CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 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 excepted)
max	indicates the maximum number of marks that can be given

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	*independent* : (sodium) nitrate concentration *dependent* : number of (leaf-like) thalli (of flowering plant);	**A** allow leaves ignore growth unqualified	[1]
(ii)	2 of: (initial) number / three thalli / three plants ; time (of investigation) / ten days ; source of plants ; temperature ; activity / interference by microorganisms (in the water) ;	*If more than two given, mark the first 2.* **A** allow thalli without any buds e.g. from the same pond / same environment allow room temperature ignore sterile	[max 1]
(iii)	2 x 2 of: 1 same volume of the sodium nitrate solution in each dish; ref. to a suitable method of measuring ; 2 light (intensity / wave length / duration) ; ref. to a method of giving standard intensity / wave length / time of illumination per day ; 3 aeration / oxygen concentration (of water) ; ref. to a method of supplying (sterile) air / oxygen ; 4 nitrate concentration ; add fresh nitrate solution daily / regularly ; 5 pH ; ref. to using a buffer ; 6 carbon dioxide (concentration) ; method of supplying carbon dioxide ; 7 size / diameter / surface area of starting thalli ; ref. to suitable method of measuring	*Read the whole. Identifying a variable is free standing, method linked to the variable. Ignore plant species, bleach.* 1 e.g. measuring cylinder, (graduated) pipette, burette, accept graduated beaker / graduated conical flask 2 e.g. lamp at fixed distance / same wattage bulb / filter of known wave length for duration, allow 12 hours / 48 hours of light OR exposure to daylight hours 3 e.g. pump / oxygen cylinder / bubbler / diffuser allow bubbling of air / oxygen 4 **A** stated time interval up to 48 hours / 2 days 5 **R** phosphate buffer 6 e.g. (sodium) hydrogen carbonate / sodium bicarbonate / CO_2 gas from a cylinder 7 e.g. ruler / grid /callipers ; ignore mass	[max 4]

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(b) (i)	4 of: *Allow marks on a labelled diagram.* 1 ref. to using (sterile) pond water to make dilutions ; 2 ref. to sterile conditions to make dilutions; 3 ref. to serial dilution ; 4 ref. to 50 : 50 dilution (each time); 5 detail in order to make all of the solutions ; 6 ref. to stirring / swirling solutions (between dilutions);	*If a method other than serial dilution is used then marks can be allowed for correct proportions of nitrate solution and pond water* 2 **A** descriptions of sterile technique 3 **A** formula $c_1/m_1.v_1 = c_2/m_2.v_2$ 4 **A** adding different proportions of nitrate solution and (pond) water / example of using formula 5 correct proportions given 1:1, 1: 3, 1:7, 1:15 if volumes are quoted, units are needed	[max 4]
(ii)	(a dish) containing <u>sterilised pond water</u> only (with same volume of water added as the sodium nitrate solution);		[1]
(c) (i)	shows the spread of data from the mean ; indicates / measures the reliability of the data ;	*Can allow both marks in (ii) if only 1 mark awarded in part (i)* **A** descriptions e.g. large deviation indicates low reliability. **A** figures from the table if any qualification of reliability given, then it must have both parts (large **and** idea of not very reliable , or small **and** idea of reliable)	
(ii)	*idea of:* (that over time) there are a larger the number of thalli / plants; *idea of:* (the longer the time for growth) the greater the difference between the individual replicates or samples ;	ignore difficulty on counting. **R** mean number of thalli. idea that there will be different growth rates so that individual replicates / samples will show grow greater variation.	[max 3]

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(d)	3 of: 1 increase in concentration (of nitrate) causes increase in the number of thalli / growth compared to control / AW ; 2 for concentrations up to 1000 mg dm^{-3} increase in number of thalli / growth increases (proportional to nitrate concentration) ; 3 above 1000 / 2000 mg dm^{-3} the rate of increase in number of thalli / growth is slower ; 4 optimum nitrate concentration is between 500 – 2000 mg dm^{-3}; 5 with time the standard deviations overlap / there is no difference in the effect of nitrate for the control / 250 mg dm^{-3} / 500 mg dm^{-3}	*Ignore references to individual data. Answers that have no reference to nitrogen concentration figures: max 1 for the idea that the growth rate increases and then decreases.* 1 *idea that* for any increase in nitrogen will increase number or growth in comparison to added nitrogen / control 3 *idea that* the rate of increase in thalli starts to decrease (above 1000 / 2000 mg dm^{-3}) Allow: 6 increase in nitrate allows more growth as more protein / DNA / chlorophyll can be synthesised; 7 high levels of nitrate reduce / inhibit growth or decrease the <u>water potential</u> of the solution or causes the plants to lose water;	[max 3]
(e)	*idea of:* using concentrations with smaller intervals within the range 500 - 2000 mg dm^{-3};	**A** if repeat the whole range with smaller intervals **A** answers in a table with values shown	[1]
(f)	graph axes with phosphate (concentration) / time on *x*-axis and thalli / growth on *y*-axis ; line(s) showing correlation between thalli number and phosphate concentration / time ; or starts high and then falls ;	units not needed **A** a line that increases, levels off and then decreases at high concentration **R** a line that start at 0 if number is on the *y*-axis if more than 1 line drawn they should be labelled: with time if phosphate is the *x*-axis with phosphate (concentration) if time is the *x*-axis	[2]
		Total:	**[20]**

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2 (a)	2 of: ref. using a counting grid / haemocytometer; ref. to counting cells in sample of known volume; ref. to using a microscope and suitable magnification; ref. to multiplication of the cell count to find the actual / original number of cells ;	**A** ref. to systematic counting method max. volume $1cm^3$ min x 400 / high magnification **A** high power **R** electron microscope Ignore resolution	[max 2]
(b)	number of stained / living cells counted in a sample; divide by total number of cells counted (in same sample) and multiply by 100;	**A** the idea of a viable count **A** both marks for a complete formula number of living / stained cells x 100; total number of cells **A** original cells for total cells	[2]
(c) (i)	idea of : there is no significant difference in the number of cells (between the two culture systems) ;		[1]
(ii)	38;	**A** as a formula (20-1) + (20-1) / 40 -2 if use (n-1) + (n-1) must state the value of n Ignore ref. to 'reject the null hypothesis'	[1]
(iii)	the difference in the cell number is significant / not due to chance (at 0.05 but not at 0.01);	ignore qualifications of significance	[1]
(d)	3 of: 1 correct ref. to population size; 2 any correct ref. to figures (from population size); 3 correct ref. to cell survival; 4 glucose / nutrient supply more consistent / not limiting; 5 lactic acid increase not high enough to become toxic / reduce pH;	*Assume that answers refer to the perfusion system* 1 e.g. greater number of cells in the culture / rate of cell increase greater / cell division faster ; 2 e.g. max. in batch 2.2 million, perfusion 32.1million 3 e.g. perfusion is always higher than batch / batch falls to 80%, perfusion stays close 100% allow any pair of figures from table 2.1 5 idea that lactic acid is not inhibiting growth rate	[max 3]
		Total:	**[10]**

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