>1 IGNORE:</b> less being absorbed, running low in gut unqualified</p> <p><b>4 ACCEPT</b> L-Dopa is a precursor to dopamine</p> <p><b>5 ACCEPT</b> metabolised for broken down</p>	(4)

Question	Answer	Additional Guidance	Mark
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Number			
6(b)(i)	when{ touched / eq } the tentacles { not pulled into body / remain outside body / eq } ;	<b>ACCEPT:</b> no response when touched / no reaction to stimulus	(1)

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	<ol style="list-style-type: none"> <li>1. use habituated sea anemone / eq ;</li> <li>2. idea of stimulate after leaving for different lengths of time ;</li> <li>3. idea of repetition at each different time ;</li> <li>4. note time when anemone responds to being touched / eq ;</li> </ol>	<p><b>2 ACCEPT</b> examples given</p> <p><b>4 ACCEPT</b> note time when withdraws tentacles into body</p>	(3)

Question Number	Answer	Additional Guidance	Mark
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7(a)(i)	<ol style="list-style-type: none"> <li>1. as it is a greenhouse gas / eq ;</li> <li>2. idea of CO<sub>2</sub> leading to global warming ;</li> </ol>	<p><b>2 ACCEPT</b> description of effect of global warming</p>	(2)
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Question Number	Answer	Additional Guidance	Mark
*7(a)(ii)	<p><b>*QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence</b></p> <ol style="list-style-type: none"> <li>1. idea of using gene involved / eq ;</li> <li>2. reference to {restriction enzyme / endonuclease} / eq ;</li> <li>3. idea of same (restriction) enzyme used to cut open plasmid / eq ;</li> <li>4. reference to sticky ends ;</li> <li>5. detail of sticky ends e.g. complementary bases exposed ;</li> <li>6. (DNA) ligase used to bind useful gene to plasmid / eq ;</li> <li>7. by forming phosphodiester bonds / eq ;</li> <li>8. idea of uptake of plasmid by bacterium ;</li> </ol>	<p><b>QWC Emphasis is on logical sequence</b></p> <p><b>1 ACCEPT</b> allele</p> <p><b>6 ACCEPT</b> join for bind</p> <p><b>7 ACCEPT</b> description of a phosphodiester bond</p>	(6)
Question Number	Answer	Additional Guidance	Mark

7(b)	<p>Correct answer gains both marks</p> <ol style="list-style-type: none"> <li>(one gene contains) <math>580\,000 \div 525</math> / 1104.76 base pairs ;</li> <li>this is { 2210 / 2209.5 } bases ;</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>(genome is <math>580\,000 \times 2</math>) = 1160 000 bases ;</li> <li>(one gene is <math>1160\,000 \div 525</math>) = { 2210 / 2209.5 } bases ;</li> </ol>	<p><b>Allow 1 mark:</b> 1105 bases</p>	<p><b>(2)</b></p>
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Question Number	Answer	Additional Guidance	Mark
7(c) (i)	<ol style="list-style-type: none"> <li>deoxyribose in DNA AND ribose in RNA ;</li> <li>thymine in DNA AND uracil in RNA ;</li> <li>idea of enzymes being used are different e.g. DNA polymerase v. RNA polymerase ;</li> <li>2 strands in DNA and 1 strand for RNA ;</li> </ol>	<p><b>2 ACCEPT</b> T and U</p> <p><b>3 ACCEPT</b> DNA formed by DNA replication and RNA by transcription</p> <p><b>4 ACCEPT</b> double helix for 2 strands in DNA</p>	<p><b>(3)</b></p>
Question Number	Answer	Additional Guidance	Mark
7(c) (ii)	<p>so it can be inserted into a bacterium / idea of less likely to degrade ;</p>	<p><b>ACCEPT:</b> less likely to {mutate / break down }</p>	<p><b>(1)</b></p>

		<b>IGNORE:</b> for storage unqualified	
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Question Number	Answer	Additional Guidance	Mark
7(d)	<ol style="list-style-type: none"> <li>1. idea that product of a gene acts as an inhibitor ;</li> <li>2. idea of inhibits next gene ;</li> <li>3. (if) 1st gene active, it inhibits 2<sup>nd</sup> gene so 3<sup>rd</sup> gene is active ;</li> <li>4. Idea of gene is transcribed for a limited time ;</li> </ol>	<p><b>1 ACCEPT</b> protein/polypeptide for product, and repressor for inhibitor</p> <p><b>3 ACCEPT</b> other logical sequence e.g. 2, 3 and then 1</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
7(e)	<ol style="list-style-type: none"> <li>1. each step requires its own enzyme / eq ;</li> </ol>		

