



Rewarding Learning

**ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2018**

Life and Health Sciences

Assessment Unit A2 5

assessing

Genetics, Stem Cell Research and Cloning

[AZ051]

WEDNESDAY 6 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.

- 1 (a) Gene/allele;
Locus/loci;
Amino acid;
Mutation; [4]

- (b) Any **two** from:
- Independent assortment/random assortment/different order (of homologous chromosomes); the way one chromosome pair lines up is totally independent of how any other pair aligns/described;
 - Gametes are genetically different/four unique/different daughter cells; due to different combinations of maternal and paternal chromosomes/random segregation;
 - Recombination of chromosomes; occurs by crossing over. [4]

- 2 (a) (i) A. Phosphate
B. Deoxyribose (sugar)
C. (Nitrogenous) base/name or letter of specific base [3]

(ii)

Type of RNA	Description
tRNA/transfer	Single chain folded into a 'clover leaf' shape.
mRNA/messenger	Long single strand.
rRNA/ribosomal	Forms over half the mass of each ribosome.

[3]

- (b) (i) A = T/C = G/complementary base pairing [1]

(ii)

Name of base	Type of base	Percentage of base found in human DNA	Percentage of base found in rat DNA
Adenine	Purine	30	29
Cytosine	Pyrimidine	20	21
Thymine	Pyrimidine	30	29
Guanine	Purine	20	21

[4]

- (iii) DNA is single stranded/DNA is not double stranded/no base pairing [1]

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			AVAILABLE MARKS	
3	(a)	(i) A. Adult stem cell/multipotent/unipotent B. Embryonic stem cell/totipotent/pluripotent	[2]	7
		(ii) (Red) bone marrow (of long bones/ribs)/bone tissue	[1]	
		(iii) Differential gene expression/described	[1]	
(b)	(i) Any two from: <ul style="list-style-type: none"> • Replace damaged cells/treat (named) disease/other appropriate response; • Medical research; • Unspecialised/undifferentiated/or description; • Can replicate many times/or description. 	[2]		
	(ii) Any one from: <ul style="list-style-type: none"> • Involves killing/destroying embryo/human life; • Against their religion/playing God; • Human rights of embryo. Any other appropriate response	[1]		
4	(a)	(i) Pancreas/islets/ β cells	[1]	
		(ii) $21 + 30 = 51$ [1]/ 51 [1]; $51 \times 3 = 153$ correct answer = [2 marks]	[2]	
	(iii) Any five from: <ul style="list-style-type: none"> • Plasmid bacterial DNA cut using enzyme (restriction endonuclease); • Same (restriction endonuclease), enzyme used to cut gene for humulin/insulin; • Produces 'sticky ends'/complementary sticky ends • Gene inserted into plasmid; • (DNA) ligase joins (humulin) gene to plasmid; • Plasmid inserted into bacteria; • Bacteria replicate/divide/multiply, producing humulin/humulin made; • Humulin purified and packaged. 	[5]		
	(iv) Any two from: <ul style="list-style-type: none"> • Fewer adverse reactions/infectious diseases/fewer allergic reactions/don't make antibodies; • Easier to make larger quantities; • Low production cost of humulin/humulin is less expensive than animal insulin; • Fewer ethical/religious issues (described)/animals not being harmed; • Humulin is absorbed more rapidly and shows its effectiveness in short duration. 	[2]		
	(v) Less than 3 amino acids difference in sequence/only 2 different in sequence/only 1 different in sequence/no difference in amino acid sequence/peptide sequence	[1]		

		AVAILABLE MARKS
(b) (i)	Any two from: <ul style="list-style-type: none"> • Glucose converted to glycogen; • Increased respiration; • Increased uptake of glucose into cells; • Lowers blood glucose/blood glucose back to normal levels. 	[2]
(ii)	$183210 - 179114 = 4096$ [1]/4096 [1] ecf $4096/179114 \times 100 = 2.29\%$ ecf [1] correct answer = [2]	[2]
(iii)	Country B has a larger population/more genetically predisposed to diabetes mellitus/unhealthy diet (explained)/more obese/other appropriate response/better diagnostic services	[1]
5 (a) (i)	Different gene/repetitive sequences/order of bases/different base sequencing/micro satellite repeat sequence	[1]
(ii)	Restriction (endonuclease/enzyme)	[1]
(iii)	Recognition sites/where enzyme cuts (DNA)/different non-coding DNA/different introns; [1] At different intervals [1]	[2]
(b) (i)	(Gel) Electrophoresis	[1]
(ii)	B [1] All bands match/all bands separated out at same distance [1]	[2]
(iii)	Any one from: <ul style="list-style-type: none"> • (Cross) contamination/contamination (of original sample)/ samples mixed/tampering with samples; • Error in PCR process. Any other appropriate response	[1]
(iv)	Any one from: <ul style="list-style-type: none"> • Paternity/maternity testing; • Medical diagnosis; • Animal breeding; • Plant breeding; • DNA genealogy/ancestry. Any other appropriate response	[1]
		16
		9

6 (a) (i) Paul : X^HY [1]

(ii)

