OCR
Oxford Cambridge and RSA

GCE

Biology B (Advancing Biology)

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

Advanced GCE

Mark Scheme for June 2017

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

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 5th 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)		*One mark for useful statement* ✓ *One mark for idea of limitation* ✓	**2**		**DO NOT ALLOW** descriptions of methodology as these are not evaluative comments **DO NOT ALLOW** incorrect reference to inaccurate **IGNORE** references to black and white / 2D image **IGNORE** references to clear image/clarity of image 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 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>
			Total	**5**		

Question			Answer	Marks		Guidance
2	(a)		***Summary of instructions to markers:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *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.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* o *award the higher mark where the Communication Statement has been met.* o *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			

			Level 3 (7-9 marks) Comprehensive details of apparatus and a method to produce reliable data are provided to include the preparation of dilutions of the stock solution of gibberellic acid. Most variables are identified and the method states how these are controlled. Details of a control and safety are included. *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.* **Level 2 (4-6 marks)** Some details of apparatus and a method to produce reliable data are provided. There is an outline of the preparation of dilutions of the stock solution of gibberellic acid. Some variables are identified and the method states how some are controlled. Details of a control or safety are included. *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.* **Level 1 (1–3 marks)** Apparatus and an outline method are suggested to provide some results but information, such as how to dilute the stock solution of gibberellic acid, may be missing. Some variables and safety details are omitted. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**9** **8**		**Indicative scientific points may include** **Apparatus & method:** • growing medium (e.g. soil, cotton wool, filter paper) • suitable containers (e.g. pots/Petri dishes etc.) for growing medium • apparatus for precise / accurate volume measurement • distilled/deionised water • details of quantitative preparation of dilution series (for GA) to include volumes & final concentrations • method of determining whether or not germination has occurred • control included (distilled water or 0 mg dm^{-3} GA) • sufficient number of values of IV (different concentrations of GA across appropriate range) **Variables** • independent variable = dilutions of gibberellic acid • dependent variable = %/proportion/fraction of seeds germinated • control variables = exposure to light/kept in dark/constant day length, watering of seeds (volume of gibberellic acid solution is not critical but the seeds must be kept wet/moist with the appropriate solution), temperature, planting density/number of seeds per container, time **Reliability** • repeats (for each concentration) **Risk Assessment** • potential chemical hazards & control

2	(b)		concentration of, gibberellin/GA_1, (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 GA_1 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 ✓ all radicles measured to nearest whole number or nearest 0.5mm **AND** within acceptable range ✓ three values for 50 are recorded together **AND** three values for 100 are recorded together **AND** three values for 150 are recorded together ✓ 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 ✓	4		**DO NOT ALLOW** measurements in cm as this is not the most appropriate level of precision for this apparatus as stated in the Q **DO NOT ALLOW** if the units are in the cells of the table **DO NOT ALLOW** if column headed as 'average' **DO NOT ALLOW** if units are incorrectly formatted **ALLOW** error carried forward for recording values in cm if the measurements are correct
			Total	13		

Suggested table formats:

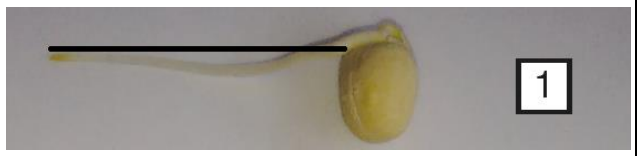
Concentration of GA_1 (mg dm^{-3})	Length of radicle (mm)	Mean length of radicle (mm)
50		
100		
150		

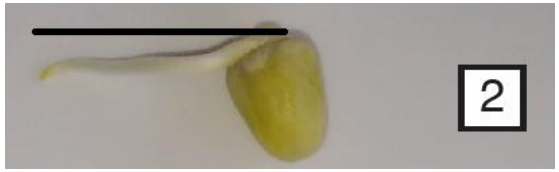
Concentration of GA_1 (mg dm^{-3})	Length of radicle (mm)			
	1	2	3	Mean
150				
100				
50				

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 *see picture 1*	Length range (mm) assuming candidate has measured to the visible emergent point *see picture 2*
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)	**Mark first answer only.** **Any one from**: *idea of* continuous readings ✓ *idea of* measured *in situ* / no need for taking samples out of experimental vessel ✓ 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 ✓	**1 max**		**ALLOW** apparatus remains permanently set up **ALLOW** no risk of further oxygen dissolving in the water as sample is processed / analysed **DO NOT ALLOW** greater degree of accuracy / improved accuracy **DO NOT ALLOW** reduces error unqualified **OR** doesn't make human error
		(ii)	**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 ✓	**2 max**		**DO NOT ALLOW** species of fish as this is given in the question **ALLOW** size of fish

