Rewarding Learning

ADVANCED
General Certificate of Education
2015

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[AB221]

MONDAY 1 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)** An organism that has had DNA introduced from another organism; [1]

(b) Reverse transcriptase – converts code in mRNA to (single strand) DNA;
DNA polymerase – makes double stranded DNA from single stranded DNA;
Plasmids – act as vectors/transfer gene into bacteria/a host cell; [3] 4

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

(ii) Proinsulin is one polypeptide; [1]

(b) **(i)** **Any two from**
- links anticodons to codons/tRNA to mRNA
- complementary nature of linkage of anticodon to codon/ensure that amino acids (or tRNA) align in correct order
- (movement of) ribosome facilitates formation of peptide bonds [2]

(ii) **Any two from**
- less mRNA needs to be manufactured
- polypeptide/protein can be made faster
- other appropriate response [2] 6

		AVAILABLE MARKS
3	**(a)** Can absorb across a range of wavelengths/can absorb both red and blue light; [1]	
	(b) In winter respiratory demands of leaves may exceed photosynthetic gain (so net loss of carbohydrate)/reduce transpirational water loss (at a time of reduced water availability, e.g. frozen soil)/reduces storm damage to trees; [1]	
	(c) (i) Any three from • in May (in early summer) the colour of the chlorophyll masks the carotene/xanthophyll colour/chlorophyll colour is dominant • in October (autumn) the amount of chlorophyll is reduced • carotene/xanthophyll colours therefore dominate • in October (autumn) the chlorophyll is broken down/withdrawn into tree [3]	
	(ii) Leaves sampled from same tree; to reduce variable of mineral availability/variability due to age/genetics; **or** Leaves taken from same part of tree(s)/position on branch; to reduce effect of light intensity/age; **or** Same type of solvent used; as pigments have different solubilities; **or** Same number of spots added for each pigment; to allow valid comparison of spot intensities; **or** Other appropriate variable (e.g. equivalent grinding used to extract pigments/using a colour chart to estimate intensity); with relevant explanation (e.g. to allow valid comparison of spot intensities/to reduce subjectivity); [2]	
	(d) (i) Any three from • hydrogen (from the splitting of water) dissociates into hydrogen ions and electrons • electrons replace electrons lost from PSII (during photoactivation) • hydrogen ions combine with electrons (from PSI) to convert NADP into NADPH • the waste product oxygen diffuses out of the leaf/is used in respiration by leaf cells [3]	
	(ii) NADPH reduces glycerate phosphate to triose phosphate; using energy from ATP/phosphate from ATP is used to convert TP → RuBP; [2]	12

