Rewarding Learning

ADVANCED
General Certificate of Education
2014

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[AB221]

MONDAY 2 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) A – mesoderm;
B – endoderm; [2]

(ii) Coelomic spaces segmented/external segmentation (ectoderm) constricted at intervals; [1]

(iii) Bilateral symmetry is the situation in which one side of an animal is the mirror image of the other side;
diagram is of a longitudinal section/not of a transverse section; [2]

(b) Annelids have a hydrostatic skeleton (fluid-filled coelomic spaces);
chordates have an internal spinal column (of calcified bones); [2] 7

2 (a) Nucleic acid – tRNA;
nitrogenous bases (DNA) – adenine, guanine, cytosine, thymine **[all needed]**;
where made (mRNA) – nucleus;
location in cell – throughout the cell; [4]

(b) Counting base pairs in DNA takes account of both strands/if nucleotides counted value would be double the number of base pairs (except when replicating or transcribing);
mRNA only has one strand so can only count in nucleotides/mRNA does not have base pairs; [2]

(c) DNA represents the entire chromosome (all the genes);
mRNA represents the length of (the coding section of) one gene; [2] 8

				AVAILABLE MARKS
3	(a)	(i)	Stroma; [1]	
		(ii)	The light-independent stage/conversion of glycerate phosphate to triose phosphate is dependent on the light-dependent stage; for ATP and NADPH; [2]	
	(b)	(i)	Ribulose bisphosphate; [1]	
		(ii)	**Any three from** • stomata are closed during the day/only open at night • resulting in reduced transpiration/water loss • when the temperature is high/humidity is low • (breakdown of malate) supplies CO_2 for the light independent reaction/photosynthesis • when light becomes available/temperatures are high during the day [3]	
	(c)	(i)	Maximise quantity of electrons produced/chloroplasts are the organelles of the light-dependent stage which generates electrons/homogenised tissue will also contain mitochondria which will produce hydrogen (from dehydrogenase activity in respiration); [1]	
		(ii)	Chloroplasts contain photosystems/photosynthetic pigments; which absorb light and become excited; so that electrons are emitted (from primary pigments) to reduce the DCPIP; **Or** The result in tube A (when compared to tube B) indicates that reduction of DCPIP requires the presence of chloroplasts/chlorophyll; the result in tube C (when compared to tube B) indicates that reduction of DCPIP only occurs (with chloroplasts) in the light; reduction of DCPIP occurs in tube B as light causes the emission of electrons from the pigment molecules/chlorophyll/photosystems in the chloroplasts; [3]	11

		AVAILABLE MARKS
4	**(a)** Independent assortment; crossing over; cross-fertilisation; [3]	
	(b) **(i)** A geographical group of (interbreeding) humans that are (largely) reproductively isolated from other groups; [1]	
	(ii) **Any five from** • producing lactase is metabolically inefficient if lactose not available in diet • in those populations where milk became available (< 9000 years ago) ability to produce lactase became an advantageous adaptation/was selected for (following gene mutation/due to improved nutrition that milk provided) • adults with the lactase allele more likely to survive (fitter) • beneficial alleles passed on to offspring • lactase allele increases in frequency/spreads through populations (that have milk available for adults) • by directional selection • in populations without milk supplies (e.g. Asians) lactase allele still selected against [5]	9
5	**(a)** **(i)** The percentage cover of mosses increases (towards the lake) as soil moisture level increases; the percentage cover of flowering plants is variable but does not change appreciably along transect/shows no correlation with soil moisture levels; [2]	
	(ii) **Any three from** • mosses (restricted to moister soils) are poorly adapted to conserve water • flowering plants are well adapted to conserve water/can regulate water loss • reference to true roots/vascular tissue/cuticle/stomata • flowering plants have various adaptations (e.g. aerenchyma) and so can be found anywhere along the transect [3]	
	(b) **(i)** Waterlogged soil very low in oxygen; ethanol produced by anaerobic respiration; [2]	
	(ii) The 95% confidence limits of all three species overlap; [1]	
	(iii) Grow the three species in the same environmental conditions; if ethanol production is similar in all three species then it is not genetic in origin/if experimental results are consistent with those shown graphically then it is genetic in origin; [2]	10

