New Specification

Rewarding Learning

ADVANCED
General Certificate of Education
2018

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[ABY21]

MONDAY 11 JUNE, AFTERNOON

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

AVAILABLE MARKS

Section A

1 **(a)** Any **two** from:
- jointed limbs
- body divided into fixed number of segments
- exoskeleton
- other appropriate response [2]

(b) **(i)** Body can be divided into two identical halves on each side of a central axis; [1]

(ii) Any **two** from:
- streamlined
- allows for cephalisation
- sensory receptors can be grouped at the front/'head' can test new environment first [2]

(c) Basic body plan can be easily modified/can evolve rapidly (in different directions)/variability allows them to colonise many habitats/evolve to occupy many niches/fast reproduction allows more opportunities for evolution; [1] 6

2 **(a)** **(i)** Cytoplasm; [1]

(ii) Only a short part of the normal aerobic pathway/does not involve substances having to diffuse into the mitochondrion; [1]

(iii) To regenerate NAD to pick up H from glycolysis reactions; [1]

(b) **(i)** Any **two** from:
- aerobic respiration produces more ATP than anaerobic
- produces 38 ATP for each glucose molecule compared to 2 in anaerobic respiration
- since aerobic respiration results in complete breakdown of glucose (to CO_2 and H_2O)
- anaerobic respiration produces toxic waste products [2]

(ii) Allows for production of extra ATP (above and beyond that produced in aerobic respiration);
to allow higher levels/rates of muscular contraction/important in predators/prey/other appropriate response; [2]

(c) **(i)** Section shaded between exercise stopped and until rate returns to normal; [1]

(ii) Extra oxygen is used to convert lactate to pyruvate/re-synthesize reserves of ATP; [1]

(d) Any **two** from:
- plants produce ethanol rather than lactate
- carbon dioxide is produced in plants
- ethanol/final product not converted back to pyruvate in plants [2] 11

				AVAILABLE MARKS
3	(a)		Ultra-rapid metabolisers produce high levels of morphine; can cause harm/be fatal; poor metabolisers produce little or no morphine; so is ineffective as a painkiller; [4]	
	(b)	(i)	In each ethnic group most people are normal metabolisers; in each ethnic group fewest people are ultra-rapid metabolisers; ethnic group B has fewer normal metabolisers than the other groups/has more ultra-rapid metabolisers **and** poor metabolisers than the other groups; proportions of each type of metaboliser are similar in groups A and C; [4]	
		(ii)	Any **two** from: • dosage of codeine • time between administering and measuring • method of testing • method of drug delivery • other appropriate response [2]	
	(c)		Homozygous for an allele producing a functional enzyme; (since both are expressed) a high level of functional enzyme is present; [2]	12
4	(a)	(i)	Green light is absorbed least; is reflected from leaves (to give the green colour); [2]	
		(ii)	Shows how effective photosynthesis is at different wavelengths; [1]	
	(b)	(i)	Use a water plant/named water plant/other appropriate apparatus, e.g. oxygen probe in a closed container; use apparatus to collect the oxygen produced over time in different environmental conditions/other appropriate response; [2]	
		(ii)	At higher light intensity more photoactivation so more electrons emitted from photosystems; more ATP and NADPH for the light-independent reaction; [2]	
		(iii)	Higher levels of carbon dioxide increase rates of carbon fixation/reaction of carbon dioxide with ribulose bisphosphate; to produce glycerate phosphate; increased temperature increases enzyme activity; of rubisco/enzymes of the light-independent reaction/light-independent reaction is enzyme controlled; [4]	
	(c)		Stomata closed (as consequence of water stress) so less carbon dioxide uptake; less glucose/carbohydrate/amino acid/protein produced for growth; [2]	13

				AVAILABLE MARKS
5	**(a)**		Usually smaller/have smaller ribosomes/no nucleus/no membrane-bound organelles/cell walls made of peptidoglycan/no microtubules/have slime capsule; [1]	
	(b)	**(i)**	(Increases genetic variation) transfer of plasmids between bacteria/ high mutation rates in plasmids; (decreases genetic variation) absence of sexual reproduction/reproduce by division; [2]	
		(ii)	Any **three** from: • overuse of antibiotics leads to antibiotic resistance being a selective advantage • antibiotic-resistance genes can spread easily between bacteria (and between populations) • rapid mutation rates in plasmids which is where the antibiotic-resistance genes are located • bacteria can reproduce rapidly thereby increasing the numbers of antibiotic-resistant bacteria populations [3]	
		(iii)	Any **two** from: • microscopic • most bacteria may have a similar morphology • very variable genomes • difficult to carry out breeding investigations • other appropriate response [2]	8
6	**(a)**	**(i)**	Rhizoids; [1]	
		(ii)	Any **two** from: • they do not possess a waterproof cuticle • or stomata • or vascular tissue [2]	
	(b)	**(i)**	Tabulated t value at p = 0.05 and d.f. = 24 is 2.064; 95% confidence limits = 58 +/- 2.064 x 2.422; **[consequent to t-value used]** upper limit = 63 and lower limit = 53 **[consequent to value above]**; [3]	
		(ii)	Bar completed and limits added accurately; [1]	
		(iii)	Higher *Sphagnum* at base of mountain and mountain top/lower *Sphagnum* cover on mountain side; more standing water in flatter areas/less standing water on mountain sides; [2]	
	(c)		Less competition; so more light available for more photosynthesis; **or** spores (when released) are more likely to be blown longer distances/more effective dispersal of species; colonisation of new areas/less competition between new plants; [2]	11

