Rewarding Learning

ADVANCED
General Certificate of Education
2024

Life and Health Sciences

Assessment Unit A2 5

assessing

Genetics, Stem Cell Research and Cloning

[AZ051]

TUESDAY 18 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.

			AVAILABLE MARKS
1	**(a)** Hydrogen bonds;	[1]	
	(b) A: Phosphate; B: Pentose sugar/deoxyribose; C: Nucleotide;	[3]	
	(c) G and C; (order not important)	[1]	5
2	**(a)** Similarity: amino group/carboxyl group/contain C,H,O and N (but not S) Difference: R group (by description)/contains S;	[2]	
	(b) • addition • deletion • substitution (in any order)	[3]	
	(c) **(i)** The alternative forms of the same gene/*wtte*;	[1]	
	(ii) AA or AO/I^AI^A or I^AI^O/A and O;	[2]	
	(iii) I^AI^B	[1]	9
3	**(a)** **(i)** Any **two** from: • a single strand of DNA • that identifies a particular section of DNA • the base sequence is complementary to a target sequence (disease causing gene)	[2]	
	(ii) • because it must be complementary to the base sequence of the disease gene; • It would be impossible to design a probe;	[2]	
	(iii) Fewer problems with disposal, fewer environmental issues;	[1]	
	(iv) Some disease will result from the interaction of several genes; have an environmental component (by description);	[1]	
	(b) **(i)** A counsellor will explain the risk/probability of developing a genetic disease; and the likelihood of passing the disorder to their children/ consequences for siblings	[2]	
	(ii) Any **three** from: • symptoms of condition • treatment options/how condition is managed • timetable for treatment • further testing • decisions about having children • possible termination • testing of foetus	[3]	
	(iii) Any **one** from: • other factors may contribute to the onset of the disease • other genes may prevent them from developing the disease • not activated	[1]	12

					AVAILABLE MARKS
4	**(a)**	**(i)**	Crime scene/paternity/ancestry/evolutionary paths/disease diagnosis; [1]		
		(ii)	2 × 32768; 65536 (6.6×10^4); [2]		
	(b)	**(i)**	95°C; [1]		
		(ii)	DNA strands separate; hydrogen bonds broken; [2]		
		(iii)	Y: primer; Any **two** from: • prevents DNA molecules from reannealing • brackets region of DNA to be copied/primer shows start/end of DNA region to be copied • primer identifies region of DNA to be copied • primer specific to the region to be copied [3]		
		(iv)	Any **one** from: • (Taq) polymerase can withstand higher temperature • remains active after each PCR cycle • reduces cost since it does not have to be replaced as regularly • reduces time for process to go to completion (by description) [1]		10
5	**(a)**		Any **five** from the following: • PCR provides enough DNA for analysis • DNA samples are digested with the same restriction endonuclease • a gel is prepared and placed in a tank flooded with buffer • the fragments from individuals are loaded into wells • a control sample of known sizes is also loaded into a well • an electric current is passed through the buffer and gel • DNA molecule moves towards anode • smaller fragments move farther (or converse) • visualised using stains • same RE, gel, buffer, current allows comparison [5]		
	(b)	**(i)**	2 [1]		
		(ii)	Rf = 106 ÷ 118; 0.90; [2]		
		(iii)	sister 3; • 1 and 4 share common band 3 with sister 3; • band 3 is **only** common band that 1 and 4 also possess; [3]		11

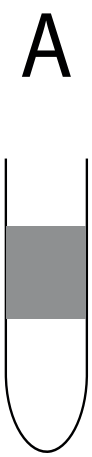
AVAILABLE MARKS

6 (a) Indicative content

- helicase unzips DNA
- by breaking H-bonds
- individual strands
- become a template
- free nucleotides
- attach to the exposed nucleotides
- using complementary base pairing
- DNA polymerase catalyses the formation of phosphodiester/ condensation bonds between adjacent nucleotides
- new DNA strands form helices [6]

Level of response	Marking criteria	Marks
Excellent	Candidates give **five or six** points from the indicative content. Presentation, spelling, punctuation and grammar are excellent.	[5]–[6]
Very good	Candidates give **three or four** points from the indicative content. Presentation, spelling, punctuation and grammar are very good.	[3]–[4]
Good	Candidates give **one or two** points from the indicative content. Presentation, spelling, punctuation and grammar are sufficiently competent to make the meaning clear.	[1]–[2]
	Response is not worthy of credit	[0]

(b) (i) Tube with smear/shading;
between top and bottom lines; [2]



(ii) New double stranded DNA molecule in semi-conservative model is composed of one parental strand and one newly synthesised strand/equal amounts of ^{14}N and ^{15}N;
New double stranded DNA molecule in conservative model is composed of one newly synthesised strand/contains only ^{14}N; [2]

(c) (i) DNA replication; [1]

(ii) 23; [1]

(iii) Regions of DNA can be exchanged between chromatids;
resulting in new allelic combinations (by description); [2]

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7 **(a)** **(i)** An organism that has had DNA introduced into its genome; from another organism; [2]

(ii) Liver cells; [1]

(b) **(i)** Vector; [1]

(ii) Gene and plasmid can be joined together easily; [1]

(iii) Nucleus; [1]

(iv)
- high volume production
- production costs are lower/less downstream processing
- *OAR* [2]

(v) Sheep do not have to be killed to obtain antitrypsin/antitrypsin more easily purified from milk than blood; [1]

AVAILABLE MARKS

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8 **(a)** **(i)** **Not** sex-linked:
Any **two** from:
- if gene was carried on X chromosome, then 4 would also have disorder
- not only males seem to be affected/both sexes can be affected
- if gene was carried on Y chromosome, then 4 and 6 would also have disorder

Not dominant:
Any **two** from:
- if dominant then 1 or 2 would show the disorder/be heterozygous since 7 has it
- 3 or 4 would have disorder/be heterozygous since 9 has it
- has skipped parental generation [4]

(ii) an allele that will only show itself in the phenotype if there are two recessive alleles/only appears in phenotype when homozygous and not in heterozygous condition; [1]

(iii) 3: Aa;
8: AA or Aa; [2]

(b) **(i)**

	A	**a**
A	AA	Aa
a	Aa	aa

[1] for gametes [2] for correct cross [3]

(ii) circle aa; [1]

(iii) ¼/0.25/25%; [1]

(c) **(i)** undifferentiated/non-specialised; [1]

(ii) Different combinations of genes;
are switched on or off; [2]

(iii) Stem cells from a healthy donor will introduce a functioning gene;
this will allow a functioning protein to be produced by the individual; [2]

AVAILABLE MARKS

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9 **(a)** **(i)**

Phenotype	Number
Purple	9 [1]
Green	7 [1]

[1]

[3]

(b) **(i)**

Phenotype	**Observed (O)**	**Expected (E)**	**O-E**	**$(O-E)^2$**	**$\frac{(O-E)^2}{E}$**
Purple/long	1225	1200	25	625	0.52
Red/round	375	400	**–25**	**625**	**1.56**
					Σ= **2.08**

[4]

(ii) 1 degree of freedom; [1]

(iii) 0.5 and 0.1;
Yes
Any **two** from:
- there is no significant difference between the observed and expected result
- null hypothesis is accepted;
- difference is due to chance alone [3]

(iv) Indicates that both alleles are linked on the same chromosome;
and cannot segregate independently; [2]

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Total

100