Rewarding Learning

ADVANCED
General Certificate of Education
2017

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[AB221]

TUESDAY 20 JUNE, MORNING

MARK SCHEME

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

/ 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)** Vectors/by description; [1]

(b) Any **two** from:
- use of bacterial strains ill-adapted to human physiology
- strains with 'suicide genes'
- containment mechanisms, e.g. 'negative-pressure' atmospheric gradients/special air filters
- strict staffing protocols, e.g. in movement within lab, cleaning arrangements
- other appropriate response [2]

(c) Relatively simple genomes/genome well understood (through sequencing)/ genomes easily accessed and manipulated, e.g. free in cytoplasm/ separation of product more straightforward/fewer ethical issues/short life cycle; [1]

4

2 **(a)**

Feature / Phylum	Bilaterally symmetrical	Triploblastic	Coelomate	Gut has both a mouth and an anus	Support by internal skeleton of bones	
Platyhelminthes	✓	✓				;
Chordata	✓	✓	✓	✓	✓	;
Annelida	✓	✓	✓	✓		;

[Mark by row] [3]

(b) **(i)** Digestion is outside the cells but within gut/body; [1]

(ii) In (cnidaria and) platyhelminthes digestion is both intracellular and extracellular;
in annelida and chordata digestion is extracellular; [2]

6

				AVAILABLE MARKS
3	**(a)**	**(i)**	W – guanine X – adenine Y – cytosine Z – uracil; [all correct = 2; 2/3 correct = 1] [2]	
		(ii)	Non-coding sections of MRNA (introns) are removed/or by description; [1]	
	(b)	**(i)**	Ribosome; [1]	
		(ii)	Any **four** from: • ribosome moves along by one codon length • (lysine) tRNA leaves the ribosome (so that P-site becomes vacant) • so that the Thr-tRNA/ACC is now on the left of ribosome (P-site) • Phe tRNA enters ribosome/Phe is brought into position (A-site) • peptide bond forms between Thr and Phe [4]	8
4	**(a)**	**(i)**	Ribulose bisphosphate –5C **and** glycerate phosphate –3C; [1]	
		(ii)	Provides energy for the conversion of glycerate phosphate to triose phosphate; provides phosphate for the conversion of triose phosphate to ribulose bisphosphate; [2]	
	(b)	**(i)**	Reflection at cuticle; [1]	
		(ii)	No carbon fixation in epidermal layers as no chloroplasts; maximum fixation in palisade layer (compared to spongy mesophyll) as higher light intensity (allow converse); as more chloroplasts/chlorophyll/photosynthesising cells; [3]	
	(c)	**(i)**	Common angled line initially leading to a higher plateau; [1]	
		(ii)	High light levels **and** high temperatures; [1]	9

				AVAILABLE MARKS
5	**(a)**	(Increases chance of cross-fertilisation) maintaining (genetic) variation; [1]		
	(b)	**(i)** Any **four** from: • pollen tube grows through the ovary wall to enter the ovule/ embryosac • aided by tube nucleus • generative nucleus divides to produce two male gametes • zygote produced by male gamete/nucleus fertilising the egg nucleus • endosperm formed by (second) male gamete joining with two polar nuclei [4]		
		(ii) Seeds will not germinate until after winter/in spring; when growing conditions (e.g. temperature/light intensity) are better/ seedling more likely to survive/co-evolution with pollinators; [2]		
	(c)	**(i)** $q = 0.1$ therefore $p = 0.9$; $2pq = 2 \times 0.1 \times 0.9$; 18%; [3]		
		(ii) The population is large/mating is random/individuals are diploid no differential selection/all phenotypes equally fertile/there is no mutation/there is no migration; [1]		11

					AVAILABLE MARKS
6	**(a)**	**(i)**	The link reaction;	[1]	
		(ii)	Mitochondrial cristae;	[1]	
		(iii)	$2CO_2$ in link reaction/X; as two pyruvate molecules are formed from each glucose molecule/ stage occurs twice for each glucose molecule; $4CO_2$ in Krebs cycle; two steps in Krebs cycle involve loss of CO_2 and Krebs cycle occurs twice for each glucose molecule;	[4]	
	(b)	**(i)**	Any **two** from: • size of beads • type of yeast/age of yeast • concentrations of glucose solutions • size of beaker/volume of glucose/depth of glucose solution • thickness of sodium alginate coating of bead	[2]	
		(ii)	As oxygen unable to diffuse in through the alginate;	[1]	
		(iii)	Beads rise more quickly at 40 °C; more CO_2 produced due to faster/more (anaerobic) respiration (at higher temperature);	[2]	
		(iv)	Any **two** from: • different amounts of glucose/food stored in yeast cell • unevenness of alginate coating allowing some CO_2 to escape • variable amounts of glucose/oxygen entering • other appropriate response	[2]	
		(v)	Bar chart; with 95% confidence limits/standard deviations/standard deviations (errors) of the mean;	[2]	15

