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 November 2020

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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

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
/	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.

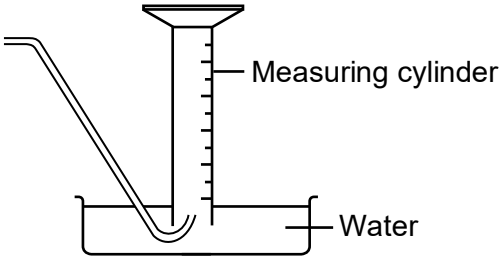
You should ensure that you have copies of these materials.

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.

Question			Answer	Marks	AO element	Guidance
1	(a)		B ✓	1	3.1a	**ALLOW** indication on diagram (e.g. ring around **B**)
	(b)		**Drawing includes:** upside-down measuring cylinder ✓ open end of measuring cylinder is under water ✓ end of delivery tube is inside or directly underneath the open end of the measuring cylinder ✓	3	3.3a	For example:  **ALLOW** maximum 2 marks if diagram **not** labelled
	(c)		the splint will stop glowing ✓ idea that (anaerobic) respiration produces carbon dioxide ✓	2	3.2a 2.1	**ALLOW** "it will be carbon dioxide/CO_2" for the result, but not for the explanation **ALLOW** indication (e.g. tick) in row 2 of table
	(d)		(anaerobic) respiration is an exothermic reaction / warms its surroundings / releases heat (energy) ✓	1	2.1	**ALLOW** "the reaction" for respiration **DO NOT ALLOW** "makes/creates/produces" energy
	(e)		**Any two from:** (water bath) controls the temperature / keeps the temperature constant ✓ only the sugar/substrate changes ✓ so the effect of changing the sugar/substrate can be seen (more clearly) ✓ reduces effects of random error / increases repeatability ✓	2	3.3b	**DO NOT ALLOW** ref. to "fair test" without explanation

Question			Answer	Marks	AO element	Guidance
1	(f)		both points plotted correctly at 400,42 and 450,45 ✓	1	2.2	**ALLOW** tolerance of +/- half a small square **IGNORE** any line(s) drawn to connect plots
	(g)		20 (cm^3) ✓	1	3.1	
	(h)		350 ✓ because no more gas was produced/collected after this time ✓	2	3.2b	**ALLOW** answer between 335 and 350 inclusive **ALLOW** line flat/horizontal/plateaus **IGNORE** "straight" line **ALLOW** volume of gas remained constant
	(i)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.24 (cm^3/s) award 2 marks** 34 – 10 **OR** 24 ✓ ÷ 100 = 0.24 ✓ cm^3/s ✓	3	 3.1a 2.2 2.2	 **ALLOW** ecf from mp1 **ALLOW** answer rounded to 0.2 **ALLOW** cm^3s^{-1}
	(j)		**Any two from:** the sugar is used up sooner ✓ maximum volume of gas is reached sooner ✓ gas starts to be produced sooner ✓ the line/volume is higher (at each time point / throughout) ✓ the line is steeper between 130 and 300 s ✓	2	3.2a	 **ALLOW** ref. to values **ALLOW** higher gradient

<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>line starts at <u>biuret solution</u> ✓

line ends at <u>lilac colour</u> ✓</td><td>2</td><td>1.2</td><td>Ignore any column in which more than one box has a line attached to it
If all boxes connected correctly ALLOW one mark, otherwise no marks as it is unclear which process the candidate has chosen as the correct one.</td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><th>Large…</th><th>Small…</th></tr><tr><td>Carbohydrate</td><td>Sugars</td></tr><tr><td>Lipid</td><td>fatty acids AND glycerol ✓</td></tr><tr><td>Protein</td><td>amino acids ✓</td></tr></table></td><td>2</td><td>1.1</td><td>ALLOW either order for fatty acids and glycerol</td></tr>
<tr><td></td><td>(c)</td><td></td><td>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 detail how natural selection meant that that people with the mutation were more likely to reproduce and pass the mutation to their offspring, so it would become more common in subsequent generations.

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)
Recognises that the mutation was an advantage.
AND
Explains how natural selection meant that people with the mutation were more likely to survive to reproduce.

