UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2009 question paper

for the guidance of teachers

9700 BIOLOGY

9700/31 Paper 31 (Advanced Practical Skills 1), maximum raw mark 40

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.

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<table>
<tr><th>Question</th><th>Expected Answers</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td colspan="4">1 (a) (i) Record colour of paper and pH for glucose and ethanol.</td></tr>
<tr><td>MMO collection 2</td><td>with reference to glucose and ethanol record a colour for each;

one colour matches one pH or between two pH values;
<table><tr><td>pH</td><td>5.2</td><td>5.5</td><td>5.8</td><td>6.1</td><td>6.4</td><td>6.7</td></tr><tr><td>colours</td><td colspan="2">brown/ orange/yellow</td><td>pink/ brown</td><td colspan="3">pink/ purple/violet/lilac/magenta/ red/burgundy/plum</td></tr></table>
OR (if no colours given) with reference to glucose and ethanol two pH values from scale, same or different;</td><td>Credit ONLY the given pH values
Credit less than/<5.2 with yellow or more than/>6.7 with purple/AW</td><td>[1]

[1]</td></tr>
<tr><td colspan="4">(ii) Decide which other concentrations to make and complete the table.</td></tr>
<tr><td>MMO decisions 3</td><td>(%) 0 and 40 plus any three which are evenly/serially spaced e.g. 0, 20, 30, 40, 50 or 0, 10, 20, 30, 40;

correct volumes used to dilute up to 10 cm^3 AND correct %;

(tubes listed) either most dilute/lowest % to most concentrated/highest % or most concentrated to most dilute;</td><td>

Ignore where 0 is listed</td><td>[1]

[1]

[1]</td></tr>
</table>

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(iii) Prepare space to record colour of each piece of paper and pH.			
PDO recording 2	single table AND all cells drawn AND %/percent(age) (top or left of data heading only);	<table><tr><td></td><td>heading</td><td>heading</td><td>heading</td></tr><tr><td>heading</td><td></td><td></td></tr><tr><td>heading</td><td></td><td></td></tr></table> Do not credit if % in body of table	[1]
	(headings) colour AND pH;	Do not credit if pH/colour in body of table	[1]
MMO collection 2	two different colours for two tubes recorded;	Collection of colour for two tubes. Credit colour differences such as light orange vs orange	[1]
	(collected data/colours or pH) clearly for 1 min(ute)/start and 10 min(utes)/end;	Credit colours only or pH values only – looking for clear collection of 1 minute and 10 minutes Credit for one tube of data for 1 min and 10 min as minimum	[1]
(b) (i) Identify a significant error – read complete answer for any correct one.			
ACE interpretation 1	judging colour/matching exact colours/colours very close together/pH paper narrow scale/colours not on scale/between colours/identification of colours; idea of timing not the same/different/described; loss of CO_2/gas/AW;	Do not credit timing unqualified	[max 1]
(ii) State degree of uncertainty (of syringes).			
ACE interpretation 1	+/– AND half total division AND cm^3;	Error with one reading is +/– half the smallest division with correct units as use syringe to measure single volume and release al contents	[1]

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(c) (i) Plot a graph of the data shown.				
PDO layout 4	O	x-axis temp(erature) (/)°C AND y-axis (number/no. of) bubbles/min or per min or min^{-1};	Do NOT credit bubbles min^{1}	[1]
	S	scale as 10°C to 2 cm and 5 to 2 cm; Credit origin other than 0 e.g. 5/10/15 if labelled Credit unlabelled origin only if should be 0	Do not credit S if awkward scale or if less than half grid on y or x axis	[1]
	P	plotting correct points using crosses/dots in circles only; Do not credit if an extra point plotted at 25°C. No cross larger than x or more than one blob larger than o. All plots must be on horizontal lines except for the 4 to 2 cm scale points within a square of the intersection/centre of dot must not touch horizontal lines.	Do not credit P plotting if awkward scale or if only blobs/dots/blobs in circles Do not credit dot with cross Credit x in circles	[1]
	L	line of best fit (no more than 2 points on one side)/points joined with straight line; Quality – line no thicker than 1 mm thick max Complete line should be smooth/not feathery.	Credit line of best fit – no extrapolation Joins point to point no extrapolation beyond first and last points	[1]
(ii) Estimate enzyme activity at 25°C.				
ACE interpretation 1		correct reading using candidate's graph at 25°C AND bubbles per minute or min^{-1};	Credit whole number of bubbles only Credit 0.5 up or down	[1]

