Rewarding Learning

ADVANCED
General Certificate of Education
2016

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[AB221]

TUESDAY 7 JUNE, AFTERNOON

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) (i) Prothallus labelled with X; [1]

(ii) Any **two** from:
- male gametes need a layer of moisture to swim/reach female gamete
- prothallus is unable to restrict water loss with no cuticle/stomata
- prothallus has limited ability to obtain water from substratum as has no true roots/vascular tissue [2]

(b) (Ferns compared to mosses) – adult plant (sporophyte) has true roots/ vascular tissue/stomata/cuticle;
(flowering plants compared to ferns) – gametophyte does not exist as independent moisture-dependent stage/pollination does not require film of water for male gametes to swim to the female gamete/seeds are more able to withstand desiccation than spores; [2] 5

2 (a) Glycolysis;
oxidative phosphorylation;
(mitochondrial) matrix;
ATP and water;
anaerobic respiration in animals; [5]

(b) (i) 0.7; [1]

(ii) 0.7 is RQ of fats;
only has elements CHO but proportion of hydrogen to oxygen is different to carbohydrates/proportions of O and C very different; [2]

(c) (i) CO_2 produced needs to be able to escape/prevent pressure build up; [1]

(ii) Any **three** from:
- for first hour RQ is 1 and then increases
- during first hour, respiration is aerobic and anaerobic after that
- CO_2 evolved is increasingly greater than O_2 used
- the substrate is carbohydrate (only) [3] 12

					AVAILABLE MARKS
3	(a)	(i)	**A** – ectoderm; **B** – enteron; [2]		
		(ii)	Any **two** from: • diploblastic/two body layers • radially symmetrical • large (fluid-filled) enteron • presence of mesogloea [2]		
	(b)		Initial digestion by extra-cellular secretions into enteron; digestion completed intracellularly in endoderm cells (following endocytosis); [2]		
	(c)		Hydrostatic skeleton formed by fluid-filled enteron/no skin (or cuticle) to reduce water loss/food obtained in water/some cnidarians adapted for locomotion in water; [1]		7
4	(a)	(i)	**X** – template/coding strand; [1]		
		(ii)	**Y** – RNA nucleotide/ribonucleotide; [1]		
		(iii)	Any **four** from: • the DNA double helix unzips through hydrogen bonds breaking • through action of enzyme helicase • mRNA forms on template strand/nucleotides assemble on template strand • through forming complementary base pairs (with DNA strand)/ examples of RNA to DNA base pairing • RNA polymerase catalyses bond formation between (ribo)nucleotides [4]		
	(b)	(i)	When lactose is present, it combines with inhibitor; changing its shape, causing the inhibitor to be released from the gene/DNA; RNA polymerase can bind to the DNA/transcription can occur; [3]		
		(ii)	Enzyme not made if substrate/lactose not present; [1]		10

5 **(a)** **(i)** Aa × Aa

gametes (A) (a) (A) (a)

	A	a
A	AA	Aa
a	Aa	aa

;

offspring genotypes AA Aa Aa aa

phenotypes F+10% F+5% F; [2]

(ii) AaBB and AABb; [1]

(iii) Aa Bb × Aa bb;

gametes (AB) (Ab) (aB) (ab) (Ab) (ab);

	AB	Ab	aB	ab
Ab	AABb	AAbb	AaBb	Aabb
ab	AaBb	Aabb	aaBb	aabb

;

offspring genotypes AABb AAbb AaBb (×2) Aabb (×2) aaBb aabb

phenotypes F+15 F+10 F+10 F+5 F+5 F; [4]

(iv) Other genes involved/polygenic/effect of environment; [1]

(b) (white fur) ddEE, ddEe and ddee;
(black fur) DDEE, DdEE, DDEe and DdEe; [2]

