CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

9700 BIOLOGY

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

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Mark scheme abbreviations:

;	separates marking points
/	alternatives answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or extra guidance)
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
ecf	error carried forward
I	ignore
mp	marking point (with relevant number)

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	any 2 of: RNA probe / RNA / probe / it / they, is single stranded / has exposed, bases / nucleotides ; *idea of* complementary bases / base pairs, (between, RNA probe / RNA / probe / it, and DNA) ; *idea that* different RNA probes / AW, base pair with, different / specific sticky ends (of DNA) ;	**A** unpaired / available, bases / nucleotides **I** free bases **A** *idea of* (hydrogen) bonding / binding, between, complementary base pairs / named base pairs / bases / nucleotides / codons	[max 2]
(ii)	any 2 of: *idea that* genetic variation is due to, mutation / small differences in base sequence / small or single change in nucleotide (pairs) (of DNA) ; ref. to point mutations ; *idea that* small pore size of gel allows separation of variant fragments ;	**A** examples, e.g. substitution, deletion, insertion, addition **I** inversion **A** descriptions in terms of, altered, allele / protein / polypeptide (sequence) / amino acid (sequence) **I** gene / phenotype	[max 2]
(b)	any 5 of: ref. to making / using, agarose (gel) ; ref. to using, wells / channels / chamber / **AW**, to place samples ; sample / wells, placed at / connected to, negative electrode / cathode / negative end (of the gel) ; **ora**.	***A*** *from diagrams as appropriate* **A** agrose / agar / (poly)acrylamide **R** starch gel **I** support used, e.g. microscope slide **A** e.g. pits / slits / chambers / use of comb / holes / **AW** **A** in / on / near / **AW**	

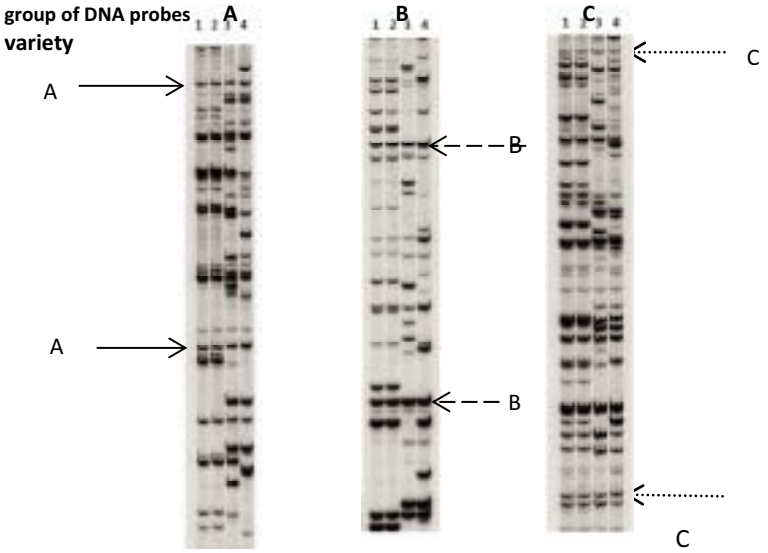
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Question	Expected answer	Extra guidance	Mark
	ref. to any detail of adding samples (to wells) ; e.g. adding (loading) dye or stain, to each sample / adding glycerine to sink DNA / use of micropipette or capillary tube / e.g. of care in loading such as preventing sideways movement / putting different DNA sample in different wells / using separate (micro)pipettes or tips or capillaries.	**A** Gilson / Finnpipette as a micropipette **I** any specified volumes	
	ref. to adding, buffer ;		
	ref. to applying potential difference / voltage difference ;	**A** ref. to current (between electrodes). **A** any description of connecting or applying a current or using a battery (to supply a current) or using a direct current **I** electricity or power unqualified / charge / electrons	
	ref. to a method of staining **and** observing the DNA ;	e.g using UV or fluorescent light **and** staining the DNA / using pre-stained gels. Stains need not be named, but must be correct if given, e.g. methylene blue / ethidium bromide / crystal violet / sybr green / acridine orange / fluorescien / **AW** **A** idea of DNA samples that are radioactive (at start) **and** autoradiograph (either directly from gel or indirectly from transfer) or take X-ray **I** radioactive or fluorescent RNA probes / Southern blotting	
	ref. to hazard **and** suitable safety precaution ;	e.g. electrical **and** not touching connectors with wet hands or wear gloves stains / named stains / buffer, toxic / irritant / harmful **and** wear gloves / goggles / mask UV light **and** goggles **A** allergy to stains / gel / buffer **and** wear, gloves / mask / goggles **I** low risk	[max 5]

