



Rewarding Learning

ADVANCED
General Certificate of Education
2023

Life and Health Sciences

Assessment Unit A2 5

assessing

Genetics, Stem Cell Research and Cloning

[AZ051]

MONDAY 26 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.

			AVAILABLE MARKS
1	DNA helicase; hydrogen; A and D; semi-conservative;	[4]	4
2	(a) (i) They each produce more (undifferentiated) stem cells;	[1]	
	(ii) Adult stem cells produce a smaller/limited range of cell types (or converse);	[1]	
	(iii) Bone marrow/brain/other appropriate response;	[1]	
	(b) Avoids using embryonic stem cell/embryonic stem cells come from aborted fetuses/fertility clinics;	[1]	4
3	(a) Coagulates/clots the milk;	[1]	
	(b) (i) 12 years;	[1]	
	(ii) 96 – 3 (correct readings from graph); 93 ÷ 96 × 100; 96.9/97	[3]	
	(iii) Any three from: <ul style="list-style-type: none"> • difficulty in obtaining rennet; • obtaining rennet from the stomach lining of young calves may create ethical issues for some; • chymosin is the most efficient enzyme in cheese-making; • can be made in large quantities; • relatively low cost; • other appropriate response. 	[3]	
	(iv) Some prefer traditional methods/better taste/texture/ other appropriate response;	[1]	
	(c) (i) Any three from: <ul style="list-style-type: none"> • the bases on the DNA probe will be complementary to the bases of the gene of interest; • will combine due to base pairing; • the fluorescent label will identify the position of the gene; • strands of the DNA have to be separated. 	[3]	
	(ii) To identify (potentially) harmful/disease-causing genes/to identify the presence of harmful microbes;	[1]	13

4 (a) Phosphate; [1]

(b) (i)

Base	Percentage of base in a section of DNA
Adenine
Guanine	22;
Cytosine	22;
Thymine	28;

[3]

(ii) Chargaff; [1]

(c) (i) Mutation; [1]

(ii) Any **four** from:

- the first amino acid is not affected;
- the second amino acid is not affected (as there is another A in the sequence immediately after the deleted A);
- the third amino acid is altered;
- the deleted base will change the sequence of bases in base triplets from the point of deletion on/will cause a 'frameshift' mutation;
- resulting in all the amino acids being changed from that point on.
- polypeptide/protein non-functional;

[4]

(iii) This will only change the base triplet affected by the substitution [1]; therefore potentially only one/that amino acid will be affected [1]; [2]

AVAILABLE MARKS

12

- 5 (a) Increases respiration of glucose/converts glucose to glycogen/fat/
increases uptake of glucose into cells. [1]
- (b) Any **six** from:
- the individual with diabetes has the higher blood sugar before the meal;
 - the blood glucose concentration of both individuals rises after taking a meal (to a peak/before falling);
 - the blood glucose level in the individual with diabetes keeps rising for longer after the meal;
 - for the majority of time the blood glucose concentration of both individuals remains within the recommended range;
 - the blood glucose concentration of the individual with diabetes is more variable;
 - the blood glucose concentration of the individual with diabetes goes outside the recommended range;
 - being both above and below the recommended range at times (or converse where appropriate).
 - individual without diabetes is always in range [6]
- (c) (i) Locus; [1]
- (ii) Restriction endonucleases; [1]
- (iii) Sticky ends; [1]
- (iv) Will join/anneal with complementary sections by base pairing; [1]
joining the plasmid/isolated gene to the bacterial DNA; [1] [2]
- (d) (i) Due to a mutation in the gene involved; [1]
- (ii) Transfusions of blood (serum)/other appropriate response; [1]
- (iii) Avoids the risk of viral infections/named viral infections
(e.g. HIV/AIDS); [1]

AVAILABLE
MARKS

15

6 (a) **Indicative content:**

- PCR is used to clone/amplify DNA;
- as there may be very little available (at e.g. a crime scene);
- **the genome** contains many repetitive non-coding sequences;
- these are the sequences involved in genetic fingerprinting;
- probability of two individuals having the same number of repetitive sequences is very low;
- laboratory techniques involve the use of restriction enzymes to isolate repetitive sequences;
- gel electrophoresis used to separate fragments of DNA;
- DNA fragments of similar lengths appear as a bar/band;
- bars/bands further away from the origin have shorter sections of DNA;
- as can travel faster across the gel;
- reference to role of buffer/electrodes/electric current.

