OCR
Oxford Cambridge and RSA

Foundation

GCSE

Biology B Twenty First Century Science

J257/04: Depth in Biology (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

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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.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions
Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
   - there is nothing written in the answer space.

   Award Zero '0' if:
   - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

   Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **2(c)** and **7(c)**

11. 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

12. 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

13. **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)		Tissue A – Xylem **AND** Tissue C – Phloem ✓	1	1.1	**DO NOT ALLOW** any box with more than one line joined to it **DO NOT ALLOW** branching lines
	(b)	(i)	C before B ✓ B before E ✓ E before D ✓	3	1.2	The correct sequence is: C (A) B E D
		(ii)	**Any two from:** (use focus controls to) move objective lens(es) upwards/away from slide (to avoid smashing slide) ✓ view from the side when moving lens towards the slide ✓ use a lamp / indirect light / do not use direct sunlight ✓ do not look down the microscope without a slide on the stage / do not look directly into the lamp ✓ place the microscope on a flat/even/non-slip surface / away from edge of bench / carry the microscope with two hands ✓ wear gloves / safety glasses / PPE when handling stain/stained material ✓ idea of clipping slide securely onto stage ✓ handle glass (slide/cover slip) gently / dispose of broken glass properly ✓	2	3.3a	**IGNORE** simple statements 'wear safety glasses' etc. Answer must relate to using the stain
	(c)	(i)	stain ✓	1	2.2	**ALLOW** dye / named stain (e.g. H&E)
		(ii)	multiply the magnifications of the two lenses ✓	1	1.2	**ALLOW** 10 x 40 **ALLOW** x400

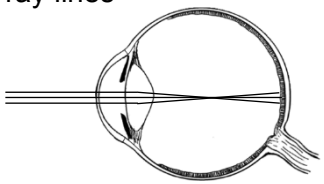
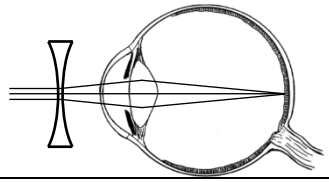
Question			Answer	Marks	AO element	Guidance
	(d)	(i)	10^1 ✓	1	1.2	
		(ii)	3 ✓	1	2.2	

Question			Answer	Marks	AO element	Guidance
2	(a)		photosynthesis **AND** (cellular) respiration ✓	1	1.1	both required, in correct order for 1 mark **DO NOT ALLOW** anaerobic respiration
	(b)		to provide <u>ATP</u> / <u>energy</u> (for other life processes / muscle contraction / active transport / chemical reactions) ✓	1	1.1	**ALLOW** releases energy **DO NOT ALLOW** energy made / created or produced **ALLOW** named chemical reactions e.g. photosynthesis, translocation

	(c)*		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)** Detailed explanation considers the effects of both light and temperature. **OR** Detailed explanation links (the glucose made by) photosynthesis to cellular respiration and how this would affect the amount of ATP/energy available for growth. *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)** Explanation links light to photosynthesis. **AND** Explanation links photosynthesis to the production of food/materials for growth **OR** ref. to faster rate / more photosynthesis. *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)** Simple explanation recognises the role of light **AND** indicates more/less light received (by a tree). *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**	**2.1**	**ALLOW** reverse argument for the other tree throughout **AO2.1 Applying understanding of factors that affect photosynthesis to explain why tree A has grown bigger than tree B** For example: • Tree A receives more light • More light / higher light intensity increases the rate/amount of photosynthesis • More sunlight means tree A will be warmer • Higher temperature increases the rate/amount of photosynthesis • More photosynthesis means more starch/glucose/sugar/carbohydrate/food will be made • Making more glucose/sugar/carbohydrate means tree A can make more materials for growth **ALLOW** credit at Level 3 for alternative ideas that explain why tree B has grown less, e.g. disease / damage / less fertile soil **ALLOW** credit at Level 3 for the idea that carbon dioxide concentration likely to be the same for both trees so would not have affected growth of one more than the other **AO2.1 Applying understanding of respiration to explain why tree A has grown bigger** For example: • More photosynthesis in tree A means more glucose for respiration More respiration means more ATP/energy for life processes that enable growth, e.g.

