



Mark Scheme (Results)

January 2015

Pearson Edexcel International  
Advanced Level  
in Biology (WBI04) Paper 01

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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	Additional Guidance	Mark
<b>1(a)</b>	<p>1. bottom left box: oxygen (atom / molecule) / O / O<sub>2</sub> ;</p> <p>2. top middle box: (inorganic) phosphate (ions) / PO<sub>4</sub><sup>3-</sup> / Pi ;</p> <p>3. top right box: GALP / glyceraldehyde (3)-phosphate / GP / glycerate (3)-phosphate / eq ;</p>	<p><b>IGNORE</b> incorrect formulae / abbreviations throughout</p> <p>1. <b>ACCEPT</b> 1/2 O<sub>2</sub> <b>NOT</b> hydrogen / H / H<sub>2</sub> / H<sup>+</sup> / proton / electrons / e</p> <p>3. <b>ACCEPT</b> glucose / hexose / triose / (simple) sugars <b>IGNORE</b> carbohydrates</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
*1(b)	<p>NB mark points 1, 2, 5, 8, 9 must refer to membranes (on the thylakoids is too vague)</p> <ol style="list-style-type: none"> <li>1. idea that membranes are site of {<i>photophosphorylation / chemiosmosis</i>} ;</li> <li>2. idea of {<i>chlorophyll / photosystems / eq</i>} in the (<i>thylakoid</i>) <i>membrane</i> ;</li> <li>3. for the <i>absorption</i> of light (energy) ;</li> <li>4. so that <i>electrons</i> are released (from <i>chlorophyll</i>) / eq ;</li> <li>5. idea that there are <i>electron carriers</i> are in the (<i>thylakoid</i>) <i>membrane</i> ;</li> <li>6. idea that <i>electrons</i> are {picked up by / passed down} <i>electron</i> {<i>carriers / proteins / acceptors</i>} ;</li> <li>7. resulting in {<i>hydrogen ions / H<sup>+</sup> / protons</i>} being {moved into / accumulated in} the <i>thylakoid space</i> / eq ;</li> <li>8. idea that <i>thylakoid membranes</i> provide the (<i>thylakoid</i>) space ;</li> <li>9. idea of {<i>ATPase / eq</i>} in the (<i>thylakoid</i>) <i>membrane</i> ;</li> <li>10. idea that {<i>hydrogen ions / H<sup>+</sup> / protons</i>} can move (diffuse) through {<i>ATPase / eq</i>} (through the <i>membrane</i> / back into the <i>stroma</i>) ;</li> <li>11. idea that <i>proton</i> movement provides the <i>energy</i> for the {formation of ATP from ADP and <i>phosphate ions / (photo) phosphorylation</i> of ADP to ATP / eq} ;</li> </ol>	<p><b>QWC emphasis on spelling ; spellings of words in italics must be correct</b>  <b>Penalise once</b></p> <ol style="list-style-type: none"> <li>1. <b>IGNORE</b> photolysis</li> <li>7. <b>NOT</b> diffuse</li> <li>8. <b>ACCEPT</b> idea of compartmentalisation from <i>stroma</i></li> <li>10. <b>ACCEPT</b> ATP {<i>synthase / synthetase</i>}</li> </ol>	<b>(6)</b>

Question Number	Answer	Additional Guidance	Mark
2(a)	1. reference to consisting of amino acids ; 2. (amino acids) joined by peptide bonds ; 3. idea of folding into {two / three} dimensional shape ; 4. held together by {ionic bonds / hydrogen bonds / disulfide bridges / eq} ; 5. between the R groups / eq ; 6. credit description of {globular / fibrous} proteins ;	2. <b>ACCEPT</b> link 3. <b>ACCEPT</b> ( $\alpha$ ) helix / ( $\beta$ pleated) sheet / secondary structure / tertiary structure / quaternary structure 4. <b>ACCEPT</b> disulfide bonds / covalent bonds 6. e.g. hydrophilic groups on the outside of globular proteins	(4)

Question Number	Answer	Mark
2(b)(i)	<b>C</b> globular proteins that decrease activation energy ;	(1)

