



A-LEVEL

Biology

BI06X

Mark scheme

2410

June 2015

Version: V1 Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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BIO6X: Task 1

Question	Marking Guidance	Mark	Comments												
1(a)	<table border="1"> <thead> <tr> <th>Solution</th> <th>Qualitative</th> <th>Quantitative</th> </tr> </thead> <tbody> <tr> <td>Limewater</td> <td>✓</td> <td></td> </tr> <tr> <td>Hyd. carb. indicator</td> <td>✓</td> <td></td> </tr> <tr> <td>Universal indicator</td> <td>(✓)</td> <td>✓</td> </tr> </tbody> </table> <p>;</p>	Solution	Qualitative	Quantitative	Limewater	✓		Hyd. carb. indicator	✓		Universal indicator	(✓)	✓	1	<p>All three ticks (shown in bold) placed correctly for 1 mark.</p> <p>Do not penalise if additional tick for universal indicator given (✓) i.e. result could be considered both quantitative (pH value) and qualitative (colour change)</p>
Solution	Qualitative	Quantitative													
Limewater	✓														
Hyd. carb. indicator	✓														
Universal indicator	(✓)	✓													
1(b)	Shows a colour (change) / shows a pH change / does not give pH (value) / no numerical values / only shows it is acidic;	1	<p>Neutral – ‘is not quantitative’ / ‘only in words’ / ‘discrete, not continuous / is subjective’</p> <p>Reject answers that suggest solution becomes alkaline.</p>												
1(c)	<ol style="list-style-type: none"> Six/same number of ‘blows’/breaths (into tube); Similar/same <u>volume</u> in/of each blow/breath / similar/same total <u>volume</u> of breaths (into each tube) ; Similar/same carbon dioxide concentration; Same person; 	2 max	<p>Ignore references to ‘time of blow’.</p> <p>2. ‘Same amount/intensity’ is insufficient.</p> <p>3. In this case, accept ‘same amount’</p> <p>Ignore ‘same volume of reagents’ or ‘same volume of solutions’ – differs with universal indicator test.</p>												

Question	Marking Guidance	Mark	Comments
2	To remove excess <u>carbon dioxide</u> / so no build up of <u>carbon dioxide</u> ;	1	
3	<p>Answers in the context of 'No':</p> <ol style="list-style-type: none"> Cannot recognise an anomaly/outlier (if only two results/not enough results); Need at least three results/several results to calculate a mean that is reliable/representative/fair; Told to stop at 40 seconds so maximum not achieved / could hold breath for longer than 40 seconds; <p>Answers in the context of 'Yes':</p> <ol style="list-style-type: none"> Both results were the same/concordant; Could not hold breath for 40 seconds so maximum is less than this; 	2 max	<p>Responses can be a mixture of 'no' or 'yes'.</p> <ol style="list-style-type: none"> All 3 aspects of answer required for credit. Accept other ways of suggesting 'several' eg 'a range of' Accept 'cannot calculate a reliable mean with only two results' Check student results (Table 2) to verify this statement before awarding.
4(a)	<u>Carbon dioxide</u> is soluble / <u>carbon dioxide</u> dissolves / <u>carbon dioxide</u> is (still) in water;	1	Accept ' <u>carbon dioxide</u> reacts with water'.
4(b)	(Carbon dioxide) is acidic / is an acid gas / produces an acid solution / produces carbonic acid;	1	<p>As a 'suggest' question, although not technically an acid, accept this suggestion.</p> <p>'Changes/lowers pH' is insufficient.</p>
Total		9	

BIO6X: Task 2

Question	Marking Guidance	Mark	Comments
5(a)	<p>Null hypothesis clearly stated; eg holding breath has no effect on the breathing/ventilation rate.</p> <p>eg there is no correlation/association between how long breath is held for and breathing rate.</p>	1	<p>Allow other appropriate ways of expressing the null hypothesis.</p> <p><i>Throughout all answers, 'breathing rate' is the same as 'ventilation rate'.</i></p> <p>Reject – 'there is no difference between how long breath is held and breathing rate'</p>
5(b)	Spearman's/ Spearman rank (correlation);	1	
5(c)	<p>Valid explanation for choice of statistical test;</p> <p>eg looking for associations between (different/two) measurements (from the same sample)</p> <p>eg looking for associations between how long you held your breath and your breathing rate afterwards</p>	1	<p>Do not credit if wrong test is chosen</p> <p>For 'association' accept 'correlation'.</p>
5(d)	<p>Test statistic calculated accurately;</p> <p><i>Working must be shown</i></p>	1	<p>Accept a calculation using either:</p> <p>Table 5 only (total of 5 pairs of measurements)</p> <p>or</p> <p>Table 5 and a value from Table 4 (breathing rate after holding breath for 0 seconds – therefore a total of six pairs of measurements)</p> <p>Accept student's correct calculation of the test statistic from their data even if the wrong test has been chosen.</p>