AVAILABLE MARKS

6 **(a)** Dominance is the interaction of alleles/one allele masks the effect of another (recessive) allele;
epistasis is the interaction of genes; [2]

(b) AaBb × AaBb

AB Ab aB ab × AB Ab aB ab;

	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

;

A___ = white $\left(\frac{12}{16}\right)$;

aaB_ = yellow $\left(\frac{3}{16}\right)$;

aabb = green $\left(\frac{1}{16}\right)$; [5]

(c) **(i)**

Category	*O*	*E*	*(O – E)*	$(O-E)^2$	$\frac{(O-E)^2}{E}$
white	126	120	6	36	0.30
yellow	26	30	–4	16	0.53
green	8	10	–2	4	0.40

χ^2= 1.23;; [2]

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

(iii) The calculated p value is greater than 0.05/calculated χ^2 is less than the tabular χ^2 value at p = 0.05 (χ^2 = 5.99)/the differences in observed values from the expected are not significant/null hypothesis is accepted/ H_0 is accepted;
consequently the results of the cross are a good fit to a 12 : 3 : 1 ratio (the expected results); [2]

13

			AVAILABLE MARKS
7	**(a)**	Chloride ions (outside the cell) create a more negative/lower water (solute) potential; drawing water out of the cell (and into the mucus) by osmosis; [2]	
	(b)	**Any three from** • positive correlation between degree of protein damage and severity of condition • if one base deleted will produce frameshift mutation • all amino acids beyond the mutation affected • base substitution less effect than base deletion • if one base substituted will change one amino acid • if one amino acid (phenylalanine) missing, likely to have significant affect on secondary/tertiary structure/bonding • change in amino sequence may result in a non-functional protein **[Do not allow reference to degenerate nature of DNA code not affecting protein produced]** [3]	
	(c)	1/2500 = q^2 = 0.0004; therefore q = 0.02, therefore p = 0.98 **[consequential to value above]**; 2pq = 2 x 0.98 × 0.02 = 0.039 = 3.9/4% **[consequential to values above]**; [3]	
	(d)	**(i) Any four from** • nutritional enhancement can reduce incidence of malnutrition-linked disease, e.g. additional vitamin A reduces blindness in developing countries • can produce useful medical/veterinary products that are more difficult/expensive to obtain by other methods • compounds toxic to insects reduce the need for pesticide use • only affects pests targeting crop/does not affect beneficial insects/ less pollution • increased ecological range produces greater yields • alleviates food shortages (in developing countries) • other appropriate response [4]	
		(ii) Any two from • possibility of causing 'superweeds' • possibility of causing allergies • lack of public understanding of science involved • outcompeting native species, reducing biodiversity • other appropriate response [2]	14
		Section A	**72**

Section B

AVAILABLE MARKS

8 (a) Any twelve from

- pyruvate (from glycolysis) enters the link reaction
- becomes decarboxylated (and combines with coenzyme A) to form acetyl CoA
- which enters Krebs cycle
- CO_2 also produced by Krebs cycle
- reduced NAD (from glycolysis) enters electron transport chain
- provides hydrogen
- (oxidised) NAD returns to cytoplasm for glycolysis
- ADP and P_i provide raw materials for ATP production
- ATP produced by Krebs cycle by substrate (linked) phosphorylation
- in the mitochondrial matrix (either the link reaction or Krebs cycle)
- in electron transport chain by oxidative phosphorylation
- on inner mitochondrial membrane/cristae
- oxygen is final electron acceptor in electron transport chain
- water is produced as a waste product
- fatty acids enter respiratory pathway at acetyl CoA
- amino acids enter at pyruvate/acetyl CoA/Krebs stages [12]

(b) Any four from

- TEM can provide detail of mitochondrion ultrastructure
- positive correlation between number of mitochondria in cell and metabolic activity
- positive correlation between size of mitochondria and metabolic activity
- positive correlation between length of inner mitochondrial membrane/ degree of infolding of cristae and metabolic activity
- as electron transport system/oxidative phosphorylation takes place on inner mitochondrial membrane [4]

Quality of written communication

2 marks: The candidate expresses ideas clearly and fluently through well-linked sentences, which present relationships and not mere 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]

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