

**MARK SCHEME for the May/June 2011 question paper
for the guidance of teachers**

9790 BIOLOGY

9790/04

Paper 4 (Practical), maximum raw mark 70

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument AVP = any valid point
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Section A

Skill	Approximate total marks	Breakdown of the marks	Q. 1	Q. 2	Q. 3	Q. 4	Q. 5	Total
Manipulation, measurement and observation	24	Successful collection of data and observations (MMO Collection)	2	8				24
		Decisions about measurements or observations (MMO Decisions)	9	5				
Presentation of data and observations	13	Recording data and observations (PDO Recording)	2					15
		Display of calculations and reasoning (PDO Display)	1	1				
		Data layout (PDO layout)	1	2				
		Interpretation of data or observations and identifying sources of error (D)					8	
Planning	16	Defining the problem (P)			6			16
		Methods (M)			10			
Analysis, conclusions and evaluation	17	Drawing conclusions (C)	3			5		15
		Suggesting improvements and evaluation (E)				7		
Total	70		18	16	16	12	8	70

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Section A

Question	Sections	Learning outcomes	Indicative material	Mark
1 (a)	MMO collection PDO display	<ul style="list-style-type: none"> set up apparatus correctly work out what to do from outline instructions given in the form of written instructions or diagrams use their apparatus to collect an appropriate quantity of data or observations, including quantitative data or subtle differences in colour or other properties of materials show their working in calculations, and the key steps in their reasoning 	<p>concentrations of glucose recorded at a minimum of five different lengths of time ;</p> <p>a replicate for each length of time ;</p> <p>data processed, e.g. mean and/or rate calculated ;</p>	
	PDO recording PDO layout	<ul style="list-style-type: none"> present numerical data, values or observations in a single table of results draw up the table before taking readings/making observations, so that candidates can record directly into the table, to avoid the need to copy up their results include in the table of results, if necessary, columns for raw data, for calculated values and for deductions use column headings that include the quantity and the unit (as appropriate) and that conform to accepted scientific conventions choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation 	<p>data recorded as a single table ;</p> <p>informative column headings, correct units in results recorded to same degree of precision</p> <p>all data recorded in a fully ruled up table ;</p> <p>AVP ; e.g. results recorded as a range (0.25 – 0.5), use of a control</p>	[any of these points to max 6]

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Question	Sections	Learning outcomes	Indicative material	Mark
(b)	MMO Decisions	<ul style="list-style-type: none"> decide how many tests, measurements or observations to perform make measurements or observations that span the largest possible range within the limits either of the equipment provided or of the instructions given make quantitative measurements or qualitative observations that are appropriately distributed within this range decide how long to leave experiments running before taking observations replicate readings or observations as necessary make and record sufficient, accurate measurements and observations 	<p>1 standardised, volume / mass / number of beads per syringe ;</p> <p>2 volume of milk added is, given / standardised ;</p> <p>3 standardised method for pouring milk into syringe ;</p> <p>4 standardised timing method ;</p> <p>5 ref to different lengths of time used ;</p> <p>6 ref to way of matching colours against colour card ;</p> <p>7 concentration of glucose recorded from Diastix ;</p> <p>8 column of beads is washed out with distilled water ;</p> <p>9 ref to constant temperature ;</p> <p>10 ref to contamination with glucose from previous sample ;</p> <p>11 control, described ;</p> <p>12 ref to repeat reading(s) for each time interval ;</p> <p>13 ref to anomalous ;</p> <p>14 ref to calculation of mean ;</p> <p>15 ref to correct use of <i>reliability</i> ;</p> <p>16 AVP ; e.g. discard first drops from syringe (as not in contact with beads)</p> <p>17 AVP ; careful timing using Diastix</p>	[max 8]
(c) (i)	MMO Decisions	<ul style="list-style-type: none"> replicate readings or observations as necessary (Individual readings or observations should be repeated where they appear to be anomalous) 	<p>standard deviation ;</p> <p>standard error ;</p> <p>confidence interval / confidence limits ;</p> <p>R range</p>	[max 1]
(ii)	C	<ul style="list-style-type: none"> drawing conclusions 	<p>1 qualitative comparison between the samples ;</p> <p>2 differences in optimum temperatures ;</p> <p>3 comparative data quote ;</p>	[3]
				[Total: 18]

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Question	Sections	Learning outcomes	Indicative material	Mark
2 (a) (i)	MMO Collection	<ul style="list-style-type: none"> set up apparatus correctly use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials 	<p>plan drawing with clear continuous lines, no cells and no shading ;</p> <p>at least three layers shown and labelled correctly – e.g. mucosa, submucosa, one or two layers of muscle ; layers shown with appropriate thickness ;</p>	[max 2]
(a) (ii)	MMO Collection PDO Display	<ul style="list-style-type: none"> make measurements using millimetre scales, graticules, protractors, stopwatches, balances, measuring cylinders, syringes, thermometers, and other common laboratory apparatus show their working in calculations, and the key steps in their reasoning 	<p>correct measurement of line shown on drawing to within 1 mm ;</p> <p>magnification calculated from measurement from drawing divided by measurement from slide ;</p>	[2]
(b)	MMO Collection MMO Decisions PDO Layout	<ul style="list-style-type: none"> use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials decide how many tests, measurements or observations to perform make measurements or observations that span the largest possible range within the limits either of the equipment provided or of the instructions given choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation 	<p><i>drawings</i> draws one, two or three cells of each type ; <i>e.g. mucous neck cell, chief cell / peptic cell, oxyntic cell / parietal cell</i> drawings show differences between cell types ;</p> <p><i>annotations</i> cytoplasm ; nucleus ; size / shape ; colour ;</p> <p>cells drawn with clear, continuous lines ;</p>	[2] [max 3] [1]