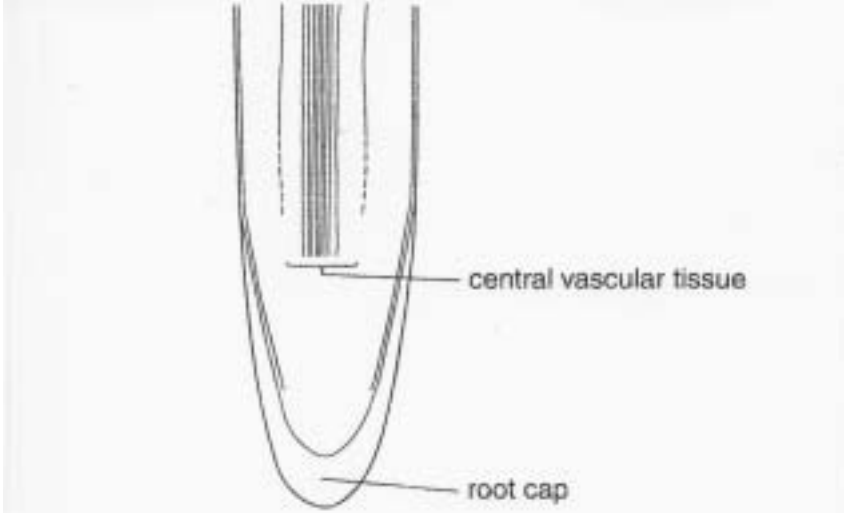
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(iii) Suggest how to make sure results are as accurate as possible and as reliable as possible.			
ACE improvements 1	control of any variable/use a water bath/same type of yeast/same volume of yeast/keep time the same/stagger the start/have separate experiments/(keep pH same) using buffer; Accuracy: collect volume using measuring cylinder/gas syringe/video to count bubbles/AW; Reliability 1: increase number or range of temperatures/2 extra named examples; Reliability 2: repeat more/several times/twice/obtain three readings/(at each temp); Reliability 3: calculate mean;	Credit in either accuracy or reliability Do not credit ref to enzymes or amount of yeast Accuracy: (change method of measuring to obtain results as close as possible to the true value) Reliable: (to have results which are as repeatable as possible) Credit only two reliability marks	[1] [1] [1] [1] [1] [max 3]
(d) State whether you think the hypothesis is supported by the student's results. Explain your answer.			
ACE conclusion 2	hypothesis true/yes/OR re-states the hypothesis OR partly true/true but only…; Either (true for) 15 to 40°C as increases from 5 to 18/ or any two correct temps within 15 and 40/41 with two correct numbers of bubbles/may have two temps and difference in number of bubbles/calculated rate of increase/gradient; OR ONLY TRUE: 15 to 40°C as increases from 5 to 18/ or any two correct temps with two correct numbers of bubbles/may have two temps and difference in number of bubbles; idea that (NOT TRUE) below 15°C and/or above 40°C as no data;	Needs clear statement Do not credit idea that totally wrong Credit temp as long as units are present once	[1] [max 1]
			[Total: 21]

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Question	Expected Answers		Additional Guidance	Mark
2 (a) Draw a large, low power, plan diagram of quarter. Label phloem and xylem in a vascular bundle.				
PDO layout 1	clear, sharp, unbroken lines AND no shading AND cannot fit totally within the 6 cm by 6 cm grid;			[1]
MMO collection 3	no cells AND outline irregular;			[1]
	clear layer/layers below cortex AND cortex at widest is thicker than narrowest point of layer below; Ignore epidermis (2 lines)			[1]
	at least 3 complete vascular bundles AND length of largest vascular bundle twice length of smallest vascular bundle; Do not credit if whole section drawn			[1]
MMO decision 1	phloem and xylem are labelled on the layer below cortex or a vascular bundle as shown by candidate;			[1]
(b) (ii) Calculate mean width of the cells in micrometres. Mark clearly the cells you used. Show your working.				
MMO collection 1	cell(s) marked on Fig 2.2 AND Credit separate or one line across cells selected	selected cell(s) measured with mm or cm shown; Do not credit if line is not on the fig. Do not credit measurements in metres or micrometres.	Check recorded cell measurements are at or between 0.5 to 5.5 cm or 5 mm to 55 mm Ignore more sig. figs. OR if single line is drawn check measurement of line is less than 170 mm/ 17 cm	[1]
MMO decision 1	5 or more complete cells measured; Credit even if not shown on Fig. 2.2. Do not credit if partial cells included.			[1]
PDO display 2	shows any number of measurements added up or line measurement and divided by number of measurements/cells;		Ignore the answer	[1]