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</td><td>6</td><td>3 x 2.1
3 x 1.1</td><td>AO2.1 Explaining why the lactose-digesting mutation was an advantage
For example:
idea that the mutation was an advantage/helpful/useful (because it enables people to digest lactose)
it was an advantage because of nutritional benefits
it was an advantage if there was competition for (limited) food
people with the mutation were more likely to drink milk / people without the mutation were less likely to drink it because of stomach pains/diarrhoea</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Recognises that the mutation was an advantage. **AND** Attempts to explain why natural selection meant that it was an advantage. *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.*			**AO1.1 Explaining how natural selection causes an advantageous mutation to become more common in a population** For example: • people with the mutation were more likely to survive/reproduce • (therefore) these people passed on their genes/DNA (to their offspring) • (therefore) these people passed on <u>the mutation</u> (to their offspring) • more likely that two people with the mutation would mate with each other • over a number of generations (people with) the mutation became more common in the population / a greater proportion of the offspring had it

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	correlation ✓ idea that correlation is negative **OR** relationship described in words ✓	**2**	3.1	 e.g. as (mean) number of cigarettes smoked per day increases, age of death generally decreases
		(ii)	(lung) cancer / lung disease(s) / type 2 diabetes ✓	**1**	1.1	**ALLOW** harmful mutations / respiratory diseases
		(iii)	**Any two from:** some of the men may have died from other causes (not related to how many cigarettes they smoke) ✓ smoking increases the risk of (some) diseases but does not make it certain that they will develop / it is possible to smoke and not get cancer/cardiovascular disease ✓ some of the men may not have accurately recorded how many cigarettes / type of cigarette they smoked ✓ idea that age when started smoking can have an effect ✓ some men may have different lifestyles/diet/exercise ✓	**2**	3.2a	**ALLOW** examples of other causes of death
		(iv)	**Any three from:** small sample / only 15 people ✓ it is not a representative sample / it is a biased sample ✓ they are all men ✓ they are all aged 50 (at start of study) ✓ they are all from one town ✓	**3**	3.1b	

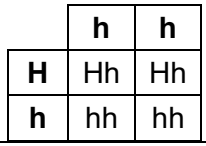
Question			Answer	Marks	AO element	Guidance
	(b)	(i)	**Any two from:** stop smoking ✓ get more exercise ✓ lose weight / reduce fat/salt in diet ✓ reduce stress ✓	**2**	2.1	**IGNORE** reduce smoking / smoke less **IGNORE** healthy eating **ALLOW** low cholesterol diet
		(ii)	**Any two from:** cheaper than medicines ✓ lower risk of harmful side effects ✓ other health benefits / also reduces risk of other diseases ✓	**2**	2.1	
		(iii)	have heart/bypass surgery / use of stent(s) ✓	**1**	2.1	**ALLOW** description, e.g. use blood vessel taken from elsewhere in body to bypass blockage in (coronary) artery in heart **ALLOW** heart transplant

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	xylem ✓	1	2.1	
		(ii)	**Any four from:** water is lost from the leaves ✓ by transpiration ✓ due to evaporation from cells in the leaves / (and diffusion of water vapour) through open stomata ✓ this pulls water up through xylem from the roots (due to cohesion-tension / because water molecules attract one another) ✓ water can fill/move through xylem (tubes/vessels) because the dead cells have no cytoplasm/end walls ✓	4	1.1	
		(iii)	nitrate (ions) / mineral (ions) ✓	1	1.1	**ALLOW** named minerals that are plant nutrients e.g. nitrogen / phosphorus / potassium / calcium / sulfur / magnesium / iron / boron / chlorine / manganese / zinc / copper / molybdenum / nickel / ions without qualification
	(b)	(i)	**Any four from:** process B is osmosis ✓ process B is the movement of water (by diffusion) ✓ process A is active transport ✓ process A is the movement of sugar(s) ✓ process A requires ATP/energy ✓	4	1.1	**ALLOW** ORA for process B (Process B does not require ATP/energy

Question			Answer	Marks	AO element	Guidance
		(ii)	**Any three from:** sugar(s) and water are loaded into the phloem tube ✓ this (causes increased pressure which) pushes the contents along the tube ✓ ref. to <u>translocation</u> ✓ from source to sink / from photosynthetic to non-photosynthetic tissue ✓ unloading sugar(s) and water out of the phloem tube (at the sink) (causes decreased pressure which) pulls the contents down the tube ✓ the contents/solution/liquid moves from higher to lower pressure ✓ idea of passing through (holes in) sieve plates ✓	**3**	1.1	**ALLOW** cells further along phloem (sinks) that use up sugars in e.g. respiration
		(iii)	phloem tube cells require ATP/energy (for active transport / for life processes) ✓ ATP is made by cellular respiration in mitochondria ✓	**2**	1.1	
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = (×)15000 award 2 marks** 4.5 ÷ 0.0003 ✓ = (×)15000 ✓	**2**	2.2	**ALLOW** ecf for magnification value

Question			Answer	Marks	AO element	Guidance
		(ii)	**Yes because:** 3×10^{-4} cm = 0.0003 cm / 3 µm ✓ they are the same size as bacterium A / the bacteria from the mistletoe ✓	**2**	2.2 3.2a	No mark for saying yes; the marks are for the explanation.