Level of response	Marking criteria	Marks
Excellent	Candidates give seven or more points from the indicative content but must include at least one point from all three sections for balance. Presentation, spelling, punctuation and grammar are excellent.	[7]–[8]
Very good	Candidates give five to six points from the indicative content including points from at least two sections. Presentation, spelling, punctuation and grammar are very good.	[5]–[6]
Good	Candidates give three to four points from the indicative content. Presentation, spelling, punctuation and grammar are sufficiently competent to make the meaning clear.	[3]–[4]
Basic	Candidates give one or two points from the indicative content. There may be some errors in spelling, punctuation and grammar.	[1]–[2]
	Response is not worthy of credit	[0]

[8]

- (b) Medical diagnosis – identifying the species causing (e.g. bacterial or viral) infection/identifying disease causing genetic mutation;

Animal breeding – checking the pedigree status of animals involved in breeding programmes;

[2]

10

			AVAILABLE MARKS
7	(a)	As there are fewer chromosomes in daughter cells/haploid number of chromosomes/23 chromosomes [1]	
	(b)	(i) Crossing over; [1]	
		(ii) 2; [1]	
		(iii) Chromosomes/chromatids break at the point of chiasma; [1] allowing genetic material to be exchanged between homologous chromosomes; [1] creating unique gene combinations (variation) [1] [3]	
	(c)	(i) Independent assortment; [1]	
		(ii) It is random which chromosome in a homologous pair enters a particular gamete; [1] giving a unique combination of chromosomes in a particular gamete [1] [2]	
	(d)	(i) 24; [1]	
		(ii) a pair of chromosomes do not segregate/separate during meiosis; [1]	
	(e)	(i) Any three from: [3] <ul style="list-style-type: none"> • there are very few children with Down's Syndrome to mothers under 29; • there is little change in risk to mothers between 19 and under and 29; • there is an exponential/dramatic increase in risk as the age of the mother increases beyond 30; • values increase as age increases except for maternal age 25–29. 	
		(ii) Gamete formation/meiosis in older mothers is more prone to mutations/errors; [1]	15
8	(a)	(i) Germ cell; [1]	
		(ii) Harmful/mutated genes could be fixed/replaced in the embryo cells; [1] allowing all the cells in the foetus/child/individual to have the 'normal' gene; [1] [2]	
		(iii) Avoids having to remove embryo from the mother's uterus to carry out the process/less risk involved; [1]	
	(b)	(i) Any three from: [3] <ul style="list-style-type: none"> • difficulty in finding suitable donors; • avoids the risk of tissue rejection; • avoids the need to repeat treatment/is a more permanent solution; • immunosuppression not required; • other appropriate response. 	
		(ii) By replacing the faulty gene with a normal one/by adding a normal gene and leaving the defective gene in position; [1]	8

- 9 (a) A recessive allele will only show itself in the phenotype if there are two recessive alleles/a recessive allele can be masked by a dominant allele; [1]

(b)

	B	b
B	BB	Bb
b	Bb	bb

[2] for correct gametes;
 [1] for correct offspring cross;
 [1] correct individual identified; [4]

- (c) When both alleles are present, the blood group is AB rather than either A or B; [1]

- (d) (i) $Bb I^O I^O$ [1]

- (ii) $BI^A BI^O$ $bI^A bI^O$ (all 4 correct = [2]; 2/3 correct = [1]) [2]

- (iii) BI^O and bI^O ; [1]

(iv)

	BI^A	BI^O	bI^A	bI^O
BI^O	$BB I^A I^O$	$BB I^O I^O$	$Bb I^A I^O$	$Bb I^O I^O$
bI^O	$Bb I^A I^O$	$Bb I^O I^O$	$bb I^A I^O$	$bb I^O I^O$

Correct parents; [1]
 Offspring correct; [2]
 (allow marks for 4 × 4 Punnett square) [3]

- (v) Does not have Batten disease and is blood group A – 3
 does not have Batten disease and is blood group O – 3
 has Batten disease and is blood Group A – 1
 has Batten disease and is blood group O – 1
 (allow double values for a 4 × 4 Punnett square) [2]
 (4 correct = [2] 2 or 3 correct = [1] < 2 correct = [0])

- (vi) $\frac{1}{8}$, 1 in eight, other appropriate answer; [1]

- (e) (i) 3; [1]

- (ii) 0.900–0.500; [1]

- (iii) The results are a good fit to the ratio 9 : 3 : 3 : 1; [1]

Total

AVAILABLE MARKS

19

100