GCE

Biology B

H422/03: Practical skills in biology

A Level

Mark Scheme for June 2024

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.

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 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 posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

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 40% 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 or the RM Assessor messaging system, or by email.

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 a 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 e-mail.

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 **1(b)** and **3(a)**.

11. **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

Annotation	Meaning
	Ignore
	Blank page

12. **Subject Specific Marking Instructions**

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

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.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>
<table>
<tr><th>Structural feature</th><th>ATP</th><th>DNA</th><th>tRNA</th><th></th></tr>
<tr><td>Contains adenine</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Contains ribose</td><td>✓</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Has hydrogen bonds within its molecular structure</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>
</td><td>3</td><td>One mark per correct row</td></tr>
</table>

<table>
<tr><td>1</td><td>(b)*</td><td></td><td colspan="3">Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.
In summary:
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.</td></tr>
<tr><td></td><td></td><td></td><td>Level 3 (5-6 marks)
Detailed description of DNA purification, electrophoresis and visualisation of DNA fragments that includes most steps.

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)
Some correct information described for DNA purification and electrophoresis and visualisation of DNA fragments.

There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1-2 marks)
Some correct information described for 2 methods: DNA purification and / or electrophoresis and / or visualisation of DNA fragments.</td><td>6</td><td>Loss of communication mark for e.g. incorrect science (methodology) or incorrect use of terms

Indicative scientific points may include (but are not limited to):

purification (credit other appropriate methods)
• grind/blend tissue and mix with salt and detergent solution
• place in (thermostatically) water bath at 60^{o}C (for 15 min)
• cool mixture by placing in ice water bath (for 5 min)
• add protease and alcohol
• add RNAase enzymes (to hydrolyse RNA)
• pour (ice) cold ethanol (down the side of tube)
• remove (DNA) strands in upper (alcohol) layer
• ref’ to use of hook or glass rod to remove DNA

separation (by electrophoresis)
• cut DNA (into fragments) using restriction enzymes / endonucleases
• use of agarose gel
• use of a loading buffer solution
• use of running buffer solution</td></tr>
</table>

			The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. **0 marks** No response or no response worthy of credit.		• ref' to use of (wide) comb to make wells • load fragments (in wells) close to the cathode / negative electrode • load control sample (of DNA) **or** ref' to DNA ladder • apply current • switch off current when buffer has moved to near the end of the gel *visualisation* • use of UV light • use of fluorescent dye • AVP e.g. Southern blotting • AVP e.g. use of nitrocellulose paper, nylon membrane • AVP e.g. fixing band locations by heating to $80^{O}C$

Question			Answer	Marks	Guidance
2	(a)		substitution changes one amino acid **AND** deletion changes , many / AW , amino acids ✓ reference to deletion mutation causing <u>frame shift</u> ✓ (shape of) <u>active site</u> , altered / no longer formed / not complementary (after deletion) ✓	**2 max**	**IGNORE** *idea that* substitution may result in same amino acid in the polypeptide chain (as this would not result in symptoms **IGNORE** references to degenerate code **ora** <u>active site</u> remains complementary after substitution mutation
2	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1,537,000 award three marks** ($q^2 = 75/7880000000 = 9.95177665 \times 10^{-9}$) $q = (\sqrt{9.95177665 \times 10^{-9}} =) 0.00009755904$ ✓ ($p = 1 - 0.00009755904 = 0.99990244$) $2pq = 0.000195098$ ✓ x 7 880 000 000 = 1537372 to four significant figures = 1537000 ✓	**3**	only penalise rounding errors once

2	**(b)**	**(ii)**	*MARK FIRST TWO ANSWERS ONLY* *idea that* undiagnosed cases of the disease may exist ✓ cannot be certain that <u>new</u> mutations do not occur / AW ✓ immigration may have occurred / AW ✓ AVP ✓ ✓	**2 max**	**IGNORE** references to people may be carriers as this is given in the stem of the question e.g. those with condition may die before they reach reproductive age e.g. (H-W) equations assume that mating is random e.g. assume all genotypes reproduce with equal success e.g. not all cases (may be) reported by health care professionals e.g. assume disease is caused by an autosomal allele
2	**(c)**		*MARK FIRST TWO ANSWERS ONLY* check whether , muscle / specimen , has been treated with preservatives ✓ cut away from the body ✓ named example of handling biological tissue appropriately ✓ *idea of* only one person working on the muscle at any one point in time ✓ AVP ✓	**2 max**	**IGNORE** general references to laboratory rules such as wear eye protection, tie hair back, lab coats **ALLOW** e.g. safe use of instruments e.g. washing hands after use / use of (non-latex) gloves **ALLOW** only one student is ‘hands on’ e.g. disinfecting work area (after dissection) dispose of muscle tissue safely (after dissection)

