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**Cambridge International Advanced Subsidiary and Advanced Level**

# MARK SCHEME for the October/November 2015 series

## 9700 BIOLOGY

**9700/53** Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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Mark scheme abbreviations:

| | |
|---|---|
| **;** | 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 of enzyme(s) / amylase(s) **;** | **A** enzyme(s) **A** named list | [1] |
| (ii) | *method must match the variable stated*<br>3 of *(for max 1)*:<br>temperature<br>pH<br>concentration / % / dilution of, starch / substrate<br>time for, hydrolysis / incubation / (product) removal / reaction / AW **;**<br><br>2 of *(for max 2)*:<br>temperature – use a, water bath / incubator **;**<br>starch / substrate concentration – use, the same (starch) solution / 2% starch solution, for all of the tests **;**<br>time – use a, (stop) clock / (stop) watch / timer / AW **;**<br>pH – use buffer **;** | **A** thermostatically / temperature, controlled room / AW<br>**I** air conditioning<br><br>**I** time unqualified<br>**A** time stated as 60 minutes / 'the 60 minutes'<br>**I** incubation / incubating<br><br>**R** *ref. to* volumes of 2% starch<br><br>**A** named buffer **R** neutral buffer | [max 3] |
| (iii) | *idea of* boiled / denatured, enzymes **or** (distilled) water **;** | **A** just / only / AW, starch<br>**A** without enzyme<br>**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*<br>8 of:<br>mp1 *idea of* using extracts hydrolysed by, all / each / 3, enzymes **;**<br><br>mp2 *ref. to* observation / counting, of the number, of spots / products / AW<br>**or**<br>measurement of, distance / length, moved by each spot / product / AW **;**<br><br>mp3 *ref. to* comparison of the chromatograms **;**<br><br>mp4 *ref. to* running chromatograms, for same time / to same distance (of solvent front) **;**<br><br>mp5 *idea of* same number of applications applied (to origin) **;**<br><br>*procedure:*<br>mp6 *ref to* using capillary or other suitable method of applying a small sample **;**<br><br>mp7 *ref to* drawing / using, a, line of origin / base line / sample line / starting line / AW **;**<br><br>mp8 drying between adding drops<br>**or**<br>evaporating the extract (before using) **;**<br><br>mp9 *idea of* placing in solvent so that level of solvent is below the, origin / line / spot / AW **;** | **I** *descriptions of hydrolysis*<br><br>**A** any idea that the 3 enzymes have been tested<br><br>**A** *ref. to* known markers (**not** comparing to $R_f$ values)<br>**A** measure position of spot<br>**I** 'residue'<br>**I** to find $R_f$ unqualified / *ref. to* solvent front<br>**A** if $R_f$ formula given which includes spot / AW distance<br><br>**A** 'look at differences between' / AW<br><br>**A** all extracts on the same chromatogram<br>**A** if time stated must be minimum of 5 minutes<br>**A** *idea of* 'almost reach / just before, the highest level '<br>**I** stopping 'before' unqualified<br>**R** spot reaches the top<br>**I** volumes<br>**A** dabs / dots / AW **A** stated number including 1<br><br>e.g. pin head / cocktail stick / tooth pick / Pasteur pipette / AW<br><br>**I** solvent line if in context of solvent front<br>**R** if line drawn with soluble marker<br>**A** suitable method for TLC<br><br>*in context of concentrating the extract*<br>**A** drying between every 2nd drop<br>**I** method of evaporating<br><br>**A** in terms of precise measurements<br>**I** names of solvents | |

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

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| Question | Expected answer | Extra guidance | Mark |
|---|---|---|---|
| (ii) | 2 of:<br>mp1 *idea that* α (amylase) gives a variety of, products / spots / blobs / stains / AW **;**<br><br>mp2 *idea that* β (amylase) gives, one product / one spot / maltose **;**<br><br>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<br>**I** *ref. to* glucose described a single molecule such as 'produces many glucose molecules'<br><br>**R** no products<br>**I** no movement<br>**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:<br>mp1 four replicates for each, treatment / type ;<br><br>mp2 large numbers of, maize / plants, used ;<br><br><br>mp3 *idea of* standardised planting of each plot ;<br><br>mp4 *idea of* randomising, treatments / plots (to prevent bias) ;<br><br>mp5 *idea of* randomising (plants) where (soil) samples are collected ;<br><br>mp6 5 soil samples for each plot / 20 soil samples (for each treatment) ;<br><br>mp7 same treatment year 1 and 2 ;<br><br>mp8 spacing of plots / standard gap between plots / AW ; | **I** size of plots **I** equal numbers of plots of each type<br><br>**A** quoted numbers, 100 per row / 2400 per plot / 9600 per 4 plots<br>**I** large sample size<br><br>**A** descriptions such as same, density / spacing<br>**A** same number of rows / 24 rows<br><br>**I** randomising the number of roundworms collected<br><br>must qualify 'sample' **A** 'around plant' for 'soil'<br>**I** several | [3] |
| (b) (i) | control(s) / baseline ; | **R** control variable(s) | [1] |
| (ii) | 1 of:<br>mp1 *idea that* used for numerical comparison (via subtraction) ;<br><br>mp2 comparison qualified ;<br><br>mp3 *idea o*: finding effectiveness of treatment ; | **I** 'to compare rootworms' unqualified | [max1] |

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| Question | Expected answer | Extra guidance | Mark |
|---|---|---|---|
| **(c)** | *assume answers refer to Bt maize unless otherwise specified*<br>3 of:<br>mp1 the number of rootworms was lower on Bt maize (than, insecticide / NBt + In – (except year1, day1) **; ora**<br><br>mp2 Bt maize is more effective (than, insecticide / NBt + In in year 1 / year 2 / both years / generally) **; ora**<br><br>mp3 *idea that* the number of rootworms fluctuated during the investigation (regardless of the control method) **;**<br><br>mp4 *idea that* (as time increases) there is a decrease in the number of rootworms for both treatments / both treatments are effective **;**<br><br>mp5 numbers of rootworms (in soil) around control (NBt) plants (also) decreases **;**<br>**or**<br>numbers of rootworms for, treatments (Bt / Nbt +In) lower than control / treatments more effective than control / NBt **;**<br><br>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<br><br>comparative **A** fewer / less for lower<br><br>**I** 'very effective' unqualified<br><br>*idea of* general downward trend<br>**A** general idea or in context of stated year(s)<br><br>*must be statements related to control*<br><br>**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 ;<br><br>38 ; | **A** as a formula (20–1) + (20–1)<br><br>*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 **;;**<br><br>*not significant (max1)*<br>*idea that* the results are caused by chance **;**<br><br>*P < 0.05 (max 1)*<br>*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<br>**or**<br>greater than 95% / 95% certain / sure, that the results are caused by chance **;** | **I** random error throughout<br><br>**A** any difference (in the results) is due to chance<br>**I** null hypothesis<br><br>**A** other numerical methods of processing e.g. 1 in 20<br>**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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