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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9700 BIOLOGY

9700/51 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for responses correctly cued by the question, or by extra guidance)
I	ignore
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted).
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	type(s) of enzyme / endopeptidase or exopeptidase **;**	**A** – the enzyme / the protease	[1]
(ii)	*(max 1)* Temperature + pH + time between samples **;** 2 of *(max 2)*: temperature – use a water bath / incubator / thermostatically controlled room **;** pH – use a buffer **;** time intervals – use a stop clock / stop watch / timer / AW **;**	**R** if more than 3 given **A** description of time / sample at 5 minute intervals *method must match the related variable* **I** air conditioning **A** named buffer **R** neutral buffer	[max 3]
(iii)	*idea of* when two (successive) chromatograms give the same results **or** no more change in results / chromatograms / spots **;**		[1]
(b)	**A** *from diagrams where applicable* 8 of: mp1 *idea of* chromatograms using hydrolysed extracts of **both** enzymes **;** mp2 *ref. to* observing / counting the number of, spots / AW **or** measurement of the distance moved by each product **;** mp3 comparison between chromatograms of the different proteases **;**	 **A** *ref. to* known markers / known standard chromatogram **I** (calculate) R_f unqualified *must have an idea of measuring a distance* **A** if R_f formula given which includes, spot / AW, distance	

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Question	Expected answer	Extra guidance	Mark
	mp4 *ref. to* running **all** chromatograms for same time **or** running to same distance moved by solvent front **;**	if time stated, then minimum of 5 minutes **A** if both extracts on same chromatogram **A** *idea of* 'almost reach / just before, the highest level' **I** stopping 'before' unqualified **R** if allow to run off the end	
	mp5 *ref. to* same number of applications applied to origin **;**	**A** spots / drops / a spot / AW **I** volume	
	procedure mp6 *ref. to* using capillary tube to give a spot (on the chromatography paper) **;**	**A** other suitable method of applying sample to give a small spot e.g. pin head / cocktail stick / toothpick / Pasteur pipette / AW	
	mp7 *ref. to* drawing **or** using a base line / line of origin **;**	**R** if line not drawn with pencil **A** suitable method for TLC	
	mp8 *idea of* concentrating the extract either by drying between adding spots **or** evaporating the extract (before using) **;**	**R** if extract is dried before using	
	mp9 *idea of* placing in solvent so that the level of solvent is below the origin line / sample / AW **;**	**A** in terms of precise measurements position of line and solvent **I** the name of the solvent, including water	
	mp10 *ref. to* covering to prevent evaporation / maintain a saturated environment **;**	**I** airtight unqualified	
	mp11 *ref. to* drying before spraying with dye **;**	**I** name of dye	
	mp12 *idea of* running at least 3 chromatograms for both enzymes **;**	*must have mp1 to credit mp12* **A** 'repeat the experiment 3 times' *only if* description has a chromatogram from each extract	
	mp13 *ref to* taking mean of / averaging, distances travelled by each spot **or** taking mean of / averaging R_f values **;**	**R** mean unqualified	

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Question	Expected answer	Extra guidance	Mark
	mp14 *safety* 1 of: *ref. to* flammable solvents **and** no naked flames **;** *ref. to* flammable solvent or toxic solvent / dye **and** safe disposal **;** *ref. to* allergy to dyes / solvents **and** wear gloves **;** *ref. to* toxic / irritant / corrosive solvent or dye **and** wear gloves / mask / eye protection / use fume cupboard / keep covered **;**	**I** ref. to the enzymes **I** chemicals unqualified **A** poisonous	[max 8]
(c)	*must state whether supported or not with reason* mp1 supported, because the time of digestion is shorter **/** fewer 'spots' **;** mp2 not supported, some will be dipeptides (and tripeptides) **;** mp3 not supported, because there is no evidence or information about charge **;** mp4 supported, as the endoprotease gives the exoprotease more 'ends to work on **;**	**ora** exoprotease gives more 'spots' / takes longer. **A** numbers (5 / 6 vs 17) **A** not all single amino acids **A** *idea that* movement is determined by solubility (and not charge) **R** *ref. to* weight / movement of the solvent	[4]
(d) (i)	circle around **only** the 3rd spot from the left on **both** chromatograms **;**	**I** any circles on the electrophoretograms **R** if extra spots ringed on chromatograms	[1]
(ii)	*need ref. to a sickle or normal peptide / amino acid **and** ref. to distance* *idea that* the sickle cell peptide / amino acid has moved a different distance / moved further (from the normal peptide) / **ora** **or** (sickle cell) peptide / amino acid has different charge / solubility (from the normal peptide) **;**	*if direction stated it must be correct e.g. sickle cell peptide has not moved as far to anode (positive electrode)* **A** (sickle cell) spot moves different distance / has moved further / has a different R_f value **I** because they look different / different position	[1]
		[Total:19]	

