

Separate Science (Biology) Unit 6 Inheritance variation and evolution – mark scheme

Foundation

Question number	Description	Marks	Page number
4.6.1 Reproduction			
1	Sperm and egg recall box tick, complete Punnett square, determine probability from Punnett square	8	4
2	DNA gap fill, naming human gametes, meiosis multiple choice from diagram	8	5
2	Define dominant allele, complete Punnett square, probability from Punnett square, complete gametes for sex determination Punnett square, calculate probability from two Punnett squares	8	6
3	Meiosis multiple choice, why different ages children are not identical, (4.1.1 measuring microscope image, magnification calculation)	13	7
4	Multiple choice, genotype from diagram, completing Punnett square, ratio of offspring from Punnett square	8	9
6	Interpreting diagrams of cells produced in meiosis, interpreting chromosome diagram for reason why female, genotype for given phenotype and alleles, completing Punnett square for genotype and phenotype, probability from Punnett square	13	10
4.6.2 variation and evolution			
2	Cloning multiple choice	3	12
4	Describing selective breeding, male and female genotype, Punnett square gamete and completion (4.6.1 also)	10	13
5	Ticking table for causes of variation, phenotype from genotype, completing Punnett square, probability from Punnett square, multiple choice (4.6.1 also)	9	14
5	Describing selective breeding, advantage of selective breeding, disadvantage for selective breeding	5	15
4.6.3 The development of understanding of genetics and evolution			

3	Reason why no fossils for earliest life forms, suggest how fossil in picture was formed, two reasons of extinction, describe natural selection	9	16
4.6.4 Classification of living organisms			
5	Binomial name, interpreting table on DNA codes for different organisms (4.6.3 also)	4	15

Common content

Question number	Description	Marks	Page number
4.6.1 Reproduction			
2	DNA structure diagram completion, DNA bases to code for amino acid, benefits of understanding genome	8	18
6	Drawing chromosomes of mosquito gamete using body cell diagram for reference, describing similarities and difference between mitosis and meiosis, describe difference between gene and allele, defining dominant allele, explaining if person in diagram is homo- or heterozygous, completing Punnett square	12	19
4.6.4 Classification of living organisms			
1	Genus name from binomial name, describing how classification systems have changed, (4.7.1) difference between population and community	7	21

Higher

Question number	Description	Marks	Page number
4.6.1 Reproduction			
5	Ticking correct statements for meiosis and mitosis, advantages of asexual reproduction, explaining advantages of sexual reproduction in bluebells	8	23
5	(4.6.4 classification table) genotypes from diagram, draw and Punnett square, percentage from Punnett square	7	25

7	X and Y chromosome in oysters using information in question, describing meiosis, using information to suggest why triploid oyster can't reproduce, explain why triploid oysters grow more quickly than diploid, evaluation of information in the question and applying knowledge (6 marks)	15	26
7	Genes multiple choice, draw Punnett square for information given in question, explain how mutation during meiosis can affect all offspring cells.	12	29
4.6.2 variation and evolution			
3	(4.7.5 explaining how genetically engineered herbicide resistance will increase yield), giving examples of genetic engineering, explaining importance of knowing human genome	9	31
5	Explaining steps in tissue culture (5 marks), explaining results of a tissue culture example and diagram	14	33
5	Describing the steps in selective breeding (4 marks), explaining why people agree and disagree with GM rice being grown	8	34
6	Describing process of evolution (4 marks)	4	36
8	Mix of 4.6.1 and 4.6.2 - Determining mean value from graph, evidence from graph that milk production in cows is controlled by more than one gene, explaining how an amino acid changing stops and enzyme working, evidence from a family tree for animal being heterozygous, drawing Punnett square and identifying offspring with certain characteristic, describing selective breeding	16	37
4.6.3 The development of understanding of genetics and evolution			
9	Describing speciation (5 marks)	5	41
4.6.4 Classification of living organisms			
3	(4.7.1 extremophile bacteria), describing the three domain system, suggesting why microorganisms in question classified as archaea.	8	39
9	Completing levels of classification table, determining binomial name	4	40

