



Rewarding Learning

ADVANCED
General Certificate of Education

Life and Health Sciences

Assessment Unit A2 5

assessing

Genetics, Stem Cell Research and Cloning

[AZ051]

Assessment

**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.

Statement	DNA	mRNA	tRNA
Nucleotides contain ribose	X	✓	✓
Long single strand	X	✓	
Nucleotides contain the base thymine	✓	X	X

[1] per correct row (must complete each box) [3]

(b) Any **three** from:

- Triplet code/base triplet hypothesis
 - Three bases codes for an amino acid
 - Sequence of bases determines the sequence of amino acids
 - Amino acids join together to form a protein
- [3]

(c) (i) Mutation [1]

(ii) Any **two** from:

- Change in base may lead to change in an amino acid (or more)
 - That can cause a change in sequence (of amino acids)
 - Cause genetic variation/non-functional protein/described
- [2]

9

2 (a) (i) crossing over [1]

(ii) Resulting in genetic recombination/a different combination of alleles on each chromosome [1]

(b) Any **one** from:

- Independent assortment (of homologous chromosomes) [1]; the way one chromosome pair lines up is totally independent of how any other pair aligns/described [1]
 - Random segregation [1]; different combination of maternal and paternal chromosomes [1]
- [2]

4

(correct process linked to correct description)

AVAILABLE MARKS

			AVAILABLE MARKS	
3	(a)	Restriction (endonucleases) enzyme	[1]	10
	(b)	(i) 2 cuts at recognition site GGCC	[1]	
		(ii) 3 (fragments)	[1]	
	(c)	(i) Any two from:		
		• Electric current		
		• Separates different sized fragments of DNA		
		• DNA fragments are negatively charged, so they move towards the positive electrode	[2]	
		(ii) 6	[1]	
		(iii) Possible father 2	[1]	
		(iv) Child has bands 1, 3, 4, 6, 9 and 11 from mother; Child has band 2, 5 and 8 which possible father 2 has; Possible father 1 does not have bands 2 and 5	[3]	
4	(a)	(i) (DNA) helicase	[1]	8
		(ii) Each strand acts as a template	[1]	
		(iii) (Free) nucleotides (DNA) polymerase	[2]	
		(iv) 64 molecules	[1]	
	(b)	(i) Any two from:		
		• Probe identifies a section of DNA that contains a specific base sequence;		
		• Short single strand of DNA;		
		• Probe attaches to complementary bases on the target DNA; • DNA fragment located using ultraviolet light/X-ray film;	[2]	
		(ii) In family planning/for parents who are carriers of defective genes/ In the case of oncogenes/deciding the best course of treatment for cancer/other named genetic condition	[1]	

5 (a) (i)

Blood group	Possible genotypes
A	$I^A I^A$ and $I^A I^O$
B	$I^B I^B$ and $I^B I^O$ (either order) [2]
AB	$I^A I^B$
O	$I^O I^O$ [1]

[3]

- (ii) • Dominant allele will be expressed over recessive allele/in blood group A ($I^A I^O$) A allele is expressed/in blood group B ($I^B I^O$) B allele is expressed;
 • In codominance both alleles are expressed/in blood group AB ($I^A I^B$)

[2]

- (b) (i) Correct gametes: I^A and I^O [1] × I^A and I^B [1] ;
 Correct cross [1];
 $\frac{1}{4}$ /25% probability [1]

[4]

- (ii) Any **two** from:
 • I^O (allele) is recessive;
 • Must have two copies of I^O (allele) to be blood group O;
 • Father does not have I^O allele/has I^A and/or I^B

[2]

11

6 (a) (i) Any **three** from:

- Select the cows that have the meat qualities required;
- Breed cows;
- Select the offspring that have the best meat qualities;
- Repeat breeding over a number of generations

[3]

- (ii) Loss of genetic variation/inbreeding/all susceptible to same disease/mastitis in cows producing high milk yield

[1]

(b) (i) Large quantities

[1]

(ii) Human serum albumen

[1]

6

AVAILABLE
MARKS

7 (a) Indicative content

- **Fragmentation**/dispersive theory;
- Parent DNA molecule breaks into segments;
- New nucleotides fill in the gaps precisely;

- **Conservative** theory;
- The complete parent DNA molecule acts as a template for the new daughter molecule, which is assembled from new nucleotides;
- The parent molecule is unchanged;

- **Semi-conservative** theory;
- Each strand acts as a template;
- Free DNA nucleotides enter opposite their complementary bases;
- Each new molecule contains one original and one new strand;

Explanation must be linked to correct theory.