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Question	Expected answer	Extra guidance	Mark
2 (a) (i)	number of aphids (on each surface of the leaf) **;**		[1]
(ii)	*idea of* using the same oily liquid (used for spraying) without the insecticide **;**	**R** water **A** oily liquid with water	[1]
(b) (i)	(standard error) is an estimate of / shows the reliability of the (population) mean **or** is the closeness of sample mean to, population / actual / true, mean **;**	*do not allow definitions of standard deviation* **I** formula used to calculate S_M **R** accuracy / reference to results or to data	[1]
(ii)	lower side of leaf treated / group B at 24, 48 and 72 hours **;** there is no overlap between the standard errors / S_M **;**	**A** any 2 from the 3 times **R** error bars	[2]

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Question	Expected answer	Extra guidance	Mark
(c)	*assume group **A** and group **B** are the treated leaves unless otherwise stated* 3 of: mp1 there are approximately the same (mean) number of aphids on all of the leaves before spraying **;** mp2 in both controls the number of aphids increases **;** mp3 insecticide is effective when sprayed on the lower surface of the leaves but not on the upper surface **;** mp4 in group **B** the number of aphids decreases (steeply) by 24 hours **;** mp5 in group **B** the (mean) number of aphids remains low from 24–72 hours **;** mp6 in group **A** the (mean) number of aphids increases (slightly) on the leaves over the time of the investigation / 24 / 48 / 72 hours **;** mp7 there is more variation in the number of aphids on the control in Group **B** **;**	**I** *answers given in terms of S_M and reliability* **A** the number of aphids goes down in group **B** but not in group **A** **A** decreases until 48 hours **A** the number of aphids on group **B** leaves went down and stayed down	[3]
(d) (i)	1 of: comparing two means **;** normal distribution **;** continuous data **;**	**R** continuous variable / continuous variation	[max 1]

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Question	Expected answer	Extra guidance	Mark
(ii)	there is no **significant** difference in the (mean total) number of aphids on group **A** and group **B** **or** there is no **significant** difference in the (mean total) number of aphids on the leaves sprayed on the upper side and the leaves sprayed on lower surface **;**	the difference in the (mean total) number of aphids on group **A** and group **B** is **not significant** the difference in the (mean total) number of aphids on the leaves sprayed on the upper side and the leaves sprayed on lower surface is **not significant / not significantly different**	[1]
(iii)	*idea of* 2 samples of 25 and subtracting 1 from each sample **;**	**A** as a formula (25 – 1) + (25 – 1) **R** (n – 1) +(n – 1) unless n is specified	[1]
		[Total: 11]	

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	type(s) of enzyme / endopeptidase or exopeptidase **;**	**A** – the enzyme / the protease	[1]
(ii)	*(max 1)* Temperature + pH + time between samples **;** 2 of *(max 2)*: temperature – use a water bath / incubator / thermostatically controlled room **;** pH – use a buffer **;** time intervals – use a stop clock / stop watch / timer / AW **;**	**R** if more than 3 given **A** description of time / sample at 5 minute intervals *method must match the related variable* **I** air conditioning **A** named buffer **R** neutral buffer	[max 3]
(iii)	*idea of* when two (successive) chromatograms give the same results **or** no more change in results / chromatograms / spots **;**		[1]
(b)	**A** *from diagrams where applicable* 8 of: mp1 *idea of* chromatograms using hydrolysed extracts of **both** enzymes **;** mp2 *ref. to* observing / counting the number of, spots / AW **or** measurement of the distance moved by each product **;** mp3 comparison between chromatograms of the different proteases **;**	 **A** *ref. to* known markers / known standard chromatogram **I** (calculate) R_f unqualified *must have an idea of measuring a distance* **A** if R_f formula given which includes, spot / AW, distance	

