UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9700 BIOLOGY

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

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AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given
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Question	Expected answer	Extra guidance	Mark
1 (a)	*independent:* (composition of the growth) medium ; *dependent:* growth / length, of the pollen (tube) **and** (percentage) germination ;		[2]
(b) (i)	3 of: 1. ref. to suitable magnification (in context of looking at pollen) ; 2. ref. to use of, an eye-piece graticule / AW (to measure the length of the pollen tubes) ; 3. ref. to calibrating eye-piece with stage, micrometer / graticule / AW ; 4. to find the value in mm of an eyepiece unit ; 5. ref. to conversion of, mm / eye-piece units / EP(G)U, to μm ;	1. e.g. ×40 – ×400 high / low / medium, power. Accept 'Adjust to suitable power / AW' 3. Allow description 3. Allow as formula: stage divided by eye-piece 5. Accept × 10^3	[3]
(ii)	*Idea of*: allows comparisons (to be made between samples with different starting number) ;		[1]
(c) (i)	mean / $\bar{x}$ (of each sample) **and** the standard deviation / *s* (of each sample) ;	Allow identified in *t*-test formula Ignore standard error	[1]
(ii)	ref. to 10 (in each sample) and subtracting 1 from each (sample number) ;	Allow as a formula (10 – 1) + (10 – 1) / 20 – 2	[1]

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(iii)	3 of: 1. ref. to critical value (at p >0.05) is 2.10 ; 2. ref. to A + B (1) **and** A + C (2), have values greater than, the critical value / 2.10 **OR** ref. to B + C (3) has value less than, critical value / 2.10 ; 3. A + B / A + C results are, significant / not due to chance / caused by an environmental factor **OR** ora for B + C ; 4. ref. to A + C (also) significant at >p = 0.01 / AW ;	1. allow if critical value clearly marked on table. e.g. ringed etc. if > used must be correct. Accept 5% 3. allow if refer to differences in the media as an environmental factor allow if identified via *t* value	[3]
(d) (i)	4 of: *support:* 1. the pollen / tubes, grow, longer / better, with calcium in media / in, B / C ; 2. ref. to (pollen) germination is (almost) the same, with and without calcium / in, all media / A & B & C ; 3. ref. to pollen germination occurs with sucrose alone / in (medium) A ; *does not support:* 4. ref. to boric acid could be causing an effect on pollen tubes ; 5. ref. medium C has, magnesium / potassium / sulphate, that may be increasing pollen tube growth ; 6. ref. to all media have sucrose (so no way of knowing its effect) / no control without sucrose ;	Ignore refs to time 1. **ora** 2. looking for idea that presence of calcium has little / no effect on pollen tube germination 3. looking for idea that pollen germination can occur without anything other than sucrose 5. allow if say additional components / components other than calcium and boric acid	[4]

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(ii)	1. ref. to making another growth medium without sucrose ; 2. *idea of* repeating the rest of the procedure (for both germination and growth of pollen) ;	*DO NOT award mp 1 if other constituents have been changed* 1. allow water only allow making up all media without sucrose allow 0 concentration taken from a range. do not allow ref. to control unqualified 2. allow if use descriptors of the method given in the question	[2]
(iii)	*1. for pollen germination* *idea of*: little / less / no, germination ; *2. for pollen tube growth* *idea of*: growth should be, similar / the same ;	1. allow ecf from range of sucrose concentrations in **(d)(ii)**, e.g. predicted result could be germination increases with concentration, decreases or stays the same *Ignore any other predictions*	[2]
			[Total: 19]
2 (a) (i)	ref. to idea of a means of supplying air / oxygen ; ref. to idea of spreading the air / oxygen through the buffer ;	e.g. oxygen cylinder / pump / named type of pump / (gas) syringe ; Allow: named chemical reaction in another tube as source, but NOT if added directly to the buffer e.g. diffuser / bubbler / bubbling / magnetic stirrer. allow stirring by hand	[2]
(ii)	temperature / idea of known time for absorption or sampling / concentration / mass, of sugars added ;	ignore volume of the buffer / oxygen concentration / pH ignore amount (of sugars)	[1]

