Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2017**

MARK SCHEME

Maximum Mark: 30

Published

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Mark scheme abbreviations

;	separates marking points
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R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
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ecf	error carried forward
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AVP	alternative valid point

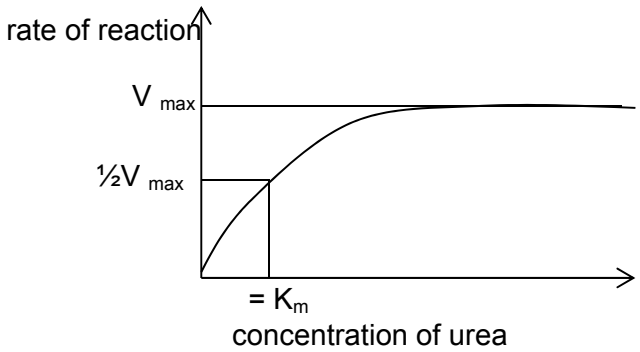
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Question	Answer	Marks
1(a)(i)	weigh / measure (out) / take / put / add / use/ AW, 6 (.01) g urea **;** add 500 cm^3 (distilled / deionised) water (and stir until dissolved) **;**	**2**
1(a)(ii)	*idea of* removing (a known and) same volume of urea solution (with second dilution taken from first dilution, etc.) at each stage of dilution **;** *idea of* adding (a known and) same volume of (distilled) water at each stage of dilution **;** **A** as a diagram showing sequence of dilution **A** as a table showing volumes (and concentrations) **A** proportional dilution for max 1 (ecf) if 4 dilutions correctly gained	**2**
1(b)(i)	*independent* temperature **;** *dependent* conductivity (of enzyme and substrate / ions / solution) **; A** in conductivity units	**2**
1(b)(ii)	substituting, the active enzyme / urease, by an unreactive substance (at all temperatures) **A** e.g. boiled or denatured enzyme / water in place of enzyme / 0.0M enzyme / (solution of) urea without urease **or** substituting, urea / substrate, with water **;** **I** 'use (distilled) water' unqualified **A** e.g. water in place of substrate / 0.0M substrate / (solution of) urease without urea	**1**

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Question	Answer	Marks
1(b)(iii)	*max 5 if mp7 not given* *any 6 from*: 1 *ref. to* a suitable range of at least 5 temperatures **;** **A** any 5 in the range 10–70 °C 2 *ref. to* using suitable apparatus (to incubate enzyme and urea solutions at constant temperature(s)) **;** e.g. (thermostatically controlled) water baths / incubators / thermostatically or temperature controlled room / (magnetic stirrer) hotplate **A** beaker plus hot water as water-bath **I** air conditioning 3 *ref. to* using same volume of urease each time **;** *total volume must not exceed 30 cm^3* 4 *ref. to* using same volume of (each) urea concentration **;** *total volume must not exceed 30 cm^3* 5 *ref. to* using (same volume of) buffer to maintain a constant pH **;** **A** use buffer to control pH *procedure:* *6* *ref. to* incubating urease **and** urea concentrations separately **;** 7 *ref. to* mixing urea and urease solutions (on the magnetic stirrer) **and** immersing (conductivity) probe **;** **I** 'probe is used' unqualified 8 *ref. to* taking reading (from meter) at same time (for each solution / temperature) **;** **A** any stated time from 0 s to 5 min **A** take reading immediately / AW **A** 'use meter to measure rate of reaction' if time context correct 9 *ref. to* testing each of the concentrations (of urea) at each temperature **;** 10 *ref. to* a min. of 3 replicates / repeats **and** a mean / find anomalies **;**	**6**

