Rewarding Learning

ADVANCED
General Certificate of Education
2013

Biology

Assessment Unit A2 2

assessing

Biochemistry, Genetics and Evolutionary Trends

[AB221]

MONDAY 3 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)** Thylakoids/grana/lamellae; [1]

(b) Higher light intensities excite the photosynthetic pigments more rapidly/ excites more pigments/more electrons raised to a higher energy level/allows more rapid energy transfer (by resonance) between the pigments; consequently more electrons are emitted/emitted more frequently (from the primary pigment/chlorophyll a); [2]

(c) Photosystem pigments absorb light mainly from the red and blue parts of the spectrum/reflect green light;
different accessory pigments have maximum absorbance at slightly different wavelengths of light; [2] 5

2 **(a)** **(i)** Mesoderm/mesenchyme; [1]

(ii) Gut cavity/enteron; [1]

(iii) **Any two from**
- higher surface area/volume ratio
- facilitates gas exchange
- short distances involved in transfer of gases to tissues/short distances involved in transfer of nutrients from gut to body tissues [2]

(b) **(i)** A body cavity within the mesoderm; [1]

(ii) Space for organs/reduction in number of (metabolically requiring) cells/ reduced metabolic needs of organism/separates muscles of gut and body wall so that contractions associated with locomotion can be independent of those associated with peristalsis/when fluid-filled can act as a hydrostatic skeleton; [1]

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

(ii) In annelids the gut has both a mouth and an anus/one way/in platyhelminthes there is one opening to the gut/food enters by and leaves through the mouth;
in annelids there is greater regional specialisation within gut (or by example)/digested and undigested food kept separate/food continually ingested while previously ingested food is digested; [2] 9

				AVAILABLE MARKS
3	(a)	(i)	Glycolysis; [1]	
		(ii)	Regenerates NAD^+; allows dehydrogenation in glycolysis to continue/accepts hydrogens (from NADH)/as NADH cannot be oxidised by passing electrons to electron transport system; [2]	
	(b)	(i)	Extra ATP produced (over and above that produced in aerobic respiration); [1]	
		(ii)	The additional oxygen required to further metabolise accumulated lactate and/or re-synthesise ATP; [1]	
	(c)		**Any four from** • respirometer used separately with KOH and without KOH/with water • cover with foil to prevent photosynthesis/carry out in darkness • use a water bath to keep respirometer at same temperature • use same peas as different peas have different metabolic rates/masses/ stages of germination • measure the movement of the coloured bead per unit time • with KOH, oxygen uptake indicated by the bead moving in • with water, the bead moving out indicates that more carbon dioxide is produced than oxygen used/no bead movement indicates CO_2 production = O_2 uptake/bead moving inwards indicates O_2 uptake exceeds CO_2 production • anaerobic respiration identified by greater CO_2 production than O_2 uptake/bead moving away from respirometer/RQ value greater than 1 [4]	9
4	(a)	(i)	Transcription, translation **[both required]**; [1]	
		(ii)	Requires enzyme reverse transcriptase/only takes place in cells infected by HIV (retroviruses); [1]	
	(b)		**Any three from** • transports amino acid (lysine) to the (correct position on) mRNA/ codon/ribosome • UUC (anticodon) joins with AAG (codon) on mRNA *[if bases not specified must use terms anticodon and codon]* • amino acid/lysine (on the tRNA) forms a peptide bond with the polypeptide chain • tRNA free to return to cytoplasm (to join with other lysine amino acids) • different tRNA molecules for each amino acid [3]	
	(c)	(i)	Gene/DNA probe; [1]	
		(ii)	**Any three from** • (genome sequencing) identification if allele for dwarfism present/ identification of homozygous dominant individuals *[must be allele not gene]* • identifies those individuals more genetically variable • selective breeding involves only those without dwarfism allele/individuals that are genetically variable • will reduce the frequency of dwarf alleles over time (unless replenished by new mutations) [3]	9

AVAILABLE MARKS

5 **(a)** **(i)** Blood group A – $I^A I^A$ and $I^A I^O$;
Blood group AB – $I^A I^B$; [2]

(ii)

Parents	phenotype	A	×	B
	genotype	$I^A I^O$		$I^B I^O$;
	gametes	I^A I^O		I^B I^O ;

	I^B	I^O
I^A	$I^A I^B$	$I^A I^O$
I^O	$I^B I^O$	$I^O I^O$

;

Children's	genotypes	$I^A I^B$: $I^A I^O$: $I^B I^O$: $I^O I^O$
	phenotypes	AB : A : B : O [3]

(iii) Mother has B antigens on her red blood cells;
children with blood groups B and AB do not have B antibodies/will not cause agglutination if mixed with donated group B blood *[must be agglutination not clotting]*;
children with blood groups A and O produce B antibodies/cause agglutination if mixed with donated group B blood; [3]

(b) **(i)** q = 0.15 therefore p = 0.85;
2pq = 2 × 0.15 × 0.85 = 0.255 **[consequential to p and q values above]**;
= 400 × 0.255 = 102 **[consequential to 2 pq value above]**; [3]

(ii) The population is large/mating is random/no migration/no differential selection/no mutations; [1] 12