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(b) (i)	3 of: 1. ref. to adding known, concentration / mass of glucose to buffer ; 2. ref. to leaving for specified time / AW ; 3. ref. to a method of removing contents of, the intestinal bag / external sample ; 4. ref. to a method of identifying presence of glucose ; 5. ref. to method of quantifying glucose ;	1. ignore 'amount' 2. do not allow 'time' unqualified – need a stated time value / idea of set time. Allow e.g. 'about 5 minutes' 3. e.g. using a pipette / syringe / AW. allow pouring out / emptying 4. e.g. Benedict's test / clinistix / dipsticks / AW 5. e.g. colour / mass, comparison with standards **or** use of biosensor **N.B** use a biosensor = 2 marks mps 4 & 5	[3]
(ii)	1. ref to calculating a rate by dividing a value for sugar by time ; 2. *idea of* calculating both rates and, making them comparative / compare ;	1. can be carried down from (b)(i) 3. ref.to difference in the original and final concentration in known time ; 4. ref. to dividing by the original external concentration ;	[2]
(c)	3 of: 1. without respiratory inhibitor glucose uptake is (much) higher / approx. × 3 ; 2. fructose uptake is not affected by inhibitor ; 3. with inhibitor uptake of both is (about) the same ; **ora** 4. both sugars are absorbed by (facilitated) diffusion ; 5. the rate of (facilitated) diffusion for both sugars is (about) the same ; 6. glucose is (also) absorbed by active transport / AW ; 7. more glucose is absorbed by active transport than by (facilitated) diffusion ; 8. intestine has active transport carriers for glucose ; 9. active transport of glucose requires oxygen ;	1. glucose to glucose comparison. Allow **ora** 3. **ora** – without inhibitor glucose uptake is greater than fructose 4. allow 'by a passive process / no energy needed' 6. allow 'requires, energy / ATP' **ora** fructose is <u>only</u> passive	[3]
			[Total: 11]

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	*independent* : type / source of pollen ; *dependent :* number / number of chromosomes (in the embryo / seeds) ;	allow species **B** and **C** (pollen) do not allow: species unqualified do not allow amount	[2]
(ii)	idea of: the type / source of pollen on the stigma ;	allow independent variable do not allow: pollination unqualified	[1]
(b) (i)	ref. to: a suitable method of collecting pollen **and** transferring (to stigma) ;	*looking for a 'how' and a 'where'.* allow any method that would work e.g. brush / sticks / cotton wool buds or shaking anthers onto stigma, into bag containing the flower, into dish and then picking up on stigma. Ignore vacuum pumps and pollen traps.	[1]
(ii)	pollen or plant allergy / described allergic reaction **and** method of preventing pollen or plant contact ;	*method should relate to (b)(i) answer* e.g. wearing mask / doing pollen transfer in a fume cupboard / environmental chamber. wearing gloves or goggles for skin or eye irritation allow scalpels / knives if used to remove anthers and cutting on a tile / away from body / keeping blades covered	[1]