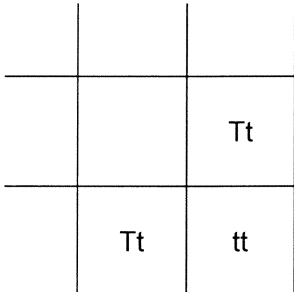
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	DNA	allow deoxyribonucleic acid allow lower case letters	1	AO1 4.4.3.1
01.2	gametes		1	AO1 4.4.3.1
01.3	meiosis		1	AO1 4.4.3.1
01.4	20		1	AO2 4.1.3.5
01.5	dominant		1	AO1 4.4.3.3
01.6	Bb or bB		1	AO2 4.4.3.3
01.7	bb circled	allow ecf from question 01.6	1	AO3 4.4.3.3
01.8	1 in 4 / 25% / 1:3 / 0.25 / $\frac{1}{4}$	allow ecf from question 01.6 do not accept 1:4	1	AO2 4.4.3.3
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	a double helix		1	AO1 4.6.1.3
	a polymer		1	
02.2	gene	in this order only	1	AO1 4.6.1.3
	genome		1	
02.3	sperm and egg(s) / ova / ovum	in either order	1	AO1 4.6.1.1
02.4	fertilisation		1	AO1 4.6.1.2
02.5	the cell divides twice		1	AO2 4.6.1.2
	the new cells have half the number of chromosomes		1	
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.													
02.1	an allele expressed even if a person only has one copy of the allele		1	AO1 4.6.1.6													
02.2	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td colspan="2" style="text-align: center;">Woman</td> </tr> <tr> <td></td> <td style="text-align: center;">e</td> <td style="text-align: center;">e</td> </tr> <tr> <td rowspan="2" style="text-align: center;">Man</td> <td style="text-align: center;">E</td> <td style="text-align: center;">Ee</td> <td style="text-align: center;">Ee</td> </tr> <tr> <td style="text-align: center;">e</td> <td style="text-align: center;">ee</td> <td style="text-align: center;">ee</td> </tr> </table>		Woman			e	e	Man	E	Ee	Ee	e	ee	ee	all 3 correct= 2 marks 1 or 2 correct = 1 mark	2	AO2 4.6.1.6
	Woman																
	e	e															
Man	E	Ee	Ee														
	e	ee	ee														
02.3	correct probability from Figure 4	if no answer in Question 02.2 allow 0.5	1	AO3 4.6.1.6													
02.4	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td colspan="2" style="text-align: center;">Woman</td> </tr> <tr> <td></td> <td style="text-align: center;">X</td> <td style="text-align: center;">X</td> </tr> <tr> <td rowspan="2" style="text-align: center;">Man</td> <td style="text-align: center;">X</td> <td style="text-align: center;">XX</td> <td style="text-align: center;">XX</td> </tr> <tr> <td style="text-align: center;">Y</td> <td style="text-align: center;">XY</td> <td style="text-align: center;">XY</td> </tr> </table>		Woman			X	X	Man	X	XX	XX	Y	XY	XY	gametes = X + X and X + Y allow in incorrect positions X, X, X and Y in correct boxes	1 1	AO2 4.6.1.6 4.6.1.8
	Woman																
	X	X															
Man	X	XX	XX														
	Y	XY	XY														
02.5	answer from Question 02.3 × 0.5 answer to calculation in mp1	an answer matching the answer from Question 02.3 × 0.5 scores 2 marks if no answer in Question 02.3, an answer of 0.25 / ¼ / 1 in 4 / 25% scores 2 marks if no answer in Question 02.3 allow 0.5 × 0.5 if no answer in Question 02.3 allow 0.25 / ¼ / 1 in 4 / 25%	1 1	AO2 4.6.1.6 4.6.1.8													
Total			8														