			AVAILABLE MARKS
6	**(a)**	Aneuploidy; [1]	
	(b)	**(i)** 30 – 0.1%, 40 – 1%; [1]	
		(ii) Risk of Down syndrome increased significantly/exponentially over age 35; under 35 (35-40) the risk of miscarriage is significantly greater than the risk of having a Down syndrome foetus; [2]	
		(iii) These mothers are not screened for Down syndrome therefore if foetus has Down syndrome will proceed to term/older mothers are screened therefore if Down syndrome detected may have abortion/more children are born to mothers under 35; [1]	
	(c)	**(i)** Polyploidy involves a full set of chromosomes; [1]	
		(ii) **Any three from** • speciation by polyploidy rapid/allopatric speciation takes place gradually over time • polyploidy involves full set of chromosomes while allopatric speciation involves an accumulation of new alleles • does not require geographical separation • does not require reproductive isolation • does not require differential (directional) selection • polyploidy mainly confined to plants **[Allow converse for each point]** [3]	
		(iii) Plant breeding; [1]	10

				AVAILABLE MARKS
7	(a)	(i)	Generative nucleus correctly labelled; embryosac correctly labelled; [2]	
		(ii)	**Any three from** • the generative nucleus divides to produce two male gametes/nuclei • by mitosis • subsequent entry of pollen tube into ovule/embryosac (via the micropyle) • one male gamete/nucleus fertilises the egg nucleus • the second male nucleus joins with the two polar nuclei to form a triploid structure/endosperm (double fertilisation) *[correct terminology needed throughout]* [3]	
	(b)	(i)	More space available inside ovary/less competition for nutrients; [1]	
		(ii)	There is no significant difference between the mean mass of the two groups of seeds/the difference between the mean mass of the two groups of seeds is due to chance; [1]	
		(iii)	$t = \frac{7.61 - 6.37}{\sqrt{0.34^2 + 0.41^2}}$; $t = \frac{1.24}{0.54} = 2.33$; [2]	
		(iv)	$0.05 > p > 0.02$ **[consequential to t-value calculated]**; [1]	
		(v)	Null hypothesis is rejected/there is a significant difference between the masses of the two types of seeds; seeds from ovaries with only one seed are significantly heavier than seeds from ovaries containing two seeds; [2] **[Consequential to p value]**	
	(c)	(i)	Large sample size (makes the sample more representative/limits the effect of anomalies)/dry mass eliminates variation due to moisture; [1]	
		(ii)	(Mean) dry mass of seeds in 'woodland centre' is greater; wider range of seed masses at 'woodland edge' ; [2] **[Allow converse for each point]**	
		(iii)	**Any three from** • more one-seed ovaries at woodland centre (or converse) • combination of one and two seed ovaries gives greater variability (than one seed ovaries) • lower pollination/fertilisation rates in woodland centre (or converse) • since there are fewer insects deep in the woodland (or converse) • more genetic variation among seeds at woodland edge (or converse) • due to greater degree of cross pollination at woodland edge (or converse) [3]	18
			Section A	**72**

Section B

AVAILABLE MARKS

8 (a) Any eight from (maximum five in each section)

Obtaining desired gene

- identifying desired gene by using a DNA probe
- use of restriction endonucleases to cut out gene
- by cutting DNA at specific base combinations/recognition sequences
- reverse transcriptase (used to obtain donor DNA)
- by manufacturing DNA from mRNA (produced by desired gene)
- DNA polymerase used to make double stranded DNA
- use of gene machine to produce small gene/synthetic DNA

Gene transfer

- incorporation of donor genes into a vector such as bacterial plasmids/ bacteriophages
- reference to sticky ends/use of same restriction enzyme in plasmid as in donor DNA
- role of DNA ligase in annealing donor DNA into vector DNA
- description of method to aid uptake into recipient cells (e.g. heat shock)
- identification of host cells that have taken up gene by the use of marker genes/gene probes/replica plating
- microinjection of DNA into animal cells
- use of 'DNA pellets' to insert donor genes into plant cells
- use of T_i plasmid/*Agrobacterium* to introduce gene into plant cells
- difference between transgenic organisms and (somatic) gene therapy (e.g. gene therapy only targeting specific cells)
- use of aerosols/liposomes/adenovirus in gene therapy [8]

(b) Eight from

Benefits (maximum five)

- production of useful medical substances (e.g. insulin, interferon, blood-clotting factors, vaccines etc)
- explanation of benefit, e.g. insulin previously only from dead animals in abbatoirs/restriction on availability/high demand
- genes introduced to improve productivity in animals (e.g. milk yield/ quality, meat production/quality)
- explanation of benefit, e.g. improved profits, less wastage
- genes introduced in plants to improve yield/commercial value (e.g. improving crop yield, prolong 'shelf-life', increase protein content, improve texture, disease resistance, pesticide resistance etc)
- explanation of benefit, e.g. improved profits, less wastage **[allow once only]**
- introduction of functional gene to restore normal metabolism (in gene therapy)
- explanation of benefit, e.g. better quality of life, longer life, treatment of named disease, e.g. cystic fibrosis
- benefit of gene transfer in 'knockin' technology described

Potential problems (maximum five)

- named potential problem associated with GEMs, e.g. new strains of disease-causing microbes
- reference to cost of/need for containment mechanisms associated with GEMs/example of safety precautions employed, e.g. 'suicide' genes, containment mechanisms
- named potential problem associated with GM crops, e.g. development of 'super weeds', hybridisation with native crops, allergies

	AVAILABLE MARKS
• limitation of gene therapy explained, e.g. only affects cells that aerosol/ liposome makes contact with/short lived as new cells produced/not passed on to next generation • potential risks of gene therapy explained, e.g. disruptive effect on host DNA/use of virus associated with allergic reaction/cancer/leukaemia • awareness that gene transfer raises ethical issues/is controversial • awareness that problems are mainly with public perception and not the science involved • example of legislation required to manage risks (e.g. special laboratories when working with GMOs) [8]	
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**