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(c)	max 5 of: 1. ref. germinating / growing seeds (to cause cell division) ; 2. ref. to using a region, showing cell division / mitosis / named example ; 3. ref. to a means of separating the cells / cutting sections / squashing; 4. ref. to staining / dying / (correct) named stain; 5. ref. to using microscope at high power / high magnification / × 400; 6. idea of: (counting) chromosomes at a named suitable stage of mitosis ; 7. ref. to (counting) several different embryos;	1. allow ref. to removing (whole or part of the) embryo 2. e.g. root tips / shoot tips / meristem / radicle / plumule do not allow: fruit 3. allow ref. of maceration / heating do not allow: centrifuging / grinding / scraping cells from an embryo 4. e.g. aceto-orcein, aceto-carmine, methylene blue do not allow iodine / ink / food dye / ninhydrin ignore glycerol; 5. allow any magnification from ×250 to ×1000 do not allow electron microscopes 6. e.g. anaphase or metaphase, allow prophase do not allow stages of meiosis	[max 5]
(d)	max 3 of: 1. cross **A** × **B** the chromosome number is a half the chromosome number of each parent ; 2. (due to) fusion of gametes with 6 chromosomes and gametes with 10 chromosomes ; 3. idea that, gametes / AW, are produced by meiosis **OR** idea that chromosome number is halved by meiosis ; 4. cross **A** × **C** the chromosome number is double the (expected) hybrid number / is tetraploid; 5. idea that mitosis (of the zygote / embryo) has involved non-disjunction / described;	1. looking for idea hybrid has half the total number of both parents together e.g. 6 plus 10 gives 16, the haploid number of the parents is the total of the hybrid 2. allow any idea that the gametes each contain half the chromosome number of the parents 3. allow: pollen / embryo sac / egg / sperm / AW do not allow : ovule / ovary / anther /stigma 4. do not allow polyploidy unless qualified e.g. 2 sets of chromosomes from each parent Allow 14 + 12 = 26 or 13 × 2 = 26 5. allow if non-disjunction is in gametes. This may also subsume mp3 if the answer refers to 'abnormal meiosis forming gametes' Allow marks on a fully annotated diagram.	[max 3]

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(e) (i)	***A** and **B*** – 8 / a variable number / any number between 0 and 16 **and** ***A** and **C*** – 13 ;	look for the idea that **A** × **B** will not be consistent number or cannot be predicted from the diploid number allow they will be the same (as the pollen)	[1]
(ii)	pollen of hybrid **A** × **B** has variable number of chromosomes ; pollen of hybrid **A** × **C** has the same (haploid) number ;	*ignore ref. to germination rates, although they can be a means of identifying each hybrid*	[2]
(f) (i)	mean = 46; mode = 48 **and** median = 46;	<table><tr><td>hybrid from the cross</td><td></td></tr><tr><td>Mean</td><td>**46;**</td></tr><tr><td>Mode</td><td>**48**</td></tr><tr><td>Median</td><td>**46;**</td></tr></table>	[2]
(ii)	comparing **means** (of two sets of data) / data is discrete / quantitative;	allow data is continuous / has a normal distribution. do not allow data is a continuous variable / continuous variation	[1]
(iii)	idea of: there is no <u>significant</u> difference in the (percentage) germination (of the two hybrids) ;	e.g. the difference in the germination (of the two hybrids) is <u>not significant</u> do not allow 'to find the difference'	[1]
(iv)	idea of: 11 sets of data – 1 in each group;	allow as a formula (11 – 1) + (11 – 1) / 22 – 2 = 20 not $(n_1 – 1) + (n_2 – 1) = 20$ unless 'n' is specified	[1]
		Total:	**21**

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2 (a) (i)	max 3 of: 1. same tissue surface area / mass / number / size of discs ; 2. ion / chloride content of water <u>at start</u> is zero / the same; 3. volume of water in all tubes <u>is the same</u> / 30 cm^3; 4. time for testing (30 min) <u>is the same</u> ; 5. same electrode;	*Looking for what has been done, rather than what should be done. If answer as what should be done, penalise once only.* 1. allow tissue from same plant / same tissue of plant. do not allow amount of tissue 3. allow if refer to water bath all having same volume	[max 3]
(ii)	idea of replicates; min of 3, to obtain a mean / identify anomalous results;	allow repeats, ignore replicated readings allow average for mean, outliers for anomalous	[2]
(b) (i)	chloride (ions) divided by time;	allow as a formula: $\frac{\text{chloride (ions) at 30 min}}{30}$ or $\frac{\text{chloride (ions)}}{\text{time}}$ allow concentration / amount / reading of the electrode do not allow volumes	[1]
(ii)	(rate at 50 °C =)14 (au) **and** (rate 60 °C =) 56 (au); increase in rate = $\frac{56}{14}$ (au) = 4 ;	allow 400%	[2]
(c)	the rate of loss would increase;	allow: all the tubes would have the same result ignore any explanations of the prediction	[1]
		Total:	**9**

