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 June 2019

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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.

Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

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

Annotation	Meaning
I	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

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.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>
<table>
<tr><td>Chloroplast</td><td></td><td>✓</td><td></td></tr>
<tr><td>Phloem</td><td>✓</td><td></td><td></td></tr>
<tr><td>Xylem</td><td></td><td></td><td>✓</td></tr>
</table>
</td><td>1</td><td>1.1</td><td>All three ticks = one mark
Four or more ticks = zero marks</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Any pair from:
light (intensity) ✓
use same lamp/distance/power/brightness (at each temperature) ✓
OR
carbon dioxide (concentration) ✓
use same concentration of sodium hydrogen carbonate solution (at each temperature) ✓
OR
volume/amount of sodium hydrogen carbonate solution ✓
use measuring cylinder/syringe/(graduated) pipette ✓
OR
length/amount of pondweed ✓
use ruler / weigh it / use same piece (at each temperature)✓
OR
species of pondweed ✓
cut from same plant ✓</td><td>2</td><td>2 x 3.3a</td><td>DO NOT ALLOW temperature (because this is the variable Eve is changing)
IGNORE reference to water in beaker
ALLOW description of ‘how’ before the variable in each pair

IGNORE reference to closing curtains/blinds

ALLOW other suitable methods of measuring volume, but not beaker

DO NOT ALLOW “same pondweed”</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
1	(c)	(i)	**Any two from:** (existing) mean volume at 45 °C does not fit the trend/line/pattern ✓ it is (much) lower than the volumes collected at 40 °C and 50 °C ✓ it appears to be an outlier/anomaly ✓ it may have been due to random/experimental/measurement error/mistake ✓	2	2 x 3.1b	**DO NOT ALLOW** "unexpected" **ALLOW** examples of errors/mistakes
		(ii)	some indication that the new mean volume is 355 ✓ data point plotted at 45,355 ✓	2	2 x 2.2	check working and graph **ALLOW** ECF for correct plot of incorrect calculation for 1 mark **IGNORE** any line(s) drawn to connect plots
	(d)		volume of gas collected increases as temperature increases / positive correlation ✓ idea that it increases most quickly between 30-40 ✓ reference to data from graph that supports trend ✓	3	3 x 3.1a	**IGNORE** references to incorrectly plotted data **ALLOW** answers that refer to "rate of photosynthesis" instead of "volume of gas collected" **IGNORE** reference to denaturing of enzymes **DO NOT ALLOW** reference to single data point read from the graph (e.g. 25,20 / 30,55 / 35,175 / 40,290 / 45,355 / 50,365); data must illustrate **trend** (e.g. volume rises by 35 mm^3 from 25 °C to 30 °C / rises 235 mm^3 from 30 °C to 40 °C / rises 55 mm^3 from 40 °C to 45 °C / rises 10 mm^3 from 45 °C to 50 °C)

Question			Answer	Marks	AO element	Guidance
	(e)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 23 (mm^3/°C) award 2 marks** (290 – 175) ÷ (40 – 35) **OR** 115 ÷ 5 ✓ = 23 (mm^3/°C) ✓	**2**	**3.1a** **2.2**	

