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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 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)	*independent variable*: free or immobilised enzyme ; *dependent variable*: time to decolourise(methylene blue) ;	**I** type / state of enzyme **A** time to change colour **R** rate	[2]
(ii)	*ref. to* first mixing the enzyme / it with (any) alginate ; *ref. to* then adding (alginate and enzyme) to <u>calcium</u> chloride ; *ref. to* method of dropping mixture (to form beads) ;	**I** any alginate concentrations **A** symbol Ca^{2+} / calcium ions e.g. using syringe or pipette **A** dropper	[3]
(iii)	*idea of* replacing the enzyme by boiled enzyme / water ;	**I** without enzyme unqualified **I** glass beads	[1]
(b)	7 of: *independent variable:* 1. same <u>volume</u> / stated <u>volume</u> of enzyme (for making beads and for testing free enzyme) ; *dependent variable*: 2. *ref. to* suitable equipment for measuring time taken for methylene blue / indicator to decolourise ; *standardised (controlled) variables: max 3* 3. *ref. to* same volume / concentration of methylene blue solution ; 4. *ref. to* same volume of ethanol / alcohol ; 5. *ref. to* same volume NAD ;	1. **I** mass of enzyme 2. e.g. stop clock / stop watch / timer **A** same number / stated number of drops	

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Question	Expected answer	Extra guidance	Mark
	6. *ref. to* method of keeping constant temperature **;**	6. e.g. water bath / temperature controlled room / incubator / environmental chamber **I** air conditioning / room temperature If temperature quoted must be maximum 40 °C	
	7. *ref. to* using buffer + maintaining pH **;**		
	procedure: 8. *ref. to* adding ethanol (and NAD) to both types enzyme using same apparatus **;**	8. e.g. in test-tube / boiling tube / beaker / flask. **R** if pour substrates through for the beads and mix in a beaker / AW for the free enzyme	
	9. *ref. to* temperature equilibration before mixing enzyme and substrate **;**		
	10. correct sequencing so that enzyme or substrate is added last **;**	10. **R** if methylene blue added last	
	reliability: 11. repeat at least 3 times **and** find mean / identify anomalies **;**	11. **A** several / many repeats **A** average for mean	
	safety: 12. *ref. to* suitable hazard **and** precaution / low risk experiment **;**	12. e.g. alcohol flammable and no open flames / methylene blue or enzyme irritant / allergen and gloves **I** allergic or toxic or irritant for NAD / ethanol	[max 7]

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Question	Expected answer	Extra guidance	Mark
(c) (i)	subtract the control values from the raw data ; divide 1 by the time (taken for the methylene blue to become colourless) ;	**A** $\frac{1}{\text{time experimental}} - \frac{1}{\text{time control}} = 2$	[2]
(ii)	shows the spread of data / results from the mean ; indicates the reliability of the data / results or data is reliable as values of *s* are very small / **ora** ;	**R** reliability of the mean **R** accuracy / validity **A** correct data quotes **I** standard deviation is less than one	[max 2]
(d)	*significant:* *idea that* the (observed) result or difference is caused by another factor / factor other than chance / immobilisation / is not due to chance ; $P < 0.05$: 5% or less than 5% chance / probability that the (observed) result or difference is not significant ; or 95 % or more than 95% chance / probability that the (observed) result or difference is significant ;	**A** 1 in 20 chance of the results being not significant **ora** *2 marks for :* 5% or <5% chance / probability that the (observed) result or difference occur by chance or 95% or >95% chance / probability that the (observed) result or difference are caused by an outside effect / not due to chance	[max 2]
			[Total: 19]

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Question	Expected answer	Extra guidance	Mark
2 (a) (i)	1 of: time for which the radioactive phosphate supplied ; total time for experiment / 12 weeks ; the species / type of plant used ;	*List rule applies* **A** how long the wells are left in place **A** time after the removal of the wells / 11 weeks **A** dominant herbaceous species **I** number of plants	[max 1]
(ii)	1 of: concentration of the radioactively labelled phosphate / ^{32}P (solution) ; volume of (radioactive phosphate) solution used ; all organisms sampled at the same time ; same tissue sampled each time for the same organism ; position of wells on the stem ;	**I** size of wells **I** number of samples per organism **A** same time / intervals between sampling	[max 1]
(b) (i)	divide the (radio)activity in the sample by the (bio) mass ;	**A** Geiger counter reading / ^{32}P activity **I** number / amount of phosphate (ions) **I** *ref. to* wet or dry (bio)mass	[1]
(ii)	to enable comparisons to be made ;	**I** valid / reliable / accurate	[1]

