UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Specimen for 2007

GCE A/AS LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9700/31

BIOLOGY
ADVANCED PRACTICAL SKILLS

Skill	Total marks	Breakdown of mark expectations		Question 1	Question 2
Manipulation, measurement and observation	16 marks	Successful collection of data and observations	8 marks	2	6
		Decisions relating to measurements or observations	8 marks	4	4
Presentation of data and observations	12 marks	Recording data and observations	4 marks	2	2
		Display of calculation and reasoning	2 marks	1	1
		Data layout	6 marks	4	2
Analysis, conclusions and evaluation	12 marks	Interpretation of data or observations and identifying sources of error	6 marks	2	4
		Drawing conclusions	3 marks	4	0
		Suggesting improvements	3 marks	2	0

MMO = Manipulation, measurement and observation
      Collection = Successful collection of data and observations
      Decisions = Decisions relating to measurements or observations
PDO = Presentation of data and observations
      Recording = Recording data and observations
      Display = Display of calculation and reasoning
      Layout = Data layout
ACE = Analysis, conclusions and evaluation
      Interpretation = Interpretation of data or observations and identifying sources of error
      Conclusions = Drawing conclusions
      Improvements = Suggesting Improvements

Question			Sections	Learning outcomes	Indicative material	mark
1	**(a)**		MMO Decisions	• Decide how many tests, measurements or observations to perform • Make and record sufficient, accurate measurements and observations	2 very simple tests ethanol emulsion, shake = clear AND benedicts + heat = red/ orange/yellow (R green); reducing sugar (R glucose/ other unqualified sugar);	1
			ACE Conclusions	• Draw conclusions from interpretations of observations, data and calculated values		1
	(b)	**(i)**	MMO Decisions	• 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	for room temperature: at least 2 and not more than 4 readings, each of at least 10 seconds and nor more than 60 seconds;	1

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		(ii)	MMO collection	• set up apparatus correctly • follow instructions given in the form of written instructions or diagrams	data reported as bubbles per unit time for at least two temperatures;	1
			MMO decisions	• decide how many tests, measurements or observations to perform • replicate readings or observations as necessary	decide to investigate three or more temperatures and to replicate readings	1
			MMO collection	• make and record sufficient, accurate measurements and observations	at least three temperatures investigated, and at least two replicate readings made;	1
			PDO recording	• 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	all data recorded in a single table with appropriate means to record bubbling rate per unit time, replicated, at more than one temperature; column headings that include quantities and unit where appropriate (such as temperature/^{o}C, number of bubbles in 10 seconds);	2
			PDO layout	• choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation	most data recorded in a table;	1

(c)	**(i)**	ACE interpretation	• evaluate the effectiveness of control of variables and thus the confidence with which conclusions might be drawn	no attempt made to control it so not well controlled /distilled water used, so no acid or alkali added, but not well controlled/no buffer added so not well controlled/yeast contains proteins/buffers/weak acids + salts that might help buffer the solution a little;	1
	(ii)	ACE interpretation	• identify the most significant sources of error in an experiment	**Two** from: IDEA OF bubbles might vary in size/ temperature change might cause gas inside tube to change volume/one example of limited accuracy of measuring equipment e.g. syringe/AVP;	1
(d)	**(i)**	MMO Decisions	• replicate readings or observations as necessary (individual readings or observations should be repeated where they appear to be anomalous)	something has gone wrong with the apparatus / the gas bubbles have leaked out somewhere / AVP (accept reading anomalous / not reliable unqualified) ;	1
	(ii)	PDO display	• show their working in calculations, and the key steps in their reasoning • use the correct number of significant figures for calculated quantities	4.9 with appropriate working shown; R no working shown R more than two significant figures	1

		(iii)	PDO layout	• select which variable(s) to plot and plot appropriately on clearly labelled x- and y-axes • plot all points or bars to an appropriate accuracy • follow the IOB recommendations for putting lines on graphs	independent variable (temperature) on x-axis, dependent variable (mean number of bubbles min^{-1}) on y-axis AND axis labels appropriate (accept ecf from table if already penalised in **1 (b) (ii)**); scale should be chosen so that data spans at least half of the width and height of the grid AND scale appropriate such as 1:10, 1:5 or 1:2 (R awkward scales such as 3:10, 7:10, 8:10) (scale does not need to start at 0); data plotted accurately to within 1 mm, using crosses or circle-with-dot AND points joined with straight ruled lines OR fine curve drawn through the data points, **not** extrapolated beyond the first or last point;	3
	(e)		ACE Conclusions	•draw conclusions from an experiment, giving an outline description of the main features of the data, considering whether experimental data supports a given hypothesis, and making further predictions	at low temperatures an increase in temperature increases bubbling rate, AND at high temperatures an increase in temperature decreases bubbling rate/AW;	1