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Question	Answer	Marks
1(b)(iii)	11 *ref. to* suitable hazard and precaution **;** **A** low risk experiment **I** medium risk experiment **R** no risk / high risk **A** urease / enzyme is allergen or irritant **and** wear gloves / goggles **A** Ammonia (given off at high temperature) is irritant / mask or gloves	
1(c)(i)	1 one curve drawn correctly **;** *does not need to go through origin* **A** straight line up then level without curving 2 V_{max} shown **;** 3 $½V_{max}$ shown **;**  4 K_m shown **; A** Michaelis-Menten (constant)	**4**
1(c)(ii)	1 **D ;** 2 (temperature showing) lowest K_m **or** shows, greater / greatest / higher / highest, affinity (of the, enzyme / urease) for its substrate / AW **;**	**2**

Question	Answer	Marks
2(a)(i)	*any 1 from:* 1 time of soaking (grain in the salt solutions) / 12 hours soaking for each set / AW **;** 2 number of grains (soaked in each, salt concentration / set / covered petri dish) **;** 3 temperature (of germination / incubation) **;** *20 °C if quoted* 4 time intervals of recording (germination) **;** **A** recorded at 8 hour intervals **or** recorded over 5 days 5 *idea of* taking a standard appearance of grain when judged to be germinated **;** *e.g. emergence of radicle*	**1**
2(a)(ii)	*any 1 from:* 1 volume of (salt) solution used, on the filter paper / in the (Petri) dish **;** **I** 'amount' unqualified 2 age of grain **;** 3 (use) undamaged / not infected / not diseased / AW, grain **;** **I** size / mass, of grain 4 *idea of* light (exposure of grains during germination / breaking dormancy) **;** 5 supply of, air / oxygen (to the grain) **;** 6 *idea of* spacing of grains **;** 7 pH (of solution) **;**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(b)(i)</td><td>
<table>
<tr><td rowspan="3">concentration of salt solution / mmol dm^{-3}</td><td colspan="4">mean (cumulative) percentage of grains that had germinated each day</td></tr>
<tr><td colspan="2">1</td><td colspan="2">5</td></tr>
<tr><td>X</td><td>Y</td><td>X</td><td>Y</td></tr>
<tr><td>0</td><td>93.8</td><td>92.0</td><td>98.0</td><td>97.0</td></tr>
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</table>
</td><td>2</td></tr>
<tr><td>2(b)(ii)</td><td>1 Pearson’s linear correlation ;
A Pearson's R Pearson's Rank correlation

2 data collected is continuous

or data, is / seems to be, (from a population that is) normally distributed

or data / results, appears to be linear ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
2(c)	***I** data quotes unqualified* *any 3 from:* 1 *idea that* (germination is rapid because) nearly all / approx. 90% / majority / most, of grains, germinated during the first day **;** 2 *idea that* (control shows) some of the barley, will not germinate, over the period of the experiment / in the first five days **;** 3 percentage germination (generally), decreases as concentration of salt increases / increases as concentration of salt decreases **;** **A** *idea of* negative correlation 4 more grains have germinated after 5 days (than after 1 day) / ora **;**	**3**
2(d)(i)	*must be comparative* ***I** data quotes unqualified* germination of barley is, higher / highest, in **X** (than **Y** at, all salt concentrations / every value / stated value(s) from 30 mmol dm^{-3} to 60 mmol dm^{-3}) **;**	**1**
2(d)(ii)	*any 1 from:* 1 *idea of* measuring / recording / investigating / AW, germination of, **X** and **Y** / both, in salty soil **;** 2 *idea of* measuring / recording / investigating / AW, growth of, **X** and **Y** / both, in salty soil **;** 3 *idea of* measuring / recording / investigating / AW, yield of, **X** and **Y** / both, in salty soil **;** 4 AVP **;** e.g. a field investigation involving a transect across an area from low to high salt then measuring abundance of the types along the transect	**1**

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<tr><td>1(a)(i)</td><td>(weigh) 51.345 / 51.35 / 51.34 / 51.4 / 51.3 g lactose ;

1 dm^3 (distilled / deionised) water (and stir until dissolved) ;</td><td>2</td></tr>
<tr><td>1(a)(ii)</td><td>idea of using different volumes of (0.15 mol dm^{-3} / stock) solution ;

idea of adding correct volume of (distilled) water to make four dilutions each of 500 cm^3 ;