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Question	Expected answer	Extra guidance	Mark
(c) (i)	1. *supports*, as increase in radioactivity does not occur until after the increase in primary consumers **;** 2. *does not support*, as no evidence about what is happening to the phosphate **;** 3. *does not support*, as radioactivity increases in other primary consumers from the beginning / these consumers have radioactivity (in tissue) **;** 4. *does not support*, as there is no evidence about transport / phloem **;**	1. **A** increases more slowly than primary consumers **A** as the (activity in) primary consumers rises it also increases in secondary and tertiary consumers **R** secondary and tertiary increase as primary decrease 3. **A** the only way these consumers can contain radioactivity is by eating the treated plants 4. **A** supports as it must go through stem <u>but</u> no evidence for transport / phloem data **A** does not support as it could be transported in the xylem	[4]
(c) (ii)	1 of: 1. **X** / primary consumers must have eaten the treated plant **;** 2. **X** takes in ^{32}P faster **;**	**A X** feeds mostly on treated plants **R** if seasonally or only when wells attached	[max1]

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Question	Expected answer	Extra guidance	Mark
(d)	2 of: 1. *idea of* labelling / using other producer species (one at a time) **;** 2. *idea that* the results from all the different primary consumers should be shown separately **;** 3. *idea that* all the results for the secondary and tertiary consumers should be shown separately **;** 4. include results / data for decomposer organisms **;** 5. include results / data for quaternary consumers **;** 6. carry out again at different times of the year **;**	**A** minimum of one other species / type of plant **I** use a variety of plants **I** repeats and take a mean **I** supplying primary consumers with radioactive phosphate	[max 2]
			[Total: 11]

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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9700 BIOLOGY

9700/52 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	*independent variable*: free or immobilised enzyme ; *dependent variable*: time to decolourise(methylene blue) ;	**I** type / state of enzyme **A** time to change colour **R** rate	[2]
(ii)	*ref. to* first mixing the enzyme / it with (any) alginate ; *ref. to* then adding (alginate and enzyme) to <u>calcium</u> chloride ; *ref. to* method of dropping mixture (to form beads) ;	**I** any alginate concentrations **A** symbol Ca^{2+} / calcium ions e.g. using syringe or pipette **A** dropper	[3]
(iii)	*idea of* replacing the enzyme by boiled enzyme / water ;	**I** without enzyme unqualified **I** glass beads	[1]
(b)	7 of: *independent variable:* 1. same <u>volume</u> / stated <u>volume</u> of enzyme (for making beads and for testing free enzyme) ; *dependent variable*: 2. *ref. to* suitable equipment for measuring time taken for methylene blue / indicator to decolourise ; *standardised (controlled) variables: max 3* 3. *ref. to* same volume / concentration of methylene blue solution ; 4. *ref. to* same volume of ethanol / alcohol ; 5. *ref. to* same volume NAD ;	1. **I** mass of enzyme 2. e.g. stop clock / stop watch / timer **A** same number / stated number of drops	

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Question	Expected answer	Extra guidance	Mark
	6. *ref. to* method of keeping constant temperature **;**	6. e.g. water bath / temperature controlled room / incubator / environmental chamber **I** air conditioning / room temperature If temperature quoted must be maximum 40 °C	
	7. *ref. to* using buffer + maintaining pH **;**		
	procedure: 8. *ref. to* adding ethanol (and NAD) to both types enzyme using same apparatus **;**	8. e.g. in test-tube / boiling tube / beaker / flask. **R** if pour substrates through for the beads and mix in a beaker / AW for the free enzyme	
	9. *ref. to* temperature equilibration before mixing enzyme and substrate **;**		
	10. correct sequencing so that enzyme or substrate is added last **;**	10. **R** if methylene blue added last	
	reliability: 11. repeat at least 3 times **and** find mean / identify anomalies **;**	11. **A** several / many repeats **A** average for mean	
	safety: 12. *ref. to* suitable hazard **and** precaution / low risk experiment **;**	12. e.g. alcohol flammable and no open flames / methylene blue or enzyme irritant / allergen and gloves **I** allergic or toxic or irritant for NAD / ethanol	[max 7]