						synthesising new materials, active transport (e.g. of nutrients)

Question			Answer	Marks	AO element	Guidance
3	(a)		*Crown gall:* destroy infected plant (material) **OR** idea of restricting movement/transport of infected plant material / soil **OR** chemical control / antibacterial spray / sterilising tools ✓ *Influenza:* vaccination/immunisation/antivirals **OR** washing hands / covering mouth when coughing/sneezing / wearing a face mask ✓	**2**	**1.1**	**ALLOW** Crop rotation **ALLOW** idea of isolating infected individuals e.g. Quarantine/Social distancing
	(b)		(ash dieback) fungus (ash dieback) spores / wind / movement of infected plant material (tobacco mosaic) virus ✓✓	**2**	**1.1**	three correct = 2 marks two correct = 1 mark one correct = 0 marks
	(c)	**(i)**	(10 + 6 + 11 + 5 + 8) ÷ 5 = 8 ✓	**1**	**1.2**	
		(ii)	80 ÷ 200 = 0.4 ✓	**1**	**2.2**	**ALLOW** 0.40 / 40% / ⅖

Question			Answer	Marks	AO element	Guidance
4	(a)		Ciliary muscle -- Changes the shape of lens Cornea -- Transparent tissue that helps to focus light by refraction Iris -- Changes the size of the pupil Retina -- Layer of receptor cells that detects light ✓✓	2	1.1	three or four correct lines = 2 marks one or two correct lines = 1 mark **DO NOT ALLOW** any box with more than one line joined to it **DO NOT ALLOW** branching lines
	(b)		D ✓	1	2.1	
	(c)		Cataracts means that Nina has cloudy areas in the lenses of her eyes ✓ Blocks/reduces light entering Nina's eyes / reaching Nina's retinas ✓	2	2.1	**ALLOW** patches in lenses **IGNORE** Clouds her vision
	(d)	(i)	focal point (where rays converge) occurs before the rays reach the retina (rays must start to converge at the lens not inside the eyeball) ✓	1	2.1	**IGNORE** presence/absence of arrowheads on ray lines 
		(ii)	light rays diverge after the glasses lens **AND** converge after the eye lens to a focal point on the retina (rays must start to diverge at the glasses lens rays must start to converge at the eye lens not inside the eyeball) ✓	1	2.1	**IGNORE** presence/absence of arrowheads on ray lines and convergence at the cornea 

Question			Answer	Marks	AO element	Guidance
5	(a)		(cellular) respiration ✓ oxygen **AND** gas exchange system / lungs / alveoli ✓ water ✓	3	1.1	**ALLOW** Produce ATP / Provide or release energy **ALLOW** Respiratory system
	(b)		gas exchange system / lungs / alveoli **AND** kidney (tubules) / excretory system ✓	1	1.1	**ALLOW** Respiratory system **IGNORE** Bladder
	(c)		insulin ✓ glucagon ✓	2	1.1	
	(d)	(i)	(embryonic) stem cells are unspecialised / can become specialised / differentiate into / become any cell type ✓ so could become/replace insulin-secreting/beta cells (in the pancreas) ✓	2	2.1	 **ALLOW** Insulin producing cells **IGNORE** glucagon
		(ii)	*Benefit*: patient will be able to make their own insulin / will no longer have to inject insulin ✓ *Risk*: rejection of the cells / harmful side-effects ✓ *Ethical issue:* killing/destroying embryos to collect embryonic stem cells ✓	3	2.1	 **ALLOW** patient will no longer have to test/monitor their blood sugar level (so closely) **ALLOW** becomes cancerous / can form tumours **ALLOW** idea that embryos cannot give consent
		(iii)	in type 2 diabetes the body stops responding to insulin/still produces insulin (so having extra insulin-secreting/beta cells may not help) ✓ in people with type 2 diabetes blood sugar level can be controlled by other methods that are lower risk/cost/lack ethical issues ✓ example of control method e.g. regular/daily moderate exercise, avoid high-sugar foods, eat foods rich in (complex) carbohydrates that are broken down/release sugar slowly ✓	3	3.2a	 **ALLOW** lose weight / healthy diet

