



Rewarding Learning

**ADVANCED
General Certificate of Education
2022**

Biology

Assessment Unit A2 1

assessing

**Physiology, Coordination and Control,
and Ecosystems**

[ABY11]

WEDNESDAY 1 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.

COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

/ 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) (i) X – Z-line;
Y – H-zone; | [2] | |
| | (ii) Any two from: <ul style="list-style-type: none">• the H-zone/Y becomes shorter• the I-band becomes shorter• the proportion of overlap between myosin and actin becomes greater• the Z-line/X becomes closer to the M-line/myosin/A-band | [2] | |
| | (b) (The calcium ions) allow the myosin heads to attach to the actin filaments/free up the myosin binding sites; | [1] | 5 |
| 2 | (a) The lag phase; | [1] | |
| | (b) The number of yeast cells was still rising/plateau or stationary phase had not been reached; | [1] | |
| | (c) $(100\,000 - 100) \div 12$;
8325 cells hour ⁻¹ ; | [2] | |
| | (d) Initially a (relatively) slow increase;
then an exponential increase in numbers;
(initial lag phase) due to nutrient assimilation/induction of appropriate enzymes/growth of cells to maturity;
(exponential phase) due to abundant food reserves/no (significant) accumulation of waste; | [4] | 8 |

- 3 (a) (Osmoreceptors in the) hypothalamus; [1]
- (b) (i) ADH concentration (in the blood) falls after drinking water to reach its lowest level/6 arbitrary units after 2 hours; then rises to return to its original level after 5 hours;
- Any **three** from:
- the solute potential of the blood becomes higher/less negative (after drinking 600 cm³ water)
 - (less ADH produced) so fewer aquaporins incorporated into the plasma membrane
 - making the walls of the collecting duct less permeable/less water is reabsorbed into the blood
 - as the solute potential lowers/becomes more negative again the concentration of ADH returns to normal [5]
- (ii) Individual 1 had drunk less water than 2 before the investigation/ individual 1 had been more active before the investigation/OAR; [1]
- (c) As the solute potential approaches the norm, the corrective mechanism is inactivated; [1]
- (d) The ADH will no longer be able to fit to the receptor (in the membrane of the cells lining the collecting ducts); aquaporins will not be incorporated into the cell membranes/cells remain relatively impermeable to water; water remains in the collecting duct/failure to reabsorb enough water/large volumes of (dilute) urine produced; [3]
- 4 (a) (i) 5; [1]
- (ii) Synaptic bulb; [1]
- (iii) Axon at position of correct node of Ranvier labelled with an arrow; [1]
- (iv) Myelin sheath acts as an insulator/no depolarisation of axon under myelin sheath; impulses jump between nodes of Ranvier/saltatory conduction; [2]
- (v) Thicker axon/higher temperature; [1]
- (b) (i) Depolarisation increases to 40 mV; fall from peak to give small 'overshoot' before resting potential; [2]
- (ii) Gated/extra channels open (allowing increased number of positive ions to enter axon); [1]
- (c) 0.74 ÷ 90/740 ÷ 90 000;
0.0082;
8.2 × 10⁻³; [3]

AVAILABLE
MARKS

11

12

- 5 (a) (i) Evergreen/can photosynthesise all year/during winter;
so can gain more light/can photosynthesise when the host tree has no
leaves/not blocking light;
or individual plants are well spaced;
less competition; [2]
- (ii) Predation/grazing; [1]
- (b) (i) Any **two** from:
- will shade some of the tree's leaves
 - will compete with the tree for water/nutrients
 - will add extra weight stress/acts as a 'sail' in windy conditions
(possibly leading to structural damage/causing the tree to fall)
 - other appropriate response [2]
- (ii) Nests for birds/fruit or berries/food in winter/other appropriate
response; [1]
- (c) (i) Climatic (climax); [1]
- (ii) Any **two** from:
- not enough water/nutrients available
 - roots cannot penetrate soil
 - too windy (for tall trees) [2]
- (iii) (Conditions are harsh) so allows photosynthesis throughout the year/
avoids the (metabolic) costs of producing new leaves; [1]
- (iv) Respiration/photosynthesis/plant growth/decomposition rates slow;
enzymes have very low kinetic energy/not at optimum temperature/
work less effectively; [2]