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(c) (i)	subtract the control values from the raw data ; divide 1 by the time (taken for the methylene blue to become colourless) ;	**A** $\frac{1}{\text{time experimental}} - \frac{1}{\text{time control}} = 2$	[2]
(ii)	shows the spread of data / results from the mean ; indicates the reliability of the data / results or data is reliable as values of *s* are very small / **ora** ;	**R** reliability of the mean **R** accuracy / validity **A** correct data quotes **I** standard deviation is less than one	[max 2]
(d)	*significant:* *idea that* the (observed) result or difference is caused by another factor / factor other than chance / immobilisation / is not due to chance ; $P < 0.05$: 5% or less than 5% chance / probability that the (observed) result or difference is not significant ; or 95 % or more than 95% chance / probability that the (observed) result or difference is significant ;	**A** 1 in 20 chance of the results being not significant **ora** *2 marks for :* 5% or <5% chance / probability that the (observed) result or difference occur by chance or 95% or >95% chance / probability that the (observed) result or difference are caused by an outside effect / not due to chance	[max 2]
			[Total: 19]

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Question	Expected answer	Extra guidance	Mark
2 (a) (i)	1 of: time for which the radioactive phosphate supplied ; total time for experiment / 12 weeks ; the species / type of plant used ;	*List rule applies* **A** how long the wells are left in place **A** time after the removal of the wells / 11 weeks **A** dominant herbaceous species **I** number of plants	[max 1]
(ii)	1 of: concentration of the radioactively labelled phosphate / ^{32}P (solution) ; volume of (radioactive phosphate) solution used ; all organisms sampled at the same time ; same tissue sampled each time for the same organism ; position of wells on the stem ;	**I** size of wells **I** number of samples per organism **A** same time / intervals between sampling	[max 1]
(b) (i)	divide the (radio)activity in the sample by the (bio) mass ;	**A** Geiger counter reading / ^{32}P activity **I** number / amount of phosphate (ions) **I** *ref. to* wet or dry (bio)mass	[1]
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(c) (i)	1. *supports*, as increase in radioactivity does not occur until after the increase in primary consumers **;** 2. *does not support*, as no evidence about what is happening to the phosphate **;** 3. *does not support*, as radioactivity increases in other primary consumers from the beginning / these consumers have radioactivity (in tissue) **;** 4. *does not support*, as there is no evidence about transport / phloem **;**	1. **A** increases more slowly than primary consumers **A** as the (activity in) primary consumers rises it also increases in secondary and tertiary consumers **R** secondary and tertiary increase as primary decrease 3. **A** the only way these consumers can contain radioactivity is by eating the treated plants 4. **A** supports as it must go through stem <u>but</u> no evidence for transport / phloem data **A** does not support as it could be transported in the xylem	[4]
(c) (ii)	1 of: 1. **X** / primary consumers must have eaten the treated plant **;** 2. **X** takes in ^{32}P faster **;**	**A X** feeds mostly on treated plants **R** if seasonally or only when wells attached	[max1]

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(d)	2 of: 1. *idea of* labelling / using other producer species (one at a time) **;** 2. *idea that* the results from all the different primary consumers should be shown separately **;** 3. *idea that* all the results for the secondary and tertiary consumers should be shown separately **;** 4. include results / data for decomposer organisms **;** 5. include results / data for quaternary consumers **;** 6. carry out again at different times of the year **;**	**A** minimum of one other species / type of plant **I** use a variety of plants **I** repeats and take a mean **I** supplying primary consumers with radioactive phosphate	[max 2]
			[Total: 11]

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Cambridge International Advanced Subsidiary and Advanced Level