2	**(d)**		cannot assess outcome statistically (as there is a small sample size) ✓ *ref to* insufficient participants for (named) stage(s) of clinical trials ✓ *idea of* not financially viable for pharmaceutical companies ✓ little scientific knowledge on which to base treatment ✓	**1 max**	**ALLOW** reference to stage 3 and/or 4 of clinical trials **IGNORE** 'clinical trials cost a lot of money' without reference to profit **ALLOW** idea of small profit margins (for pharmaceutical company)
2	**(e)**		*information technology* databases of genome sequences (for comparisons) ✓ *research* identify SNP(s) used for diagnosis (of rare disease) **or** modify/ AW , drugs / treatment , to target a specific , mutation / SNP ✓	**2**	

<table>
<tr><td>3</td><td>(a)*</td><td></td><td colspan="3">Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.

In summary:
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):
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• The science content determines the level.
• The Communication Statement determines the mark within a level.</td></tr>
<tr><td></td><td></td><td></td><td>Level 3 (5-6 marks)
Comprehensive description of an experimental plan, including measurement of core body temperature and an appropriate statistical test. To include reference to safety

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)
Description of an experimental plan, including measurement of core body temperature or an appropriate statistical test.

There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1-2 marks)
Appropriate elements of an experimental plan outlined analysis for the investigation stated.

The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</td><td>6</td><td>Loss of communication mark for e.g. incorrect science (method) or incorrect use of terms (apparatus)

Indicative scientific points may include (but are not limited to):

AO3: To develop and refine practical design and procedures

Safety
• exclude participants with <u>other</u> underlying health conditions
• gain consent from all participants
• sterilisation of thermometer between participants

Measurement of temperature
• difficulty in measuring core temp routinely so use peripheral sites
• location of temperature measurement: oral, tympanic, axillary site
• justification of location used e.g. reference to inner ear and blood flow being close to hypothalamus
• specified apparatus e.g. digital thermometer</td></tr>
</table>

			0 marks No response or no response worthy of credit.		• resolution of temp measured specified: 0.1°C (digital thermometer) / 0.5°C (alcohol thermometer) *Experimental plan* • details of sample size (e.g. min of 15 participants in **each** group) • use of repeats (e.g. measure **each** participant several times) • details of control variables (e.g. age, biological sex, ethnicity, standardised conditions) *Statistical testing* • idea of identifying anomalies • calculating means & calculation of SD • unpaired *t*-test • correct degrees of freedom stated for sample size used

Question			Answer	Mark	Guidelines
3	(b)	(i)	use after subject has been seated for, 5 to 10, minutes ✓ (use on) upper (left / non-dominant) arm ✓ support (left) arm **and** no, talking / looking at device ✓ inflate cuff (until pressure is sufficient), to stop blood flow ✓ use stethoscope (under the cuff) to hear (Korotkoff) sounds ✓ slowly, decrease / release, pressure ✓ record reading, when first sound is heard **and** when sounds stop **or** record the two values from digital display ✓ **AVP** ✓ ✓	**4 max**	**ALLOW** "inflate until no sounds are heard" e.g. ref' to sound indicates systolic pressure and absence of sound indicates diastolic pressure e.g. reference to brachial artery

3	**(b)**	**(ii)**	*in person with hypothyroidism* *explanation of conclusions* systolic pressure higher ✓ diastolic pressure , similar / slightly higher ✓ (person has) some evidence of (pre-)hypertension ✓ *limitations (3 max)* only one person from each group / larger sample size is needed to draw conclusions ✓ reference to named uncontrolled variables ✓ *idea that* measurements may not have been taken by health professional ✓ no evidence of repeat measurements to obtain a mean ✓	**4 max**	**ALLOW** reverse arguments for person without hypothyroidism **ALLOW** 'both have diastolic pressure of around 80 (mmHg)' **IGNORE** small sample size unqualified e.g. smoker, alcohol intake, undertaken exercise before measurement taken, BMI, other (named) health conditions, age, biological sex, stress / 'white coat syndrome'
3	**(c)**		haemocytometry / flow cytometry ✓	**1**	