Question Number	Answer	Mark
2(b)(ii)	<b>C</b> hydrolysis reactions ;	(1)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(iii)</b>	1. idea of {protein / (protein) fragments} loaded onto the gel ; 2. idea that an electric current is applied ; 3. idea that gel electrophoresis separates the (protein) fragments ; 4. idea of looking at number of (protein) bands ; 5. idea of looking at size of (protein) bands ; 6. idea of looking at position of (protein) bands;	3. <b>ACCEPT</b> from a description  <b>NB</b> {fragments / lines / stripes / blocks} are not an eq for bands in mp 4 - 6 ref to bands compared = 1 mark  6. <b>ACCEPT</b> distance travelled	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(iv)</b>	1. idea that antibodies bind to {antigen / protein}; 2. idea that an antibody will only bind to one {antigen / protein} ; 3. idea that antibodies can be labelled to visualise the antigen ;	1. <b>IGNORE</b> refs to active site  2. <b>ACCEPT</b> specific 'an antibody will only bind to one antigen / eq' = 2 marks 3. e.g. radioactive label, fluorescent tag, dye attached	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
2(c)	1. idea that cell not actively synthesising the protein ; 2. idea that mRNA (for that protein) is no longer present / eq ; 3. post-transcriptional modification of mRNA / eq ; 4. idea that pre-mRNA will be different from post-mRNA / eq ; 5. idea that protein has been secreted from cell ; 6. so only mRNA present / eq ; 7. idea of a mistake during translation ; 8. so different amino acid inserted ;	3. <b>ACCEPT</b> named modification e.g. splicing, introns removed 4. <b>ACCEPT</b> new mRNA formed (linked to different protein shape) 5. <b>ACCEPT</b> proteins have been used 6. <b>ACCEPT</b> only if linked to mp 5 8. <b>ACCEPT</b> only if linked to mp 7	<b>(2)</b>



Question Number	Answer	Additional Guidance	Mark
<b>*3(a)</b>	<ol style="list-style-type: none"> <li>1. reference to {greenhouse gases / named greenhouse gas} ;</li> <li>2. credit example of how these gases {are produced / increase} ;</li> <li>3. idea that (greenhouse) gases {accumulate / increase / eq} in the (upper) atmosphere ;</li> <li>4. idea that {UV light / short wave lengths} pass through the (greenhouse) gases ;</li> <li>5. but {(infra red) radiation / IR / long wave lengths / heat energy / eq} are {absorbed / trapped / eq} (by the greenhouses gases) ;</li> <li>6. <b>reflected from the earth's surface</b> ;</li> <li>7. <b>idea that (mean) temperature of earth's {surface / atmosphere} increases</b> ;</li> </ol>	<p><b>QWC emphasis clarity of expression</b></p> <ol style="list-style-type: none"> <li>1. e.g. water vapour, carbon dioxide ; methane <b>NOT</b> carbon monoxide, sulfur dioxide</li> <li>2. e.g. burning of fossil fuels, deforestation</li> </ol>	<b>(5)</b>

Question Number	Answer	Additional Guidance	Mark
3(b)	1. idea of using computer models ; 2. idea of using graphs ; 3. idea of extrapolation of data ;		(2)

Question Number	Answer	Additional Guidance	Mark
3(c)	1. idea that there is more food available ; 2. as a result of less competition (from other animals that eat the caterpillars) / eq ; 3. idea that {chicks / birds after hatching / eq} {have a longer period of time to develop / grow faster / more likely to survive} ; 4. idea that great tits have more energy {to breed / for courtship /eq} ; 5. idea that if there are more great tits then there will be {more eggs / more chicks / greater genetic diversity} ; 6. idea that there may be time for a second brood ;	3. <b>ACCEPT</b> idea adults more likely to survive  5. <b>ACCEPT</b> larger gene pool	(3)

