



Rewarding Learning

ADVANCED
General Certificate of Education
2024

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[ABY21]

FRIDAY 14 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.

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

AVAILABLE
MARKS

Section A

1 (a)

Division	Multicellular	Disperse by seeds	Disperse by spores	Possess rhizoids	Possess vascular systems
Mosses	✓	✗	✓	✓	✗
Ferns	✓	✗	✓	✗	✓
Flowering plants	✓	✓	✗	✗	✓

Mark for each correct column ;;;;; [5]

(b) Advantage: resists desiccation/food store avoids need to produce food/take in nutrients initially;
 Disadvantage: more difficult to disperse; [2]

7

2 (a) Similarity: both contain amino groups/carboxyl groups/same structure except R group;
 Difference: R groups/cysteine contains sulfur; [2]

(b) Deletion;

Any **four** from:

- removal of a base
- alters reading frame
- this may affect the amino acid coded for by **that** triplet
- all triplets after mutation may be affected
- amino acid sequence/primary sequence of polypeptide may be altered/shortened if chain termination codon is induced (converse) [5]

(c) (i) Alternative forms of the **same** gene; [1]

(ii) $I^A I^A$ and $I^A I^O$; [1]

(iii) Both alleles are expressed (in the phenotype); [1]

(iv) Multiple alleles occur when there are more than two forms of an allele (controlling a phenotype);
 polygenic inheritance is (additive effect of) more than two genes (controlling a phenotype); [2]

12

			AVAILABLE MARKS
3	<p>(a)</p> <p>1 Glycolysis</p> <p>2 Link reaction</p> <p>3 Krebs cycle</p> <p>4 Electron transfer chain/ETC;; (4 = [2], 3/2 = [1], 1 = [0])</p>	[2]	
	<p>(b) (i) produces reduced NAD/_{red} NAD; provides H/electrons for ETC;</p>	[2]	
	<p>(ii) Any five from:</p> <ul style="list-style-type: none"> • Hydrogen enters the ETC/carried by NADH/FADH₂ • hydrogen atoms passed initially with electrons passing after • hydrogen/electrons lose energy/pass along carriers at successively lower energy levels • if sufficient energy is released oxidative phosphorylation takes place • ADP + P generates ATP • each _{red} NAD= 3ATP/ _{red} FAD= 2 ATP 	[5]	
	<p>(c) Enzyme synthesis/protein synthesis; formation of secretory vesicle/exocytosis;</p>	[2]	11
4	<p>(a) Rf = distance moved by band ÷ distance moved by reference line = 97 mm ÷ 110 mm; = 0.88;</p>	[2]	
	<p>(b) Child 1; child 1 has band 4; from another man/not common with man or woman;</p>	[3]	5

			AVAILABLE MARKS	
5	(a)	(i) Standard absorption curve with correct peaks;; axes labels: x-axis wavelength, y-axis absorption; units x-axis nm;	[4]	15
		(ii) Rate of photosynthesis;	[1]	
		(iii) Green;	[1]	
	(b)	(i) (Iridoplast) has ordered arrangement/parallel; grana show more continuous appearance;	[2]	
		(ii) Palisade (mesophyll);	[1]	
	(c)	(i) Any four from:		
		<ul style="list-style-type: none"> • light reaching the plant will have much of the blue/red wavelengths removed/absorbed • reflecting blue light is less significant since there is less blue available • iridoplasts can absorb green part of spectrum • green light provides energy for the light dependent stage • better competitor (at low light levels) 	[4]	
		(ii) More opportunity for light absorption; so more energy available/ less energy wasted for photosynthesis;	[2]	