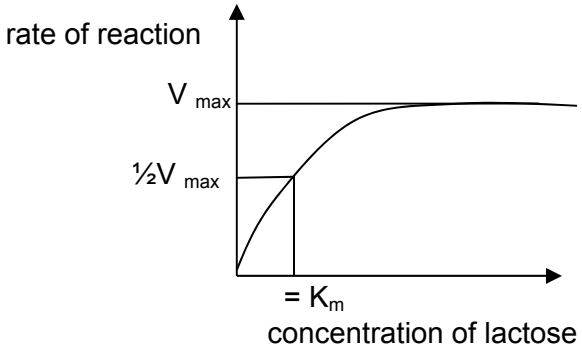
e.g. for 2 marks
<table><tr><th>vol 0.15 mol dm^{-3} / cm^3</th><th>vol. water / cm^3</th><th>(conc)</th></tr><tr><td>400</td><td>100</td><td>0.12</td></tr><tr><td>300</td><td>200</td><td>0.09</td></tr><tr><td>200</td><td>300</td><td>0.06</td></tr><tr><td>100</td><td>400</td><td>0.03</td></tr></table>
R serial dilution procedure</td><td>2</td></tr>
<tr><td>1(b)(i)</td><td>independent: pH ;

dependent : glucose concentration ;</td><td>2</td></tr>
<tr><td>1(b)(ii)</td><td>idea of
substituting the active enzyme by an unreactive substance (at all pH)
or
substituting lactose with water / 0.0M lactose or another sugar ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
1(b)(iii)	*max 5 if mp7 not given* *any 6 from*: 1 *ref. to* a suitable range of at least 5 different pH **;** **A** any 5 in the range 1–14 2 *ref to* using (same volume of each) buffer solution **;** 3 *ref. to* using same volume of lactase solution for (each) measurement **;** *total volume must not exceed 30 cm^3* 4 *ref. to* using same volume of (each) lactose concentration **;** *total volume must not exceed 30 cm^3* 5 *ref. to* maintaining a constant temperature using a suitable method **;** *procedure:* 6 *ref. to* incubating lactose and lactase solutions separately **;** 7 *ref. to* adding lactose **and** lactase solutions together and immersing glucose biosensor without delay (i.e. no additional steps / no stirring) **;** 8 *ref. to* taking a glucose reading after the same time for each solution tested (minimum of two) **;** 9 *ref. to* testing each of their concentrations of substrate at every pH **;** 10 *ref. to* a minimum of 3 replicates and a mean / find anomalies **;** 11 low risk experiment **;**	**6**

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Question	Answer	Marks
1(c)(i)	one curve drawn correctly ; V_{max} shown ; $½V_{max}$ shown ; K_m shown ;  	**4**
1(c)(ii)	**B** ; the (K_m) value is low<u>est</u> / it shows the great<u>est</u> affinity (of the enzyme) for its substrate ;	**2**
2(a)(i)	*any 1 from:* volume of (salt) solution used for irrigation ; time (of day or length of watering time) at which irrigated (in the field plots) ; any other added nutrient / fertiliser used on the crop plants ;	**1**

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Question	Answer	Marks
2(a)(ii)	*any 1 from:* 1 temperature **;** 2 (sun)light (availability) **;** 3 rainfall / soil water **;** 4 humidity / wind **;** 5 (variation in) soil pH **;** 6 other soil feature e.g. drainage / fertility / nutrients already present / aeration / type of soil **;** 7 pests / disease **;**	**1**
2(b)	*idea of* water content of the (different) crops / plants will vary **;** to allow comparison between different crops / plants **;** (dry mass) is the organic matter / biomass **;**	**2**
2(c)	plot the yields for each crop on a graph (including for control plots irrigated with water) **; A** annotated sketch use intercept at 50% / half the yield to find salt concentration **; A** annotated sketch **or** find the yield / dry mass of control **and** halve / find 50% **; A** in an equation showing percentage loss find which of the concentrations gives yield that is closest match to half the control **; A** in an equation showing percentage loss	**2**

