



BIOLOGY

9790/02

Paper 2 Data Analysis and Planning

May/June 2017

MARK SCHEME

Maximum Mark: 60

Published

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

Question	Answer	Marks
1(c)(ii)	<p><i>description:</i> a. ATP causes contraction / change in length and glucose does not cause contraction ;</p> <p><i>max 3 for explanation</i></p> <p><i>ATP explanation</i> 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 ;</p> <p><i>glucose explanation</i> 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) ;</p>	4
1(d)	<p><i>any two from:</i> 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</p>	2
2(a)	<p><i>any four from:</i> a. rate rises as CO₂ concentration increases for both ; b. C4 higher rate of photosynthesis at lower CO₂ 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% CO₂ ; e. C3 shows a greater increase (as CO₂ concentration increases) / ORA ; f. difference in rate decreases as CO₂ concentration increases; g. calculation of a gradient ; h. use of comparative data ; <i>units stated at least once</i></p>	4

Question	Answer	Marks
2(b)	<p><i>any five from:</i></p> <p><i>low CO₂</i></p> <p>C3</p> <p>a. (lower as) O₂ out-competes CO₂ / high O₂ : CO₂ ; b. for rubisco ; c. increased photorespiration / reduced photosynthesis</p> <p>C4</p> <p>d. (higher as) separation of, O₂ from CO₂ / 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) ;</p> <p><i>high CO₂</i></p> <p>C3</p> <p>h. CO₂ out-competes O₂ (for rubisco) ;</p> <p>C4</p> <p>i. other factor limiting / CO₂ no longer limiting ; j. ref to ATP use / malate transport ;</p>	5
2(c)(i)	allows comparison between plants with, different areas / numbers of leaves ;	1
2(c)(ii)	<p><i>answer assumes C4 type / ORA C3 type</i></p> <p><i>any three from:</i></p> <p>a. C4 more efficient at using CO₂ ; 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</p>	3

Question	Answer	Marks
2(d)	<p><i>minimum of 1 explanation</i></p> <p><i>when:</i></p> <ul style="list-style-type: none">a. higher temperatures ; A ref. to global warming ;b. high light intensity ;c. low CO₂ concentration ;d. dry conditions ; <p><i>explanation:</i></p> <ul style="list-style-type: none">e. no / less, photorespiration / protected from high O₂ concentration ;f. stomata don't need to be opened as much / reduced water vapour loss ;	3

Question	Answer	Marks
	<p>P = defining the problem M = methods</p> <p>Analysis, conclusions and evaluation</p> <p>A = Interpretation of data or observations and identifying sources of error C = Drawing conclusions E = Suggesting Improvements and evaluation</p>	
3	<p><i>any 25 from:</i></p> <p>P – defining the problem</p> <p>a. hypothesis or null hypothesis or prediction ; e.g. malonate is a competitive inhibitor</p> <p>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</p> <p>c. identifies independent variable ; concentration of succinate / presence absence of malonate</p> <p>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</p> <p>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</p> <p>f. risk assessment ; ref. to hazard and precaution</p> <p><i>some points may be taken from a diagram or a flow or sequence diagram</i></p>	25

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

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