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Question	Expected answer	Extra guidance	Mark
(c)	any 2 of:	**I** size of wells	
	volume of, DNA / sample, (added to the wells) ;	**I** mass **I** amount **I** volume of genes	
	idea of time / distance, allowed for the samples to run (on the gel) / **AW** ;	**I** distance between anode and cathode / time unqualified	
	pH / (type of) buffer / electrolyte ;		
	volume of buffer / enough buffer to cover gel ;		
	voltage difference used for the electrophoresis ;	current / voltage / amount of voltage or current / charge applied / potential difference / intensity of current.	
	type of stain / time allowed for staining ;	**I** volume / amount, of stain	
	type / thickness / consistency / volume / density / concentration / composition / pore size / permeability, of gel ;	**I** amount	
	restriction enzymes used ;		
	temperature ;		[max 2]

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Question	Expected answer	Extra guidance	Mark
(d) (i)	an arrow to a row of DNA fragments at the same position for group A and group B and group C ; **I** extras *all must be correct*	e.g.  	[1]
(ii)	varieties 1 and 2 ; they have, an identical / the same / very similar, pattern (of DNA fragments) ;	**I** a lot of the same fragments / many fragments same **A** they have the same (DNA) fragments in common **A** they are stained in the same parts **A** the fragments reached the same distance	[2]
			[Total: 14]

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Question	Expected answer	Extra guidance	Mark
2 (a) (i)	for **one** mark, any 2 of: depth, seeds / grains, planted (is the same / 3 cm) ; distance between, seeds / grains (is the same / 25 cm) ; number of / #, seeds / grains ; distance between rows (is, the same / 75 cm) ; size / area / number, of plots ; time plot left before planting / **AW** ; variety / type / species, of legume ; *2 correct = 1 mark*	**A** fruits **A** planting depth / depth of seeds **I** time unqualified **A** 'only legume used as green manure' **I** sp of *Sorghum* **A** ref. to randomising the plots used for each type of manuring **I** parts of legume being ploughed in	[1]

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Question	Expected answer	Extra guidance	Mark
(ii)	any 2 of: rainfall / water / humidity / chance of rain ; temperature ; intensity / duration of (sun)light ; soil qualified ; ; ***2 max*** *– one from* ***P*** *and one from* ***Q*** wind (speed) ; pollution / named pollutant ; carbon dioxide ;	*Apply the 'lines rule' from page 2* **I** ref. to climate / weather unqualified **I** amount throughout **I** wavelength **I** exposure to light unqualified but **A** 'time of exposure to light as **AW** for duration **P** depth / fertility / organic content / minerals / humus / nutrients / ions / named minerals, e.g. nitrates / soil pH **Q** soil water / soil moisture / water potential / soil aeration / soil oxygen conten **R** microorganisms in soil **I** pesticide / herbicide as a pollutant **unless** linked to idea of drift	[max 2]
(iii)	*idea that* the plant ploughed in / the legume / green manure, (has time to,) decompose / release nutrients / fertilise the soil ;	**A** to allow nitrification / ammonification / description of decomposition, of green manure / **AW** **I** nitrogen fixing **I** general unqualified responses on 'let it adapt / equilibrate, etc.'	[1]
(iv)	4 / several / many / more than one, replicates of each, type of green manure / treatment / (type of) trial plot ;	**I** large number of seeds **I** use of random number generator **I** 'many experiments going on at same time'	[1]