Level of response	Marking criteria	Marks
Excellent	Candidates give 7 or more points from the indicative content to include a point of linked explanation. Presentation, spelling, punctuation and grammar are excellent.	[7]–[8]
Very good	Candidates give five to six points from the indicative content to include a point of linked explanation. Presentation, spelling, punctuation and grammar are very good.	[5]–[6]
Good	Candidates give three to four points from the indicative content to include a point of linked explanation. 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) (i) bacteria/yeast [1]

(ii) Any **two** from:

- Cattle/cows
- Dogs
- Pigs

[2]

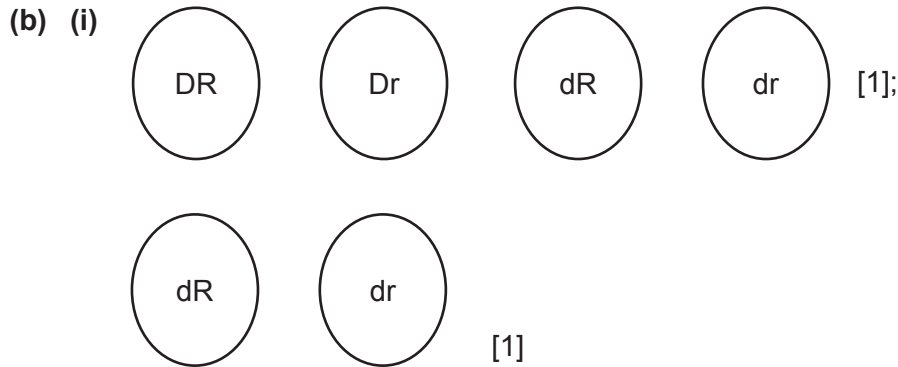
(iii) Any **two** from:

- Not identical to human insulin;
- Extraction of hormone is difficult
- Difficult to obtain large quantities
- Ethical issues/religious issues
- High production cost

[2]

13

- 8 (a) (i) DDRr [1]
 (ii) Dark (fur colour) smooth (coat) [1]
 (iii) Appearance due to expression of genotype (and interaction with the environment)/physical appearance [1]



	DR	Dr	dR	dr
dR	DdRR	DdRr	ddRR	ddRr
dr	DdRr	Ddrr	ddRr	ddrr
dR	DdRR	DdRr	ddRR	ddRr
dr	DdRr	Ddrr	ddRr	ddrr

[2] [4]

- (ii) $\left[\begin{array}{l} \text{dark fur, rough coat} \quad 3 \\ \text{dark fur, smooth coat} \quad 1 \end{array} \right] \quad \left[\begin{array}{l} \text{dark fur, rough coat} \quad 6 \\ \text{dark fur, smooth coat} \quad 2 \end{array} \right] [1]$
 $\left[\begin{array}{l} \text{light fur, rough coat} \quad 3 \\ \text{light fur, smooth coat} \quad 1 \end{array} \right] \text{ OR } \left[\begin{array}{l} \text{light fur, rough coat} \quad 6 \\ \text{light fur, smooth coat} \quad 2 \end{array} \right] [1] [2]$

(c) (i)

Category	Observed (O)	Expected (E)	(O - E)	(O - E) ²	$\frac{(O - E)^2}{E}$
dark fur, rough coat	21	25	-4	16	0.64
dark fur, smooth coat	27	25	2	4	0.16
light fur, rough coat	24	25	-1	1	0.04
light fur, smooth coat	28	25	3	9	0.36

[1] per column
 $\chi^2 = 1.20 [1] [5]$

- (ii) $0.900 > p > 0.500$; [1]
 (iii) Results are a good fit of the ratio 1:1:1:1;
 The calculated p value is greater than 0.05/calculated χ^2 (1.20) is less than the tabular χ^2 value at $p = 0.05$ ($\chi^2 = 7.81$)/no significant difference between observed and expected/null hypothesis accepted; [2]
 (iv) DdRr;
 ddrr (either order) [2]

			AVAILABLE MARKS	
9	(a)	(i) 1480 × 3; 4440 (correct answer [2])	[2]	
		(ii) • Pancreatic duct may become blocked which leads to less efficient digestion/prevents pancreatic enzymes reaching the duodenum; • Poor absorption (of nutrients)	[2]	
		(iii) Adenovirus; Liposomes	[2]	
		(iv) Aerosol/inhaler (accept spray)	[1]	
		(v) healthy/functional CFTR gene only in epithelial cells; Not in germ line/gametes	[2]	
	(b)	(i) Two copies of Phe508del allele	[1]	
		(ii) Any three from: • Chloride ions transported out of cells; • create a more negative/lower water (solute) potential; • drawing water out of the cell (and into the mucus) by osmosis; • Resulting in normal/thin/watery mucus	[3]	
	(c)	(i) Group 2	[1]	
		(ii) Any four from: • Group 2 had greatest increase in FEV; • At 5% improvement of (46-22) in comparison to placebo group; • At 5% improvement of (46-39) in comparison to group 3; • At 10% improvement of (27-13) in comparison to group 1 (placebo group); • At 10% improvement of (27-24) in comparison to group 3	[4]	
		(iii) Allows scientist to determine the effects of Lumacaftor and Ivacaftor; control/comparator group	[2]	20
Total				100