MARK SCHEME for the May/June 2014 series

9700 BIOLOGY

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

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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)
<u>**underline**</u>	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)

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**	

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 <u>micro</u>pipette 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. ref. to adding, buffer ;	**A** Gilson / Finnpipette as a micropipette **I** any specified volumes	
	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]

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]

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. **group of DNA probes variety** 	[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]

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]

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]

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]

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]

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]
16			**[Total: 16]**