3	**(d)**		drawing has clear continuous lines **and** covers 50% of the available space (of the box) ✓ image accurately represents photomicrograph to include overall shape and proportions ✓ lumen and muscle layer correctly labelled **and** ruled, horizontal, label lines which are touching correct structure ✓	**3**	**DO NOT ALLOW** incomplete, overlapping or sketched lines, shading or hatching **IGNORE** details such as the number of folds **IGNORE** any additional labels or annotations (as question only asks for muscle layer and lumen) **DO NOT ALLOW** label lines with arrow heads

Question			Answer	Mark	Guidance
4	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 78.60 award two marks** (4936/6280 =) 0.785987 ✓ (x 100 = 78.5987 =) 78.60 ✓ (to match the number of decimal places of the data within the same column)	**2**	
4	**(a)**	**(ii)**	*Accurate because:* many / thousands / 6280 / AW , of loci studied ✓ the same loci were studied in each population ✓ *Not accurate/inaccurate because:* small sample sizes (within each population) ✓ *idea that* the two measures (of genetic diversity) show different patterns of results ✓	**3 max**	e.g. 'A has the lowest percentage of polymorphic loci but the joint second highest heterozygosity'
4	**(b)**		$cm^3\ h^{-1}$ **or** cm^3 / h ✓	**1**	**ALLOW** mm^3 or ml instead of cm^3 **ALLOW** s^{-1} or min^{-1} instead of h^{-1} **ALLOW** s or min instead of h

4	**(c)**	**(i)**	*significant impact:* (callose blocking sieve pores) reduces / prevents , translocation / mass flow (of assimilates) ✓ *non-significant/ uncertain: 2 max from* *idea of* it depends on how long callose remains ✓ it depends on how many phloem (sieve tubes) have been blocked ✓ (little impact / AW as) only one phloem (sieve tube) has been blocked / plant has many phloem (sieve tubes) ✓	**3 max**	
4	**(c)**	**(ii)**	*MARK FIRST TWO ANSWERS ONLY* consistency in / AW , how much pathogen is transferred ✓ *idea of* ensuring aphids feed in the same region of the plant ✓ plants grown in same (environmental) conditions ✓ AVP ✓	**2 max**	**ALLOW** standardising the duration of time that an aphid feeds **ALLOW** standardising the region of plant on which an aphid feeds e.g. plants of the same age, no other plant disease present, not previously infected with the same pathogen e.g. pathogens may not infect the site so no callose produced

Question			Answer	Mark	Guidance
5	(a)	(i)	(in general there is a) negative correlation / described ✓ *idea that* (negative) correlation is, stronger / more obvious, after 10 AU ✓ large variation (in number of invertebrate species), at similar salinity values ✓	2 max	**ALLOW** at salinity levels lower than 10AU there is a no / weaker correlation **and** at a salinity level above 10AU there is / strong(er) correlation **ALLOW** greater variation in results at lower salinity levels
5	(a)	(ii)	use transect ✓ random selection of (initial) transect position ✓ placement of quadrat at regular intervals / systematic sampling ✓ use of, photographic / dichotomous, key to identify species ✓ count species, within quadrat ✓	3 max	**IGNORE** reference to SACFOR and % cover as Q asks for NUMBER of species present **IGNORE** generalised comments on random sampling as data must be collected *across* the wetland **ALLOW** correct reference to counting number of plants touching pins (when using point quadrat)

5	**(b)**	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.713 award three marks** (for F*)* n/N = 0.048 **and** $(n/N)^2$ = 0.002 ✓ Σ = 0.287 ✓ *D* = 0.713 ✓	**3**	**ALLOW** more decimal places, if correctly rounded, for all MPs **ALLOW** ECF if Σ is correct for incorrect values for **F** **ALLOW** ECF if Σ has been added up incorrectly
5	**(b)**	**(ii)**	no (significant) change / similar biodiversity **or** slight / AW , increase in biodiversity ✓	**1**	**ALLOW** ECF from incorrect calculation in **(i)**
5	**(b)**	**(iii)**	*idea of* different methods may have been used (to gather data) ✓ sampling may have taken place at different, times of year / season ✓ AVP ✓	**1**	e.g. named example of effect of human activity e.g. (over)fishing in lake, industrialisation resulting in pollution, agricultural run-off, climate change

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