



**General Certificate of Education (A-level)  
June 2013**

**Biology**

**BIO6X**

**(Specification 2410)**

**Unit 6X: Externally Marked Practical  
Assignment**

**Final**

***Mark Scheme***

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**BIO6X: Task 1**

Question	Marking Guidance	Mark	Comments
1(a)	Oxygen;	1	Accept O <sub>2</sub>
1(b)	<ol style="list-style-type: none"> <li>Proportional to/correlates with the rate of photosynthesis;</li> <li>Oxygen produced in light-dependent reaction/photolysis;</li> </ol>	2	Allow even if incorrect gas named <ol style="list-style-type: none"> <li>Accept a description, eg the faster the rate the more bubbles given off</li> </ol>
1(c)	Yes (no mark): <ol style="list-style-type: none"> <li>Respiration uses oxygen;</li> <li>Fewer bubbles;</li> </ol> <b>OR</b> No (no mark): <ol style="list-style-type: none"> <li>Respiration uses oxygen/produces CO<sub>2</sub>;</li> <li>Rate of respiration (likely to be) constant/CO<sub>2</sub> soluble;</li> </ol>	2	Accept the converse, ie <ol style="list-style-type: none"> <li>Respiration produces CO<sub>2</sub></li> <li>More bubbles/increases rate of photosynthesis</li> </ol>
2	To minimise/prevent temperature changes;	1	Allow to insulate plant from heat from lamp
3	To allow the rate of bubbling/photosynthesis to stabilise/become constant;	1	
4(a)	<ol style="list-style-type: none"> <li>Temperature – an additional measure to reduce heating;</li> <li>Piece of plant/species of plant - Use the same piece/mass/length of aquatic plant throughout;</li> <li>Carbon dioxide/sodium hydrogencarbonate - Use same water source/use same concentration of sodium hydrogencarbonate;</li> <li>Wavelength/colour/intensity of light source – Use the same light bulb/control the background light;</li> </ol>	3 max	<ol style="list-style-type: none"> <li>Eg a controlled water bath, double-glazing, low heat bulb</li> <li>Allow leaf surface area/chlorophyll concentration – use the same piece/mass/length of aquatic plant throughout</li> <li>Accept use sodium hydrogencarbonate so CO<sub>2</sub> in excess/not limiting</li> <li>Allow wattage for brightness</li> </ol> Accept pH add buffer

4(b)	1. To ensure only the <u>light intensity</u> /independent variable affects the results/photosynthesis/dependent variable;	1	'for fair test' not sufficient
<b>Total</b>		<b>11</b>	

**BIO6X: Task 2**

Question	Marking Guidance	Mark	Comments
5(a)	There is no difference in the rate of photosynthesis with green/coloured light and white light;	1	Accept no relationship between colour of light and rate of photosynthesis Accept number of bubbles Reject colour and rate will be the same
5(b)	Standard error/95% confidence limits;	1	Accept SE
5(c)	Looking for differences between <u>mean</u> values;	1	
5(d)	Test statistics calculated correctly;	1	
5(e)	<p>If student's ranges overlap:</p> <ol style="list-style-type: none"> <li>1. Probability greater than 0.05/5% that (differences in) results are due to chance;</li> <li>2. Accept null hypothesis;</li> </ol> <p><b>OR</b></p> <p>If student's ranges do not overlap:</p> <ol style="list-style-type: none"> <li>3. Probability less than 0.05/5% that (differences in) results are due to chance;</li> <li>4. Reject null hypothesis;</li> </ol>	2	<p>Do not accept 'hypothesis is true/false'</p> <ol style="list-style-type: none"> <li>1. Probability less than 95%/0.95 that results are not due to chance</li> <li>3. Probability more than 95%/0.95 that results are not due to chance</li> </ol>
<b>Total</b>		<b>6</b>	

**BIO6X: Written Test**

Question	Marking Guidance	Mark	Comments
6	Same concentration of chlorophyll/same number of chloroplasts/same number of leaves/same surface area;	1	Allow different pieces of plant will photosynthesise at different rates
7	<ol style="list-style-type: none"> <li>1. Long enough to minimise effect of miscounting;</li> <li>2. Short enough to maintain accurate counting;</li> <li>3. Time to allow sufficient repeats to be carried out;</li> </ol>	1 max	
8	<ol style="list-style-type: none"> <li>1. Enough for statistical test;</li> <li>2. Enough for more representative <u>mean</u>;</li> <li>3. Limited by time available;</li> <li>4. Reduce the effect of anomalies on the <u>mean</u>;</li> </ol>	2 max	<p>Do not allow for identification of anomalies</p> <p>2. Allow any expression of 'better mean' eg more accurate, more reliable, more precise</p> <p>Allow idea of running <u>mean</u> to give consistent mean</p>
9	<p>67.4%;;</p> <p>89 converted to incorrect % - 1 mark;</p> <p>Sum set out correctly but wrong final answer – 1 mark;</p>	2 max	<p>Ignore number of decimal places</p> <p>Rounding must be correct</p> <p>ie 132-43 either divided by a figure or not then x100</p>
10	<ol style="list-style-type: none"> <li>1. Shelter for fish eg to reduce stress / avoid predators;</li> <li>2. Food source for plant eating fish;</li> <li>3. Oxygen production for fish <u>respiration</u>;</li> <li>4. Remove CO<sub>2</sub> produced from fish <u>respiration</u> / remove CO<sub>2</sub> so water does not become acidic;</li> <li>5. Remove nitrogenous waste/named example from fish;</li> </ol>	2 max	