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	divides by 400 and multiplies by (cm) 10 000/10^4 or (mm) 1000/10^3;	E.g. cell 1 = 20 mm cell 2 = 21 mm cell 3 = 17 mm cell 4 = 16 mm cell 5 = 21 mm Mean = $\frac{20+21+17+16+21}{5}$ = 19 mm 19 mm = 19 × 1000 μm = 19 000 Mag. = ×400 Actual = $\frac{19000}{400}$ = 475 Must show division by 400	[1]
(ii) Label with a line and the letter X, the area from which section may have been cut.			
ACE conclusion 1	 Fig. 2.3	Credit anywhere between bracket for central vascular tissue and end of label line for root cap Do not credit if longitudinal section shown	[1]

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(c) Make a large labelled drawing of 3 complete cells which are touching, include at least 1 cell with a nucleus.

PDO layout 1	clear, sharp, AND unbroken lines Ignore cell walls crossing over as cells appear to overlap.	no shading AND Ignore nucleus. Do not credit stippled cytoplasm or shaded cell walls.	cannot fit totally into the 6 cm by 6 cm grid;		[1]
MMO collection 1	<u>3 complete cells</u> marked on Fig. 2.4 AND	drawn 3 complete cells touching; Ignore additional incomplete cells.			[1]
PDO recording 1	2 nuclei each drawn near to one edge of cell; Nucleus not in centre of cell. Do not credit if additional detailed organelles or cell wall details e.g. plasmodesmata have been drawn which are not visible.				[1]
MMO decisions 2	space between outer wall and cytoplasm shown in part of two cells; Ignore labelling. nucleus and cell wall correctly labelled; Do not credit nucleolus.				[1] [1]

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(ii) Show the differences between the cells in Fig. 2.2 and Fig. 2.4.

PDO recording 1	organise as a table/ Venn diagram/ ruled connected boxes	headed	comparative statements opposite each other;		[1]
ACE interpretation 3					[max 3]

feature	Fig. 2.2	Fig. 2.4
nuclei Ignore ref. to nuclear membrane/size	few/less distinct/less stained	more/dense/obvious/ more stained;
chromosomes/dividing cells/mitosis/anaphase interphase	present fewer in interphase	not visible all in interphase;
cytoplasm/ plasma membrane	more/fills cells not visible/pulled away	less/does not fill cells/ visible/pulled away;
size/ number of cells Credit more (tightly packed)	smaller/calculated mean/ecf/more	larger/calculated more than Fig 2.2/fewer;
shape of cells	have oval/corners/angular/h exagonal	rounded/AW;
(Intercellular) spaces/gaps	fewer/more/larger; Credit either way	

[Total: 19]

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9700 BIOLOGY

9700/32 Paper 32 (Advanced Practical Skills 2), maximum raw mark 40

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Question	Expected Answers	Additional Guidance	Mark
1 (a) (i) Decide which other salt concentrations to make and complete the table.			
MMO decisions 3	0 and 5% salt plus at least three evenly/serial spaced ignoring 0; e.g. 5/3.75/2.5/1.25 or serial 10/5/2.5/1.2 or 5/2.5/1.25/0.625 or 1/3/5/7 check any others.	Ignore % in body of table.	[1]
	correct volumes used to dilute up to 10 cm^3 AND correct % salt AND correct % of yeast and salt half % salt; Credit rounding up or down and from 0.5 either way.		[1]
	(tubes listed) either most dilute/lowest % to most concentrated % or most concentrated to most dilute; Ignore 0.		[1]
(ii) Prepare space and record results.			
PDO recording 2	single table AND all cells drawn AND %/percent(age);	heading | heading | heading heading heading Do not credit if % in body of table.	[1]
	(number/no. of) drops/AW; (heading to the left or above the data)	Do not credit bubbles or if drops repeated in table.	[1]
MMO collection 2	suitable time with units e.g. per minute/min/min^{-1}/ secs/seconds/s maximum time 5 minutes, minimum time 30 sec;	Ignore mean/time in table Credit anywhere even outside the table	[1]
	any two different concentrations/tubes show different numbers of drops;		[1]

