



Rewarding Learning

ADVANCED
General Certificate of Education
2025

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[ABY21]

FRIDAY 13 JUNE, MORNING

MARK
SCHEME

General Marking Instructions

Introduction

The main purpose of the mark scheme is to ensure that examinations are marked accurately, consistently and fairly. The mark scheme provides examiners with an indication of the nature and range of candidates' responses likely to be worthy of credit. It also sets out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives

Below are the assessment objectives for Biology.

Candidates should be able to demonstrate:

- AO1** Knowledge and understanding of scientific ideas, processes, techniques and procedures.
- AO2** Apply knowledge and understanding of scientific ideas, processes, techniques and procedures:
- in a theoretical context
 - in a practical context
 - when handling qualitative data
 - when handling quantitative data.
- AO3** Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to:
- make judgements and reach conclusions
 - develop and refine practical design and procedures.

Quality of candidates' responses

In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 17 or 18-year-old which is the age at which the majority of candidates sit their GCE examinations.

Flexibility in marking

Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive marking

Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 17 or 18-year-old GCE candidate.

Awarding zero marks

Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Marking calculations

In marking answers involving calculations, examiners should apply the 'own figure rule' so that candidates are not penalised more than once for a computational error. To avoid a candidate being penalised, marks can be awarded where correct conclusions or inferences are made from their incorrect calculations.

Types of mark schemes

Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Levels of response

In deciding which level of response to award, examiners should look for the best fit' bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement.

The following guidance is provided to assist examiners.

- **Threshold performance:** Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range
- **Intermediate performance:** Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.
- **High performance:** Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in extended written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

Level 1: Quality of written communication is basic.

Level 2: Quality of written communication is good.

Level 3: Quality of written communication is excellent.

In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

Level 1 (Basic): The candidate makes only a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 (Good): The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is some use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

Level 3 (Excellent): The candidate successfully selects and uses the most appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is widespread and accurate use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.

/ denotes alternative points
 ; denotes separate points
comments on mark values are given in bold
comments on marking points are given in italics

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Where one response is required to gain a mark, candidates will not gain credit if a correct response is given alongside one or more incorrect responses. This is referred to as listing.

Section A

1	(a)	(i)	DNA; mRNA;	[2]	6
		(ii)	Helicase/RNA polymerase;	[1]	
	(b)	(i)	Three bases code for one amino acid;	[1]	
		(ii)	Terminates protein synthesis/stop codon;	[1]	
		(iii)	Degenerate;	[1]	
2	(a)	(i)	Carbon dioxide/rubisco concentration is limiting;	[1]	7
		(ii)	Light dependent reactions decrease in evening so less NADPH and ATP produced; subsequent decrease in light independent reactions/less CO ₂ taken up by RuBP;	[2]	
		(iii)	CO ₂ output is indicated; respiration must be taking place;	[2]	
	(b)		Net production (area above x-axis) is greater in summer; there is a greater amount of carbohydrate produced;	[2]	
3	(a)	(i)	Glycolysis;	[1]	10
		(ii)	Anaerobic; presence of ethanol;	[2]	
		(iii)	Soil is low in oxygen; anaerobic respiration produces some ATP;	[2]	
	(b)		2 ATP used and 4 ATP produced;	[1]	
	(c)	(i)	Glucose/carbohydrate;	[1]	
		(ii)	$RQ = \frac{\text{CO}_2 \text{ produced}}{\text{O}_2 \text{ consumed}}$;	[1]	
		(iii)	CO ₂ = 1.0 × 50; = 50 mm ³ ;	[2]	
			or $\frac{50}{50} = 1.0$;		

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4	(a)	(i) Jointed limbs/legs;	[1]	9
		(ii) Insect possesses 6 legs/arachnid has 8 legs/OAR;	[1]	
		(iii) The body can be divided into two identical halves; on each side of the central axis;	[2]	
	(b)	(i) Escape ground-based predators/access food (e.g. nectar)/easier to colonise new habitats/OAR;	[1]	
		(ii) Increases the surface area; so more oxygen diffuses to muscle cells for aerobic respiration;	[2]	
		(iii) Final electron/hydrogen acceptor; allowing oxidative phosphorylation to occur;	[2]	
5	(a)	(i) Mean leaf length and width approximately the same; shade leaves have a higher mean length and mean width; (<i>allow converse</i>)	[2]	17
		(ii) Chloroplasts increase in number/produce more chlorophyll; to absorb a higher percentage of light;	[2]	
	(b)	(i) There is no significant difference between the mean leaf mass per unit area of the two samples;	[1]	
		(ii) $0.52 - 0.13 = 0.39$; (<i>ignore +/-</i>) $\sqrt{0.0009 + 0.0016} = 0.05$; $0.39 \div 0.05 = 7.8$;	[3]	
		(iii) 60 (degrees of freedom);	[1]	
		(iv) $p < 0.001$; the difference in means is highly significant;	[2]	
		(v) Reject the null hypothesis; $p < 0.05$;	[2]	
	(c)	Any four from; <ul style="list-style-type: none"> • small leaves are sufficient since there is enough light • small leaves reduce lower leaf shading • (small leaves have) fewer stomata which prevents water loss • lighter colour to reduce heating effect/less chlorophyll needed • thicker leaf prevents water loss 	[4]	