11(a)	Highest proportion of red light – this produced fastest photosynthesis;	1	
11(b)	<ol style="list-style-type: none"> <li>1. Light intensity/energy;</li> <li>2. Heat given off;</li> </ol>	1 max	1. Allow wattage/power of bulb
12	<ol style="list-style-type: none"> <li>1. To draw bubble(s) onto scale (for measuring);</li> <li>2. To draw solution in to tube;</li> <li>3. To remove bubbles to enable repeat (reading);</li> </ol>	1 max	
13	<ol style="list-style-type: none"> <li>1. Volume of gas measured/ calculated / volume of bubbles not measured;</li> <li>2. Description of how to calculate volume of gas - <math>\pi r^2 \times \text{length}</math> where <math>r</math> = radius of bore of tube;</li> <li>3. Avoids problem of bubbles being differing sizes;</li> <li>4. Avoids problem of miscounting number of bubbles;</li> </ol>	2 max	
14	<ol style="list-style-type: none"> <li>1. Peaks at 420-430 and 660-670;</li> <li>2. No absorption of light between approximately 500 and 600;</li> <li>3. Highest peak at 420-430;</li> </ol>	2 max	
15	<ol style="list-style-type: none"> <li>1. Less (light) energy passes through leaves/reaches ground;</li> <li>2. Smaller range of wavelengths passes through leaves;</li> <li>3. Little light for chlorophyll to absorb;</li> <li>4. So insufficient photosynthesis (for growth);</li> <li>5. Photosynthesis unlikely to exceed respiration;</li> </ol>	3 max	<ol style="list-style-type: none"> <li>2. Accept reference to only green (and yellow) light pass through</li> <li>3. Accept carotenoids can absorb this light</li> <li>4. Sufficient photosynthesis for plants with carotenoids</li> </ol>

16	<ol style="list-style-type: none"> <li>1. Light not limiting/lots of light (as no shading);</li> <li>2. Light-dependent reaction not limiting/fast;</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>3. Temperature not limiting/Warm (as no shading);</li> <li>4. Fast reactions of enzymes in light-independent reaction;</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>5. High use of CO<sub>2</sub>;</li> <li>6. Light-independent reaction is limiting;</li> </ol>	2	Mark as a pair
17	<ol style="list-style-type: none"> <li>1. Bar chart;</li> <li>2. Error bars to represent standard deviation (of mean);</li> <li>3. Photosynthetic pigment on x axis and mass of pigment on y axis;</li> </ol>	2 max	Accept suitable sketch
18	<ol style="list-style-type: none"> <li>1. Number leaves on the branch;</li> <li>2. Use random number table/calculator/pick numbers from bag to determine which leaf to pick;</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>3. Collect large number of leaves;</li> <li>4. Pick out of bag with some idea of randomness;</li> </ol>	2	2. Accept use of random number generator
19	<p>No (no mark)</p> <ol style="list-style-type: none"> <li>1. No stats test carried out;</li> <li>2. Standard error/95% confidence interval calculation identified;</li> </ol> <p>Yes (no mark)</p> <ol style="list-style-type: none"> <li>3. No overlap shown by the standard deviations;</li> <li>4. Ranges around mean stated;</li> </ol>	2 max	<ol style="list-style-type: none"> <li>2. If awarded, student scores 2 marks – for points 1 and 2</li> <li>4. 88.6-92.8 and 111.0-111.2 (1 × SD) or 86.5-94.9 and 110.9-111.3 (2 × SD)</li> </ol>



20	<p>In shade leaves:</p> <ol style="list-style-type: none"> <li>1. Greater amount of enzyme/enzyme activity (for production of chlorophyll b);</li> <li>2. Greater gene expression/transcription of the gene/more mRNA produced/gene switched on;</li> <li>3. Greater translation;</li> <li>4. Enzyme/substrate is light sensitive – faster rate of reaction with lower light;</li> </ol>	2 max	
21	<ol style="list-style-type: none"> <li>1. (Some of the) light that passes through is absorbed by chlorophyll b;</li> <li>2. This is light of around 500 and/or around 640;</li> </ol>	2	<ol style="list-style-type: none"> <li>2. Accept any value or range between 460 and 540 and/or 600 and 670</li> </ol>
22(a)	<p>Supports hypothesis 2 (no mark)</p> <ol style="list-style-type: none"> <li>1. Greater carotenoid found in sun leaves than shade leaves of beech tree;</li> <li>2. Sun leaves exposed to much brighter light than shade leaves;</li> </ol> <p><b>OR</b></p> <p>It supports hypothesis 2 because it does not support hypothesis 1 (no mark)</p> <ol style="list-style-type: none"> <li>3. Although carotenoids absorb wavelengths of light that pass through leaves;</li> <li>4. There are not more carotenoids in shade leaves;</li> </ol>	2	

22(b)	<ol style="list-style-type: none"> <li>1. Mass of pigments/carotenoids in sun and shade leaves of other trees;</li> <li>2. Position of carotenoids in leaf cells;</li> <li>3. Effect of bright light on (isolated) chlorophyll;</li> <li>4. Whether without carotenoids chlorophyll is damaged (supporting hypothesis 2)/photosynthesis is reduced (supporting hypothesis 1);</li> </ol>	1 max	
	<b>Total</b>	<b>33</b>	