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Question	Answer	Marks
2(d)	*any 3 from:* 1 the growth monocotyledons are less affected than dicotyledons **; ora** 2 potato growth is most decreased by salinity / most sensitive **;** 3 barley growth is least decreased by salinity / most tolerant **;** 4 all (crop / yields) are affected by / are sensitive to (saline) **;** 5 all dicotyledons are reduced by narrow(er) range of concentrations / concentrations between 1.0–1.3 g dm^{-3} **or** monocotyledons are reduced by a wide(r) range of concentrations / concentrations between 2.3–4.8 g dm^{-3} **;** 6 no crops have 50% yield reduction in concentrations below 1.0 g dm^{-3} **;**	**3**
2(e)	*any 2 from:* 1 *ref. to* different environmental conditions **;** 2 does not allow for different cultivation methods / examples of different methods of cultivation **;** 3 seeds are planted directly in saline soil / seeds are not pre-germinated in salt-free conditions **;** 4 does not allow for build-up of salinity from irrigation **;**	**2**

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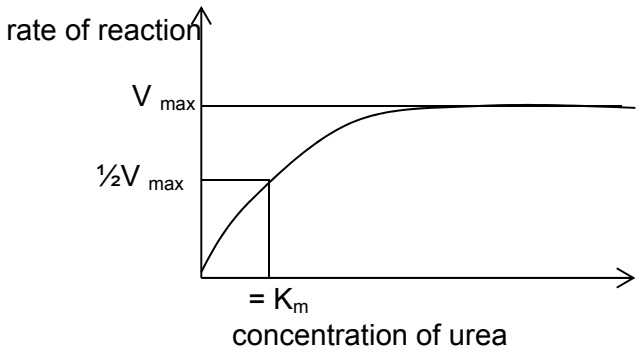
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1(a)(ii)	*idea of* removing (a known and) same volume of urea solution (with second dilution taken from first dilution, etc.) at each stage of dilution **;** *idea of* adding (a known and) same volume of (distilled) water at each stage of dilution **;** **A** as a diagram showing sequence of dilution **A** as a table showing volumes (and concentrations) **A** proportional dilution for max 1 (ecf) if 4 dilutions correctly gained	**2**
1(b)(i)	*independent* temperature **;** *dependent* conductivity (of enzyme and substrate / ions / solution) **; A** in conductivity units	**2**
1(b)(ii)	substituting, the active enzyme / urease, by an unreactive substance (at all temperatures) **A** e.g. boiled or denatured enzyme / water in place of enzyme / 0.0M enzyme / (solution of) urease without urease **or** substituting, urea / substrate, with water **;** **I** 'use (distilled) water' unqualified **A** e.g. water in place of substrate / 0.0M substrate / (solution of) urease without urea	**1**

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Question	Answer	Marks
1(b)(iii)	*max 5 if mp7 not given* *any 6 from*: 1 *ref. to* a suitable range of at least 5 temperatures **;** **A** any 5 in the range 10–70 °C 2 *ref. to* using suitable apparatus (to incubate enzyme and urea solutions at constant temperature(s)) **;** e.g. (thermostatically controlled) water baths / incubators / thermostatically or temperature controlled room / (magnetic stirrer) hotplate **A** beaker plus hot water as water-bath **I** air conditioning 3 *ref. to* using same volume of urease each time **;** *total volume must not exceed 30 cm^3* 4 *ref. to* using same volume of (each) urea concentration **;** *total volume must not exceed 30 cm^3* 5 *ref. to* using (same volume of) buffer to maintain a constant pH **;** **A** use buffer to control pH *procedure:* *6* *ref. to* incubating urease **and** urea concentrations separately **;** 7 *ref. to* mixing urea and urease solutions (on the magnetic stirrer) **and** immersing (conductivity) probe **;** **I** 'probe is used' unqualified 8 *ref. to* taking reading (from meter) at same time (for each solution / temperature) **;** **A** any stated time from 0 s to 5 min **A** take reading immediately / AW **A** 'use meter to measure rate of reaction' if time context correct 9 *ref. to* testing each of the concentrations (of urea) at each temperature **;** 10 *ref. to* a min. of 3 replicates / repeats **and** a mean / find anomalies **;**	**6**