Question			Answer	Marks	AO element	Guidance
2*			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)** Explains in general terms why both washing hands and drinking yogurt drink are good. **AND** Explains why both washing hands and drinking yogurt drink are helpful in Layla's context. *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)** Makes valid points about both washing hands and drinking yogurt drink, but only in general terms (not in Layla's context). **OR** Makes valid points about both washing hands and drinking yogurt drink, but only in Layla's context (not including ideas from general terms). *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)** Only makes valid points about washing hands. **OR** Only makes valid points about drinking yogurt drink. *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**	**4 x 1.1** **2 x 2.1**	**AO1.1 Explains in general terms why washing hands and drinking yogurt drink are good** *Washing hands* • idea that bacteria/viruses/fungi/microorganisms can cause disease(s) / are pathogens • relevant named example, e.g. *Salmonella*, influenza, HIV • they can be present/spread on hands • they can be spread by touching bodily fluids/surfaces/skin • washing hands reduces/stops the spread • washing hands removes/kills microorganisms that cause disease(s) • washing hands removes dirt/sweat/fluids that trap microorganisms that cause disease(s) *Drinking yogurt drink* • contains helpful/good/friendly bacteria • tops up microbial/bacterial defences (in the gut) • helps protect/defend against (microorganisms that cause) disease • by competing with harmful bacteria (for space/nutrients) • improves digestion **AO2.1 Explains why this is helpful in Layla's context** *Washing hands* • Layla touches (contaminated/dirty) patients/surfaces • Stops/reduces chance of Layla spreading diseases/microorganisms to patients • Stops/reduces chance of Layla spreading diseases/microorganisms to food/water/surfaces/equipment • Stops/reduces chance of Layla spreading diseases/microorganisms from patients to herself *Drinking yogurt drink* • Protects/defends against microorganisms that have entered Layla's gut (from patients/surfaces/food/hands) • Stops/reduces chance of Layla developing symptoms

Question			Answer	Marks	AO element	Guidance
3	(a)		A population ✓	1	1.1	more than 1 box ticked = zero marks
	(b)		the community is all of the (interacting populations of) phytoplankton, zooplankton, fish and shellfish ✓ the ecosystem is all of the populations/organisms/biotic components plus their (abiotic) environment ✓	2	2 x 2.1	**ALLOW** all of the living things **ALLOW** living/non living for biotic/abiotic
	(c)		(plastic litter breaks down into microplastics which are small enough) for fish to eat but cannot be digested ✓ the fish will not get enough energy/materials/nutrients/food so will die ✓ idea that death rate faster than reproduction rate ✓	3	3.1a 2.1 2.1	 **ALLOW** "the fish will starve to death" **DO NOT ALLOW** "the fish will die" without explanation **IGNORE** blockages
3	(d)	(i)	**Any four from:** the bacteria will cause a large/rapid increase in the amount of microplastics in the sea ✓ this will cause fish to die (of starvation) even faster ✓ animals that eat fish could die due to insufficient food ✓ animals that eat fish could die due to (increased) bioaccumulation of microplastics in the food web ✓ the bacteria could cause disease/harm/infection ✓ the bacteria would compete with existing microorganisms which could disrupt food chains/cycling of materials ✓	4	4 x 2.1	 **ALLOW** disruption of food chain **IGNORE** Toxicity

Question			Answer	Marks	AO element	Guidance
		(ii)	(random) mutation(s) (in the bacteria's DNA/genes/genome) ✓ enabled the bacteria to make a protein/enzyme/substance (that can break down plastic) ✓	2	1.1 2.1	 **IGNORE** survival advantage

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	guard cells ✓	1	1.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3.75 x 10^{-2} (mm) award 2 marks** 15 ÷ 400 = 0.0375 ✓ = 3.75 x 10^{-2} (mm) ✓	2	2x 2.2	
	(b)	(i)	(step 3) could damage the eye ✓ do not use in direct sunlight / suggested alternative e.g. use a lamp ✓ (step 4) could smash/damage the slide/lens ✓ start with objective lens at lowest position and use coarse focus to move it up/away from the slide ✓	4	 1.2 3.3b 1.2 3.3b	No marks for identifying the stages
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 28.3 (mm^2) award 3 marks** radius = 6 ÷ 2 = 3 ✓ area = 3.14 x 3^2 = 28.26 ✓ = 28.3 (mm^2 to 3 sig. fig.) ✓	3	 2.2 2.2 1.2	 **ALLOW** ECF if wrong radius used **ALLOW** correct sig.fig from their answer
		(iii)	(255 ÷ 28.3 =) 9(.011) / (255 ÷ 28.26 =) 9(.023) ✓	1	2.2	**ALLOW** ECF 255 divided by answer to **(b)(ii)**

