

GCE

Biology B (Advancing Biology)

Unit **H422A/03**: Practical skills in biology

Advanced GCE

Mark Scheme for June 2017

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Subject-specific Marking Instructions**INTRODUCTION**

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question		Answer	Marks	Guidance
1	(a)	2.7 ✓ mm week ⁻¹ ✓	2	IGNORE working determined from reading a single value at 30 weeks i.e. 81/30. Candidates should use the slope of a tangent to a curve as a measure of a rate of change. ALLOW marks within range of 2.35-2.85 when calculated from a tangent ALLOW 'mm per week' or 'mm / week'
	(b)	growth of the fetus is unexpected if the value is outside the, band / range OR growth of the fetus is expected if the value is inside the, band / range ✓	1	ALLOW 'abnormal growth' for unexpected ALLOW 'normal growth' for expected DO NOT ALLOW answers using just one set of data, e.g. if the growth rate is in the 5 th percentile the fetus is growing (too) slowly ALLOW idea that 'BPD values which vary between the three sets of data indicates unexpected growth' DO NOT ALLOW references to unhealthy growth

	(c)	<p><i>One mark for useful statement ✓</i></p> <p><i>One mark for idea of limitation ✓</i></p>	2	<p>DO NOT ALLOW descriptions of methodology as these are not evaluative comments</p> <p>DO NOT ALLOW incorrect reference to inaccurate</p> <p>IGNORE references to black and white / 2D image IGNORE references to clear image/clarity of image</p> <p>Examples include non-invasive low risk to/safe for, fetus/mother low cost more <u>precise</u> than external measurements e.g. fundal height can monitor growth of different part of fetus' body idea of mobile equipment</p> <p>Examples include idea that produces image which can lack detail depends on correct position of fetus requires interpretation by trained medical staff resolution is low(er) (compared to other scans e.g. MRI, CT) level of detail is low(er) (compared to other scans e.g. MRI, CT) image can be blurred due to baby movement (hence the value is <u>imprecise</u>)</p>
		Total	5	

Question	Answer	Marks		Guidance
2	(a)			<p>Summary of instructions to markers: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a ‘best-fit’ approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i></p> <ul style="list-style-type: none">○ <i>award the higher mark where the Communication Statement has been met.</i>○ <i>award the lower mark where aspects of the Communication Statement have been missed.</i> <ul style="list-style-type: none">• The science content determines the level.• The Communication Statement determines the mark within a level.

2	(b)	<p>concentration of, gibberellin/GA₁, (mg dm⁻³) in first column (ascending or descending order) AND length of radicle (mm) to the right of the IV, with each concentration of GA₁ recorded in separate row AND mean column to the right of the DV AND informative column headings with correct unit symbols AND all cells surrounded by straight ruled lines with complete outer border ✓</p> <p>all radicles measured to nearest whole number or nearest 0.5mm AND within acceptable range ✓</p> <p>three values for 50 are recorded together AND three values for 100 are recorded together AND three values for 150 are recorded together ✓</p> <p>all three mean values calculated correctly from candidates own measurements AND recorded to consistent number of decimal places AND all means recorded to, the same / one more decimal place, than raw data ✓</p>	4	<p>DO NOT ALLOW measurements in cm as this is not the most appropriate level of precision for this apparatus as stated in the Q</p> <p>DO NOT ALLOW if the units are in the cells of the table</p> <p>DO NOT ALLOW if column headed as 'average'</p> <p>DO NOT ALLOW if units are incorrectly formatted</p> <p>ALLOW error carried forward for recording values in cm if the measurements are correct</p>
		Total	13	

Suggested table formats:

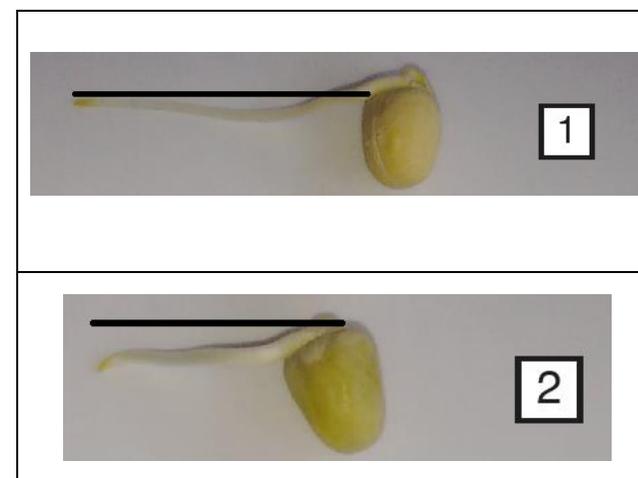
Concentration of GA ₁ (mg dm ⁻³)	Length of radicle (mm)	Mean length of radicle (mm)
50		
100		
150		