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Question	Expected answer	Extra guidance	Mark
(b) (i)	44 / 44.1 / 44.14 ; ; *working:* $(\frac{2964}{6715} \times 100 = 44\%)$	**A** answer up to 2 d.p. 44.1 or 44.14. (**not** 44.10 / 44.13) *max 1 for correct answer with incorrect decimal places* **A** ecf from incorrect subtraction for max 1 max 1 for following working 9679 – 6715 **or** divisor is the matching control value for chosen figures	[2]
(ii)	3:1 ; ; **or** × 3 ; ;	answer must be in whole numbers max 1 for following working 782 – 398 / 384 1:3 = one mark 1:3 with qualification (clearly identifying which is roots and which is shoots) = two marks **A** shoots have 3 × the effect of roots alone	[2]
(c) (i)	there is no <u>significant</u> difference between the (dry) mass of *Sorghum* grown, with green manure / with treatment, and *Sorghum,* without green manure / with no treatment / in the control ;	**A** ref. to 'roots' + 'shoots' + 'roots and shoots' / legume, as **AW** for green manure **R** 'no significant difference between different types of green manure' – needs to relate to control / no treatment **I** 'no significant difference between results of data compared' **I** 'no significant difference between control and other plots' **I** 'insignificant' for not significant but **A** non significant	[1]
(ii)	comparing the means (of two sets of data) / data is continuous / data is not discrete / normal distribution ;	*If more than one reason given, all must be correct.* **I** number of means	[1]

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Question	Expected answer	Extra guidance	Mark
(iii)	*statistically significant:* *idea that* the (observed) results are caused by, an outside factor / a factor other than chance / the green manure / the treatment ; *P < 0.05*: *idea that* 0.05 means that there is 5% / less than 5% chance of obtaining the (observed) results by chance ; ***or*** *idea of* 95% or more certain that the (observed) results are caused by an outside effect ;	**A** ref. to 'roots' + 'shoots' + 'roots and shoots' / legume (use), instead of 'green manure' **A** the results are not due to chance **I** difference is, more than / higher than, the critical value **I** reject the null hypothesis **I** random / systematic error **A** there is a 1 in 20 chance of the results being caused by chance / not caused by another factor **ora** **A** ref. to 'roots' + 'shoots' + 'roots and shoots' / legume as **AW** for green manure **I** random / systematic error	[2]

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Question	Expected answer	Extra guidance	Mark
(d)	any 3 of: mp1 *idea that* green manuring / it / AW, increases the (dry) mass of, shoots / roots / grain / whole plant / *Sorghum ;* mp2 (legume) shoots cause a greater / increase in (dry) mass than (legume) roots ; mp3 (legume) 'shoots and roots' cause greater / more, increase in (dry) mass than, shoots / roots, alone ; **ora** **or** (legume) 'shoots and roots' cause greatest / most, increase in (dry) mass ; mp4 (legume) 'shoots and roots' cause a significant, increase / difference / effect, in (dry mass of), Sorghum / the plant / each different part / AW (of Sorghum) ; mp5 (legume) shoots (only) caused a significant, increase / difference / effect, in, (dry mass of), grain / whole plant ; mp6 (legume) roots (alone) do not cause any significant increase / difference / effect, in (dry mass) ;	**A** yield / growth, for increase of (dry) mass mp1 a general point from Table 2.1 mp1 **A** 'roots' + 'shoots' + 'roots and shoots' / 'treatment' / it / legume, as **AW** for 'green manure' mp1 **A** ora – no, green manure / **AW**, shows the lowest (dry) mass of shoots / roots / grain / whole plant, (of *Sorghum)* mp2 and mp3 need a comparative statement / idea mp4, mp5 and mp6 need a ref. to significance **I** ref. to chance / insignificance	[max 3]
			[Total: 16]

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