	<ol style="list-style-type: none"> <li>2. to catalyse / control the step ;</li> <li>3. idea of the product of one step being the {substrate / eq} for the next step ;</li> <li>4. all steps must function for nitrogen to be converted to ammonia / eq ;</li> <li>5. idea of involvement of { cofactors / coenzymes / eq } ;</li> </ol>	<p><b>1 ACCEPT</b> appropriate ref to specificity e.g. enzyme 1 only acts on substrate 1</p> <p><b>3 ACCEPT</b> intermediates involved / reactant for substrate</p> <p><b>4 ACCEPT</b> nitrogen gas {reduced to /H<sup>+</sup> added to form} ammonia</p> <p><b>5 ACCEPT</b> ATP / FAD / NAD</p>	<p><b>(4)</b></p>
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Question Number	Answer	Additional Guidance	Mark
7(f)	<ol style="list-style-type: none"> <li>1. idea of being non-pathogenic ;</li> <li>2. virus will {identify / bind to / eq} cancer cells / eq ;</li> <li>3. virus destroys cancer cells / eq ;</li> </ol>	<p><b>1 ACCEPT</b> attenuated, harmless</p> <p><b>3 ACCEPT</b> replicates in cancer cells</p>	<p><b>(2)</b></p>

Question Number	Answer	Additional Guidance	Mark
7(g)	1. (small number of) healthy people / eq ;		

	2. in case the treatment is dangerous / eq ; 3. idea of establishing dosage ;	<b>2 ACCEPT</b> ref to side effects, to make sure it is safe	<b>(3)</b>
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Question Number	Answer	Additional Guidance	Mark														
7(h)	<table border="1"> <thead> <tr> <th data-bbox="392 515 1012 571">Stem</th> <th data-bbox="1012 515 1447 571">Insulin</th> </tr> </thead> <tbody> <tr> <td data-bbox="392 571 1012 646">1. { any / eq } genes can be activated</td> <td data-bbox="1012 571 1447 646">most genes deactivated / eq ;</td> </tr> <tr> <td data-bbox="392 646 1012 790">2. { un / less } differentiated</td> <td data-bbox="1012 646 1447 790">Differentiated ;</td> </tr> <tr> <td data-bbox="392 790 1012 865">3. cell can continue to divide / no Hayflick limit</td> <td data-bbox="1012 790 1447 865">{ limited / no } cell division / Hayflick limited ;</td> </tr> <tr> <td data-bbox="392 865 1012 940">4. can give rise to various different cell types</td> <td data-bbox="1012 865 1447 940">cannot give rise to other types of cell ;</td> </tr> <tr> <td data-bbox="392 940 1012 1015">5. No insulin made / insulin gene not active</td> <td data-bbox="1012 940 1447 1015">Insulin made / insulin gene active ;</td> </tr> <tr> <td data-bbox="392 1015 1012 1082">6. Found in various locations / named location (other than pancreas)</td> <td data-bbox="1012 1015 1447 1082">Found in pancreas ;</td> </tr> </tbody> </table>	Stem	Insulin	1. { any / eq } genes can be activated	most genes deactivated / eq ;	2. { un / less } differentiated	Differentiated ;	3. cell can continue to divide / no Hayflick limit	{ limited / no } cell division / Hayflick limited ;	4. can give rise to various different cell types	cannot give rise to other types of cell ;	5. No insulin made / insulin gene not active	Insulin made / insulin gene active ;	6. Found in various locations / named location (other than pancreas)	Found in pancreas ;	<b>1 ACCEPT</b> switched off  <b>2 ACCEPT</b> specialised for differentiated	<b>(3)</b>
Stem	Insulin																
1. { any / eq } genes can be activated	most genes deactivated / eq ;																
2. { un / less } differentiated	Differentiated ;																
3. cell can continue to divide / no Hayflick limit	{ limited / no } cell division / Hayflick limited ;																
4. can give rise to various different cell types	cannot give rise to other types of cell ;																
5. No insulin made / insulin gene not active	Insulin made / insulin gene active ;																
6. Found in various locations / named location (other than pancreas)	Found in pancreas ;																

Question Number	Answer	Additional Guidance	Mark
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<b>7(i)</b>	radiation could lead to { cancer / mutation / eq } ;	<b>ACCEPT:</b> named example e.g. deletion	<b>(1)</b>
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