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	46		1	AO1 4.6.1.2 4.6.1.8
03.2	half the mass of the DNA in cell A		1	AO2 4.6.1.2
03.3	meiosis		1	AO1 4.6.1.2
03.4	mutation		1	AO1 4.6
03.5	any two from: <ul style="list-style-type: none"> • different egg / sperm each time • genes from two parents • each gamete / egg / sperm has different alleles / genes / DNA / genetic information 	ignore different chromosomes ignore the children have different genes / alleles	2	AO2 4.6 4.6.1.1
03.6	8		1	AO2 4.1.2.2 4.6.1.2
03.7	40	allow in range 39 to 41	1	AO2 4.6.1.2
03.8	$\frac{40}{500}$ × 1000 80	an answer of 80 scores 3 marks allow ecf from Question 03.7 for 3 marks an answer of 0.08 scores 2 marks allow $\frac{\text{answer to Question } \mathbf{03.7}}{500}$	1 1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.9	embryo is (very) small		1	AO2 4.5 4.5.3.4
	(so) embryo not seen / felt or lost in normal menstrual flow	ignore not noticed	1	AO3
Total			13	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	Gregor Mendel		1	AO1 4.6.3.3
04.2	DNA		1	AO1 4.6.3.3
04.3	when the dominant allele is not present		1	AO1 4.6.1.6
04.4	tt	allow homozygous recessive	1	AO2 4.6.1.6
04.5		all 3 correct = 2 marks 2 correct = 1 mark 0 or 1 correct = 0 marks allow tT for Tt	2	AO2 4.6.1.6
04.6	circle drawn around either TT or tt on Figure 5	allow circles drawn round both	1	AO2 4.6.1.6
04.7	correct ratio from question 04.5 eg 3 : 1	allow multiples of stated ratio allow 3 : 1 if no answer to question 04.5	1	AO3 4.6.1.6
Total			8	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	A		1	4.1.3.4 AO3
06.2	C		1	4.1.3.5 AO3
06.3	D there is an extra chromosome or there are three copies of one of the chromosomes or there are 7 chromosomes	no marks if incorrect cell given	1 1	4.1.3.4 AO3 AO3
06.4	mitosis		1	4.1.3.4 AO2
06.5	have XX or have two X chromosomes	allow there is no Y chromosome	1	4.4.3.2 AO3
06.6	bb	do not accept uppercase letters	1	4.4.3.3 AO2

<p>06.7</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2"></td> <th colspan="2">Woman</th> </tr> <tr> <td colspan="2"></td> <th>B</th> <th>b</th> </tr> <tr> <th rowspan="2">Man</th> <th>B</th> <td>BB Eye colour: brown</td> <td>Bb Eye colour: brown</td> </tr> <tr> <th>b</th> <td>Bb Eye colour: brown</td> <td>bb Eye colour: blue</td> </tr> </table> <p>(Probability of child having brown eyes =) $0.75 / 3:1 / 3 \text{ in } 4 / \frac{3}{4}$</p>			Woman				B	b	Man	B	BB Eye colour: brown	Bb Eye colour: brown	b	Bb Eye colour: brown	bb Eye colour: blue	<p>3 correct genotypes = 2 marks 2 correct genotypes = 1 mark</p> <p>eye colour correct for all their genotypes</p> <p>allow 75 % do not accept 1:4</p> <p>probability must match their description of eye colour</p> <p>if no eye colour given allow correct probability from genotypes</p>	<p>2</p> <p>1</p> <p>1</p>	<p>4.4.3.3 AO2</p> <p>AO2</p> <p>AO3</p>
		Woman																	
		B	b																
Man	B	BB Eye colour: brown	Bb Eye colour: brown																
	b	Bb Eye colour: brown	bb Eye colour: blue																
<p>06.8</p>	<p>any two from:</p> <ul style="list-style-type: none"> • lean / slim body • strong / muscular / long legs • muscular body • aerodynamic / streamlined shape • thin / short fur (to prevent overheating) 	<p>ignore long body unqualified</p>	<p>2</p>	<p>4.4.4.5 AO3</p>															
<p>Total</p>			<p>13</p>																

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	plants can be produced quickly		1	AO1 4.1.2.3
02.8	any one from: <ul style="list-style-type: none">• glucose / sugars / starch• amino acids / protein• hormones • ions / minerals • vitamins • water	allow named hormones eg auxin allow magnesium / nitrate allow named vitamins e.g. vitamin B allow H ₂ O / H2O ignore oxygen / carbon dioxide / agar / nutrients / fertiliser	1	AO2 4.1.2.3
Total			10	