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Question	Expected answer	Extra guidance	Mark
	mp4 *ref. to* running **all** chromatograms for same time **or** running to same distance moved by solvent front **;**	if time stated, then minimum of 5 minutes **A** if both extracts on same chromatogram **A** *idea of* 'almost reach / just before, the highest level' **I** stopping 'before' unqualified **R** if allow to run off the end	
	mp5 *ref. to* same number of applications applied to origin **;**	**A** spots / drops / a spot / AW **I** volume	
	procedure mp6 *ref. to* using capillary tube to give a spot (on the chromatography paper) **;**	**A** other suitable method of applying sample to give a small spot e.g. pin head / cocktail stick / toothpick / Pasteur pipette / AW	
	mp7 *ref. to* drawing **or** using a base line / line of origin **;**	**R** if line not drawn with pencil **A** suitable method for TLC	
	mp8 *idea of* concentrating the extract either by drying between adding spots **or** evaporating the extract (before using) **;**	**R** if extract is dried before using	
	mp9 *idea of* placing in solvent so that the level of solvent is below the origin line / sample / AW **;**	**A** in terms of precise measurements position of line and solvent **I** the name of the solvent, including water	
	mp10 *ref. to* covering to prevent evaporation / maintain a saturated environment **;**	**I** airtight unqualified	
	mp11 *ref. to* drying before spraying with dye **;**	**I** name of dye	
	mp12 *idea of* running at least 3 chromatograms for both enzymes **;**	*must have mp1 to credit mp12* **A** 'repeat the experiment 3 times' *only if* description has a chromatogram from each extract	
	mp13 *ref to* taking mean of / averaging, distances travelled by each spot **or** taking mean of / averaging R_f values **;**	**R** mean unqualified	

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	mp14 *safety* 1 of: *ref. to* flammable solvents **and** no naked flames **;** *ref. to* flammable solvent or toxic solvent / dye **and** safe disposal **;** *ref. to* allergy to dyes / solvents **and** wear gloves **;** *ref. to* toxic / irritant / corrosive solvent or dye **and** wear gloves / mask / eye protection / use fume cupboard / keep covered **;**	**I** ref. to the enzymes **I** chemicals unqualified **A** poisonous	[max 8]
(c)	*must state whether supported or not with reason* mp1 supported, because the time of digestion is shorter **/** fewer 'spots' **;** mp2 not supported, some will be dipeptides (and tripeptides) **;** mp3 not supported, because there is no evidence or information about charge **;** mp4 supported, as the endoprotease gives the exoprotease more 'ends to work on **;**	**ora** exoprotease gives more 'spots' / takes longer. **A** numbers (5 / 6 vs 17) **A** not all single amino acids **A** *idea that* movement is determined by solubility (and not charge) **R** *ref. to* weight / movement of the solvent	[4]
(d) (i)	circle around **only** the 3rd spot from the left on **both** chromatograms **;**	**I** any circles on the electrophoretograms **R** if extra spots ringed on chromatograms	[1]
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(ii)	lower side of leaf treated / group B at 24, 48 and 72 hours **;** there is no overlap between the standard errors / S_M **;**	**A** any 2 from the 3 times **R** error bars	[2]

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Question	Expected answer	Extra guidance	Mark
(c)	*assume group **A** and group **B** are the treated leaves unless otherwise stated* 3 of: mp1 there are approximately the same (mean) number of aphids on all of the leaves before spraying **;** mp2 in both controls the number of aphids increases **;** mp3 insecticide is effective when sprayed on the lower surface of the leaves but not on the upper surface **;** mp4 in group **B** the number of aphids decreases (steeply) by 24 hours **;** mp5 in group **B** the (mean) number of aphids remains low from 24–72 hours **;** mp6 in group **A** the (mean) number of aphids increases (slightly) on the leaves over the time of the investigation / 24 / 48 / 72 hours **;** mp7 there is more variation in the number of aphids on the control in Group **B** **;**	**I** *answers given in terms of S_M and reliability* **A** the number of aphids goes down in group **B** but not in group **A** **A** decreases until 48 hours **A** the number of aphids on group **B** leaves went down and stayed down	[3]
(d) (i)	1 of: comparing two means **;** normal distribution **;** continuous data **;**	**R** continuous variable / continuous variation	[max 1]