Question Number	Answer	Additional Guidance	Mark
<b>3(d)</b>	1. idea that fewer birds are {dying in / exhausted from / eq} the migration ; 2. so there are more birds to breed / eq ; 3. idea that energy is not being used in {flying / migrating / eq } ; 4. idea of more energy to {attract mate / courtship / build nests / protect chicks / lay more eggs / produce healthier chicks /eq} ; 5. idea that time is not spent migrating ; 6. idea that more time is available to {find a mate / build a nest / eq} ;	1. <b>ACCEPT</b> idea that migrating birds die  3. <b>ACCEPT</b> energy is {conserved / saved}  4. <b>IGNORE</b> breed / reproduce unqualified <b>ACCEPT</b> to find food  5. <b>ACCEPT</b> idea that time is spent in migration  6. <b>IGNORE</b> breed / reproduce unqualified	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
4(a)	<p><b>• requires less washing time</b></p> <p>1. idea that at any one time point alcohol-based products decrease the number of bacteria more (graph 2) ;</p> <p><b>• act faster</b></p> <p>2. idea that {maximum / eq} bacteria removed after one minute for alcohol-based products (graph 2);</p> <p><b>• irritate hands less often</b></p> <p>3. no evidence / eq</p> <p><b>• are more effective than other hand-washing products</b></p> <p>4. alcohol-based product decreases the number of bacteria the most / eq (graph 1 or 2);</p>	<p>Each mark point must be linked with correct claim</p> <p>1. <b>IGNORE</b> a link to acts faster <b>ACCEPT</b> description of one time point / comparison between the products at two time points</p> <p>2. <b>IGNORE</b> a link to requires less washing time</p> <p>3. <b>ACCEPT</b> no {effect / data} shown</p>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(b)</b>	1. idea that data in graph 2 is more reliable ; 2. idea that a mean has been worked out for both sets of data indicating some reliability; 3. idea that { error bars (graph 2) indicates reliability / no error bars (graph 1) doesn't indicate reliability / eq } ; 4. idea that not reliable as no indication of sample size (for either graph 1 or 2) ; 5. idea of overlap of error bars (graph 2 at 4 minutes of washing) indicates less reliable data ; 6. idea that not reliable as there are no details of methodology ;	1. Do not piece together 2. Piece together 3. <b>ACCEPT</b> SD or SE bars 5. <b>ACCEPT</b> SD or SE bars <b>ACCEPT</b> converse	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(c)</b>	1. idea of a comparison to number of bacteria on hands with and without washing ; 2. credit suitable method of counting bacteria ; 3. credit an explanation of how a mean is calculated ;	1. piece together 2. e.g. looking at a { swab / fingerprint / eq } under a microscope, growing bacteria from finger on agar / counting bacteria using { haemocytometer / counting chamber } 3. <b>ACCEPT</b> idea that a number of repeats (minimum 3) needed to calculate mean	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>4(d)</b>	1. screening (patients / visitors) / isolating infected patients / quarantine / eq ; 2. washing bedding frequently / eq ; 3. removal of jewellery / removal of outdoor clothing / eq ; 4. wearing { protective clothing / named clothing } / eq ; 5. appropriate disposal of { dressings / needles / laundry / eq } / eq ; 6. sterilisation of { bedding / surfaces / equipment / eq } ;	1. <b>ACCEPT</b> beds more spread out 2. <b>IGNORE</b> washing bedding between patients <b>ACCEPT</b> disposable pillow 4. e.g. masks, gloves	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>5(a)</b>	1. delay of 4 hours before rigor starts ; 2. increase in rigor from 4 until 14 hours ; 3. decrease in rigor after 14 hours ;	1. <b>ACCEPT</b> value up to 4.5 hours 2. <b>ACCEPT</b> value between 13 and 14.5 hours CE from mp 1 applies 3. <b>ACCEPT</b> value between 13 and 14.5 hours CE applies from mp 2	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>5(b)</b>	1. idea that probe inserted in to liver to record core temperature ; 2. idea that the closer to death the temperature taken the more accurate the estimate of the time of death ; 3. idea of (core) temperature dropping (with time after death) ; 4. idea of heat loss from body ; 5. idea that a <b>change</b> in {conditions / named example} will affect rate of temperature drop ;	2. <b>ACCEPT</b> reliable 3. <b>ACCEPT</b> body cooling 5. e.g. change in ambient temperature	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
<b>5(c)</b>	<ol style="list-style-type: none"> <li>1. a value for rigor of 100 (au) indicates that body has been dead for 14 hours / if the person died 8 hours ago the extent of rigor should be 42(au) ;</li> <li>2. which is 6 hours longer than the estimate using body temperature ;</li> <li>3. idea that factors will affect temperature drop and rigor in different ways;</li> <li>4. credit example of factor that will affect { rigor / temperature drop} ;</li> </ol>	<ol style="list-style-type: none"> <li>1. <b>ACCEPT</b> value between 13 and 14.5 hours / 42 and 44 (au)</li> <li>2. value should correspond to mp1, if mp1 not awarded then <b>ACCEPT</b> value between 5 and 6.5 hours</li> <li>4. e.g. clothing, ambient temperature, activity before death</li> </ol>	<b>(3)</b>