Concentration of GA ₁ (mg dm ⁻³)	Length of radicle (mm)			
	1	2	3	Mean
150				
100				
50				

Acceptable ranges of values for radicles:

Use data set according to method/end points used by candidate

Concentration of GA ₁ (mg dm ⁻³)	Radicle	Length range (mm) assuming candidate has measured to the edge of the seed <i>see picture 1</i>	Length range (mm) assuming candidate has measured to the visible emergent point <i>see picture 2</i>
150	1	29-30	35-36
	4	26-28	26-28
	8	25-26	27-30
100	2	16	19-21
	5	21-22	23-25
	9	19-20	22-24
50	3	9-10	10-12
	6	11	17-21
	7	18-19	22-23



Question			Answer	Marks	Guidance
3	(a)	(i)	<p>Mark first answer only. Any one from: <i>idea of continuous readings</i> ✓ <i>idea of measured in situ / no need for taking samples out of experimental vessel</i> ✓ greater degree of <u>precision</u> ✓ produces quantitative data ✓ objective / not subjective ✓ smaller % error ✓ results can be stored for later, use/processing ✓ time intervals can be varied / time intervals can be more frequent ✓ initial recording time/ start time, can be delayed ✓</p>	1 max	<p>ALLOW apparatus remains permanently set up</p> <p>ALLOW no risk of further oxygen dissolving in the water as sample is processed / analysed</p> <p>DO NOT ALLOW greater degree of accuracy / improved accuracy</p> <p>DO NOT ALLOW reduces error unqualified OR doesn't make human error</p>
		(ii)	<p>Mark first two answers only: age (of fish) ✓ sex (of fish) ✓ mass (of fish) ✓ food, mass / quantity / type ✓ volume of / mineral ion content in / other organisms in, water ✓</p>	2 max	<p>DO NOT ALLOW species of fish as this is given in the question</p> <p>ALLOW size of fish</p>

		(iii)	<p>Any one from:</p> <p>to remove, any respiring / photosynthesising microbes/microbial growth (which would interfere with respirometer readings) ✓</p> <p><i>idea of to reset the respirometer to zero ✓</i></p>	1 max		Microbes must be stated as either respiring or photosynthesising to gain credit
	(b)	(i)	there is no (significant) difference between the <u>means</u> (metabolic rate at different temperatures/at 10 °C & 16 °C) ✓	1		
		(ii)	68.89 ✓	1		ALLOW 68.9