Question	Answers	Extra information	Mark	AO / Spec. Ref.									
04.1	mutation		1	AO1 4.6.2.1									
04.2	any three from: <ul style="list-style-type: none"> choose the cats with the blue tail breed these cats together choose offspring with blue tails and breed these together repeat until all cats have blue tails 	allow choose the cats with the desired characteristic allow breed for several generations	3	AO1 AO2 4.6.2.3									
04.3	they are rare / beautiful / expensive	allow description e.g. the breeder will make (more) profit	1	AO3 4.6.2.3									
04.4	they are produced by inbreeding		1	AO2 4.6.2.3									
04.5	(male cat) XY or YX (female cat) XX	both required for the mark allow lower case letters	1	AO1 4.6.1.6									
04.6	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>(X)</td> <td>(X)</td> </tr> <tr> <td>(X)</td> <td>XX</td> <td>XX</td> </tr> <tr> <td>(Y)</td> <td>XY</td> <td>XY</td> </tr> </table>		(X)	(X)	(X)	XX	XX	(Y)	XY	XY	allow 2 or 3 derivation squares correct for 1 mark	2	AO2 4.6.1.6
	(X)	(X)											
(X)	XX	XX											
(Y)	XY	XY											
04.7	random (if X or Y goes into each sperm)	allow it is a chance event allow it is only a probability	1	AO3 4.6.1.6									
Total			10										

Question	Answers	Extra information	Mark	AO / Spec. Ref.																
05.1	<table border="1"> <thead> <tr> <th></th> <th>Gene</th> <th>Envi</th> <th>Both</th> </tr> </thead> <tbody> <tr> <td>Brown...</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>Light...</td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>Short</td> <td></td> <td>✓</td> <td></td> </tr> </tbody> </table>		Gene	Envi	Both	Brown...	✓			Light...			✓	Short		✓			1	AO2 4.6.2.1
		Gene	Envi	Both																
	Brown...	✓																		
Light...			✓																	
Short		✓																		
			1																	
			1																	
05.2	bb		1	AO2 4.6.1.4																
05.3	brown	allow light brown or dark brown	1	AO2 4.6.1.4																
05.4	(using bb for mother's gametes) correct combination in all four boxes, eg <table border="1"> <tbody> <tr> <td></td> <td>(b)</td> <td>(b)</td> </tr> <tr> <td>(B)</td> <td>Bb</td> <td>Bb</td> </tr> <tr> <td>(b)</td> <td>bb</td> <td>bb</td> </tr> </tbody> </table>		(b)	(b)	(B)	Bb	Bb	(b)	bb	bb	allow any combination of mother's gametes as mark is for filling in boxes correctly	1	AO2 4.6.1.4							
	(b)	(b)																		
(B)	Bb	Bb																		
(b)	bb	bb																		
05.5	50%, 0.5, ½	the award of this mark is consequential to the answer in question 05.4 ignore ratios	1	AO2 4.6.1.4																
05.6	phenotype		1	AO2 4.6.1.4																
05.7	almost certainly have no effect		1	AO1 4.6.2.1																
Total			9																	

