Oxford Cambridge and RSA

H

GCSE (9–1)

Biology B (Twenty First Century Science)

J257/04: Depth in Biology (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for Autumn 2021

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.

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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.

1. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

2. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
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

3. **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.

The breakdown of Assessment Objectives for GCSE (9-1) in Biology B:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

Question			Answer	Marks	AO element	Guidance
1	(a)	(i)	Particles of water ✓	1	1.1	more than one box ticked = 0 marks
		(ii)	From where they are concentrated - to where they are less concentrated ✓	1	1.1	more than one line drawn = 0 marks
		(iii)	**Any two from:** it is partially-permeable / semi-permeable ✓ it has holes/pores that are big enough to let small molecules through, but too small to let bigger molecules through ✓ idea that active transport carries some/specific molecules through the membrane ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
1	(b)	(i)*	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Most key steps of the method are described, with reference to the apparatus used to carry them out **AND** a description of how the measurements would be processed to calculate (mean) percentage change in mass. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Most key steps of the method are described, with reference to the apparatus used to carry them out. **OR** Most key steps of the method are described, with a description of how the measurements would be processed to calculate (mean) percentage change in mass. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Some key steps of the method are described. *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	3.3a	**AO3.3a Description of key steps in method** For example: • Weigh each potato piece before placing in the solution. • Soak each piece for suitable/same period of time. • Remove the pieces from the solution, and dry/remove water from the surface. • Weigh each piece again. • Idea of repeating or soaking multiple pieces in each solution so that the mean (of the percentage change in mass) can be calculated. **AO3.3a Description of apparatus used** For example: • Weigh each potato piece using a balance. • Time the soaking using a stopwatch/timer. • Remove potato pieces from solutions using forceps. • Dry potato pieces using paper towel/blotting paper. **AO3.3a Description of data processing** For example: • Calculate difference in mass by taking initial mass from final mass • Calculate percentage change in mass as follows: $\frac{\text{(final mass – initial mass)}}{\text{initial mass}} \times 100$

Question			Answer	Marks	AO element	Guidance
1	(b)	(ii)	"mean % change in mass (%)" label correctly added to y-axis ✓ both points plotted correctly at 0,16 and 6,–24 ✓	2	1.2	 **IGNORE** lines drawn to connect plots **ALLOW** a half square tolerance for each point
		(iii)	**Max two from:** when the water contained 0 g or 2 g of sugar, the potato pieces increased in mass ✓ when the water contained 4 g or 6 g of sugar, the potato pieces decreased in mass ✓ no change of mass at 2.5g ✓ **Max two from:** (increase in mass) due to water moving into the potato (cells) (by osmosis) ✓ (decrease in mass) due to water moving out of the potato (cells) (by osmosis) ✓ at equilibrium/2.5g there is no net movement/same number of particles moving each way ✓	4	3.1a x 2 2.1 x 2	**DO NOT ALLOW** negative correlation
		(iv)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.1 (g/cm^3) award 2 marks** (0% change at) 2.5 g ✓ 2.5 g ÷ 25 cm^3 = 0.1 g/cm^3 ✓	2	 3.2a 3.2b	 **ALLOW** any number from 2.4 to 2.6 inclusive **ALLOW** any number from 0.09 – 0.11 inclusive

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>Bacterium</th><th>Fungi</th><th>Protist</th><th>Virus</th></tr>
<tr><td>Ash dieback</td><td></td><td>✓</td><td></td><td></td></tr>
<tr><td>Crown gall</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Tobacco mosaic</td><td></td><td></td><td></td><td>✓</td></tr>
</table>
✓ ✓ ✓
</td><td>3</td><td>1.1</td><td>One mark per correct row
IGNORE any row containing more than one tick</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>antimicrobial substances ✓

cell walls ✓</td><td>2</td><td>1.1</td><td>More than two ticks = 0 marks</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>cuticle / waxy coating (on leaves) ✓</td><td>1</td><td>1.1</td><td>ALLOW waxy cuticle</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Any two from:

(no white blood cells so) memory cells are not created after vaccination ✓

(so) plants cannot become immune (to a pathogen) ✓

(so) plants will not produce antibodies if (re)infected with the pathogen ✓</td><td>2</td><td>2.1</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	2 46 ✓ cell division 4 23 ✓	2	1.1	One mark for each correct row
		(ii)	so that zygote/fertilised egg cell has 46/normal number of chromosomes ✓	1	1.1	**ALLOW** restores diploid number
	(b)	(i)	A: FSH / follicle stimulating hormone ✓ B: oestrogen ✓ C: Progesterone ✓	3	1.1	**ALLOW** answers next to descriptions and not on answer line
		(ii)	(extra) hormone A will cause a follicle(s) to mature (ready to release an egg) ✓ (extra) LH will cause ovulation / cause an egg(s) to be released (from the mature follicle) ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
4	(a)		her sex chromosomes would be XX ✓	1	2.1	
	(b)		genetic test(ing) ✓ (to look for) allele(s)/mutation(s)/genetic variant(s) that cause(s) blue eye colour ✓	2	2.1	**ALLOW** genome sequencing / idea of looking at gene sequences
	(c)		most features (are controlled by the genome but) are affected/modified by environment/lifestyle ✓ **AND any three from:** some of her features would have been entirely caused by her environment/lifestyle (and not affected by her genome) ✓ correct example of a feature (which is either affected by or caused by environment/lifestyle) ✓ correct example of a lifestyle factor that can affect features ✓ correct example of an environmental factor that can affect features ✓ idea that we still don't know what many parts of the genome do / how they could have affected her phenotype/features ✓	4	1.1 2.1 x 3	e.g. height, weight, scar(s) e.g. her diet, the amount of exercise she had, diseases she caught/developed, injury/fighting/accidents e.g. toxins/poisons/chemicals she was exposed to, sunlight/temperatures/weather she was exposed to
	(d)		genetic variants ✓ phenotype ✓	2	2.1	
	(e)		genome sequencing **OR** genetic testing for particular genes/alleles/mutations/variants ✓ idea of comparing sequences/test results with known organisms (to match with duck) ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
5	(a)		**Any two from:** measurements made using digital thermometer will be more <u>accurate</u> / <u>closer to the true value</u>(s) ✓ digital thermometer can measure to 2 decimal places / 4 sig. figs. / it has greater resolution/sensitivity✓ digital thermometer makes it easier to read values between whole degrees ✓ digital thermometer is less likely to be affected by measurement errors ✓	2	3.3b	**IGNORE** refs. to safety / breaking the glass thermometer **DO NOT ALLOW** quicker **DO NOT ALLOW** easier to use
	(b)		0.9 (°C) ✓	1	3.1a	
	(c)	(i)	Beth's body temperature increased during exercise/period B ✓	1	3.1a	
		(ii)	the results are only for Beth/one person (but the prediction is for all humans) ✓	1	3.1b	**ALLOW** reference to increase of temperature between 70 & 75 minutes (in period C)
		(iii)	repeat the investigation/measurements with other people ✓	1	3.1b	Both parts required for the mark
	(d)		ATP/energy ✓ (cellular) respiration ✓ exothermic ✓	3	2.1	

Question			Answer	Marks	AO element	Guidance
5	(e)		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Describes the results **AND** explains some of what happened in the student's skin and nervous system to reduce the body temperature. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes the results **AND** explains some of what happened in the student's skin to reduce the body temperature. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Describes the results in period C, but does not provide any explanation for them. *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**	**3.1a x 2** **2.1 x 4**	**AO3.1a Description of results in period C** For example: • During period C the student was resting / not exercising • The student's body temperature decreased / returned to normal / returned to the (resting) value from period A • From 37.7 °C to 36.8, then back up to 36.85 **AO2.1 Explanation of what happened in the student's skin (to reduce body temperature)** For example: • Increased sweating • Evaporation of (water from) sweat • red flushing/vasodilation (of capillaries) • allowing more warm blood to flow near the surface of the skin • hairs lying flat / relaxation of hair erector muscles • idea that these responses increase (the rate of) heat loss / cool the body • idea that (rate of) heat loss > heat generated **AO2.1 Explanation of what happened in the student's nervous system** For example: • High body/blood temperature detected by receptors • In the hypothalamus/brain • Nerve impulses sent (along motor neurons) to trigger responses in skin/effectors • Idea that negative feedback shuts off the responses once the body/blood temperature reaches/dips below normal