Question			Answer	Marks	AO element	Guidance
4	(b)	(iv)	this is only a small area/sample of the whole leaf surface ✓ it may not be a representative sample / there may be more/fewer stomata elsewhere ✓	2	2x 2.1	 **ALLOW** more stomata on underside of leaf / density may vary
	(c)		**Max three from (advantages):** take in carbon dioxide for photosynthesis ✓ release waste oxygen from photosynthesis ✓ take in oxygen for aerobic respiration ✓ release waste carbon dioxide from respiration ✓ transpiration provides water for photosynthesis✓ **Any from (disadvantages):** loss of water (vapour) ✓ pathogens/bacteria/fungi/viruses may enter ✓	4	4 x 1.1	**IGNORE** any statement for which the candidate has not made clear whether it's an advantage or a disadvantage **DO NOT ALLOW** "gas exchange" without reference to named gases/processes **ALLOW** for uptake of minerals / ions / nutrients but not food

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	50 (%) ✓	1	2.2	
		(ii)	70 560 (people) ✓	1	2.2	
	(b)		mutations could be in genes/coding DNA that controls the cell cycle/cell division/mitosis ✓ mutations/changes could be in non-coding DNA that affects expression of genes that control the cell cycle / cell division/mitosis ✓ leading to uncontrolled cell division/mitosis ✓	3	3 x 1.1	**ALLOW** one mark for the idea that the mutations affect the cell cycle without explanation of how **ALLOW** produces a tumour **DO NOT ALLOW** quick or rapid cell division
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = –98 (%) award 2 marks** (1 – 53) = –52 (–52 ÷ 53) x 100 ✓ = –98(.1) (%) ✓	2	 2.2 2.2	**ALLOW** (1 – 52) = -51 as answer still -98% **ALLOW** one mark max. for an answer of 98 without the minus sign
		(ii)	(no) because: (98%) only true for (reduction in concentration of) NNK ✓ Idea of other carcinogens not reduced by as much ✓	2	 3.1b 3.1a	Still read answer if yes

Question			Answer	Marks	AO element	Guidance
5	(c)	(iii)*	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)** A detailed explanation of genetic and lifestyle factors that affect Beth's risk of developing cancer. **AND** A detailed explanation of the best course of action for her. *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)** A partial explanation of factors that affect Beth's risk of developing cancer. **AND** A partial explanation of the best course of action for her. *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 factors that affect Beth's risk of developing cancer. **OR** Explains the best course of action for her. *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	2 x 2.1 4 x 3.2a	**AO2.1 Applying knowledge to describe factors that affect Beth's risk of developing lung cancer** *Genetic factors* • Family history of lung cancer increases her risk • Because she might have inherited alleles/variants that increase the risk of cancer • But this does not mean she will definitely get it, because lifestyle factors also affect the risk *Lifestyle factors* • Smoking (cigarettes) increases her risk of cancer • Because (cigarette) smoke contains carcinogens / substances that can cause cancer/change DNA • Reducing smoking will reduce her risk of cancer **AO3.2a Making judgements based on evidence to explain the best course of action for Beth** • Smoking cigarettes and using e-cigarettes together could decrease her intake of the carcinogen NNK, but not by much • Smoking cigarettes and using e-cigarettes together could <u>increase</u> her intake of other carcinogens/benzene and acrolein • Using only e-cigarettes (without cigarettes) will reduce her intake of all carcinogens, and therefore reduce her risk of cancer • But using only e-cigarettes still has a risk of cancer because the vapour contains carcinogens • Beth should stop smoking (cigarettes) • If Beth switches to e-cigarettes she should also try to stop using those as soon as she can

<table>
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<tr><td>6</td><td>(a)</td><td>(i)</td><td><table><tr><th>Interphase</th><th>Mitosis</th></tr><tr><td>the numbers of organelles increase ✓

each chromosome is copied ✓</td><td>chromosome (copies) separate / are pulled apart ✓</td></tr></table></td><td>3</td><td>3 x 1.1</td><td>ALLOW either order within Interphase column