AVAILABLE
MARKS

12

			AVAILABLE MARKS
6	(a)	(i) Ciliary muscle (body) contracts; causing suspensory ligaments to slacken; (tension on lens reduces) and lens returns to its thicker shape causing more refraction of light; [3]	
		(ii) Rods; [1]	
		(iii) High sensitivity is the ability to 'see'/of photoreceptors to be stimulated in low light intensities; due to convergence of rods; enabling summation of (sub-threshold) light stimuli; producing action potential in bipolar neurones/ganglion cells; [4]	
	(b)	(i) Daylight causes the conversion of P_{660} to P_{730} and P_{730} is converted to P_{660} in darkness; increased conversion of P_{660} to P_{730} as daylength increases (from March to June)/shorter time (nights) to convert P_{730} back to P_{660} ; reduced conversion (of P_{660} to P_{730}) as daylength decreases (from June to November)/longer time (nights) to convert P_{730} back to P_{660} ; [3]	
		(ii) Flowering occurs when P_{730} concentration reaches a critically low level/falls to a low level; [1]	
		(iii) Artificially increase the daylength in the period beyond June/add flash of light during night; to delay the date when P_{730} falls to a critical level to initiate flowering; [2]	14
7	(a)	(i) Decomposers; [1]	
		(ii) Nitrifying bacteria require oxygen/nitrification is an aerobic process; (drainage and non-compaction) will increase oxygen availability/discourage denitrification; [2]	
	(b) Leghaemoglobin will bind to oxygen diffusing through the root; controls oxygen availability (to the nitrogen-fixing bacteria)/absorbs excess oxygen; so that the bacteria receive (just enough) oxygen (for respiration) but that the nitrogen-fixing enzymes do not receive too much oxygen; [3]		
	(c) Denitrification activity increases with soil depth until levelling out (at 15 cm); denitrifying bacteria are anaerobic/denitrification is an anaerobic process; at increasing depth the soil is more waterlogged and so contains less oxygen; [3]	9	

- 8 (a) (i) Have RNA rather than DNA/use RNA to make DNA/RNA as the genetic material; [1]
- (ii) In human food/chimpanzee bite/other appropriate response; [1]
- (b) (i) Number of helper T-cells falls below a critical level/reaches a low level; Any **two** from:
 • helper T-cells are not able to stimulate production of killer T-cells/memory cells;
 • not able to stimulate production of B-cells/plasma cells/antibodies;
 • not able to promote phagocytosis; [3]
- (ii) The drugs block the CD4 receptors; HIV cannot infect the helper T-cell; [2]
- (c) (i) Regulate/deactivate immune responses; no regulation of killer T-cell activity/number (so unable to prevent insulin-secreting cells being attacked); [2]
- (ii) Immune system triggered/more active than normal (as a consequence of earlier infection); heightened immune activity continues (as a consequence of suppressor T-cells being damaged) and killer T-cells destroy insulin-producing cells; [2]

Section A

AVAILABLE MARKS

11

82

Section B

AVAILABLE
MARKS

9 (a) Indicative content

- (energy) reflected by sea surface
- evaporation of water
- missing phytoplankton cells
- missing chloroplasts in phytoplankton
- wrong wavelengths to be absorbed
- biochemical inefficiencies in photosynthesis
- herring unable to digest cellulose (in the phytoplankton)
- energy loss between producer and primary consumer is greater than subsequent losses between consumers
- losses due to excretion/egestion (allow once)
- losses due to respiration (allow once)
- losses to decomposer chain (allow once)
- puffins/eagles unable to eat/digest all their prey
- explanation, e.g. unable to eat/digest bone/feathers
- (puffins/eagles) are endotherms
- therefore greater energy losses via respiration (to maintain a constant body temperature)
- quotation of specific values in energy transfer, e.g. < 1% of solar energy will be converted into production in the phytoplankton/10 – 20% efficiency between consumers
- further detail re reasons why this food chain particularly inefficient, e.g. two endotherms in chain/puffins and eagles live in particularly difficult habitats therefore respiration losses will be particularly high

Band	Response	Mark
3	Candidates use the most appropriate specialist terms to clearly describe and explain the loss of energy through the food chain 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]
2	Candidates use appropriate specialist terms to clearly describe and explain the loss of energy through the food chain 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]–[8]
1	Candidates partially describe and explain how energy is lost through the food chain using a minimum of one point of indicative content. Spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[4]
0	Response not worthy of credit.	[0]

[12]

(b) Indicative content

- fertiliser increases primary productivity/growth in crops
- through increasing soil mineral content/prevents mineral content becoming limiting
- confinement (in sheds/small field sections) reduces livestock movement therefore reducing respiration losses
- confinement in (heated) sheds/close proximity can lead to reduced heat loss in livestock (reducing energy required to maintain body temperature)
- confinement in fields allows manure to be spread more evenly/more efficient grazing of grass/grass in unused sections more recovery time
- less high-energy food is required to maintain growth (therefore increasing production-input ratio)
- high-protein foods provide the protein needed for more growth/reduced quantity of indigestible material

Band	Response	Mark
3	Candidates use the most appropriate specialist terms to clearly explain how fertiliser, confinement, high energy and high protein foods increase efficiency in agriculture 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]
2	Candidates use appropriate specialist terms to clearly explain how fertiliser, confinement, high energy and high protein foods increase efficiency in agriculture using a minimum of three points of indicative content. Spelling, punctuation and grammar are excellent and the form and style are of a high standard.	[3]–[4]
1	Candidates partially explain how fertiliser and/or confinement, and/or high energy and/or high protein foods increase efficiency in agriculture using a minimum of one point of indicative content. Spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[2]
0	Response not worthy of credit.	[0]

[6]

18

Section B

18

Total

100

**AVAILABLE
MARKS**