7 **(a)** The segregation of the two alleles of one gene is independent of the segregation of the two alleles of the second gene during gamete formation; [1]

(b) **(i)** bbDD and bbDd;
BBdd and Bbdd; [2]

(ii) BbDd × Bbdd

gametes (BD)(Bd)(bD)(bd) (Bd)(bd);

	BD	Bd	bD	bd
Bd	BBDd	BBdd	BbDd	Bbdd
bd	BbDd	Bbdd	bbDd	bbdd

;

offspring genotypes BBDd BbDd (×2) BBdd Bbdd (×2) bbDd bbdd

phenotype black black blue blue red fawn;;

ratio 3 : 3 : 1 : 1 ;

[5]

(c) Hh × Hh

gametes (H)(h) (H)(h);

	H	h
H	HH	Hh
h	Hh	hh

;

HH identified as lethal genotype; [3]

(d) Mating may not be random/breeding populations may not be large/there is artificial (differential) selection; [1]

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AVAILABLE MARKS

				AVAILABLE MARKS
8	(a)	(i)	Prokaryotes/bacteria; [1]	
		(ii)	Human insulin is more effective than animal insulin/less risk of transfer of pathogens from livestock/able to meet demand (for high and rapidly increasing number of diabetes patients)/other appropriate response; [1]	
	(b)		Functional genes/viruses/liposomes may not reach all parts of lungs/may not penetrate cells due to immune response/other appropriate response; [1]	
	(c)	(i)	Tissue types do not match so attacked by T-killer cells/cell-mediated response/other appropriate response; [1]	
		(ii)	Any **four** from: • issues over functional DNA gaining entry to cells is bypassed/no need for vectors • no issue over expression (as incorporated fully into DNA/ chromosomes) • treatment long term/no need for reapplication • functional DNA will be in all blood cells (made by stem cells) • no risk of infection/allergic response from vector viruses • no risk of rejection [4]	
		(iii)	May affect genome in unexpected ways/harmful mutation will still pass on to offspring/other appropriate response; [1]	9
			Section A	**82**

Section B

AVAILABLE MARKS

9 (a) Indicative content

- DNA carries the code for protein synthesis in its base sequence
- DNA helicase separates the two DNA strands
- messenger RNA is made from DNA by transcription in the nucleus
- bases in mRNA are complementary to the coding strand
- catalysed by RNA polymerase
- introns are removed from mRNA
- mRNA moves to ribosomes in the cytoplasm via nuclear pores
- both units of a ribosome link together to form functioning ribosome at the first three bases (at one end of the mRNA)/ribosome consists of large and small subunits/ribosomal RNA and protein
- each set of three bases/base triplet
- is known as a codon
- codes for an amino acid
- transfer RNA has three bases (anticodon) complementary to codon
- each tRNA brings specific amino acid to correct position on mRNA
- due to the nature of complementary pairing between codon and anticodon
- this occurs at the aminoacyl (A) site of ribosome
- ribosome moves along three bases/one codon
- a second (peptidyl (P)) site is where adjacent amino acids are linked together by condensation/peptide bonds to form a polypeptide/protein

Band	Response	Mark
A	Candidates use the most appropriate specialist terms to clearly describe and explain the roles of DNA, RNA and ribosomes in protein synthesis using a minimum of **nine points** of indicative content. Spelling, punctuation and grammar are excellent and the form and style are of a high standard.	[9]–[12]
B	Candidates use appropriate specialist terms to clearly describe and explain the roles of DNA, RNA and ribosomes in protein synthesis using a minimum of **five points** of indicative content. Spelling, punctuation and grammar are good and the form and style are of a good standard.	[5]–[8]
C	Candidates partially describe and explain the roles of DNA and/or RNA and/or ribosomes in protein synthesis using a minimum of **one point** of indicative content.	[1]–[4]
D	Response not worthy of credit.	[0]

[12]

(b) Indicative content

- epigenetics causes change/variation in gene expression
- but does not involve changes in DNA sequence
- can be by methylation and histone modification
- methylation is addition of methyl group/CH_3 to CG sequence
- in liver tissue genes coding for the enzymes are switched on
- but switched off in other tissues
- by methylation (as long term)
- methylation effect passed from cell to cell by mitosis

Band	Response	Mark
A	Candidates use the most appropriate specialist terms to clearly explain how epigenetics can account for the fact that enzymes associated with liver function are only produced in liver cells using a minimum of **five points** of indicative content. Spelling, punctuation and grammar are excellent and the form and style are of a high standard.	[5]–[6]
B	Candidates use appropriate specialist terms to clearly explain how epigenetics can account for the fact that enzymes associated with liver function are only produced in liver cells using a minimum of **three points** of indicative content. Spelling, punctuation and grammar are good and the form and style are of a good standard.	[3]–[4]
C	Candidates partially explain how epigenetics can account for the fact that enzymes associated with liver function are only produced in liver cells using a minimum of **one point** of indicative content.	[1]–[2]
D	Response not worthy of credit.	[0]

[6] 18

Section B **18**

Total **100**

AVAILABLE MARKS