Question Number	Answer	Additional Guidance	Mark
<b>6(a)</b>	1. (rate of) {production of / energy incorporated into / eq} {biomass / organic material / eq} ;  2. by plants ;  3. (NPP) = GPP - R / eq ;	1. <b>ACCEPT</b> energy available to next trophic level  2. <b>ACCEPT</b> autotrophs / producers	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
6(b)	<ol style="list-style-type: none"> <li>1. Credit <b>two</b> appropriate named ions ;</li> <li>2. idea that calcium ions used in synthesis of { calcium pectate / middle lamella / cell wall / eq } ;</li> <li>3. when cells are { dividing / growing / eq } ;</li> <li>4. idea that nitrates are used in synthesis of { nucleic acids / DNA / RNA / amino acids / protein / enzymes / chlorophyll / eq } ;</li> <li>5. credit appropriate link with NPP</li> <li>6. idea that magnesium ions needed to produce chlorophyll ;</li> <li>7. chlorophyll used for { photosynthesis / light absorption / synthesise glucose / eq } ;</li> <li>8. idea that phosphates are used in synthesis of { nucleic acids / DNA / RNA / ADP / ATP / NADP / eq } ;</li> <li>9. credit appropriate link with NPP</li> </ol>	<p>1. e.g. { calcium / magnesium } ions, nitrates , phosphates  <b>IGNORE</b> incorrect formulae</p> <p>5. e.g. enzymes used in Calvin cycle, DNA for synthesis before mitosis, RNA for translation, proteins for enzymes,</p>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
6(c)	1. idea that tropical forest has the highest NPP <b>and</b> desert has the lowest NPP ; 2. credit manipulation of figures to compare NPP values of two environments; 3. { tropical forest has best combination of factors / desert has worst combination of factors / eq } ; 4. idea that { rain / water } is needed for { photolysis / light-dependent reaction / eq } ; 5. idea that temperature affects rate of enzyme action ;	1. <b>ACCEPT</b> from a description of all three environments Piece together 2. e.g. Tropical forest is $1200 \text{ gm}^{-2}\text{yr}^{-1}$ more than savannah <b>IGNORE</b> answers without correct units 3. <b>ACCEPT</b> ideal conditions <b>IGNORE</b> optimum conditions 4. <b>ACCEPT</b> idea of { transpiration / translocation } if qualified 5. <b>ACCEPT</b> from a description	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(a)(i)</b>	1. adenovirus has DNA, HIV has RNA / eq ; 2. adenovirus has double-stranded (DNA), HIV has single-stranded (RNA) / eq ; 3. adenovirus has one molecule (of DNA), HIV has two strands (of RNA) / eq ; 4. adenovirus has no envelope, HIV has an envelope / eq ; 5. adenovirus does not contain {reverse transcriptase / integrase}, HIV has {reverse transcriptase / integrase} / eq ; 6. adenovirus has spikes, HIV has {gp (120) / glycoproteins / CD4 binding sites} ;	<b>Do not piece together</b>  2. <b>IGNORE</b> helical  3. <b>ALLOW</b> HIV has two molecules of RNA  4. <b>ACCEPT</b> (phospho)lipid bilayer / host cell-derived membrane  6. <b>NOT</b> if wrong numbers are given	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>7(a)(ii)</b>	1. capsid / protein coat / capsomeres ; 2. spikes ; 3. enzymes;	<b>NB</b> 1 right answer and 1 wrong answer = 1 mark, 2 right answers and 1 wrong answer = 1 mark 1. <b>NOT</b> envelope <b>IGNORE</b> viral protein  3. <b>NOT</b> reverse transcriptase / integrase	<b>(2)</b>

Question Number	Answer	Mark
7(b)(i)	C natural active immunity	(1)