	X^H	X^h
X^H	X^HX^H	X^HX^h
Y	X^HY	X^hY

Correct gametes (X^H and X^h for Jessica [1] with X^H and Y for Paul [1]);
 Correct cross
 $\frac{1}{4}$ /25% probability [4]

(iii) $\frac{1}{4}$ /25% [1]

(iv) Any **two** from:

- Males only have to have 1 affected allele or 1 small h or recessive allele;
- Y chromosome does not carry the haemophilic gene;
- Female has to inherit two affected alleles/female can be carriers. [2]

(b) **Advantage**

Can make informed decisions/person knows if they are a carrier/know chance of having a child with genetic condition/may be less anxious
 Any other appropriate response [1]

Disadvantage

Could decide not to have children/adverse effect on mental health/depression/expensive/specialised labs
 Any other appropriate response [1] [2]

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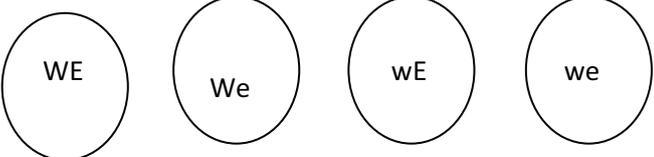
10

- 7 (a) (i) Water cannot leave the cells (via osmosis)/water builds up in the cell; [1]
- (ii) Increased diffusion distance/reduced gaseous exchange; [1]
Trapping of microbes/microorganism; [1] [2]
- (iii) The pancreatic duct may become blocked which leads to less efficient digestion/prevents pancreatic enzymes reaching the duodenum/poor absorption (of nutrients)/other appropriate response linked to **digestion**; **Reproductive** passages may be blocked/fertility problems/infertility; Any other appropriate response
- Correct body system; [1]
Correct linked explanation; [1] [2]
- (b) (i) Any **three** from:
 - Liposomes/adenovirus used;
 - Use of inhaler/aerosol;
 - Transfer healthy/normal (CFTR) gene;
 - Cells produced normal mucus/normal gene expressed/functional protein produced. [3]
- (ii) Any **one** from:
 - Only affects cells that aerosol or liposomes make contact with/insufficient cells targeted/not all cells take the gene up;
 - Short lived (as new cells continually produced)/treated cells die/treatment needs repeated;
 - Not passed on to next generation/gene not replicated;
 - (Use of virus) can cause lung infection;
 - (Gene therapy) is associated with cancer/leukaemia;
 - Possible disruptive effects on host DNA;
 - Use of virus is associated with an allergic reaction. [1]
- (c) (i) 2000 to 2010; [1]
- (ii) More treatment available/better treatment available
Any other appropriate response
Increase research/research funding [1]
- (iii) Straight line drawn, continuing line at the same gradient to 2020 [1];
48 [2]; [2]

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- 8 (a) (i) wwee [1]
 (ii) WwEe [1]

- (b) (i)  vertical [1]
 horizontal [1]

	WE	We	wE	we
WE	WWEe	WwEe	WwEE	WwEe
We	WwEe	WwEe	WwEe	Wwee
wE	WwEE	WwEe	wwEE	wwEe
we	WwEe	Wwee	wwEe	wwee

all correct = [2 marks] [2]

- (ii) 9 wild wing shape : 3 wild wing shape : 3 curled wing shape : 1 curled wing shape
 small eye size : normal eye size : small eye size : normal eye size [2]

- (c) (i) 2 correct = [1]
 all correct = [2]

Category	Observed (O)	Expected (E)	(O-E)	(O-E) ²	$\frac{(O-E)^2}{E}$
Wild wing shape small eye size	236	250	-14	196	0.784
Curled wing shape small eye size	257	250	7	49	0.196
Wild wing shape normal eye size	239	250	-11	121	0.484
Curled wing shape normal eye size	268	250	18	324	1.296

[1] for each correct column;

$X^2 = 2.76$ [1] [5]

- (ii) 3 degrees of freedom (4-1); [1]

- (iii) 0.500 to 0.100 or reversed; [1]

- (iv) The calculated p value is greater than 0.05/calculated X^2 is less than the tabular X^2 value at $p = 0.05$ ($X^2 = 7.81$)/no significant difference between observed and expected/null hypothesis accepted; [1]

Results are a good fit the ratio of 1:1:1:1; [1] [2]

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9 Indicative content

- (DNA) replication is semi-conservative;
- Each new molecule contains one original strand and one new strand one parent and one daughter;
- (DNA) helicase;
- Unwinds DNA/unzips DNA;
- Breaking hydrogen bonds;
- Between (complementary) bases/described;
- Each strand acts as a template;
- Free DNA nucleotides enter opposite their complementary bases (A with T and C with G);
- (DNA) polymerase;
- Joins adjacent nucleotides;
- By condensation reactions/phosphodiester bonds form/sugar phosphate backbone forms.

Any other appropriate response

Level of response	Marking criteria	Marks
Excellent	Candidates give six to eight points from the indicative content. Presentation, spelling, punctuation and grammar are excellent.	[6]–[8]
Good	Candidates give three to five points from the indicative content. Presentation, spelling, punctuation and grammar are sufficiently competent to make the meaning clear.	[3]–[5]
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]

Only [1] for Quality of written communication

[8]

Total

8

100

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