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	the genome is all the genetic material/DNA of the fungi ✓ it is stored in the nucleus (of each cell of the fungi) ✓	2	2.1	**ALLOW** genetic make-up / complete set of genes
		(ii)	**Any four from** a copy of a gene is made / a copy of (part of) the DNA is made / a copy of part of the genome is made from messenger RNA / mRNA ✓ amino acids are joined together ✓ at a ribosome ✓ idea that the order (of amino acids) is determined by the sequence/order/instructions of the mRNA/DNA/genome ✓ idea that each codon/set of three nucleotides/triplet code is the code for an amino acid ✓	4	1.1	**ALLOW** amino acids are building blocks / monomers for proteins
	(b)		role in (catalysing) breakdown of dead organisms / of waste / decomposition ✓ idea that this cycles/releases substances/elements that other organisms need/use ✓	2	2.1	**ALLOW** named example, e.g. carbon / nitrogen **ALLOW** idea that this makes soil more fertile
	(c)	(i)	use a water bath ✓ set at a particular temperature / which is controlled thermostatically/electronically ✓	2	3.3b	Needs idea of control
		(ii)	substrate concentration ✓ use the same mass/amount of substrate in the same volume of solution (in each test) ✓	2	3.3a	**DO NOT ALLOW** temperature or pH

Question			Answer	Marks	AO element	Guidance
	(d)		9 ✓	**1**	**3.1a**	
	(e)	**(i)**	1.5 (arbitrary units) ✓	**1**	**3.1a**	**ALLOW** any value in the range 1.48 to 1.52 inclusive
		(ii)	*Describe*: rate of reaction is highest/is at optimum at pH 9 ✓ rate of reaction is lower at all other pH values **OR** rate of reaction increases up to pH 9/the optimum and then decreases at pH values above that ✓ *Explain*: at the optimum/pH 9 the active site (of the enzyme) is exactly the right shape to fit the substrate ✓ at lower/higher pH the shape of the enzyme/active site changes / fits the substrate less well ✓	**4**	**3.1a x 2** **2.1 x 2**	**ALLOW** most enzyme-substrate complexes made
	(f)		if it affected/changed the gene / DNA sequence / coding DNA / DNA (for the enzyme) ✓ it could change the enzyme's shape/activity ✓ so that the enzyme works better/best in acidic soil / at pH 4 ✓	**3**	**2.1 x 2** **3.1b**	**DO NOT ALLOW** enzyme works best in a lower pH than A & B
	(g)		(for) the enzyme samples from two of the three places / the enzyme samples from places A and B work best at alkaline pH / pH 9 ✓ (against) but the enzyme from place C works best at acidic pH / pH 4 **and** its maximum rate of reaction is much higher than that of the other two samples ✓	**2**	**3.1b**	**ALLOW** idea that only three samples so more would be needed to see if C is an outlier

Question			Answer	Marks	AO element	Guidance
7	(a)		**Any three from** most mutations have no effect on phenotype ✓ idea that a (point) mutation may not change the amino acid coded for (in the protein made from the allele/gene/DNA) ✓ idea that mutations may affect things inside the body that cannot be observed ✓ idea that the effect(s) of a mutation may be modified by the environment (so could be masked/compensated for) ✓ idea that the effect(s) of a mutation may be masked/compensated for by other genes/(dominant) alleles **OR** idea that most characteristics are caused by many genes/alleles so a change to one may have no (observable) effect ✓ idea that mutation could be in non-coding part of DNA / may not be expressed ✓	3	1.1	
	(b)		**First check the answer on answer line** **If answer = 90.5 award 3 marks** 2542 – 242 = 2300 ✓ (2300 ÷ 2542) × 100 = 90.4799371 ✓ = 90.5 (%) to 1 d.p. ✓ **OR** (242 ÷ 2542) × 100 = 9.5200629 ✓ 100 – 9.5200629 = 90.4799371 ✓ = 90.5 (%) to 1 d.p. ✓	3	**2.2 x 2** **1.2**	**IGNORE** Sign of answer **ALLOW** answer of 90.48 for 2 marks **ALLOW** ecf **ALLOW** ecf for candidate answer rounded to 1 d.p.