AVAILABLE MARKS

7 **(a)** $C^B\ C^Y$ $C^P\ C^Y$

;

	C^P	C^Y
C^B	$C^B C^P$	$C^B C^Y$
C^Y	$C^P C^Y$	$C^Y C^Y$

;

$\underbrace{C^B C^P \quad C^B C^Y}_{\text{brown}}$ $C^P C^Y$ pink $C^Y C^Y$ yellow ; [3]

(b) **(i)**

Category	**Observed** ***(O)***	**Expected** ***(E)***	***(O–E)***	$(O–E)^2$	$\frac{(O–E)^2}{E}$
brown	89	100	11	121	1.21
pink	55	50	5	25	0.5
yellow	56	50	6	36	0.72

;

$X^2 = 2.43$; [2]

(ii) 2 degrees of freedom;
$0.5 > p > 0.1$; [2]

(iii) The results of the cross are a good fit to a 2 : 1 : 1 ratio/there is no significant difference between the observed and expected results; [1]

(c) Aa C^BC^P × Aa C^YC^Y;

(AC^B) (AC^P) (aC^B) (aC^P) × (AC^Y) (aC^Y)

	AC^B	AC^P	aC^B	aC^P
AC^Y	not banded AAC^BC^Y brown	not banded AAC^PC^Y pink	not banded AaC^BC^Y brown	not banded AaC^PC^Y pink
aC^Y	not banded AaC^BC^Y brown	not banded AaC^PC^Y pink	banded aaC^BC^Y brown	banded aaC^PC^Y pink

; ;

AAC^BC^Y	AaC^BC^Y(2)	AAC^PC^Y	AaC^PC^Y(2)	aaC^BC^Y	aaC^PC^Y
not banded brown	not banded brown	not banded pink	not banded pink	banded brown	banded pink
3		3		1	1

; ;

[5]

(d) **(i)** There is a negative correlation between mean summer temperature and percentage of brown snails/as mean summer temperature increases the percentage of brown snails decreases (or converse);

Any **three** from:
- in warmer temperatures it is disadvantageous to be brown as brown snails will absorb too much heat/in cooler temperatures it is advantageous to be brown as brown snails will absorb heat
- brown snails more likely to survive in cooler temperatures than other colours/are fitter/selected for (or converse)
- and pass their alleles on to offspring
- example of directional selection explained [4]

(ii) Regions where brown snails are dominant/have selective advantage will decrease (or converse);
as temperature will increase **[must be linked to temperature; not just climate change]**; [2]

Section A

AVAILABLE MARKS

19

72

Section B

AVAILABLE MARKS

8 (a) One essential point

- determining the order of nucleotides/bases in the complete genome/a gene

and eleven other points (must include at least one ethical point)

- has resulted in the sequencing of the human genome/Human Genome Project
- creation of genome libraries/biobanks
- (use of 'DNA chips'/microarray to) determine if an individual is a carrier of a genetic disorder
- improved diagnostics to test for presence of genes that increase susceptibility to, e.g. cancer or heart disease
- supporting gene therapy
- replacing non-functional gene by functioning gene
- leading to cure/treatment for disease, e.g. cystic fibrosis
- development of 'designer' drugs matched to an individual's genetic profile/personalised medicine
- more effective/fewer side effects
- develops understanding of genes role in protein production/allows the primary structure of proteins to be worked out
- other (non-medical) benefits (e.g. analysis of migration pathways/ ancestral data)
- named ethical issue associated with genetic screening, e.g. decisions re foetal abnormality/access to results of screening (e.g. insurance/ employers)
- possibility of 'designer babies' (in an ethical context)
- the need for legislation [12]

(b) Any **four** from:

- identification of desired gene within a chromosome by using a DNA probe
- use of restriction endonucleases to remove gene
- cuts DNA at recognition sequences/specific base combinations
- reverse transcriptase
- converts mRNA to single strand DNA
- following identification of mRNA in suitable cells
- DNA polymerase used to make double strand DNA
- direct synthesis of gene (gene machine) [4]

Quality of written communication
[2] marks
The candidate expresses ideas clearly and fluently through well-linked sentences, which present relationships and not merely list features. Points are generally relevant and well-structured. There are few errors of grammar, punctuation and spelling.

[1] mark
The candidate expresses ideas clearly, if not always fluently. The account may stray from the point or may not indicate relationships. There are some errors of grammar, punctuation and spelling.

[0] marks
The candidate produces an account that is of doubtful relevance or obscurely presented with little evidence of linking ideas. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the account. [2]

18

Section B	**18**
Total	**90**