Cambridge International Examinations
Cambridge Pre-U Certificate

BIOLOGY **9790/02**

Paper 2 Data Analysis and Planning **May/June 2017**

MARK SCHEME

Maximum Mark: 60

Published

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Notes:

The following abbreviations may be used in mark schemes:

;	separates marking points
/	alternative and acceptable answers for the same marking point
allow / accept / **A**	answers that can be accepted
not / reject / **R**	answers that are not worthy of credit
ignore / **I**	statements that are irrelevant – applies to neutral answers
AW / owtte	credit alternative wording / or words to that effect
ecf	error carried forward
(words)	bracketed words that are not essential to gain credit
<u>words</u>	underlined words must be present in answer to gain credit
max	indicates the maximum number of marks that can be given
ORA	or reverse argument
AVP	any valid point – marking points not listed on the mark scheme but which are worthy of credit

Question	Answer	Marks
1(a)	(i) –11 **;** (ii) –10.0 **; A** –10 (iii) –28.2 **; ecf**	**3**
1(b)	*bar chart acceptable or line graph with, glucose / boiled ATP, indicated separately* a. correct axes labels with units **;** *test solution added* *percentage change in length* b. appropriate selection of scales with plots drawn to occupy at least half of grid along both axes **;** c. all plots correct **;** d. glucose and boiled ATP data shown **;** *glucose data may be a point plotted at 0 mg dm^{-3} ATP* *e. either* bars not in contact with each other **R** histogram OR line graph with suitable line of best fit for 0.1 to 1.0 mg dm^{-3} ATP **;**	**5**
1(c)(i)	*description (internal max 3):* a. muscles / muscle fibres, shorten when ATP added **;** b increasing concentrations of ATP leads to increased shortening **;** c. ref. to, levelling off / plateau at higher concentration **;** d. use of comparative data **;** *explanation (internal max 3):* e. ATP used as an immediate source of energy / ATP hydrolysed **;** f. (ATP) causes myosin heads to detach from actin **;** g. myosin heads, change shape / bend (power stroke) **;** h. actin filaments pulled together (so muscle shortens) **;**	**5**

Question	Answer	Marks
1(c)(ii)	*description:* a. ATP causes contraction / change in length **and** glucose does not cause contraction **;** *max 3 for explanation* *ATP explanation* b. (no / little / slight difference between boiled and unboiled ATP) because ATP unaffected by boiling; c. ATP, not a protein **;** d. (less effect than unboiled) because (some) ATP breaks down on boiling **;** *glucose explanation* e. glucose not used for respiration / respiration too slow **;** f. glucose not a suitable, substrate (for ATPase) / source of energy **;** g. glucose can't enter muscle fibres (fast enough) **;**	**4**
1(d)	*any two from:* a. muscle tissue may be damaged **;** b. muscle tissue may be different, qualified (e.g. width / diameter / type / species) **;** c. ATP concentrations, only four / not at regular intervals / not enough intermediates **; I** ref. to range d. only one glucose concentration **;** e. ref. to temperature fluctuation / AW **;** f. ref. to only one time interval **;** g. no replicates **;** h. volume of test solution not given / may be different **;** i. no control with, 0 mg dm^{-3} ATP used / water **;** j. AVP **;** e.g. ATP activity may vary / unstable compound / no control of calcium levels	**2**
2(a)	*any four from:* a. rate rises as CO_2 concentration increases for both **;** b. C4 higher rate of photosynthesis at lower CO_2 concentration / **ORA ;** c. C3 and C4 have similar / rate at 0.05% **; A** C3 higher d. C4 starts to, level off / plateau, around 0.03% CO_2 **;** e. C3 shows a greater increase (as CO_2 concentration increases) / **ORA ;** f. difference in rate decreases as CO_2 concentration increases; g. calculation of a gradient **;** h. use of comparative data **;** *units stated at least once*	**4**

