Rewarding Learning

ADVANCED
General Certificate of Education
2022

Life and Health Sciences

Assessment Unit A2 5

assessing

Genetics, Stem Cell Research and Cloning

[AZ051]

MONDAY 27 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.

COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

			AVAILABLE MARKS
1	Haploid; Equator; Assortment; Crossing over [4]		4
2	**(a)** Liver; [1]		
	(b) **(i)** *E.coli*; [1]		
	(ii) (DNA) Ligase; Joins insulin gene into plasmid; [2]		
	(c) Disadvantages: Any **two** from: • Adverse reactions • High production cost • Difficult to obtain large quantities • Ethical or religious issue described [2]		6
3	**(a)** Complementary strand antiparallel; Nucleotides drawn correctly; Base pairing correct (G opposite C, T opposite A and C opposite G); [3]		
	(b) **(i)** Base [1]		
	(ii) Line/band drawn in middle [1]		
	(iii) Each new strand contains half of the original DNA and half of newly synthesised DNA; half ^{15}N and half ^{14}N [2]		7
4	**(a)** **(i)** Bone marrow; [1]		
	(ii) • Stem cells can divide to form new stem cells; • Stem cells differentiate into white blood cells; • White blood cells contain (functional) ADA (enzyme) [3]		
	(iii) The virus could cause an infection/child may not be able to receive treatment if ill/any other appropriate response; [1]		
	(b) • Treatment is long term/treatment does not need to be repeated; • Reduction in the risk of rejection; • Any other appropriate response; [2]		
	(c) • Destruction of embryo; • Religious beliefs/"playing God" [2]		9

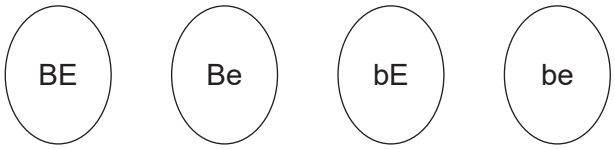
AVAILABLE MARKS

5 **(a)** **(i)** BbEe/BbEE; [1]

(ii) Brown (coat colour); [1]

(iii) Epistasis is when one gene interferes with the expression of another gene;
E/e gene interfering with expression of B/b/described; [2]

(b) **(i)**



[2]

	BE	Be	bE	be
BE	BBEE	BBEe	BbEE	BbEe
Be	BBEe	BBee	BbEe	Bbee
bE	BbEE	BbEe	bbEE	bbEe
be	BbEe	Bbee	bbEe	bbee

[2]

(ii) Phenotypes:
Black coat colour: 9
Brown coat colour: 3
Yellow coat colour: 4 [3]

(c) Breed with homozygous recessive for coat type (dd);
Breeder's dog may be homozygous dominant (DD) or Heterozygous (Dd);
If all offspring are straight coat, then dog is homozygous dominant for coat type (DD);
If half (any) offspring are curly, then the dog is heterozygous for coat type (Dd); [4] 15

6 **(a)** **(i)** Sex linked;
Only males suffer (have red-green colour blindness)/no females with condition; [2]

(ii) Recessive;
Female 2 (and or 4) is a carrier and does not suffer from the disease; [2]

(b) Individual 2: X^BX^b;
Individual 8: X^bY;
NOTE: Allow 1 mark for correct allele(s) (without sex chromosomes) [2]

			AVAILABLE MARKS
(c)	**(i)**	Any **five** from: • Most common/highest (percentage) cone defect is a M-cone defect; • Least common/lowest (percentage) cone defect is a S-cone defect; • Males and females have same percentage (0.01%) with S-cone defect; • Males have higher M-cone defect and L-cone defect percentage than females; • 4.65 difference in M-cone defect between males and females; • 1.28 difference in L-cone defect between males and females; • Overall 6.31% of males with a cone defect compared to 0.38% in females/5.93% difference [5]	
	(ii)	**L**–cones and **M**-cones [1]	
	(iii)	20 000/100 × 1.3 = 260; 15 000/100 × 0.2 = 3; (260 + 3) 263 [3]	
	(iv)	Age/eye damage/trauma to eye/eye disease/cataracts/glaucoma/cancer mutation/any other appropriate response [1]	16
7	**(a)**	An organism that has had DNA introduced from another organism; [1]	
	(b)	• **Plasmid** – Description: A circular loop of DNA; Role: act as vectors/transfer gene into bacteria/host cell; [2] • **DNA probe** – Description: A short single strand of DNA; Role: used to identify sections of DNA that contain a specific base sequence; [2]	
	(c)	Benefits (MAX **four** points from): • Production of medical substances (e.g. insulin); • Reduces ethical/religious issues/fewer adverse reactions; • Larger quantities of medical substances can be made; • Increased purity; • Increase crop yield/increase productivity in animals; • Provide food to growing world population; • Transgenic crops are able to grow in a wider ecological range, e.g. areas of drought/crops are disease resistant/described; • Any other appropriate response; Ethical issues (MAX **four** points from): • Could cause allergies; • GM crops could lead to 'superweeds'/cross-pollination with non GM crops; • Risk of altering ecosystems/GM crops could outcompete non-crop species/described; • Create new strains of disease-causing microbes; • Animals may suffer; • Cross-species transfer of DNA/plant to animal • Any other appropriate response	

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

[8]

AVAILABLE MARKS

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8 **(a)** 333 × 3;
999 [2]

(b) PCR/polymerase chain reaction [1]

(c) **(i)** Tt;
Explanation – any **two** from:
- Non taster remains uncut (t);
- Taster (T) is cut to produce two fragments of DNA;
- Three DNA fragments produced [3]

(ii) Non-taster [1]

(d) **(i)** Control/neutralise the mouth/in case they had eaten anything bitter/ other appropriate response [1]

(ii)

Category	Observed (O)	Expected (E)	(O – E)	$(O - E)^2$	$\frac{(O - E)^2}{E}$
somewhat + extremely bitter taste	122	140	–18	324	2.314
not bitter at all	78	60	18	324	5.400

$X^2 = 7.71$ [5]

(iii) 1 degree of freedom [1]

(iv) 0.010 and 0.001 [1]

(v) Reject null hypothesis;
There is a significant difference between the observed and expected frequencies [2]

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				AVAILABLE MARKS
9	**(a)**	To identify people at a higher risk of developing this cancer Early detection/early treatment/monitored for cancer/any other appropriate response; [2]		
	(b)	**(i)**	Tumour suppressor gene is 'turned off'/inactivated; No longer able to control cell division/cell division is too fast/ cell division is out of control; [2]	
		(ii)	Amino acid sequence not changed/degenerate nature of the code/ more than one triplet can code for the same amino acid [1]	
		(iii)	Diet/carcinogens/cigarette smoke/chemicals/UV radiation/pathogenic bacteria or viruses/stress/alcohol/any other appropriate response [1]	
	(c)	**(i)**	(2.4 – 0.7)/2.4 × 100; 70.8 [2]	
		(ii)	Mitomycin C – (cross links) prevents the DNA being unzipped; Prevents DNA replication [2] Fluorouracil – Cannot make nucleotides with base thymine no base to pair with adenine; DNA not copied [2]	
		(iii)	More effective at preventing DNA replication in cancer cells/slow down replication of cancer cells even more/synergistic response/ any other appropriate response [1]	13
			Total	**100**