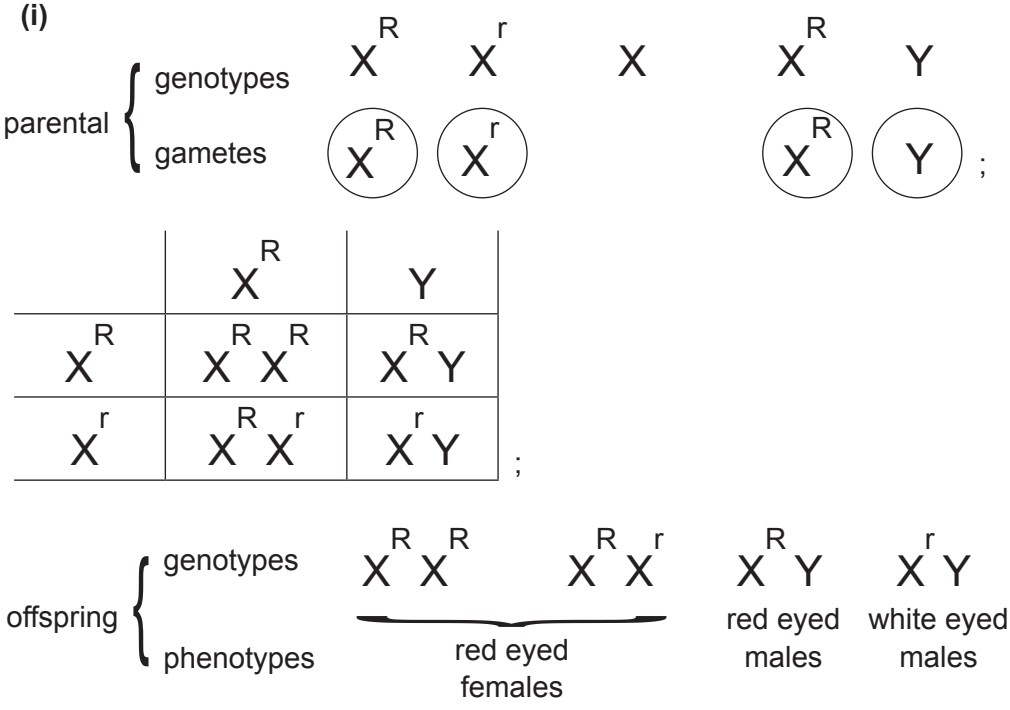
				AVAILABLE MARKS
4	(a)	(i)	Substitution; [1]	
		(ii)	GAG to GUG; [1]	
		(iii)	Glutamate to valine (consequential to codons in (ii)); [1]	
			Any two • more than one codon can code for a particular amino acid • example provided from table • for many amino acids the choice of third base is not critical [2]	
	(b)		Reduced blood flow/red blood cells unable to squeeze through the capillaries as easily; [1]	
	(c)		**Any five from** • in Africa/areas where mosquitoes or malaria common, heterozygotes have selective advantage • only limited anaemia but protected from malaria • heterozygotes most likely to reproduce/pass sickle cell allele on to offspring • in northern Europe/areas where no mosquitoes or malaria, heterozygotes (and homozygotes with sickle cell anaemia) are selected against (or converse)/sickle cell allele(s) selected against (as less fit) • sickle cell allele less likely to be passed on • this is an example of directional selection [5]	11

			AVAILABLE MARKS
5	(a)	**Any two from** • infected ash seedlings (from Europe) were used in the plantations; • spores unable to cross the Irish Sea/reach Ireland from infected sites in Britain; **or** • different (genetic) strain of tree in Ireland; • with increased natural resistance; [2]	
	(b) (i)	Genome sequencing is determining the sequence of DNA bases/ nucleotides; in an entire organism/in all the (haploid) chromosomes; [2]	
	(ii)	**Any three from** • identify alleles/genes (in tree 35) that confer resistance • method of identifying alleles/genes, e.g. knock out technology, that confer resistance • insert resistance alleles/genes into British ash/breed native ash trees with Danish trees • method of removing/inserting alleles or genes explained [3]	
	(c) (i)	**Any two from** • many genes involved • other non-genetic (lifestyle) factors involved • costs/complexity involved • many forms of cancer [2]	
	(ii)	Drugs that match the patient/tumour genome; more effective treatment/fewer side effects; [2]	11

				AVAILABLE MARKS
6	(a)	(i)	Adenine; [1]	
		(ii)	Energy is released as (terminal) phosphate is removed; [1]	
		(iii)	**Any two from** • energy released in small steps/small amount of energy released • single reaction • ATP can be easily transported around the cell [2]	
	(b)	(i)	To prevent photosynthesis taking place; photosynthesis would produce oxygen (to compensate for some of the oxygen used in respiration)/to ensure the movement of KOH is only due to respiration; [2]	
		(ii)	Variety B had germinated faster than variety A/other appropriate response; [1]	
		(iii)	98 – 56 = 42 cm^3 used; 42/10 = 4.2 cm^3 per gram **[consequent to values from graph];** 4.2/10 = 0.42 $cm^3\ g^{-1}\ hr^{-1}$ **[consequent to value above];** **[max. 1 mark if both readings are incorrect]** [3]	
	(c)	(i)	There is no significant difference between the mean number of mitochondria in the two varieties of peas/the difference between the means of the number of mitochondria of the two varieties of pea is due to chance; [1]	
		(ii)	$t = \frac{6.3 - 5.8}{\sqrt{0.62^2 + 0.68^2}}$; $t = \frac{0.5}{0.92} = 0.54$; [2]	
		(iii)	$p > 0.1$ **[consequential to t-value calculated];** [1]	
		(iv)	Null hypothesis is accepted/there is no significant difference between the mean numbers of mitochondria in the cells of variety A and B; the difference in growth rate/respiration rate is not due to the number of mitochondria/must be due to some other factor; [2]	16