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Question	Expected answer	Extra guidance	Mark
(ii)	there is no **significant** difference in the (mean total) number of aphids on group **A** and group **B** **or** there is no **significant** difference in the (mean total) number of aphids on the leaves sprayed on the upper side and the leaves sprayed on lower surface **;**	the difference in the (mean total) number of aphids on group **A** and group **B** is **not significant** the difference in the (mean total) number of aphids on the leaves sprayed on the upper side and the leaves sprayed on lower surface is **not significant / not significantly different**	[1]
(iii)	*idea of* 2 samples of 25 and subtracting 1 from each sample **;**	**A** as a formula (25 – 1) + (25 – 1) **R** (n – 1) +(n – 1) unless n is specified	[1]
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ora	or reverse argument
mp	marking point (with relevant number)
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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	type of enzyme(s) / amylase(s) **;**	**A** enzyme(s) **A** named list	[1]
(ii)	*method must match the variable stated* 3 of *(for max 1)*: temperature pH concentration / % / dilution of, starch / substrate time for, hydrolysis / incubation / (product) removal / reaction / AW **;** 2 of *(for max 2)*: temperature – use a, water bath / incubator **;** starch / substrate concentration – use, the same (starch) solution / 2% starch solution, for all of the tests **;** time – use a, (stop) clock / (stop) watch / timer / AW **;** pH – use buffer **;**	**A** thermostatically / temperature, controlled room / AW **I** air conditioning **I** time unqualified **A** time stated as 60 minutes / 'the 60 minutes' **I** incubation / incubating **R** *ref. to* volumes of 2% starch **A** named buffer **R** neutral buffer	[max 3]
(iii)	*idea of* boiled / denatured, enzymes **or** (distilled) water **;**	**A** just / only / AW, starch **A** without enzyme **R** if boil / heat mixture (to denature enzyme)	[1]

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Question	Expected answer	Extra guidance	Mark
(b)	**A** *from diagrams where applicable* 8 of: mp1 *idea of* using extracts hydrolysed by, all / each / 3, enzymes **;** mp2 *ref. to* observation / counting, of the number, of spots / products / AW **or** measurement of, distance / length, moved by each spot / product / AW **;** mp3 *ref. to* comparison of the chromatograms **;** mp4 *ref. to* running chromatograms, for same time / to same distance (of solvent front) **;** mp5 *idea of* same number of applications applied (to origin) **;** *procedure:* mp6 *ref to* using capillary or other suitable method of applying a small sample **;** mp7 *ref to* drawing / using, a, line of origin / base line / sample line / starting line / AW **;** mp8 drying between adding drops **or** evaporating the extract (before using) **;** mp9 *idea of* placing in solvent so that level of solvent is below the, origin / line / spot / AW **;**	**I** *descriptions of hydrolysis* **A** any idea that the 3 enzymes have been tested **A** *ref. to* known markers (**not** comparing to R_f values) **A** measure position of spot **I** 'residue' **I** to find R_f unqualified / *ref. to* solvent front **A** if R_f formula given which includes spot / AW distance **A** 'look at differences between' / AW **A** all extracts on the same chromatogram **A** if time stated must be minimum of 5 minutes **A** *idea of* 'almost reach / just before, the highest level ' **I** stopping 'before' unqualified **R** spot reaches the top **I** volumes **A** dabs / dots / AW **A** stated number including 1 e.g. pin head / cocktail stick / tooth pick / Pasteur pipette / AW **I** solvent line if in context of solvent front **R** if line drawn with soluble marker **A** suitable method for TLC *in context of concentrating the extract* **A** drying between every 2nd drop **I** method of evaporating **A** in terms of precise measurements **I** names of solvents	

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Question	Expected answer	Extra guidance	Mark
	mp10 *ref. to* covering to prevent evaporation ;	**A** maintain saturated environment / AW **I** airtight unqualified	
	mp11 *idea of* drying before spraying (with dye) ;	**I** name of dye	
	mp12 *ref. to* running at least 3 chromatograms per extract / AW ;	**R** 'repeat three times' *must refer only to chromatograms if hydrolysis also described*	
	mp13 *ref. to* taking mean of / averaging, distances travelled by each spot / R_f values ;	**R** mean unqualified	
	safety: mp14 1 of: *ref. to* flammable solvents **so** no naked flames ; *ref. to* toxic / flammable solvents or dyes **so** safe disposal ; *ref. to* allergy to dyes / solvents **so** wear gloves ; *ref. to* irritant / corrosive / toxic, solvents or dyes **so** wear gloves / masks / eye protection / use fume cupboard / keep covered ;	**I** goggles for protection against flames **I** *ref. to* enzymes **A** poison	[max 8]
(c) (i)	chromatogram: **A** | **B** | **C** type of amylase: β (amylase) | α (amylase) | γ (amylase) ;		[1]