Question	Answer	Marks
2(b)	*any five from:* *low CO_2* **C3** a. (lower as) O_2 out-competes CO_2 / high O_2 : CO_2 **;** b. for rubisco **;** c. increased photorespiration / reduced photosynthesis **C4** d. (higher as) separation of, O_2 from CO_2 / LDR from LIR (ref to PEP, OA, malate) **;** e. rubisco not inhibited / ref. to role **;** f. reduced photorespiration **;** g. ref. to leaf anatomy (Kranz, bundle sheath) **;** *high CO_2* **C3** h. CO_2 out-competes O_2 (for rubisco) **;** **C4** i. other factor limiting / CO_2 no longer limiting **;** j. ref to ATP use / malate transport **;**	**5**
2(c)(i)	allows comparison between plants with, different areas / numbers of leaves **;**	**1**
2(c)(ii)	*answer assumes C4 type / ORA C3 type* *any three from:* a. C4 more efficient at using CO_2 **;** b. smaller stomata aperture **;** c. fewer stomata **;** d. stomata need to be open for less time **;** e. more stomata results in greater loss of water vapour **;** f. stomata closed during this 12 hour period; g. AVP **;** e.g. any relevant structural feature	**3**

Question	Answer	Marks
2(d)	*minimum of 1 explanation* *when:* a. higher temperatures **;** **A** ref. to global warming **;** b. high light intensity **;** c. low CO_2 concentration **;** d. dry conditions **;** *explanation:* e. no / less, photorespiration / protected from high O_2 concentration **;** f. stomata don't need to be opened as much **/** reduced water vapour loss **;**	**3**

Question	Answer	Marks
P = defining the problem M = methods **Analysis, conclusions and evaluation** A = Interpretation of data or observations and identifying sources of error C = Drawing conclusions E = Suggesting Improvements and evaluation		
3	*any 25 from:* **P – defining the problem** a. hypothesis or null hypothesis or prediction **;** e.g. malonate is a competitive inhibitor b. theory to support hypothesis or prediction **;** e.g. malonate competes with succinate for the SDH active site / increasing concentration of succinate will out-compete malonate inhibitor c. identifies independent variable **;** concentration of succinate / presence absence of malonate d. identifies dependent variable **;** time to reach an end-point e.g. time to go colourless / to reach an absorbance reading, absorbance after set time interval e. identifies at least two control variables **;** e.g. temperature, concentration / volume, of pea cell suspension, pH, volumes of named solutions used, inhibitor concentration, time interval as appropriate f. risk assessment **;** ref. to hazard and precaution *some points may be taken from a diagram or a flow or sequence diagram*	**25**

Question	Answer	Marks
	M – methods g. use a range of (at least five) concentrations of succinate (including zero) ; h. dilution table for succinate ; i. add 1% inhibitor (malonate) at appropriate time ; j. add indicator solution (0.005% methylene blue) ; k. equilibrate pea cell suspension and succinate separately in a water bath at stated temperature (15–35 °C) ; l. use of a pH meter ; m. add pea suspension to diluted succinate solutions ; n. mix / stir thoroughly / use of a stirrer ; o. staggered start / timing sequence ; p. time until, methylene blue goes colourless / set colour / set absorbance OR absorbance after set time ; q. judgement of endpoint (use of comparator tube / white card / cross on paper) OR use of colorimeter ; r. repeat without malonate ; s. repeats / replicates to obtain at least three sets of results ; t. use of a control (boiled pea suspension) ;	

Question	Answer	Marks
	A – analysis u. suitable table drawn to record results ; v. calculation of rate (1 / time) ; w. calculation of, standard deviation / standard error / 95% CL ; x. plot as a line graph [succinate] on *x*-axis, (mean) rate on *y*-axis ; y. find V_{max} ; z. find K_m or K_i ; Ψ. state effects of inhibitor on, V_{max} ; competitive no effect on Vmax (at high [S]), non-competitive decreases V_{max} ϕ. state effect of inhibitor on K_m ; competitive increases K_m, non-competitive no effect on K_m π. discuss effects of S concentration on inhibition ; μ. use of a suitable statistical test in correct context ; β. use of error bars / SD / SE ;	