		(iii)	**Any one from**: to remove, any respiring / photosynthesising microbes/microbial growth (which would interfere with respirometer readings) ✓ *idea of* to reset the respirometer to zero ✓	**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**		**ALLOW** e.c.f. throughout from 3(b)(ii) for 3 marks ***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.) **ALLOW** one mark for correct substitution $t = \frac{\lvert 86.0 - 131.6 \rvert}{\sqrt{\frac{68.89}{10} + \frac{68.89}{10}}}$ $t = \frac{\lvert 131.6 - 86.0 \rvert}{\sqrt{\frac{68.89}{10} + \frac{68.89}{10}}}$ **ALLOW** one mark for correct calculation (d.p. not critical here) $\frac{45.6}{\sqrt{13.78}}$ **OR** $\frac{45.6}{3.71}$ ***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.) **ALLOW** one mark for correct substitution $t = \frac{\lvert 86.0 - 131.6 \rvert}{\sqrt{\frac{68.9}{10} + \frac{68.9}{10}}}$ $t = \frac{\lvert 131.6 - 86.0 \rvert}{\sqrt{\frac{68.9}{10} + \frac{68.9}{10}}}$ **ALLOW** one mark for correct calculation (d.p. not critical here) $\frac{45.6}{\sqrt{13.78}}$ **OR** $\frac{45.6}{3.71}$

		(iv)	**Any three from**: degrees of freedom is 18 ✓ the $t_{calculated}$ value is greater than the $t_{critical}$ value at 5% (p = 0.05) / AW ✓ the $t_{calculated}$ value is (also) greater than the $t_{critical}$ value at 1%/0.1% (p = 0.01/0.0001) / AW ✓ (so the researcher can) reject the null hypothesis ✓ the difference in (mean) metabolic rate is not due to chance / there is a significant difference in the mean metabolic rate ✓	**3 max**		**ALLOW** e.c.f. througout from 3(b)(iii) for 3 marks **ALLOW** 2 marks maximum if the incorrect degrees of freedom have been used **ALLOW** correct reference to using 5% probability level **ALLOW** 12.291 is greater than 2.101 **ALLOW** 12.291 is greater than 2.878 **OR** 3.922

	(c)		**Mark first two answers only.** **Any two from:** *For laboratory investigation:* 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 ✓ 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 ✓	**2 max**		**ALLOW** ORA throughout for marine fish *in situ* **ALLOW** aquatic plants affect oxygen availability 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
			Total	**14**		

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

	(c)	***Summary of instructions to markers:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *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.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***

		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 *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..* **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). *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.* **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. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**		**Ethical considerations may include:** ***For animal testing*** • 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 ***For human testing*** • 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 ***Against animal testing*** • 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 ***Against human testing*** • *idea that* 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		**ALLOW** maximum of one mark for 19.849 **OR** 19.8 (incorrect number of decimal places) **DO NOT ALLOW** 19.9 (incorrect rounding) If answer is incorrect or missing **ALLOW** maximum of one mark for correct working $\frac{996}{5018} \times 100$

	(b)	**(i)**	*Analysis of data* more cases of respiratory tract infections among smokers than expected **OR** pneumonia is more common than bronchitis among both smokers and non-smokers **OR** smoking appears to significantly increase the risk of bronchitis and may also (slightly) increase the risk of getting pneumonia ✓	**3**		**ALLOW** more cases of pneumonia and bronchitis among smokers than expected
			supporting data referring to expected number of cases ✓			e.g. expected cases of pneumonia among smokers 297.95 or 298 **OR** expected cases of bronchitis among smokers 150.07 or 150 **OR** e.g. expected cases of pneumonia among non-smokers 1203.05 or 1203 **OR** expected cases of bronchitis among non-smokers 605.93 or 606
			supporting data referring to % of cases ✓			23.09% or 23.1% or 23% of smokers had bronchitis compared with 13.08 or 13.1% or 13% of non-smokers **OR** about 33.63% or 33.6% or 34% of smokers had pneumonia compared to 28.99% or 29.0% or 29% of non-smokers
			Comment on hypothesis null hypothesis should be rejected ✓			**ALLOW** hypothesis is not supported **IGNORE** hypothesis is, false / wrong / contradicted

Data processing for Q 5bi

Calculating % values:

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

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

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

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

Calculating expected values:

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

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

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

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

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

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 significance 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**		*Apparatus could include* • suitable vessels for holding solutions, e.g. test tubes • volumetric apparatus, e.g. measuring cylinder, syringe, (graduated) pipette, burette **ALLOW** 10.0000AU in place of 'F' **ALLOW** description (serial) dilution of 'F' e.g. • 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) *Volumes* 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 *Sequence* must result in correct dilutions being produced, i.e. start with stock solution and proceed in order

	(e)		E and F have same sized, zone of inhibition ✓ most appropriate (concentration) is, 1.0000 a.u. / E ✓ reason given for not choosing, 10.0000 a.u. / solution F **OR** reason given for choosing, 1.0000 a.u. / solution E ✓	**3**		**DO NOT ALLOW** E is optimum concentration **ALLOW** • 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 • *idea that* it is good practice to prescribe the lowest effective dose
			Total	**15**		

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553