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Question	Expected answer	Extra guidance	Mark
(ii)	2 of: mp1 *idea that* α (amylase) gives a variety of, products / spots / blobs / stains / AW **;** mp2 *idea that* β (amylase) gives, one product / one spot / maltose **;** mp3 *idea that* γ (amylase) (only breaks 1–6 links so) some products are, large / may be insoluble / will hardly move / AW **;**	**I** *ref. to* heavy and light **I** *ref. to* glucose described a single molecule such as 'produces many glucose molecules' **R** no products **I** no movement **A** *idea that* having identified two amylase types then other must be the third ;	[max 2]
		[Total:16]	

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Question	Expected answer	Extra guidance	Mark
2 (a) (i)	number of rootworms / (insect) larvae ;		[1]
(ii)	3 of: mp1 four replicates for each, treatment / type ; mp2 large numbers of, maize / plants, used ; mp3 *idea of* standardised planting of each plot ; mp4 *idea of* randomising, treatments / plots (to prevent bias) ; mp5 *idea of* randomising (plants) where (soil) samples are collected ; mp6 5 soil samples for each plot / 20 soil samples (for each treatment) ; mp7 same treatment year 1 and 2 ; mp8 spacing of plots / standard gap between plots / AW ;	**I** size of plots **I** equal numbers of plots of each type **A** quoted numbers, 100 per row / 2400 per plot / 9600 per 4 plots **I** large sample size **A** descriptions such as same, density / spacing **A** same number of rows / 24 rows **I** randomising the number of roundworms collected must qualify 'sample' **A** 'around plant' for 'soil' **I** several	[3]
(b) (i)	control(s) / baseline ;	**R** control variable(s)	[1]
(ii)	1 of: mp1 *idea that* used for numerical comparison (via subtraction) ; mp2 comparison qualified ; mp3 *idea o*: finding effectiveness of treatment ;	**I** 'to compare rootworms' unqualified	[max1]

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(c)	*assume answers refer to Bt maize unless otherwise specified* 3 of: mp1 the number of rootworms was lower on Bt maize (than, insecticide / NBt + In – (except year1, day1) **; ora** mp2 Bt maize is more effective (than, insecticide / NBt + In in year 1 / year 2 / both years / generally) **; ora** mp3 *idea that* the number of rootworms fluctuated during the investigation (regardless of the control method) **;** mp4 *idea that* (as time increases) there is a decrease in the number of rootworms for both treatments / both treatments are effective **;** mp5 numbers of rootworms (in soil) around control (NBt) plants (also) decreases **;** **or** numbers of rootworms for, treatments (Bt / Nbt +In) lower than control / treatments more effective than control / NBt **;** mp6 *idea that* results for year 2 show smaller numbers of rootworms / greater effectiveness as a treatment **;**	**A** Bt gene / cry gene for Bt maize **I** quoted raw data comparative **A** fewer / less for lower **I** 'very effective' unqualified *idea of* general downward trend **A** general idea or in context of stated year(s) *must be statements related to control* **I** *ref. to* trend	[3]
(d) (i)	there is no **significant** difference in the number of rootworms (in the soil) around plants treated with insecticide / NBt + In plants, and Bt plants **;**	**A** the difference in the number of rootworms (in the soil) around insecticide treated plants / NBt + In plants and Bt plants is **not significant / not significantly different**	[1]
(ii)	*idea of* two samples of 20 and subtracting 1 from each of them ; 38 ;	**A** as a formula (20–1) + (20–1) *if the wrong number of samples allow max 1 for correct use in formula*	[2]

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(e)	there is a, 95% / greater than 95%, chance that the difference is due to chance **;;** *not significant (max1)* *idea that* the results are caused by chance **;** *P < 0.05 (max 1)* *idea that* p< 0.05 means that there is only a, less than 5% / 5% chance / probability, of obtaining results by a factor other than chance **or** greater than 95% / 95% certain / sure, that the results are caused by chance **;**	**I** random error throughout **A** any difference (in the results) is due to chance **I** null hypothesis **A** other numerical methods of processing e.g. 1 in 20 **R** misconceptions such as, 5% of results are due to a factor other than chance / 95% of the results are due to chance	[2]
		[Total:14]	

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