ALLOW DNA replicated / copied / doubled</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>the stem cell is not specialised / is undifferentiated ✓

as it divides (by mitosis) it becomes differentiated by switching genes on and off ✓

to become a specialised cell with a particular function / named specialised cell / making particular proteins ✓</td><td>3</td><td>3 x 1.1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>Any three from:
idea that red blood cells contain haemoglobin to transport oxygen to body tissues ✓

sickle cells have smaller volume so can carry less haemoglobin/oxygen ✓

sickle cells have smaller surface area so absorption of oxygen is slower ✓

sickle cells get stuck/form clots in blood vessels ✓</td><td>3</td><td>3 x 2.1</td><td>DO NOT ALLOW less surface area so less oxygen carried

IGNORE surface area to volume ratio</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
6	(c)	(i)	people who are homozygous for the normal allele are more likely to catch malaria (and die) ✓	5	3.2a	
			people who are heterozygous/carriers (for the sickle-cell allele have resistance to malaria, so) are more likely to survive to reproduce and pass on the sickle-cell allele ✓		3.2a	**ALLOW** have one allele for sickle cell for heterozygous
			this is natural selection (of the sickle-cell allele) / they have an advantage ✓		1.1	
			so the sickle-cell allele becomes more common in each generation / more likely that offspring will inherit the sickle-cell allele ✓		2.1	
			more likely that offspring will be homozygous for the sickle-cell allele / more likely that heterozygous/carrier will mate with another heterozygous/carrier or somebody with the disease ✓		2.1	
		(ii)	people who are homozygous for the normal allele would not die of malaria, so the normal allele/this genotype would be more common in the population ✓	2	3.2a	
			impossible for a person who is homozygous for the normal allele to have a child who has SCD (no matter who they mate with) ✓		3.2a	

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	**Any three from:** Idea of enzymes have an optimum temperature / work best within a small temperature range ✓ rate of enzyme-catalysed reactions would decrease if body temperature got warmer / colder than optimum temperature/37°C ✓ if body temperature got too high enzyme could be denatured/would permanently stop working ✓ idea that if body temperature changed, rate of enzyme-catalysed reactions could be too slow to support the needs of cells/tissues/organs (and you could be unwell/die) ✓	3	3 x 1.1	**DO NOT ALLOW** reference to homeostasis without explanation **DO NOT ALLOW** low temperatures denature enzymes
		(ii)	optimum/peak at/around 50 °C ✓ idea that they have/are adapted to suit/work best in their environment ✓	2	2.1 1.1	**DO NOT ALLOW** "above 50°C" as this is ambiguous
		(iii)	water will move out of the cells ✓ **AND any two from:** due to osmosis (through the cell membrane) ✓ because the seawater has a higher concentration of salt / lower concentration of water molecules (than the cell cytoplasm) ✓ the cells will reduce in volume/shrink/shrivel/crenate ✓	3	3 x 2.1	**ALLOW** the idea that sea water has lower water potential (than the cell cytoplasm)

Question			Answer	Marks	AO element	Guidance
7	(b)		**Any four from:** the differences/mutations could only affect parts of the enzyme/protein (molecule) away from the active site ✓ not all mutations/variants affect phenotype/shape of the enzyme ✓ **OR** not all mutations/variants affect the activity of the protein made ✓ the differences/mutations might not change the (order of) amino acids in the enzyme/protein/active site ✓ (because) different sets of three bases can code for the same amino acid / there is redundancy in the code ✓ idea that if the order of amino acids in the active site has changed, it has not changed the shape (that resulted when the protein/enzyme molecule folded up) ✓	4	4 x 2.1	**ALLOW** degenerate code **ALLOW** the idea of post-transcriptional editing/modification (of the mRNA) **ALLOW** the idea of post-translational editing/modification (of the chain of amino acids)

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