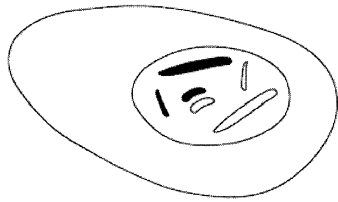
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	<i>Triticum spelta</i>		1	AO2 4.4.4.4
05.2	(pig) 2 and (wheat) 4	both needed for 1 mark	1	AO3 4.4.4.4
05.3	pig	allow ecf from question 05.2	1	AO3 4.4.4.4
05.4	only a small sample (of DNA)	ignore references to structure and appearance	1	AO3 4.4.4.4
05.5	any three from: <ul style="list-style-type: none"> • (farmer) selects heaviest / largest chickens / parents • (cross) breeds these chickens together • (farmer) selects the heaviest / largest offspring (to breed) • repeats this many times (until you have the desired chicken) 	allow (farmer) selects chickens with the best / most meat	3	AO1 AO2 4.4.4.5
05.6	high(er) income / profit		1	AO3 4.4.4.5
05.7	the chickens may weigh too much to be able to stand		1	AO3 4.4.4.5
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(organism) soft-bodied or (fossil) destroyed	allow lack hard parts / skeleton / shell allow (organism) eaten / decayed allow buried (very) deep allow they are (very) small	1	AO1 4.6.3.5
03.2	any two from: <ul style="list-style-type: none"> the fish (dies) buried in sediment / sand / mud (only) the soft parts decayed / eaten or the hard parts / bones did not decay or were not eaten mineralisation occurred 	allow other examples of sediments do not accept rock(s) allow description of mineralisation eg bones turned to stone allow imprinted (in the sediment)	2	AO2 4.6.3.5
03.3	any two from: <ul style="list-style-type: none"> drought ice age / global warming volcanic activity asteroid / meteor collision (new) predators (new) disease / named pathogen competition for food competition for mates lack of habitat or habitat change 	ignore pollution allow earthquakes / tsunami allow hunters / poachers allow eaten allow lack of food allow isolation or lack of mates if no other marks awarded allow natural disaster / climate change / weather change / catastrophic event / environmental change for 1 mark	2	AO1 4.6.3.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	a change in a gene		1	AO1 4.6.2.1
03.5	<p>there is variation (between members of a species)</p> <p>better adapted survive</p> <p>(reproduce and) pass on (favourable) allele(s) / gene(s) / mutation(s) / DNA / genetic material</p>	<p>allow in terms of an example</p> <p>allow mutation</p> <p>allow 'survival of the fittest'</p> <p>ignore pass on characteristic(s)</p>	<p>1</p> <p>1</p> <p>1</p>	<p>AO1 4.6 4.6.2.2 4.6.3.1</p>
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	chromosome(s)	allow gene(s) / allele(s)	1	AO1 4.6.1.4 4.1.2.1
02.2	X = sugar Y = nucleotide Z = base		1 1 1	AO1 4.6.1.5
02.3	double helix		1	AO1 4.6.1.4
02.4	3		1	AO2 4.6.1.5
02.5	any two from: <ul style="list-style-type: none"> • diagnosis of inherited / genetic disorder • gene therapy or treatment of inherited disorders • understanding (human) evolution or • understanding ethnic origins (of a person) or • understanding ancestry • tracing human migration patterns 	allow descriptions or named examples allow research / understand genetic disorders allow other examples – eg identification of criminals (1) paternity determination (1)	2	AO1 4.6.1.4
Total			8	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1		should include same number and shape of chromosomes as Figure 6 , but locations can be different ignore shading	1	4.1.3.4 AO2
06.2	any four from: (similarities) <ul style="list-style-type: none"> • increase in number of organelles / mitochondria / ribosomes (prior to division) • DNA is replicated / doubled • chromosomes are moved to opposite ends of the cell (differences) <ul style="list-style-type: none"> • cell divides into two genetically identical cells in mitosis but four not genetically identical cells in meiosis • mitosis produces cells with a full set of chromosomes but meiosis produces cells / gametes with half the number of chromosomes 	do not accept duplicate / replicate allow chromosomes replicate / double ignore genetic information allow cell increases in volume / size (prior to division) allow cell divides once to produce genetically identical cells in mitosis but cell divides twice to produce not genetically identical cells in meiosis allow mitosis produces diploid cells and meiosis produces haploid cells if no other marks awarded allow 1 mark for mitosis produces cells for growth but meiosis produces gametes / sex cells	4	4.1.3.4 4.1.3.5 AO1
06.3	alleles are different forms of the same gene		1	4.4.3.3 AO1

06.4	(allele) that is always expressed or only needs one allele to be expressed		1	4.4.3.3 AO1
06.5	(heterozygous) has a child without achondroplasia so must have a recessive allele to pass on or because if he was homozygous all of his children would have achondroplasia or parent 2 is unaffected, therefore she must have passed on a recessive allele	must give heterozygous to gain reason mark	1	4.4.3.3 AO3
06.6	female A and a and male a and a (gametes) A a and a a Aa, Aa, aa, aa Aa have achondroplasia and aa do not have achondroplasia	if symbols other than A and a used then there must be a key correct derivation from parental gametes	1 1 1 1	4.4.3.3 AO2 AO2 AO2 AO3
Total			12	

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	Canis	ignore italics ignore capitalisation	1	AO2 4.4.4.4

Question	Answers	Mark	AO / Spec. Ref.
01.2	Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.4.4.4
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	AO1 4.4.4.4
	No relevant content	0	
	Indicative content (originally) <ul style="list-style-type: none"> • organisms placed in groups based on similar structures • or characteristics • influenced by where organisms are found • classification by Carl Linnaeus (more recent) <ul style="list-style-type: none"> • organisms with similar internal structures grouped together • because of development of microscopes • organisms with similar biochemical processes grouped together • organisms with similar DNA grouped together • more fossils / species have been found / studied • the three domain system • classification by Carl Woese for full marks answers must refer to both original and more recent classification		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	population is the number of one species (in the area / habitat)		1	AO1 4.4.2.1
	(whereas a) community is all the individuals / populations of the different species (living in the area / habitat)	allow (whereas a) community is all the different organisms (living in the area / habitat) ignore reference to time	1	