Question			Answer	Marks	AO element	Guidance
	(c)*		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)** Detailed explanation correctly uses examples of technical terms, e.g. selection / advantage / proportion / frequency **AND** Explains that in each generation elephants with the no-tusks allele are more likely to reproduce and pass on the allele, and this means the allele becomes more common in each successive generation. *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)** Explains that elephants with the no-tusks allele are more likely to survive and reproduce **AND** Explains that this means the allele becomes more common in the next generation. *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)** Simple explanation recognises that elephants with no tusks are more likely to survive **AND** reproduce. *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**	**2.1**	**AO2.1 Applying understanding of the selection of favourable genetic variants to explain why the no-tusk allele has become more common** For example: **Survival & Reproduction:** • Elephants with the allele do not have tusks so are less likely to be killed (by the hunters) • The actions of the hunters create a type of (artificial) selection (pressure) • ref. to “natural” selection • Having the no-tusk allele is a reproductive/selective advantage • Having the no-tusk allele gives rise to a phenotype better suited to the environment in which the hunters are operating • Elephants with the no-tusk allele are more likely to reproduce **Becomes more common in next generation:** • Elephants with the allele are more likely to pass on the allele • In each generation, a greater proportion of the offspring are born to a parent with the no-tusk allele / a greater proportion inherit their alleles/genes/genome from a parent with the no-tusk allele • Due to this selection, the no-tusk allele becomes more common in the next generation • Idea that this pattern repeats with each generation of elephants (i.e. children and then grandchildren)

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td>female AND does not have tusks ✓</td><td>1</td><td>2.1</td><td>DO NOT ALLOW “heterozygous” as this refers to the genotype not the phenotype</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Any two from
to be homozygous for the no-tusks allele / to be $X^T X^T$
an elephant would have to inherit X^T / T / no tusk / dominant allele from both father and mother ✓

(but) elephants cannot inherit X^T / T / no tusk /dominant allele from their father / can only inherit X^t from their father ✓

(because) all (living/adult) fathers/males have the genotype $X^t Y$ ✓

(because) all elephants with the genotype $X^T Y$ die before they are born ✓</td><td>2</td><td>2.1</td><td>ALLOW male elephants with the X^T / T /no tusk /dominant allele die before they are born</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>mother’s gametes correct AND father’s gametes correct ✓

all genotypes of offspring correct ✓</td><td>2</td><td>2.1</td><td><table><tr><td></td><td>X^t</td><td>Y</td></tr><tr><td>X^T</td><td>$X^T X^t$</td><td>$X^T Y$</td></tr><tr><td>X^t</td><td>$X^t X^t$</td><td>$X^t Y$</td></tr></table>DO NOT ALLOW ecf on genotypes</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>Any two from (yes/correct because):
2 out of every 4/50% babies are likely to be female ✓

2 out of every 4/50% babies are likely to be male ✓

1 out of every 2 males will die before birth (because it’s $X^T Y$) ✓</td><td>2</td><td>3.2b</td><td></td></tr>
<tr><td></td><td>(e)</td><td></td><td>elephants with no tusks will become more common (with every new generation) ✓
males will become less common (in every generation) ✓
the elephants may eventually become extinct (if there are not enough males for the females to reproduce with) ✓</td><td>3</td><td>3.2a</td><td></td></tr>
</table>

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