(f)		ACE Conclusions	• draw conclusions from an experiment, giving an outline description of the main features of the data, considering whether experimental data supports a given hypothesis, and making further predictions	IDEA OF at low temperatures the data supports the student's hypothesis AND above 48 ^{o}C/at high temperatures the hypothesis is not supported/the rate drops as temperature increases; prediction including student's hypothesis for low temperatures PLUS at high temperatures, as temperature increases, the rate of production of gas will decrease/AW;	2
(g)		ACE Improvements	• suggest modifications to an experimental arrangement that will improve the accuracy of the experiment or the accuracy of the observations that can be made, including the use of new methods or strategies to investigate the question • describe such modifications clearly in words or diagrams	*accept improvements that would enhance the reliability or accuracy of the experiment – three in outline or one or two explained – could be related to errors identified earlier or others* collect gas; measure its volume accurately; e.g. of specific method of doing so such as inverted burette over water/gas syringe; use more replicates/repeat more times at each temperature; use more temperatures/ specified wider range between 0 and 100 ^{o}C; use more accurate measuring devices/one named specific measuring device; use a buffer to control pH/ other specific means to control a plausible variable; AVP;;	2

2	(a)	(i)	MMO Collection	• 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	*Rancunculus* root t.s. recognisable in drawing (large circle containing smaller circle containing star-shaped region); proportions of stele/root diameter acceptable (between 1:5 and 1:10) AND at least 4 tissues shown (epidermis, parenchyma, endodermis, xylem, phloem);	2
		(ii)	MMO Collection PDO Display	• 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	correct measurement of line shown on drawing to within 1 mm AND measurement of diameter of specimen between 1.5 and 4 mm, to no more than 0.5 mm reported accuracy; working shows measurement from drawing divided by measurement from slide;	1 1
		(iii)	ACE Interpretation	• estimate, quantitatively, the uncertainty in quantitative measurements • express such uncertainty in a measurement as an actual or percentage error	their reported measurement $\pm$ 0.5 mm (accept answers between $\pm$ 0.2 mm and $\pm$ 1.0 mm)	1
		(iv)	ACE Interpretation	• show an understanding of the distinction between systematic errors and random errors	ruler made with incorrect intervals/user not viewing at right angles/AVP;	1

(b)		MMO Collection	• use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials	at least half of area of available space used to represent/describe a number of cells; drawings/descriptions of cells including starch granules, cell walls and air spaces between corners of the cells;	2
		MMO Decisions	• 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	at least three and no more than six cells drawn/ described; largest cell drawn/described at least twice the size of smallest; cells with a range from 2 or less up to 10 or more starch grains; including both cells with air spaces between the corners and those without;	max 3
		PDO Layout	• choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation	drawing used to represent observations – clear outline drawings, sharp pencil and no shading;	1
(c)	**(i)**	PDO layout	• choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation	table used to present data; (R comparative lists without lines to divide information)	1

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		(ii)	MMO Collection	• use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials	Give at least 4 comparisons, including at least one similarity and at least one difference, and including one subtle judgement (judgement involving more than just size, colour or shape);	1
			PDO Recording	• 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 • record raw readings of a quantity to the same degree of precision and observations to the same level of detail	all observations and comparisons recorded in a single table with difference(s) recorded to the same level of precision (e.g. sizes recorded in mm) or detail (e.g. stele 40% of total width of S3 vs. stele 8% of total width of specimen S4);	1
		(iii)	ACE Interpretation	• describe and summarise the key points of a set of observations	central stele/named feature (e.g. xylem/tubular cells);	1
	(d)		MMO Decisions	• make and record sufficient, accurate measurements and observations	correctly label xylem on both pictures;	1
			ACE Interpretation	• describe and summarise the key points of a set of observations	pick out at least one valid reason for each decision (e.g. Fig. 2.1 thick cell walls, Fig.2.2 end walls of cells absent);	1