Question	Answers	Mark	AO / Spec. Ref.
01.4	Level 3: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3 4.4.2.1 4.4.2.2 4.4.2.3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2 4.4.2.1 4.4.2.2 4.4.2.3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO2 4.4.2.1 4.4.2.2 4.4.2.3
	No relevant content	0	
	Indicative content		
	<ul style="list-style-type: none"> • no / fewer wolves means more food for (Brown) bears • so less competition • so population of bears may increase • therefore elk / bison population may decrease • less predation of elk / bison by wolves • and / or Brown bears unable to control populations of herbivores • would increase populations of elk / bison • rabbits predated less • therefore rabbit population may increase • grass decreases due to more rabbits • grass decreases due to more elk / bison • grass increases due to fewer elk / bison • decline in all herbivores due to over-grazing 		

Question	Answers	Extra information	Mark	AO / Spec. Ref.																				
05.1	<table border="1" data-bbox="328 398 1169 808"> <thead> <tr> <th data-bbox="328 398 697 454"></th> <th colspan="3" data-bbox="697 398 1169 454">statement is true for</th> </tr> <tr> <th data-bbox="328 454 697 533"></th> <th data-bbox="697 454 825 533">mitosis only</th> <th data-bbox="825 454 968 533">meiosis only</th> <th data-bbox="968 454 1169 533">both mitosis and meiosis</th> </tr> </thead> <tbody> <tr> <td data-bbox="328 533 697 611">all cells produced are genetically identical</td> <td data-bbox="697 533 825 611">✓</td> <td data-bbox="825 533 968 611"></td> <td data-bbox="968 533 1169 611"></td> </tr> <tr> <td data-bbox="328 611 697 730">in humans, at the end of cell division each cell contains 23 chromosomes</td> <td data-bbox="697 611 825 730"></td> <td data-bbox="825 611 968 730">✓</td> <td data-bbox="968 611 1169 730"></td> </tr> <tr> <td data-bbox="328 730 697 808">involves DNA replication</td> <td data-bbox="697 730 825 808"></td> <td data-bbox="825 730 968 808"></td> <td data-bbox="968 730 1169 808">✓</td> </tr> </tbody> </table> <p data-bbox="751 837 1054 936"> 3 correct = 2 marks 2 correct = 1 mark 0 or 1 correct = 0 marks </p>		statement is true for				mitosis only	meiosis only	both mitosis and meiosis	all cells produced are genetically identical	✓			in humans, at the end of cell division each cell contains 23 chromosomes		✓		involves DNA replication			✓		2	AO1 4.1.2.2 4.6.1.2
	statement is true for																							
	mitosis only	meiosis only	both mitosis and meiosis																					
all cells produced are genetically identical	✓																							
in humans, at the end of cell division each cell contains 23 chromosomes		✓																						
involves DNA replication			✓																					
05.2	any two from: <ul data-bbox="328 1115 730 1615" style="list-style-type: none"> many offspring produced takes less time (more) energy efficient genetically identical offspring successful traits propagated / maintained / passed on (due to offspring being genetically identical) no transfer of gametes or seed dispersal not wasteful of flowers / pollen / seeds colonisation of local area 	ignore references to one parent only allow asexual is faster allow offspring are clones allow no vulnerable embryo stage allow no need for animals must imply local area	2	AO3 4.6.1.1 4.6.1.3																				