		(iii) 12.285 ✓✓✓	3	<p>ALLOW e.c.f. throughout from 3(b)(ii) for 3 marks</p> <p>For calculations using 68.89 from Q3b(ii): ALLOW 12.291 or 12.284 (as candidate has rounded before the final the step in either case) OR 12.2849 or 12.29 for 2 marks (wrong number of d.p.)</p> <p>ALLOW one mark for correct substitution</p> $t = \frac{ 86.0 - 131.6 }{\sqrt{\frac{68.89}{10} + \frac{68.89}{10}}} \qquad t = \frac{ 131.6 - 86.0 }{\sqrt{\frac{68.89}{10} + \frac{68.89}{10}}}$ <p>ALLOW one mark for correct calculation (d.p. not critical here)</p> $\frac{45.6}{\sqrt{13.78}} \quad \text{OR} \quad \frac{45.6}{3.71}$ <p>For calculations using 68.9 from Q3b(ii): ALLOW 12.284 OR ALLOW 12.291 or 12.284 (as candidate has rounded before the final the step in either case) OR 12.2840 or 12.28 for 2 marks (wrong number of d.p.)</p> <p>ALLOW one mark for correct substitution</p> $t = \frac{ 86.0 - 131.6 }{\sqrt{\frac{68.9}{10} + \frac{68.9}{10}}} \qquad t = \frac{ 131.6 - 86.0 }{\sqrt{\frac{68.9}{10} + \frac{68.9}{10}}}$ <p>ALLOW one mark for correct calculation (d.p. not critical here)</p> $\frac{45.6}{\sqrt{13.78}} \quad \text{OR} \quad \frac{45.6}{3.71}$
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		<p>(iv)</p> <p>Any three from: degrees of freedom is 18 ✓</p> <p>the $t_{\text{calculated}}$ value is greater than the t_{critical} value at 5% ($p = 0.05$) / AW ✓</p> <p>the $t_{\text{calculated}}$ value is (also) greater than the t_{critical} value at 1%/0.1% ($p = 0.01/0.0001$) / AW ✓</p> <p>(so the researcher can) reject the null hypothesis ✓</p> <p>the difference in (mean) metabolic rate is not due to chance / there is a significant difference in the mean metabolic rate ✓</p>	<p>3 max</p>	<p>ALLOW e.c.f. throughout from 3(b)(iii) for 3 marks</p> <p>ALLOW 2 marks maximum if the incorrect degrees of freedom have been used</p> <p>ALLOW correct reference to using 5% probability level ALLOW 12.291 is greater than 2.101</p> <p>ALLOW 12.291 is greater than 2.878 OR 3.922</p>
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	(c)	<p>Mark first two answers only.</p> <p>Any two from: <i>For laboratory investigation:</i> only one species of fish has been investigated ✓ only two temperatures investigated ✓ small sample size ✓ temperature affects the solubility of oxygen ✓ smaller volume of water, is less thermally stable / may vary in salinity (due to evaporation) ✓ correct reference to acclimatisation period ✓</p> <p>aquatic plants affect oxygen concentration ✓ (fish) have different food / fed at regular intervals ✓ fish in oceans will be affected by wider fluctuations in temperatures (as lab is controlled) ✓ temperature fluctuations at the ocean surface will be greater than at depths ✓ (fish naturally) have different, feeding/ habitat depths ✓ AVP ✓</p>	2 max		<p>ALLOW ORA throughout for marine fish <i>in situ</i></p> <p>ALLOW aquatic plants affect oxygen availability</p> <p>e.g. idea that increasing sea surface temperatures may affect growth or populations of other marine organisms e.g. metabolic rates of fish in laboratory conditions may be affected by stress e.g. (as temperature increases) marine fish may migrate</p>
		Total	14		

Question			Answer	Marks	Guidance
4	(a)	(i)	<p><i>Median</i> (aged 18-25) 262 AND (aged 68-75) 299 ✓</p> <p><i>Range</i> (aged 18-25) 37 AND (aged 68-75) 14 ✓</p>	2	<p>IGNORE units</p> <p>DO NOT ALLOW 258 to 295 or 297 to 311 as command word in the question states <i>calculate</i></p>
		(ii)	<p>the mean, uses all the data (in the calculation) ✓</p> <p>the median, is less affected by outliers / AW ✓</p>	2	IGNORE references to 'central tendency' as both averages provide this
		(iii)	<p>Any one from (if one outlier is widely out compared with the other data) the range doesn't always give a true indication of the spread of data</p> <p>OR</p> <p>the range can be distorted by an outlier ✓</p>	1max	<p>ALLOW 'it' for 'range'</p> <p>ALLOW outlier can give a false impression of the spread of data</p> <p>OWTTE</p>
	(b)		<p><i>idea that</i> the data collected are from the same individual (paired measurements) ✓</p> <p><i>idea of</i> allows comparison of how each individual has changed (not how the average has changed) ✓</p>	2	IGNORE the 2 data sets are linked unqualified

(c)	<p>Summary of instructions to markers: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i></p> <ul style="list-style-type: none">○ <i>award the higher mark where the Communication Statement has been met.</i>○ <i>award the lower mark where aspects of the Communication Statement have been missed.</i> <p>• The science content determines the level. • The Communication Statement determines the mark within a level.</p>
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	<p>Level 3 (5–6 marks) Provides a comprehensive consideration of the ethical arguments for and against the use of humans and of animals in this type of experiment. The account is well balanced</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated..</i></p> <p>Level 2 (3–4 marks) Describes some of the ethical arguments for and against the use of humans and animals in this type of experiment. The account may not be fully balanced (for & against, animals & humans).</p> <p><i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) Describes some of the arguments either for or against the use of humans or animals in this type of experiment. The account lacks detail or is not well balanced.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	<p>Ethical considerations may include:</p> <p><i>For animal testing</i></p> <ul style="list-style-type: none"> • painful experiments can be carried out on animals with the use of analgesics • drugs/medicines not yet approved for human use can be used on animals • potentially lethal effects can be investigated in animal studies (e.g. sleep deprivation, drugs, gene deletion/'knock out') • lifetime effects can be studied on animals without implications for (human) family / friends <p><i>For human testing</i></p> <ul style="list-style-type: none"> • informed consent is possible for humans • human volunteers can withdraw (e.g. if experiment is painful) • idea of conclusions/results of drug effectiveness are more applicable to humans • can be used to determine effective dosage <p><i>Against animal testing</i></p> <ul style="list-style-type: none"> • informed consent is not possible for animals • animals cannot withdraw from experiments • painful experiments can be carried out on animals / objections on the basis of animal cruelty • idea of conclusions/results of drug effectiveness are not fully applicable to humans <p><i>Against human testing</i></p> <ul style="list-style-type: none"> • <i>idea that</i> expenses compensation may affect human volunteer pool • lifetime effects can have implications for, family / friends / volunteer
	Total	13	