  

Question Number	Answer	Mark
7(b)(ii)	D virus-infected host cells	(1)

  

Question Number	Answer	Mark
7(b)(iii)	C cytokine	(1)

  

Question Number	Answer	Mark
7(b)(iv)	C mitosis	(1)COMP

Question Number	Answer	Additional Guidance	Mark
<b>7(b)(v)</b>	<ol style="list-style-type: none"> <li>1. destruction of (virus-)infected (host) cells / eq ;</li> <li>2. by {chemicals/ enzymes / perforins} (released from T killer cells) /eq ;</li> <li>3. idea that {virus / adenovirus} are released (from cells) ;</li> <li>4. idea that antibodies can now bind to (virus / adenovirus) ;</li> <li>5. idea that the virus can now be {phagocytosed (by macrophages) / destroyed by macrophages / eq} ;</li> <li>6. idea that memory (T killer) cells form for secondary immune response ;</li> </ol>	<ol style="list-style-type: none"> <li>1. <b>ACCEPT</b> a description e.g. lysis, bursting <b>NOT</b> destruction of virus</li> <li>2. <b>IGNORE</b> cytokines</li>   <li>5. <b>ACCEPT</b> description e.g. engulfed <b>NOT</b> virus is killed</li>   <li>6. <b>ACCEPT</b> description of secondary immune response</li> </ol>	<b>(4)</b>

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	1. idea of using an (oxygen) {probe / meter / sensor / titration method / chemical test / eq} ; 2. idea of {removing a sample (of water) to analyse / holding probe in the water} ;	2. 'dip a probe in the water' = 2 marks	(2)

Question Number	Answer	Mark
8(a)(ii)	<b>C</b> 96.7%	(1)

Question Number	Answer	Additional Guidance	Mark
8(a)(iii)	1. idea that there is <b>less</b> {pollution / pollutants / chemicals} ; 2. idea that there are <b>fewer</b> microorganisms (to use oxygen) ; 3. idea that there are <b>more</b> plants (to produce oxygen) ; 4. idea that there will be <b>more</b> photosynthesis (to produce the oxygen) ; 5. idea that water is flowing <b>faster</b> (so gets oxygenated) ; 6. idea that another stream is flowing into this one ; 7. idea that the water is <b>cooler</b> (so holds more oxygen);	2. <b>ACCEPT less</b> eutrophication 3. <b>ACCEPT</b> algae / phytoplankton 5. <b>ACCEPT</b> more flow	(1)

Question Number	Answer	Additional Guidance	Mark
<b>8(b)(i)</b>	1. idea of { taking sample of water / kick sampling }; 2. credit details of sampling method ; 3. idea of sampling at (regular) intervals along the river / eq ; 4. idea of counting the numbers of shrimp and bloodworm ; 5. idea of measuring other { abiotic / named abiotic } factor ; 6. credit method of recording data ;	1. <b>ACCEPT</b> stone washing, using a net / coring 2. e.g. same volume of water, kick sampling for same length of time, how stones are washed ; same volume of core 3. <b>ACCEPT</b> minimum of 3 sites <b>ACCEPT</b> systematic sampling <b>NOT</b> random <b>IGNORE</b> repeats 5. e.g. width, depth, velocity, temperature <b>IGNORE</b> oxygen 6. e.g. tallying, plotting a graph, putting data into a table	<b>(4)</b>



Question Number	Answer	Additional Guidance	Mark
8(b)(ii)	<p>1. idea that bloodworms are better <b>adapted</b> to lower oxygen concentrations ;</p> <p>2. credit an adaptation of bloodworms ;</p> <p>3. {predators / eq} of bloodworm cannot live in polluted water / eq ;</p> <p>4. food of bloodworms still available in polluted water / eq ;</p>	<p>1. <b>ACCEPT</b> converse</p> <p>2. e.g. lower metabolic rate, less active, haemoglobin with high affinity for oxygen ; able to respire anaerobically, large surface area, thin skin <b>ACCEPT</b> appropriate comment about shrimp eg gills require high concentration gradients of oxygen</p> <p>3. <b>ACCEPT</b> converse for shrimps</p> <p>4. <b>ACCEPT</b> converse for shrimps</p>	(2)