Question			Answer	Marks	AO element	Guidance
6	(a)		new species can be formed ✓ the characteristics of species can change over generations ✓	2	1.1	
	(b)	(i)	mutations ✓ (that create) new genetic variants/alleles / differences in the DNA/genome/genes ✓ **OR** different combinations of chromosomes/alleles/genetic variants ✓ (received during) sexual reproduction / fertilisation of gametes ✓	2	1.1	**ALLOW** description of a mutation e.g. insertion, deletion, substitution
		(ii)	fossils ✓ that have some similarities and some differences to living organisms ✓ **OR** domesticated animals / new varieties of plants ✓ created by selective breeding / (artificial) selection by humans ✓ **OR** different species having many characteristics in common / appearing to have common ancestry ✓ (but) differing in ways that mean they are better/well adapted to their environment ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
6	(c)	(i)	some bacteria have a mutation/genetic variant that makes them resistant to the antibiotic ✓ idea that the antibiotic selects / causes (natural) selection of resistant bacteria / only bacteria with resistance (mutation/variant) survive ✓ surviving bacteria reproduce/divide ✓ so resistance mutation/variant becomes more common ✓	4	2.1	**ALLOW** ref. to horizontal gene transfer / passing plasmids to other bacteria
		(ii)	**Any two from:** idea that less antibiotic means less selection of resistant bacteria / means non-resistant bacteria will survive ✓ resistant bacteria will have to compete with non-resistant bacteria ✓ (this will help to ensure that) resistant bacteria remain a small(er) proportion of the bacterial population ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
7	(a)		$\frac{1.1}{(1.1 + 1.4)}$ x 100 = 44% ✓	1	1.2	
	(b)		bacteria are microorganisms/decomposers ✓ they will help to break down/decompose the waste (to make compost) by releasing enzymes ✓	2	2.1 1.1	**ALLOW** other terms such as Saprotrophs, Saprobionts
	(c)		plants need/absorb minerals/ions from soil ✓ these minerals/ions/substances are used to build biomass/proteins/carbohydrate/plant material ✓ **AND any two from:** idea that composting/decomposing the plant material means that these substances are cycled/reused ✓ helps (new) plants to grow / keeps soil fertile ✓ idea that this is (more) sustainable ✓ (because) don't need to bring in fertiliser from elsewhere ✓	4	1.1 x 2 2.1 x 2	**ALLOW** named ions/substances e.g. nitrate/nitrogen **ALLOW** "nutrients" **ALLOW** reverse argument for marking points 3 and 4, e.g. throwing plant waste away means these substances are lost ✓, so soil could become infertile ✓ **IGNORE** greenhouse gas production arguments
	(d)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.3:1 award 3 marks** volume = 2 x 10 x 20 = 400 cm^3 ✓ 520 ÷ 400 = 1.3 ✓ Ratio = 1.3:1 ✓	3	2.2	**ALLOW** 13:10 answer for 2 marks

Question			Answer	Marks	AO element	Guidance
	(d)	(ii)	greater surface area (to volume ratio) ✓ more surface for (enzymes from) bacteria/microorganisms/decomposers to work on ✓	2	2.1	
	(e)	(i)	decomposition/break down is catalysed by enzymes (released by microorganisms/decomposers) ✓ **AND any two from:** these enzymes have an optimum temperature at which they work best / at which reactions they catalyse are fastest ✓ decomposition/breakdown is slower at temperatures below the optimum because rate of reactions is slower at lower temperatures ✓ decomposition/breakdown is slower at temperatures above the optimum because the shape of (the active site of) the enzymes changes / they become denatured ✓	3	2.1	**ALLOW** reference to fewer collisions (between enzymes/active sites and substrates) / lower kinetic energy
		(ii)	the line between 10 °C and 20 °C ✓	1	3.2a	
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.22 award 2 marks** (3.0 – 0.8) ÷ (20 – 10) ✓ = 0.22 g/day per °C ✓	2	3.2b	

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