AVAILABLE MARKS

10

				AVAILABLE MARKS
6	(a)	(i)	(Aerobic) bacteria gather at B as higher oxygen levels; as point where spiral chloroplast reaches cell surface so photosynthesis takes place; *[or converse]* [2]	
		(ii)	Intensity/wavelengths of light should be same at A and B; [1]	
	(b)	(i)	Repeat investigation using different wavelengths of light; [1]	
		(ii)	More photosynthesis/oxygen evolved/more motile bacteria in red and/or blue light (than green); [1]	
	(c)	(i)	Carbon dioxide output indicated; shows influence of respiration; [2]	
		(ii)	In midsummer carbon dioxide uptake is higher and there is net uptake for longer period of time; carbon dioxide output is higher in midsummer (in darkness/during night); *[or converse]* and Any **two** from: • in summer more light/higher light intensity so more photosynthesis • photosynthesis aided by warmer temperatures • respiration rates are higher in summer due to warmer temperatures/more growth [4]	
	(d)	(i)	Tabulated t value at p = 0.05 and d.f. = 19, is 2.093; 95% confidence limits = 9 (mean) $\pm$ 2.093 $\times$ 1.433 **[consequent to t-value used]**; upper limit = 12 and lower limit = 6 **[consequent to value above]**; [3]	
		(ii)	95% limits added accurately **[consequent to value in (i)]**; [1]	
		(iii)	In poor fertility soils nutrient levels are too low to replace leaves more often/in high fertility soils nutrient levels are high enough to support leaf replacement more often/with shorter leaf lifespan soil fertility is increased (due to decomposition of leaves); [1]	16

				AVAILABLE MARKS
7	(a)	(i)	White blood cell; [1]	
		(ii)	SNP is on the X chromosome/only one X chromosome in males; [1]	
		(iii)	In males with AAD, there are more T bases/fewer C bases; the same pattern exists in females; but it is less obvious in females due to the effect of the heterozygote; [3]	
		(iv)	$p < 0.03$ means that there is less than a 3% probability of the variation between the two samples being due to chance (random variation); the two samples are significantly different; [2]	
	(b)		Any **two** from: • there are many genes involved in the condition • (the adrenal glands lie deep in abdomen/just above kidneys) therefore are not easily accessible • other appropriate response [2]	
	(c)	(i)	A 'knockin' mouse has DNA/a gene added/gene activity amplified and a 'knockout' mouse has a gene removed or been made inoperative; [1]	
		(ii)	Any **two** from: • the mouse is (a mammal so) biochemically/physiologically similar to humans • has a short life cycle/large number of offspring per litter • easily kept in laboratory conditions (small) • other appropriate response, e.g. ethically more acceptable [2]	12
			Section A	**72**

Section B

AVAILABLE MARKS

8 **(a)** Any **twelve** from:

- **variation** must be **genetic** (to be important in evolution)
- variation is produced by **sexual** reproduction
- due to **meiosis**/**random nature** of **cross-fertilisation**/**mutation**
- example – crossing over/independent assortment/gene or chromosome mutation or explained
- **selection** acts on the (genetic) **variation** in the population/species
- **directional selection** (is important in evolution/speciation)
- favours particular **phenotypes**/**alleles** in a population/species
- individuals with these alleles more likely to **survive**/**pass on these alleles** to offspring
- **reproductive isolation** prevents two or more populations from **interbreeding**
- thus preventing **gene flow**/are **genetically isolated**
- **reproductive isolation** is often due to **geographical separation** (or by example, e.g. mountains)
- reproductive isolation can be by **named other method(s)**, e.g. ecological, behavioural
- reproductive isolation results in **genetic divergence**
- due to **differential selection** pressures/different **environmental** conditions
- **speciation** has occurred when individuals from two or more reproductively isolated populations are **unable to reproduce to produce fertile offspring** (should they come in contact)
- **speciation** involving **geographical separation** is **allopatric** [12]

(b) Polyploidy is **chromosome** (mutation);
involving increases in **complete sets** of chromosomes;

Any **two** from:

- speciation by polyploidy is **rapid** (whereas speciation by reproductive isolation takes place gradually over a long time)
- polyploidy does not require **geographical**/**reproductive separation**
- polyploidy does not require differential (directional) **selection**
- polyploidy occurs in **plants** [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

	AVAILABLE MARKS
Section B	**18**
Total	**90**