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	**Any four from:** collect sample of bacteria from tree ✓ extract/isolate antigen from bacteria ✓ inject the bacteria/antigen into an animal/mouse ✓ take antibody-producing cells/white blood cells from the animal/mouse ✓ identify/isolate the cell that is making antibodies against the bacteria/antigen ✓ grow/clone this cell (in culture) ✓	**4**	2.1	**ALLOW** fuse with tumour cell to form a hybridoma
		(ii)	**Any three from:** attach the (monoclonal) antibodies to an enzyme / fluorescent substance ✓ add the (monoclonal) antibodies to the bacteria from the mistletoe ✓ positive result is (monoclonal) antibodies sticking to the bacteria ✓ positive result is bacteria sticking together in clumps ✓ positive result is fluorescence / colour change ✓	**3**	2.1	

Question			Answer	Marks	AO element	Guidance
5	(a)		correct Punnett square ✓ correct proportion from their Punnett Square ✓	2	2.1 2.2	
	(b)		most features are affected by the environment / some features are caused by the environment ✓ most features are the result of multiple genes (rather than single gene inheritance) ✓	2	1.1	**ALLOW** the idea that features / gene expression can be affected by non-coding DNA
	(c)	(i)	**Any two from:** electrical stimulation/invasive methods could cause pain / could cause further damage (to brain) ✓ could be difficult to map functions to brain regions using (functional/f) MRI if person cannot control their body movements ✓ ethical issue described ✓	2	2.1	e.g. person who is confused or cannot speak cannot give (informed) consent / wrong to cause pain/discomfort to people who are already suffering **DO NOT ALLOW** "playing God"
		(ii)	neurons/nerve cells cannot divide / cannot complete the cell cycle ✓ (the brain) cannot make new neurons to replace dead neurons ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
		(iii)	**Any two from:** embryonic stem cells are unspecialised / can become any type of cell ✓ idea of using embryonic stem cells to make new neurons ✓ (by) growing them in culture ~~/~~ ✓ (by) using chemicals to cause/control their differentiation/specialisation ✓ implanting stem cells / new neurons into brain ✓	**2**	2.1	
		(iv)	**Any two from:** ethical objection to killing/harvesting embryos (to get stem cells) ✓ reference to (high) risk of implanting stem cells / new neurons into brain ✓ idea that it might cause (unintended) side-effects/harm ✓ stem cells / new neurons might be rejected (by the immune system) ✓	**2**	2.1	**ALLOW** e.g. mutated stem cells behave like cancer cells

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	the drug destroys the mRNA so it does not reach a ribosome ✓ (so) the mRNA cannot be used to join amino acids together ✓ (so) the protein (that kills neurons/causes brain damage) is not made ✓	**3**	2.1	**ALLOW** "the faulty allele/gene is transcribed"
		(ii)	drug must be able to move/diffuse/be transported from blood into cell (cytoplasm) ✓ mRNA leaves the nucleus / travels through the cytoplasm (to reach a ribosome) where protein is made ✓	**2**	2.1	

Question			Answer	Marks	AO element	Guidance
6			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)** Describe in detail the detection, response and effects on blood/urine, and uses specific scientific terminology (e.g. hypothalamus, pituitary gland, ADH, kidney tubules). *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 detection, response AND effects on blood/urine, but does **not** use specific scientific terminology (e.g. hypothalamus, pituitary gland, ADH, kidney tubules) **OR** Describes detection, response and effects on blood/urine, but mixes up some of the increases and decreases. **OR** Describe in detail either the detection OR response OR effects on blood/urine, and uses SOME specific scientific terminology (e.g. hypothalamus, pituitary gland, ADH, kidney tubules). *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)** Describe either the detection OR response OR effects on blood/urine, and uses SOME specific scientific terminology (e.g. hypothalamus, pituitary gland, ADH, kidney tubules). OR	**6**	3 x 1.1 3 x 2.1	**AO1.1 Describing how the body detects and responds** For example: *Detection:* • receptors in the hypothalamus/brain detect change (in blood concentration) *Response:* • (more) hormone made/secreted by pituitary gland • the hormone is ADH • (ADH causes) increase in permeability of kidney tubules • more water reabsorbed by kidney from urine into the blood **AO2.1 Describing how the body's response effects Alex's blood and urine** For example: *Effects on blood/urine (after body has responded):* • small(er) volume of urine produced • urine becomes (more) concentrated • reabsorption of water by kidney (from urine) replaces water lost from blood / returns water balance of blood to normal

Question			Answer	Marks	AO element	Guidance
			Describes detection OR response OR effects on blood/urine, but mixes up some of the increases and decreases. *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.*			

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