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

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	there is no significant difference in the activity of, the enzyme / lactase, whatever type of immobilisation is used **;**	**A** in terms of, rate of reaction / production or amount or concentration, of glucose **A** if choose 2 of the types of immobilisation **I** 'any difference in the activity of enzymes is due to chance'	[1]
(ii)	the method / way, of immobilising (the enzyme) **;**	**I '**the immobilisation of the enzyme' unqualified **A** 'the different types of immobilised enzymes'	[1]
(iii)	*idea of* using a biosensor to find the concentration of glucose (in a known time) **;**	**A** clinistix / dip sticks / glucose meter / glucose monitor / glucose concentration detector **A** Benedict's test / permanaganate test, qualified : *idea of* semi-quantitative / description to compare colours **I** use of HC*l*	[1]
(b)	7 of: *independent variable:* 1. *ref. to* using, the same (equivalent) / fixed, concentration of, enzyme / lactase **;** *dependent variable:* 2. *ref. to*, measuring with biosensor AW / comparing dip sticks **or** clinistix to colour chart **;** *control variables :* 3. *ref. to*, same / fixed, volume of lactose solution **;**	1. **A** known concentration of enzyme. **R** same mass of immobilised enzyme **I** volume 2. **A** Benedict's solution / Benedict's test / permanganate test, qualified by e.g. *idea of* semi-quantitative / compare colours to standard **R** *ref. to* heating with HC*l* 3. **I** *ref. to* using milk	

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Question	Expected answer	Extra guidance	Mark
	4. *ref. to* method of keeping same temperature (for each enzyme) ;	4. e.g. temperature controlled room / environmental chamber / incubator If temp given max 60 °C **A** water bath **I** air conditioning.	
	5. *ref. to* buffer to control pH (at same level for each enzyme) ;		
	6. standardising time (for lactose to be in contact with enzyme) / AW ;	6. e.g. time for all solution to pass through / fixed time for collection of solution that has passed through / solution left in (a closed) column for a fixed time **I** 'time for, hydrolysis / experiment'	
	7. *ref. to* method of timing (in context of mp6) ;	7. using stop clock / stop watch / timer. **A** in context of 'time for hydrolysis'	
	Procedure 8. *ref. to* suitable apparatus to set up columns for immobilised enzyme ;	8. **A** syringe (barrel) / burette / (glass) tube / funnel **A** use flasks / beakers / AW **A** from a labelled diagram	
	9. *ref. to* (method of) controlling flow rate through enzyme ;	9. e.g. tubing with adjustable clip / tap, entering or leaving the column. not available if beaker or flask used in mp8 **I** pour at, same / steady, speed	

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Question	Expected answer	Extra guidance	Mark
	10. *ref. to* method of collecting product **;**	10. e.g. in a, beaker / flask / container etc. if use beaker or flask in mp8 **must** have *idea of* obtaining a separate solution from immobilised enzyme **A** from a diagram	
	reliability 11. repeat at least 3 times **and** find mean / identify anomalies **;**	11. **A** several / AW, repeats **A** average for mean	
	safety: 12. *ref. to* named hazard **and** suitable precaution **;**	12. e.g. enzyme / (named) sugar / alginate/ Benedict's reagent, may be, irritant / allergen, **and** wear gloves / eye protection hot glassware **and** tongs / gloves if Benedict's test done **A** low risk experiment **I** no risk **I** water and electricity	[max 7]
(c) (i)	(**A**) 315 **and** (**C**) 240 **;**		[1]
(ii)	volume of lactose (solution added) **;** time **;**		[2]

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Question	Expected answer	Extra guidance	Mark
(d) (i)	*significant:* *idea that* the (observed) result or difference is caused by another factor / factor other than chance / immobilisation / is not due to chance **;** *P* < *0.05*: 5% or less than 5% chance / probability that the (observed) result or difference is not significant **;** or 95 % or more than 95% chance / probability that the (observed) result or difference is significant **;**	**A** named immobilisation method(s) as AW for outside factor **A:** there is 1 in 20 chance of the results being not significant **ora** **R** '95% of results are caused by an outside factor' '5% of the results are caused by chance' *allow 2 marks for :* 5% or < 5% chance / probability that the (observed) result / difference occur by chance or 95% or > 95% chance / probability that the (observed) result / difference are caused by an outside effect / not due to chance	[max 2]