Question		Answer	Marks	Guidance
5	(a)	19.85 ✓✓	2	<p>ALLOW maximum of one mark for 19.849 OR 19.8 (incorrect number of decimal places)</p> <p>DO NOT ALLOW 19.9 (incorrect rounding)</p> <p>If answer is incorrect or missing ALLOW maximum of one mark for correct working</p> $\frac{996}{5018} \times 100$

Data processing for Q 5bi

Calculating % values:

$$\% \text{ of smokers who have bronchitis: } \frac{230}{996} \times 100 = 23.09\% (23.1\%, 23\%)$$

$$\% \text{ of non-smokers who have bronchitis: } \frac{5260}{4022} \times 100 = 13.08\% (13.1\%, 13\%)$$

$$\% \text{ of smokers who have pneumonia: } \frac{335}{996} \times 100 = 33.63\% (33.6\%, 34\%)$$

$$\% \text{ of non-smokers who have pneumonia: } \frac{1166}{4022} \times 100 = 28.99\% (29.0\%, 29\%)$$

Calculating expected values:

$$\% \text{ of population who are non-smokers} = \frac{(5018-4022)}{5018} \times 100 = 19.85\%$$

$$\% \text{ of population who are smokers} = \frac{4022}{5018} \times 100 = 80.15\%$$

$$\text{Expected number of smokers who have bronchitis: } \frac{19.85}{100} \times 756 = 150.07 (150.1, 150)$$

$$\text{Expected number of non-smokers who have bronchitis: } \frac{80.15}{100} \times 756 = 605.93 (605.9, 606)$$

$$\text{Expected number of smokers who have pneumonia: } \frac{19.85}{100} \times 1501 = 297.95 (298.0, 298)$$

$$\text{Expected number of non-smokers who have pneumonia: } \frac{80.15}{100} \times 1501 = 1203.05 (1203.1, 1203)$$

	(ii)	chi-squared ✓	1		ALLOW χ^2 test
	(iii)	(chi-squared test) tests the <u>significance</u> of the difference between, observed and expected results ✓	1		
	(c)	cilia ✓	1		ALLOW ciliated epithelium ALLOW goblet cell
	(d)	states apparatus, to hold solution AND measure volumes ✓ 'F' is, stock / initial, solution used in the (serial) dilution ✓ correct volumes ✓ correct sequence ✓	4		<p><i>Apparatus could include</i></p> <ul style="list-style-type: none"> • suitable vessels for holding solutions, e.g. test tubes • volumetric apparatus, e.g. measuring cylinder, syringe, (graduated) pipette, burette <p>ALLOW 10.0000AU in place of 'F' ALLOW description (serial) dilution of 'F' e.g.</p> <ul style="list-style-type: none"> • measurement of one aliquot (antibiotic solution) and, adding to / mixing with, water • removal of one aliquot of new solution and, adding to / mixing with, water (repeated five times) <p><i>Volumes</i> one tenth of each solution forms the aliquot and is mixed with nine aliquots of water ALLOW 'parts' in place of absolute volumes IGNORE scale of volumes</p> <p><i>Sequence</i> must result in correct dilutions being produced, i.e. start with stock solution and proceed in order</p>

	(e)	<p>E and F have same sized, zone of inhibition ✓</p> <p>most appropriate (concentration) is, 1.0000 a.u. / E ✓</p> <p>reason given for not choosing, 10.0000 a.u. / solution F</p> <p>OR</p> <p>reason given for choosing, 1.0000 a.u. / solution E ✓</p>	3	<p>DO NOT ALLOW E is optimum concentration</p> <p>ALLOW</p> <ul style="list-style-type: none"> • 10.0000 a.u./ solution F, is not optimal because it is wasteful / expensive • may cause (worse) side-effects • greater % of antibiotic isn't absorbed in gut / AW • greater % is egested OWTTE • <i>idea that</i> it is good practice to prescribe the lowest effective dose
		Total	15	

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