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(iii) Identify two of most significant errors			
ACE interpretation 1	different times before measuring/timing not the same; drops have air bubbles/different sizes/different masses/too fast; not airtight/air lock/froth/bubbles in nozzle;	Do not credit not enough time.	[max 2]
(iv) State degree of uncertainty (of ruler used).			
ACE interpretation 1	+/– AND either half smallest division OR whole smallest division AND units/cm/mm;	Ruler has error at each end of measurement of half smallest division = +/– half a division × 2 = +/– whole division with units mm. Credit half division as ruler may have started at zero. Do not credit % error unless candidate shows formula including the measured length of the pipette i.e. 3.5 cm /35 mm. e.g. 0.1/3.5 × 100 = +/– 2.8% or 1/35 × 100 = +/– 2.8% 0.05/3.5 × 100 = +/– 1.4 cm etc.%	[1]

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(v) Suggest how to make sure results are as accurate as possible and as reliable as possible			
ACE improvements 3	C (identification or control of any relevant variables) use buffer/same pH same type of yeast keep time same/set up separate expts/stagger time; Ignore use water bath/same temp.	Credit in either accuracy or reliability.	[1]
	Accuracy: collect volume using measuring cylinder/video/time lapse photography/alternative method/ credit idea of making sure all drops are counted e.g. removal of all air locks in context /AW;	Accuracy: (change/improvement to method of measuring to obtain results as close as possible to the true value)	[1]
	Reliability 1: increase number/range of concentrations/2 named examples;	Reliable: (method to control variables so more repeatable)	[1]
	Reliability 2: repeats more/several times/twice/obtain three readings (at each concentration)/collect class data (for same expt.);	Do not credit repeat experiment unqualified.	[1]
	Reliability 3: calculate mean/average;	Do not credit three reliability marks.	[1] [max 2]

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(b) (i) Plot a graph of the data shown in Table 1.3.				
PDO layout 4	O	x-axis mass of (dried) yeast (/)g 100 cm^{-3} glucose solution y-axis % or percentage, absorbance;		[1]
	S	y axis 20 to 2 cm and x axis 0.5 to 2 cm; Credit origin 0.50/1.00 if labelled.	Do not credit S if awkward scale. Must use more than half the grid in either direction.	[1]
	P	plotting correct points using crosses/dots in circles only; Do not credit if any extra points plotted in same way as other points e.g. at 60% or 25%. No 2 crosses larger than x or blobs bigger than o. Plots at 1.00, 1.50, 2.00 and 2.25 must be within the horizontal lines for the correct box plot 3.00 must be on horizontal line and correct vertical.	Do not credit P plotting if awkward scale or if only blobs/dots/blobs in circles.	[1]
	L	curve through at least 4 points/points joined with straight line; Quality – line no thicker than 1 mm thick Complete line should be smooth/not feathery.	Ignore extrapolation to zero. Do not credit any extrapolation beyond the last horizontal/vertical lines or extrapolation which does not reach zero.	[1]
(ii) Complete the Table 1.4 (readings at 60% and 25% absorbance using graph).				
ACE interpretation 1		correct readings from candidate's graph at 60 and 25% absorbance to two decimal places;	2.40 and 1.70 most likely. Must be to two decimal places as in table.	[1]
(iii) Show clearly on the graph how you obtained the mass.				
ACE interpretation 1		for both vertical and horizontal lines;	Credit even if reading from wrong value.	[1]

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(d) State whether you think the hypothesis is supported by the student's results. Explain your answer.

ACE conclusion 2	not true/no; decreases between day 1 **and** day 3 or quote of data or not enough data/ described;	Credit ecf from their results	[1+1]
	true/yes; mass on day 1/quoted and day three/quoted are higher than day 0/quoted OR 0/quoted 5 absorbance between days 1 and 3 showing it would be higher or add mass for day 1 and day 3 and divide by 2 = 2.00;	Credit statement – even if the supporting argument is weak.	[1+1]
	no and then yes or yes then say no or partly or might be true; not enough data/described;		[1+1]

[Total: 21]