7 **(a)** X^RY;
X^rX^r; [2]

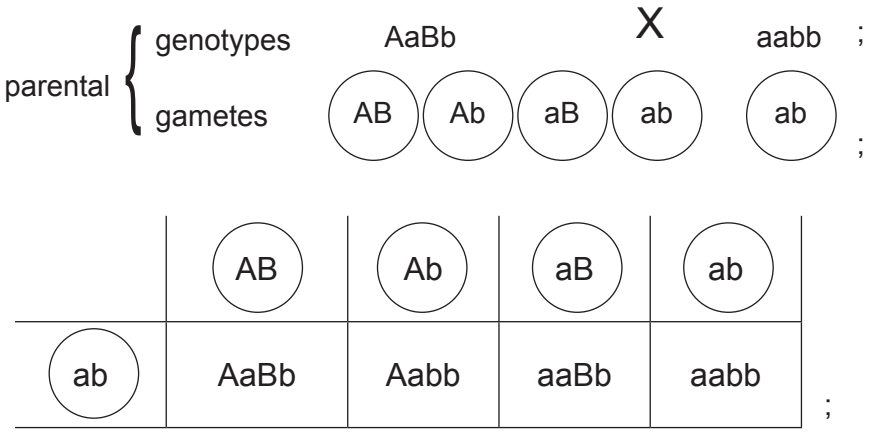
(b) **(i)**



[3]

(ii) Chi-square; [1]

(c)



offspring	genotypes	AaBb	Aabb	aaBb	aabb
	phenotypes	normal wings normal body colour	normal wings ebony body colour	vestigal wings normal body colour	vestigal wings ebony body colour ;

[4]

(d) **Any two from**

- large number of offspring produced in each cross
- number of traits (e.g. eye colour, wing type, body colour) that are inherited in typical Mendelian pattern/that show discontinuous variation/ distinct forms
- other appropriate response, e.g. short life cycle/fewer ethical concerns/ easy to culture/can be kept in lab [2]

12

Section A **72**

AVAILABLE MARKS

Section B

AVAILABLE MARKS

8 (a) Any ten points

mosses

- mosses are poorly adapted to retain water due to lacking true roots, stems and leaves
- rhizoids cannot penetrate the substratum to obtain water/'leaves' do not have cuticle or stomata
- do not possess vascular tissue so support is by turgor/cannot grow to large size
- reproduction requires moisture for sperm to swim to egg
- sporophyte generation has limited water retention properties through presence of cuticle/stomata

ferns/angiosperms

- ferns and angiosperms have true roots, stems and leaves
- roots are able to penetrate the substratum to reach water
- waterproof cuticle reduces water loss by evaporation/transpiration
- have fine control over stomata
- vascular tissue allows ferns/angiosperms to reach large sizes/distribute water through plant/provide support
- fern gametophyte (prothallus) is delicate with no true roots/cuticle/ stomata
- also moisture-requiring for reproduction
- therefore ferns are usually restricted to damp habitats
- an example of fern adaptation for arid environments (e.g. bracken is able to colonise dry environments due to extensive lateral growth)
- in angiosperms the gametophyte stage is much reduced/does not exist as separate plant/is protected within (sporophyte) plant
- male gamete (within pollen grain) not dependent on water for transport to female gamete
- seeds are more resistant to aridity than spores (produced by mosses and ferns) [10]

(b) Any six from

- development of bilateral symmetry in Platyhelminthes (as opposed to radial symmetry in cnidarians)
- allows concentration of sensory receptors/mouth at 'front'/streamlined for more effective movement
- transition from diploblast to triploblast state in Platyhelminthes
- provides extra layer for more tissue differentiation/increase in size
- transition from acoelomate to coelomate in Annelida
- coelomate condition provides space for development of organs/ increases SA/volume of metabolically active tissue/separates muscle movements for locomotion and gut
- development of one-way gut in Annelida
- initially extracellular and intracellular then development of extracellular digestion only
- development of (metameric) segmentation in Annelida
- development of waterproofed skin in some chordates is adaptation for terrestrial life (in reptiles, birds and mammals)/post-anal tail for balance on land/vertebral column (notochord) for support on land [6]

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 content. [2]

	AVAILABLE MARKS
Section B	18
Total	**90**