- 6 (a) (i) Fluorescent materials easily disposed of/not as dangerous as radioactive sources/correct reference to detection; [1]
- (ii) The probe must be complementary/so that base pairing can occur; to the disease-causing/specific gene (target sequence); [2]
- (iii) Some diseases are caused by several genes; environmental triggers/epigenetic change; [2]
- (b) (i) (Overexpression) results in greater transcription of a gene; therefore greater translation/more protein produced; [2]
- (ii) Any **two** from:
- more receptor proteins embedded in the membrane
 - great number of growth factors can bind
 - increase rate of cell division [2]
- (iii) Herceptin binds (competitively) to the receptor molecule; so the growth factor has fewer sites to bind; [2]
- (c) (i) Much faster diagnosis/more cost effective; [1]
- (ii) Quantifiable; [1]
- (iii) Use of the drug is determined by patient's genome; [1]
- (d) (i) Methyl groups/CH₃ are added to cytosine; [1]
- (ii) **A** Of all tissue tested a smaller percentage/proportion showed methylation/a larger proportion did not show methylation;
- B** A larger percentage/proportion of the cancer tissue showed increased methylation/smaller proportion of tissue shows decreased methylation; [2]
- (iii) Any **two** from:
- not all tumours are due to methylation
 - most tumours due to methylation are because of increased methylation (converse)
 - there are other mechanisms resulting in tumour development [2]

AVAILABLE
MARKS

19

- 7 (a) Parental genotypes: $X^R Y$ and $X^r X^r$;
gametes: X^R Y and X^r X^r ;

	X^R	Y
X^r	$X^R X^r$	$X^r Y$
X^r	$X^R X^r$	$X^r Y$

Phenotype ratio 1 white-eyed male: 1 red-eyed female; [5]

- (b) (i) There is no significant difference between observed and expected numbers of the four phenotypes; [1]

(ii)

Phenotype	Observed (O)	Expected (E)	O-E	(O-E) ²	$\frac{(O-E)^2}{E}$
Red-eyed male	23	25	-2	4	0.16
Red-eyed female	31	25	6	36	1.44
White-eyed male	22	25	-3	9	0.36
White-eyed female	24	25	-1	1	0.04
					$\chi^2 = 2.00$

Rows correctly completed ;;; correct sum; [4]

(iii) 3 df; [1]

(iv) $0.90 > p > 0.5$; [1]

(v) The null hypothesis is accepted; [1]

13

Section A

82

8 Indicative content

Transcription

- DNA molecule unwinds and unzips/hydrogen bonds broken
- by helicase
- RNA polymerase binds to the template strand of DNA
- free ribonucleotides join to the template strand by complementary base pairing (by description)
- condensation **reaction** between sugars and phosphates (is catalysed by RNA polymerase)

Modification after transcription

- introns are removed from mRNA
- exons are spliced together (in the correct sequence)
- this produces functional mRNA molecule/final mRNA molecule (coding for a polypeptide)
- mRNA exits nucleus via a nuclear pore

Translation

- mRNA attaches to ribosomes
- each set of three bases/base triplet on mRNA is known as a codon
- and codes for a particular amino acid
- tRNA has a three base anticodon
- which is complementary to the codon
- each tRNA brings a specific amino acid (to correct position on mRNA)
- codon and anticodon **join**
- this occurs at the aminoacyl/A site in the ribosome
- ribosome moves along three bases/one codon
- the first codon now occupies the peptidyl/P site
- a second tRNA (with attached amino acid) now enters the A site
- adjacent amino acids are linked together by condensation/peptide bonds to form a polypeptide
- this continues until the polypeptide is released at a stop codon

Modification after translation

- occurs in the ER/Golgi apparatus
- sections of polypeptide chain may be removed
- addition of carbohydrate or lipid may occur/formation of conjugated proteins
- to produce quaternary structure proteins

Band	Response	Mark	AVAILABLE MARKS
3	Candidates use appropriate specialist terms to describe the processes of protein synthesis with thirteen points of indicative content. They must use good spelling, punctuation and grammar and the form and style are of a very good or better standard.	[13]–[18]	18
2	Candidates sometimes use appropriate specialist terms to describe the processes of protein synthesis with six points of indicative content. They must use satisfactory spelling, punctuation and grammar and the form and style are of a good standard.	[6]–[12]	
1	Candidates partially describe the processes of protein synthesis with one point of indicative content. They must use limited correct spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[5]	
0	Response not worthy of credit.	[0]	
		[18]	18
		Section B	18
		Total	100