Question	Marking Guidance	Mark	Comments
5(e)	<p>1. (Calculated value greater than/or equal to critical value so) reject null hypothesis;</p> <p>2. Less than/equal to 0.05 probability that the (correlation in) results occurred by chance OR Greater than 0.95 probability that the (correlation in) results did not occur by chance;</p> <p>OR</p> <p>1. (Calculated value less than critical value so) accept null hypothesis;</p> <p>2. Greater than 0.05 probability that the (correlation in) results occurred by chance OR Less than/equal to 0.95 probability that the (correlation in) results did not occur by chance;</p>	2	<p>Neither mark is possible if Q5 (d) has not been completed.</p> <p>1. Allow correct interpretation of calculated test statistic even if the calculation or the choice of test is incorrect.</p> <p>2. Accept 5%/95% probability but not 0.05%/0.95% probability.</p> <p>Note:</p> <p>CV (5 pairs of measurements) = 1.00</p> <p>CV (6 pairs of measurements) = 0.89</p>
Total		6	

BIO6X: Written Test**Section A**

Question	Marking Guidance	Mark	Comments
6	Brain/conscious thought/thinking can affect/influence breathing (rate) / can control own breathing (rate);	1	Idea of breathing (rate) alters when you think about it.
7	1. Avoid change in breathing rate / avoid change in number of breaths per minute/per unit time 2. Standardise the procedure/method;	1 max	1. Two aspects needed: change and reference to rate etc.. 1. Accept increase or decrease for 'change' 2. Accept 'control the variable' but 'it was a control' is insufficient.
8	1. (Principle) 10 seconds is enough time to have an effect (on breathing rate/VR) / less than 10 seconds is not enough time to have an effect (on breathing rate/VR) ; 2. (There will be a) low build up of carbon dioxide (in blood/body); 3. (So) little fall in <u>blood</u> pH; 4. (Therefore) less recovery time needed;	2 max	Accept the converse (MP 2, 3 and 4) if the longest time for holding breath was used first. 3. Credit reference to production of carbonic acid or dissociation of carbonic acid or release of hydrogen ions as a result of carbon dioxide presence
9	1. Breathing rate is changing in first 30 seconds; 2. Breathing rate might be different in next 30 seconds; 3. Doubling may give a false breathing rate; 4. Problem/issue of counting 'part' breaths;	2 max	4. 'Multiplying' is insufficient for idea of 'doubling'.

Question	Marking Guidance	Mark	Comments
10	<ol style="list-style-type: none"> (PV =) tidal volume/TV × ventilation rate/VR/number of breaths per minute/BR; (TV =) 0.6 and (VR =) 9; (PV =) $5.4 \text{ dm}^3 \text{ min}^{-1} / 5.4 \text{ dm}^3 \text{ per minute} / 5.4 \text{ dm}^3/\text{minute}$; 	3	<p>Principle: Question requires an explanation so do not infer MP1 or MP2 from a correct volume in MP3.</p> <ol style="list-style-type: none"> Accept description of TV eg 'volume of air taken in at each breath'. Mark is for extracting the two appropriate values to use. Mark is for value and correct units. Accept a correct calculation with units based on wrong values given in MP2.
11	<ol style="list-style-type: none"> (Holding breath means) carbon dioxide build up (in blood) makes <u>blood</u> acidic/lowers <u>blood</u> pH; (Due to release of) hydrogen ions/H^+; (Detected by) <u>chemoreceptors</u>; (Chemoreceptors in) aorta/carotid artery; Reference to (role of) medulla; (Increase in nerve/electrical) impulses via sympathetic/autonomic nervous system; 	4 max	<ol style="list-style-type: none"> Reference to increase in CO_2 and blood required. No credit for further detail of dissociation. Any reference to chemoreceptors is sufficient. Accept either location. Accept reference to the 'respiratory centre in brain'. Reject 'messages/signals' for mp6 only.

Question	Marking Guidance	Mark	Comments
12	(Maintaining constant pH to avoid) 1. Named protein / enzyme (in blood) sensitive to/affected by change in pH; 2. (Resultant) change of charge/shape/tertiary structure; 3. Described effect on named protein or enzyme eg less oxygen binds with haemoglobin / less transport across membranes / fewer substrates can fit active site / fewer enzyme-substrate complexes;	3	Accept converse for MP2 and MP3. 1. Named example should be a protein that might be affected (by change in pH) eg haemoglobin, carrier protein in plasma membrane. 1. Accept 'change in H ⁺ concentration' for 'change in pH'. 2. The change in charge idea relates to the enzyme/protein and not the blood (plasma) or red blood cells. 2. 'Denaturation' alone is insufficient. 3. Idea of 'less' or 'fewer' required. Ignore suggestion of 'no' or 'none'.
13(a)	So that carbon dioxide poisoning/any identified effect of carbon dioxide poisoning does not occur Or for safety (reasons);	1	Ignore trivial answers eg1 'would affect health', eg2 'would have dangerous effects'.