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	genetic variation (in offspring)	allow bluebell example described (max 3 if not bluebell)	1	AO1
	(so) better adapted survive	allow reference to natural selection or survival of the fittest	1	AO1
	(and) colonise new areas by seed dispersal or can escape adverse event in original area (by living in new area)	must imply new area	1	AO3
	many offspring so higher probability some will survive		1	AO3 4.6.1.1 4.6.2.1 4.6.1.3 4.7.1.1
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	same kingdom + phylum + class + order or same order or they have the top four groups the same	allow both Poales	1	AO3 4.6.4
05.2	Rr / rR	do not accept RR or rr ignore heterozygous do not accept homozygous	1	AO3 4.6.1.6 4.6.3.3
05.3	C ^W C ^W		1	AO3 4.6.1.6
05.4	parental genotypes / gametes correct for both parents: C ^R C ^W C ^R C ^W / C ^R and C ^W genotypes of offspring correctly derived in a Punnett square: C ^R C ^R C ^R C ^W C ^W C ^W correct identification of phenotypes from their cross: C ^R C ^R = red C ^R C ^W = pink C ^W C ^W = white	allow R and W throughout allow own symbols if defined allow correctly derived genotypes from incorrect gametes allow colours correctly identified from different offspring, only if pink and other colour(s) are given	1 1 1	AO2 4.6.1.6
05.5	answer correctly derived from Question 05.4 to match stated phenotypes	allow 50(%) if no offspring given in Question 05.4 allow to match genotypes if no phenotypes given	1	AO2 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	one X and one Y chromosome and 9 pairs of other chromosomes		1	AO2 4.6.1.6
07.2	any three from: <ul style="list-style-type: none"> • (called) meiosis • DNA / chromosomes replicate or • DNA makes a copy • two divisions to form 4 cells • so only 1 set of chromosomes per cell • (daughter cells / gametes) are all genetically different 	correct spelling only allow cells are haploid ignore half the DNA if no other mark awarded allow 1 mark for forms gametes / cells which are all different or only happens in testes and (embryonic) ovaries	3	AO1 4.6.1.2
07.3	(meiosis will not work because) number of chromosomes cannot halve	allow chromosomes cannot form pairs allow chromosomes cannot split up evenly	1	AO2 4.6.1.2
07.4	do not use energy in reproduction so more (energy) available to synthesise proteins	allow converse if clearly describing diploid oysters allow other correct molecules or cell components	1 1	AO2 4.6.1.3 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	<p>any two from:</p> <ul style="list-style-type: none"> • global warming may be raising temperature of water and killing oysters • pollutants in the water may be toxic and kill the oysters or increased acidity of the oceans is killing oysters • new competitors / triploid oysters are using up the normal food source • new pathogens may be causing diseases • new predators eating oysters 	<p>allow correctly named pollutant with reason</p> <p>ignore over harvesting</p>	2	<p>AO2 4.7.3.5 4.7.3.2 4.7.1.2 4.7.1.3</p>