- 6 (a) $200 - 6.5 = 193.5$;
 $193.5 \div 200 \times 100 = 96.75$; [2]
- (b) (Change in) non-coding region; [1]
- (c) (i) Number of repeats of microsatellites is more variable;
therefore more likely to be unique/to distinguish between individuals; [2]
- (ii) Greater number of repeated sequences;
smaller probability of identification error; [2]
- (d) (i) Restriction endonucleases;
Cuts DNA into fragments at specific base sequences; [2]
- (ii) Band 5;
migrates/moves shortest distance; [2]
- (iii) Contains the most DNA (fragments); [1]

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- 7 (a) (i) Gametes: BG, Bg, bG, bg;

	BG	Bg	bG	bg
BG	BBGG	BBGg	BbGG	BbGg
Bg	BBGg	BBgg	BbGg	Bbgg
bG	BbGG	BbGg	bbGG	bbGg
bg	BbGg	Bbgg	bbGg	bbgg

Offspring phenotype	Dark-brown	Mid-brown	Light-brown	Hazel	Blue
Expected ratio	1	4	6	4	1

expected ratio numbers total 16; [5]

- (ii) Observed ratio often differs due to meiotic variation/crossing over/
independent assortment/random fertilisation; [1]

- (b) Continuous (variation); [1]

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8 (a) (i) Reduced consumption of milk;	[1]	AVAILABLE MARKS
(ii) The mutation allows the individual to continue producing lactase; diet was likely to include more milk or dairy as farming increased;	[2]	
(iii) Any two from: <ul style="list-style-type: none"> • epigenetic change involves no base changes • involves methylation • is not inherited • involves histone modification • involves changes in gene expression <i>(accept converse for references to SNPs)</i>	[2]	
(b) (i) There is a very small number of these human remains available;	[1]	
(ii) To provide a large enough sample of DNA for analysis;	[1]	
(c) (i) $q^2 = 0.15$; $q = \sqrt{0.15} = 0.39$;	[2]	
(ii) Heterozygous frequency = 0.48; $0.48 \times 450 = 216$ (from table)/ 214 (from table and Hardy-Weinberg calculation);	[2]	
(iii) Any two from: <ul style="list-style-type: none"> • gene mutations produced M alleles • M allele enables better nutrition • selection pressure favours the M allele 	[2]	
(iv) Modern humans provide a large population size;	[1]	14
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Section B

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- 9 (a) Any **six** from:
- selection that favours average phenotypes
 - selects against extreme traits
 - leading to reduced genetic variation
 - occurs in stable/unchanging environments (where existing traits are optimal)
 - individuals with traits near the average have higher survival rate and greater reproductive success
 - proportion of average individuals increases
 - decreases the potential for evolutionary change
 - because reduced variation around average

Band	Response	Mark
3	Candidates use appropriate specialist terms to describe the process of stabilising selection with five points of indicative content. They use good spelling, punctuation and grammar and the form and style are of a very good or better standard.	[5]–[6]
2	Candidates sometimes use appropriate specialist terms to describe the process of stabilising selection with three points of indicative content. They use satisfactory spelling, punctuation and grammar and the form and style are of a good standard.	[3]–[4]
1	Candidates partially describe the process of stabilising selection with one point of indicative content. They use limited correct spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[2]
0	Response not worthy of credit.	[0]

[6]

(b) Any **twelve** from:

- variation due to meiosis
- reference to meiotic mechanism(s)
- cross fertilisation
- gene mutation/by description
- chromosome mutation/by description
- gives rise to a new phenotype
- directional selection occurs in a changing environment
- directional selection favours one extreme variant
- leading to a modal shift
- individuals with extreme trait have higher survival rate
- and greater reproductive success
- resulting in increased allele/phenotype frequency in population
- this occurs over a significant time period
- speciation forms a group of individuals capable of interbreeding to produce fertile offspring
- geographical isolation leads to allopatric speciation
- example of geographical isolation
- reproductive isolation
- example of reproductive isolation
- genetic divergence arises from geographical isolation/maintained by reproductive isolation

Band	Response	Mark
3	Candidates use appropriate specialist terms to describe the process of directional selection with nine points of indicative content. They use good spelling, punctuation and grammar and the form and style are of a very good or better standard.	[9]–[12]
2	Candidates sometimes use appropriate specialist terms to describe the process of directional selection with five points of indicative content. They use satisfactory spelling, punctuation and grammar and the form and style are of a good standard.	[5]–[8]
1	Candidates partially describe the process of directional selection with one point of indicative content. They use limited correct spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[4]
0	Response not worthy of credit.	[0]

[12]

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Section B

18

Total

100

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