Question	Marking Guidance	Mark	Comments
13(b)	<ol style="list-style-type: none"> 1. Difficult to recognise / is subjective / no physical/visible effects; 2. (Also) a symptom of other conditions / caused by other factors; 3. Helps confirm 'problem' / helps recognise further 'danger' from carbon dioxide; 4. (Because) other symptoms will also/already be present; 	2 max	<ol style="list-style-type: none"> 1. Neutral – 'qualitative' 2. Idea of not a unique symptom. 3. Accept other ways of expressing 'problem' or 'danger'. 4. 'Confusion' is related to 5%, so idea that symptoms for 1% and 3% are also likely to be present as well.
Total		19	

BIO6X: Written Test

Section B

Question	Marking Guidance	Mark	Comments
14	<ol style="list-style-type: none"> Other gases/nitrogen/water vapour in atmosphere/A; Only oxygen and carbon dioxide in gas mixtures/C and D; Composition of/gases in A not controlled / composition of gas mixtures/C and D controlled; 	2 max	
15	<ol style="list-style-type: none"> Breathing rate <i>lowest</i> when no carbon dioxide/in (pure) oxygen/B; (Generally) presence of carbon dioxide increases breathing rate / as concentration of carbon dioxide increases breathing rate increases / there is a positive correlation; Breathing rate increases when (carbon dioxide) higher than 0.1%/concentration in atmosphere/A; Breathing rate of grasshopper 3 falls in D/16%/gas mixture 2 (whereas others increase); 	3 max	<ol style="list-style-type: none"> Idea of 'lowest' must be stated. A general point incorporating all concentrations. This MP requires a specific comparison to 0.1% or the atmospheric concentration. Accept 'gas mixtures 1 and 2/C and D' for 'higher carbon dioxide'. <p>Restating data alone is insufficient for any mark point.</p>
16(a)	<p>54;;</p> <p>OR</p> <ol style="list-style-type: none"> Correct data/column A chosen; Correct calculation of mean from data chosen; 	2 max	<p>A correct answer of 54 gets 2 marks.</p> <p>MP1 and MP2 allow a possible mark for an incorrect calculation or choice of wrong data.</p> <ol style="list-style-type: none"> Check – the three values must be from same column.

Question	Marking Guidance	Mark	Comments
16(b)	<ol style="list-style-type: none"> 1. Small sample/only 3 (grasshoppers) so may not be representative (of all grasshoppers/insects); 2. Grasshoppers are not the only insects/species so genetic/behavioural/metabolic differences; 3. (Insects) not all mature/are at different stages of development/different sizes so different metabolic rates; 4. Movement not restricted/not at rest in meadow so (rate of) respiration higher; 5. (Naturally-occurring) carbon dioxide concentration lower in meadow so breathing rate lower; 	3 max	<p>Explanations required, therefore both parts of answer required for credit in each marking point.</p> <p>Accept appropriate converse answers.</p> <p>Accept 'respiration' for 'metabolism' and vice versa.</p>
17	Fish keep moving/swimming / movement of gill covers too fast to count (at higher temperatures);	1	<p>Accept converse.</p> <p>Reject personal errors eg with counting.</p> <p>Neutral – 'water not clear' or 'difficult to see movement of gill covers'.</p>
18	<ol style="list-style-type: none"> 1. There is only one dependent variable / there are not two dependent variables / water temperature is the independent variable / breathing rate is dependent on water temperature; 2. Water temperature <i>plus</i> breathing rate are not both properties of fish or water temperature <i>plus</i> breathing rate are not both properties of water; 	1 max	<p>Accept either approach for 1 mark.</p> <ol style="list-style-type: none"> 1. For 'independent' accept 'manipulated'. Reject –'need two continuous variables'. 2. Accept reference to the 'two variables' (instead of water temperature <i>plus</i> breathing rate)

19(a)	As (water) temperature increases, oxygen (concentration/solubility) falls and ventilation rate increases;	1	MP requires all 3 aspects before credit is possible. The correct context is required for each aspect so eg do not reward 'as oxygen concentration falls, water temperature increases' or 'as temperature increases, ventilation rate increases and oxygen concentration falls'.
19(b)	<ol style="list-style-type: none"> 1. As concentration/solubility of oxygen falls less <u>oxygen</u> flows over gills/less <u>oxygen</u> enters gills/less <u>oxygen</u> enters fish; 2. (As a result) <u>blood</u> oxygen (concentration) falls/is lower; 3. An increase in ventilation rate increases/maintains the flow of oxygen/carbon dioxide across gills/into (or out of) fish; 4. Maintains diffusion/concentration gradient(s) (in gills); 5. To maintain oxygen supply to cells/tissues/organs / to maintain respiration; 	3 max	<p>For MP1 and MP2 accept converse.</p> <ol style="list-style-type: none"> 1. Both aspects needed for mark. 3. Accept idea in relation to either gas or 'gas exchange'. 4. Gradient(s) relates to either/both gas(es). 5. Accept a named example of 'tissues' eg muscle.
Total		16	