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(ii)	*Idea of*: allows comparisons (to be made between samples with different starting number) ;		[1]
(c) (i)	mean / $\bar{x}$ (of each sample) **and** the standard deviation / *s* (of each sample) ;	Allow identified in *t*-test formula Ignore standard error	[1]
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(iii)	3 of: 1. ref. to critical value (at p >0.05) is 2.10 ; 2. ref. to A + B (1) **and** A + C (2), have values greater than, the critical value / 2.10 **OR** ref. to B + C (3) has value less than, critical value / 2.10 ; 3. A + B / A + C results are, significant / not due to chance / caused by an environmental factor **OR** ora for B + C ; 4. ref. to A + C (also) significant at >p = 0.01 / AW ;	1. allow if critical value clearly marked on table. e.g. ringed etc. if > used must be correct. Accept 5% 3. allow if refer to differences in the media as an environmental factor allow if identified via *t* value	[3]
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(ii)	1. ref. to making another growth medium without sucrose ; 2. *idea of* repeating the rest of the procedure (for both germination and growth of pollen) ;	*DO NOT award mp 1 if other constituents have been changed* 1. allow water only allow making up all media without sucrose allow 0 concentration taken from a range. do not allow ref. to control unqualified 2. allow if use descriptors of the method given in the question	[2]
(iii)	*1. for pollen germination* *idea of*: little / less / no, germination ; *2. for pollen tube growth* *idea of*: growth should be, similar / the same ;	1. allow ecf from range of sucrose concentrations in **(d)(ii)**, e.g. predicted result could be germination increases with concentration, decreases or stays the same *Ignore any other predictions*	[2]
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(ii)	temperature / idea of known time for absorption or sampling / concentration / mass, of sugars added ;	ignore volume of the buffer / oxygen concentration / pH ignore amount (of sugars)	[1]

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(b) (i)	3 of: 1. ref. to adding known, concentration / mass of glucose to buffer ; 2. ref. to leaving for specified time / AW ; 3. ref. to a method of removing contents of, the intestinal bag / external sample ; 4. ref. to a method of identifying presence of glucose ; 5. ref. to method of quantifying glucose ;	1. ignore 'amount' 2. do not allow 'time' unqualified – need a stated time value / idea of set time. Allow e.g. 'about 5 minutes' 3. e.g. using a pipette / syringe / AW. allow pouring out / emptying 4. e.g. Benedict's test / clinistix / dipsticks / AW 5. e.g. colour / mass, comparison with standards **or** use of biosensor **N.B** use a biosensor = 2 marks mps 4 & 5	[3]
(ii)	1. ref to calculating a rate by dividing a value for sugar by time ; 2. *idea of* calculating both rates and, making them comparative / compare ;	1. can be carried down from (b)(i) 3. ref.to difference in the original and final concentration in known time ; 4. ref. to dividing by the original external concentration ;	[2]
(c)	3 of: 1. without respiratory inhibitor glucose uptake is (much) higher / approx. × 3 ; 2. fructose uptake is not affected by inhibitor ; 3. with inhibitor uptake of both is (about) the same ; **ora** 4. both sugars are absorbed by (facilitated) diffusion ; 5. the rate of (facilitated) diffusion for both sugars is (about) the same ; 6. glucose is (also) absorbed by active transport / AW ; 7. more glucose is absorbed by active transport than by (facilitated) diffusion ; 8. intestine has active transport carriers for glucose ; 9. active transport of glucose requires oxygen ;	1. glucose to glucose comparison. Allow **ora** 3. **ora** – without inhibitor glucose uptake is greater than fructose 4. allow 'by a passive process / no energy needed' 6. allow 'requires, energy / ATP' **ora** fructose is <u>only</u> passive	[3]
			[Total: 11]

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