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Question	Answer	Marks
1(b)(iii)	11 *ref. to* suitable hazard and precaution **;** **A** low risk experiment **I** medium risk experiment **R** no risk / high risk **A** urease / enzyme is allergen or irritant **and** wear gloves / goggles **A** Ammonia (given off at high temperature) is irritant / mask or gloves	
1(c)(i)	1 one curve drawn correctly **;** *does not need to go through origin* **A** straight line up then level without curving 2 V_{max} shown **;** 3 $\frac{1}{2}V_{max}$ shown **;**  4 K_m shown **; A** Michaelis-Menten (constant)	**4**
1(c)(ii)	1 **D ;** 2 (temperature showing) lowest K_m **or** shows, greater / greatest / higher / highest, affinity (of the, enzyme / urease) for its substrate / AW **;**	**2**

Question	Answer	Marks
2(a)(i)	*any 1 from:* 1 time of soaking (grain in the salt solutions) / 12 hours soaking for each set / AW **;** 2 number of grains (soaked in each, salt concentration / set / covered petri dish) **;** 3 temperature (of germination / incubation) **;** *20 °C if quoted* 4 time intervals of recording (germination) **;** **A** recorded at 8 hour intervals **or** recorded over 5 days 5 *idea of* taking a standard appearance of grain when judged to be germinated **;** *e.g. emergence of radicle*	**1**
2(a)(ii)	*any 1 from:* 1 volume of (salt) solution used, on the filter paper / in the (Petri) dish **;** **I** 'amount' unqualified 2 age of grain **;** 3 (use) undamaged / not infected / not diseased / AW, grain **;** **I** size / mass, of grain 4 *idea of* light (exposure of grains during germination / breaking dormancy) **;** 5 supply of, air / oxygen (to the grain) **;** 6 *idea of* spacing of grains **;** 7 pH (of solution) **;**	**1**

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A Pearson's R Pearson's Rank correlation

2 data collected is continuous

or data, is / seems to be, (from a population that is) normally distributed

or data / results, appears to be linear ;</td><td>2</td></tr>
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2(c)	***I** data quotes unqualified* *any 3 from:* 1 *idea that* (germination is rapid because) nearly all / approx. 90% / majority / most, of grains, germinated during the first day **;** 2 *idea that* (control shows) some of the barley, will not germinate, over the period of the experiment / in the first five days **;** 3 percentage germination (generally), decreases as concentration of salt increases / increases as concentration of salt decreases **;** **A** *idea of* negative correlation 4 more grains have germinated after 5 days (than after 1 day) / ora **;**	**3**
2(d)(i)	*must be comparative* ***I** data quotes unqualified* germination of barley is, higher / highest, in **X** (than **Y** at, all salt concentrations / every value / stated value(s) from 30 mmol dm^{-3} to 60 mmol dm^{-3}) **;**	**1**
2(d)(ii)	*any 1 from:* 1 *idea of* measuring / recording / investigating / AW, germination of, **X** and **Y** / both, in salty soil **;** 2 *idea of* measuring / recording / investigating / AW, growth of, **X** and **Y** / both, in salty soil **;** 3 *idea of* measuring / recording / investigating / AW, yield of, **X** and **Y** / both, in salty soil **;** 4 AVP **;** e.g. a field investigation involving a transect across an area from low to high salt then measuring abundance of the types along the transect	**1**

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