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Question	Expected answer	Extra guidance	Mark
(ii)	(Table 1.1 shows) method **A** gives the highest (mean) total glucose collected **;** (Table 1. 2) supports as stats. tests shows that the difference between method **A** and methods **B** / **C** is <u>significant</u> **;**	**A** it appears to give a faster rate of reaction / hydrolysis / glucose production **A** difference not due to chance	[2]
			[Total: 17]
2 (a) (i)	*idea that* individual leaves will be different, sizes / (surface) areas **;** *idea that* can then compare (the plants with covered / uncovered leaves) **;**	**A** some leaves bigger / smaller **I** *ref. to* accuracy / standardisation **I** 'different starting points' unqualified	[2]
(ii)	add the values per unit area / take total (for all leaves on each type of plant) **and** divide by, the total number of leaves / 30 **;**	**A:** if calculate mean per plant and then add and divide by 6 / number of plants **I** surface area calculations	[1]
(b) (i)	3 of: 1. (content of radioactive phosphate is lower in covered leaves) because no photosynthesis **; ora** 2. (content of radioactive phosphate is lower in covered leaves) because of lower transpiration **; ora** 3. *ref to* (content of radioactive phosphate is higher in uncovered leaves) as radioactive phosphate / radioactivity is being used to produce organic compounds / named compounds / (named) phosphate containing products of photosynthesis **;** 4. (in both radioactivity) increases up to day 3 / initially (after transfer to unlabelled phosphate), as (it / radioactive phosphate) is still being transported (into leaf from rest of plant) **;**	1. **A** little / less photosynthesis **A** description of photosynthesis. 2. **A** description of transpiration. 3. **A** in terms of use in an e.g. ATP / nucleic acid / phospholipid, synthesis. **I** splitting of ATP into ADP + iP	

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Question	Expected answer	Extra guidance	Mark
	5. *idea that* (after 3 days) plants start to use unlabelled phosphate as proportion of labelled to unlabelled phosphate has dropped **;** 6. (after 3 days compounds containing) radioactive phosphate have been, moved out by phloem / translocated from the leaves **;**	5. **A** *idea of* replace labelled with unlabelled 6. **A** transported / carried / taken / moved / AW, out of leaves / to other parts **I** *ref. to* radioactive decay in mp5 and mp6 **I** *ref. to* loss of phosphate to the atmosphere	[max 3]
(ii)	2 of: 1. more plants used **;** 2. more leaves used **;** 3. more readings per leaf **;** 4.ref. to finding, *s* (standard deviation) / S_M (standard error) **;**	 **I** samples / trials unqualified **I** control with no ^{32}P to account for / eliminate background radiation	[max 2]
(c)	3 of: 1. *idea of* obtaining section of, root / stem / leaf **;** 2. *idea of* covering sections with film (to expose to radioactivity) **;**	 2. **R** if expose section / leaf / plant AW to X-rays / X-ray crystallography **I** *ref. to* UV / light / gamma rays etc. **A** if film applied to, leaf / dissected out tissues / pieces of leaf **I** additional description involving microscopes	

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Question	Expected answer	Extra guidance	Mark
	3. *idea of* fogging / black spots, show position of / AW, radioactivity / tissue / radioactive tissue / named tissue **;** 4. *idea of* **comparing / AW**, to sections of, root / stem / leaf, to identify tissue (that corresponds to the fogged zones) **;**	3. if separate tissues have separate films placed on them then **A** 'find the film with black spots' 4. **R** if section not taken **A** comparison to diagram or photograph **I** name of tissue, correct or incorrect	[max 3]
(d)	1. (radioactivity in covered leaves) unchanged / little change as, unaffected by / not exposed to, air movement **or** (radioactivity in covered leaves) unchanged / little change as, transpiration / AW, does not change **;** 2. (uncovered leaves) radioactivity is lower / radioactivity lost more rapidly due to faster transpiration **;**	**I** further explanation **A** idea of no / little transpiration 2. **A** (uncovered leaves) radioactivity higher, initially / up to stated day, because transpiration brings (remaining) labelled phosphate faster **A** (uncovered leaves) lower than / like, covered leaves as (high) winds cause stomata to shut **A** (uncovered leaves) higher as wind encourages more CO_2 exchange so more photosynthesis **I** *ref. to* loss of phosphate to the atmosphere	2
			[Total: 13]

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