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Question	Sections	Learning outcomes	Indicative material	Mark
(c)	PDO layout MMO Collection	<ul style="list-style-type: none"> choose a suitable and clear method presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials 	<p>table with column for features to compare – must be direct comparisons ; (P1 = stomach, P2 = ileum)</p> <p><i>comparisons may be similarities or differences</i> <i>examples of features</i> presence / absence of serosa ; thickness of muscle layer(s) ; folded surface, rugae / AW, and villi ; blood supply ; glands, gastric pits and crypts ; epithelial cell types ;</p>	[max 4]
(d)	MMO Decisions	<ul style="list-style-type: none"> make and record sufficient, accurate measurements and observations 	<p>microvilli ; large surface area for absorption ;</p>	[2]
				[Total: 16]

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Section B

Question 3

Sections	Expected answer	Mark
P	<ol style="list-style-type: none"> 1 Hypothesis or prediction ; <i>e.g. reference to difference in RQ and changes in both seeds over time</i> 2 Theory to support hypothesis or prediction ; <i>e.g. ref to nature of storage substances / effect of mixed metabolism on RQ</i> 3 Outline of strategy ; <i>e.g. determine oxygen uptake using soda lime and carbon dioxide production without soda lime, RQ calculation, at different times during germination (minimum 48 hours)</i> <i>this could be awarded at the end of the plan</i> 4 Explanation of determination of carbon dioxide production; <i>e.g. without soda lime movement of fluid depends on relationship between uptake of oxygen and production of oxygen</i> 5 At least two control variables ; <i>e.g. temperature, mass of soda lime, duration of measurements, conditions used for germinating seeds, seeds kept in the dark</i> 6 Risk assessment ; <i>e.g. avoid contact with soda lime – precaution described</i> 	[6]
M	<ol style="list-style-type: none"> 1 germinate seeds under, same / stated, conditions ; 2 place known mass of seeds in respirometer with soda lime, leave time to adjust ; 3 respirometer must be airtight / adjust position of meniscus with plunger ; 4 measure distance moved by fluid and time taken ; 5 repeat with same seeds and respirometer (at same stage of germination) ; 6 remove plunger to allow oxygen to enter ; 7 to prevent respiration becoming anaerobic ; 8 use a control respirometer with soda lime but no seeds ; 9 use results to compensate for natural movement of fluid ; 10 repeat without soda lime ; 11 determine distance travelled by fluid and calculate carbon dioxide production ; 12 method to calculate volumes of gases – $\pi r^2 h$; 13 calculate gas exchange per unit mass of seed ; 14 calculation of RQ ; 15 replicate respirometers at each stage of germination for each type of seed ; 16 presentation of data – plot RQ against time for each type of seed ; 	[max 10]
		[Total: 16]

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Questions	Sections	Expected answer	Mark
4 (a)	E	avoid bias ; samples must be representative of whole population ; avoid sampling dogwhelks, in places easy to find / AW ; mean is more likely to be true reflection of population as a whole ;	[max 2]
(b)	E	ref to precision of results ; <i>idea that</i> difficult to position ruler over either end of the aperture / whole shell ; therefore uncertainty at <i>both</i> ends of the ruler ; divisions on the ruler are 1 mm, so uncertainty is 0.5 mm in reading the ruler ; but also uncertainty in positioning the ruler ; students could estimate this – e.g. greater than 0.5 mm ; measurements should be expressed +/- x mm ; shows how to calculate percentage, error / uncertainty ;	[max 4]
(c)	E	<i>idea that:</i> students collected dogwhelks of different, sizes / lengths, so needed a parameter independent of, size / age, of dogwhelks ;	[1]
(d) (i)	C	reject (null) hypothesis ; there is a (significant) difference between the ratios for the two populations ; probability that result is due to chance is, very small / less than 5% or 0.05 ; <i>P</i> is less than 5% or 0.05 which is accepted value ;	[max 3]
(d) (ii)	C	large foot size relative to body length ; gives better attachment to rock surface ; reduces chance of being dislodged by wave action ; ref to insufficient data on abiotic feature(s) ; <i>idea that</i> difference could have another cause ; <i>ecf</i> if null hypothesis accepted any other adaptation, e.g. volume of mucopolysaccharide ; use of data to suggest that there is no difference between the populations ; e.g. mean \pm standard deviation	[max 2]
			[Total: 12]

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Questions	Sections	Expected answer	Mark
5 (a)	D	AaBb ;	[1]
(b)	D	haploid genotype <i>whether correct or not</i> ;	[2]
		yellow non-waxy yellow waxy white non-waxy white waxy	
		AB Ab aB ab ;	
(c) (i)	D	–64 4096 3.71 ; $\chi^2 = 5.2(0)$;	[2]
(ii)	D	there is no significant difference between the observed numbers of, phenotypes / pollen grains of the four types, and, the expected ratio / 1:1:1:1 ;	[1]
(iii)	D	3 ;	[1]
(iv)	C	<i>assumed in the question that the genes are not on the same chromosome</i> yes because, $p > 0.05$ / 5% or < 0.5 , but > 0.1 ; <i>either</i> equal chance of each genotype being expressed in the pollen grains ; <i>or</i> <i>idea that</i> (null hypothesis is accepted) results are not significantly different from expected ;	[max 1]
			[Total: 8]