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<table>
<tr><th>Question</th><th>Expected Answers</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td colspan="4">2 (a) (i) Draw large low power plan section given. Annotation.</td></tr>
<tr><td>PDO layout 1</td><td>clear, sharp, unbroken lines AND no shading AND cannot fit totally within the acetate grid;</td><td></td><td>[1]</td></tr>
<tr><td>MMO collection 3</td><td>no cells AND epidermal layer drawn as two lines;</td><td></td><td>[1]</td></tr>
<tr><td></td><td>1 or 2 vascular bundles AND a closed tapering end;</td><td></td><td>[1]</td></tr>
<tr><td></td><td>shows a region at the closed tapered end (for collenchyma);</td><td></td><td>[1]</td></tr>
<tr><td>MMO decision 2</td><td>Any TWO from:
<table>
<tr><td>(epidermal cells)</td><td>clear/large/ thin cell walls/one cell thick;</td></tr>
<tr><td>(collenchyma cells)</td><td>thick cell walls/densely stained/small;</td></tr>
<tr><td>(mesophyll cells)</td><td>red cells/irregular/rectangular shapes/loosely-packed/ spaces;</td></tr>
<tr><td>(xylem)</td><td>large <u>cells or vessels</u>/lignified/red/brown/thick walls/ clear;</td></tr>
<tr><td>(phloem)</td><td>small cells;</td></tr>
</table>
Credit tissue red etc. reject large tissue idea.
Ignore lumen/hollow/empty/air/labels look for the line and apply description</td><td>Credit any correct description.

Do not credit functions.</td><td>[max 2]</td></tr>
</table>

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(ii) Make a large labelled drawing of 2 epidermal cells and the cells which form the layer inside touching these two cells.

<table>
<tr><td>PDO layout 1</td><td colspan="3">clear, sharp, unbroken lines AND no shading AND cannot fit totally within the acetate grid 6 cm × 6 cm;
For any cells drawn. For the complete drawing.</td><td></td><td>[1]</td></tr>
<tr><td>MMO collection 1</td><td colspan="2"><u>only 2 complete epidermal cells</u> drawn AND</td><td colspan="2">at least 2 complete cells underneath touching;</td><td>[1]</td></tr>
<tr><td>PDO recording 1</td><td colspan="4">valid observation; Do Not credit if textbook or too much detail
<table>
<tr><td>epidermal cells</td><td>oil droplet Do not credit if nucleus present</td></tr>
<tr><td></td><td>projection on outer wall</td></tr>
<tr><td></td><td>granules inside</td></tr>
<tr><td></td><td>1 cell shape has vertical sides and a bowed upper and lower surfaces</td></tr>
</table></td><td>[1]</td></tr>
<tr><td>MMO decisions 2</td><td colspan="4">Any two correct
epidermal/mesophyll/other layer of cell(s)
cell wall
nucleus (on mesophyll cell) Ignore on epidermis
cytoplasm
air space (between cells)
chloroplast (in mesophyll cell)
vacuole
oil droplet/highly stained part of cell/darkened area/AW (in epidermal cell)
Ignore starch grain/cell membrane</td><td>[max 2]</td></tr>
</table>

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(b) Calculate the area of view. Count and record no. of stomata in field of view. Calculate no. of stomata per mm^2.			
PDO display 1	calculation of field of view shown; 3.14×0.15^2 or $3.14 \times (1.5 \times 10^{-1})^2$ $(3.14 \times 150^2)(/1000\ 000$ or $10^6)$; Credit $(3.14 \times 300^2/4)$ $(/1000\ 000/10^6$ or $\times 10^{-6})$		[1]
MMO collection 1	ref to 0.15 mm/150 µm;		[1]
MMO decision 1	(uses stage micrometer to obtain) diameter 300 µm/0.3 mm or radius/0.15 mm/ 150 µm;		[1]
MMO collection 1	marks stomata on fig. AND between 20 and 36;		[1]
PDO display 1	shows number of stomata divided by their calculated area/correct answer whole number only;		[1]

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(c) Show the differences between the cells in Fig. 2.2 and Fig. 2.4.

PDO recording 1	organise as a table/ Venn diagram/ ruled connected boxes	headed	comparative statements opposite each other; First two statements.		
ACE interpretation 1 ACE conclusion 1					[max 2]

feature	Fig. 2.4	Fig. 2.5
number of stomata/ cells	more/calculated no. per mm^2	fewer/calculated no. per mm^2;
size of stomata/cells	smaller	larger/longer;
shape of stomata/cells	oval/rounded/irregular/ puzzle-shaped/	rectangular/triangular/ regular;
orientation of stomata/ cells	random/scattered/ irregular	lined up/parallel; /regular;
(epidermal) cell walls	thinner/smoother	thicker/rougher/ folded;
	(folded/irregular) all round	folded along sides/no folds at ends;

Ignore stomata open and closed/sunken.
Ignore drawings credit annotations if comparative

[Total: 19]

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