Question	Answers	Mark	AO / Spec. Ref.
07.6	Level 3: A judgement strongly linked and logically supported by a sufficient range of correct reasons is given.	5–6	AO3
	Level 2: Some logically linked reasons are given. There also may be a simple judgement.	3–4	AO3 AO2
	Level 1: Relevant points are made. They are not logically linked.	1–2	AO2
	No relevant content	0	
	Indicative content for: <ul style="list-style-type: none"> • oysters are available to eat all year so eating oysters has become very popular • cheaper to produce so more food for expanding population • oysters grow faster so more oysters for supermarkets / restaurants or more profit for farmers • stocks are replenished each year so more sustainable fishing • they can harvest / sell all year so more stable and profitable for oyster farmers against: <ul style="list-style-type: none"> • carcinogen put into environment / oysters so may enter the food chain or cause cancer in humans • bigger triploid oysters may outcompete the smaller native diploid oysters so upset balance of the ecosystem / cause extinction • people may not buy / eat them because they have used a carcinogenic chemical so reduced profit for farmers / suppliers / supermarkets / restaurants • farmers have to buy new seed oysters every time so more expensive other content: <ul style="list-style-type: none"> • shouldn't be eating the oysters until they are thoroughly tested • should be looking for alternative ways to get triploid oysters • should stop using triploid oysters until the effect on the (marine) environment is known • would replace lost oyster beds but could change the ecosystem • oysters available to eat all year but probably do not taste the same or have the same flavour 		4.7.3.2 4.7.3.6 4.7.2.1 4.7.1.3 4.7.1.1
Total		15	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	a short section of DNA		1	AO1 4.4.3.1
07.2	a sequence of amino acids		1	AO1 4.4.3.1
07.3	genome		1	AO1 4.4.3.1
07.4	phenotype		1	AO1 4.4.3.4
07.5	(parents genotype shown one homozygous recessive, one heterozygous dominant) rr and Rr	may be on diagram	1	AO2 4.4.3.3
	(possible offspring genotypes shown) Rr Rr rr rr	allow correct derivation of offspring genotypes from incorrect gametes	1	
	all offspring with Marfan syndrome phenotype circled / labelled		1	
	probability 0.5 / ½ / 50%	allow correct probability from incorrectly derived offspring	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	<p>gametes / sperm / eggs are produced by meiosis (cell division)</p> <p>when gametes fuse this mutation is in the fused / new cell</p> <p>(after fertilisation) <u>mitosis</u> produces every cell of embryo / offspring</p> <p>(which) will be genetically identical</p> <p>or</p> <p>(mutated) DNA from gamete is in every cell of offspring</p>	<p>allow at fertilisation for when gametes fuse</p> <p>allow zygote for fused cell</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO1 4.1.3.5</p> <p>AO2 4.1.3.5</p> <p>AO1 4.1.3.4</p> <p>AO1 4.1.3.4</p>
Total			12	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	vectors are used to insert genes into cells		1	AO1 4.6.2.4
	vectors are usually plasmids or viruses		1	
03.2	wheat not affected by spraying / herbicide	allow only weeds affected / killed by spraying / herbicide	1	AO1 AO2 4.6.2.4 4.7.1.1 4.4.1.1
	(so) wheat gets more light / water / nitrates / ions / minerals	allow less competition for light / water / nitrates / ions / minerals ignore nutrients ignore carbon dioxide ignore space	1	
	(so) more photosynthesis / glucose / proteins (for more yield)	idea of more needed at least once for mp 2 and 3	1	
03.3	any two from: <ul style="list-style-type: none"> • production of human insulin / medicines • crops resistant to diseases / pests • crops resistant to frost • crops resistant to drought • crops / foods with added nutrients • plants / crops with more / bigger fruits or higher yield • crops with improved taste • crops with improved shelf life 	allow examples such as potatoes resistant to blight allow examples such as golden rice with vitamin A gene allow examples such as larger tomatoes	2	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	<p>identify genes linked to (certain) disease</p> <p>so can lead to better prevention / treatment of that disease</p> <p>or</p> <p>identify genes causing inherited disorders (1)</p> <p>so may prevent children being born with the disorder by using IVF or gene therapy (1)</p> <p>or</p> <p>tracing human migration patterns from the past or evolution of humans (1)</p> <p>so to better understand the ancient history of humans (1)</p>	<p>allow correctly named diseases such as cancer / diabetes</p>	<p>1</p> <p>1</p>	<p>AO1 AO2 4.6.1.3</p>
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(several groups) so many / several plants can be produced	allow each (group) will give a new plant	1	AO1 4.1.2.3 4.6.1.3 4.6.2.5
	(nutrients) for making protein / amino acids or for making chlorophyll or for providing energy or for respiration	allow other examples do not accept making energy ignore for growth	1	
	(add hormones) so differentiation occurs or so roots / shoots develop	allow for the formation of different tissues / organs / named allow to stimulate cell division	1	
	(sterile conditions) to prevent growth / entry of microorganisms / named type or prevent decay / disease	ignore to kill microorganisms ignore contamination unqualified	1	
	(temperature = 20 °C) so optimum / good growth	allow reference to enzymes working well ignore enzymes not denatured ignore reference to pathogens / microorganisms	1	
05.7	(all new plants have been) produced by asexual reproduction / mitosis or produced without (fusion of) gametes	ignore produced from one parent	1	AO2 4.1 4.1.2.2 4.6.1.1 4.6.2.5
	(so) all are genetically identical / clones or all are C ^R C ^W / heterozygous	allow all are the same genotype / alleles / genes / DNA	1	
Total			14	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(the scientists) chose / used (traditional varieties of) rice plants with short stems and rice plants with large grains or chose rice plants with short stems and large grains.		1	AO2 4.6.2.3
	(cross) bred the rice plants	allow cross pollinated the rice plants	1	AO1 4.6.2.3
	(from the offspring) chose the plants with best / desired characteristics or chose plants with short(est) stems and big(gest) grains		1	AO1 4.6.2.3
	bred repeatedly until all plants had desired characteristics or bred repeatedly until they bred true or bred repeatedly until they produced IR8		1	AO1 4.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	<p>agree (max 3 marks)</p> <ul style="list-style-type: none"> • resistance to disease / pests / pathogens so higher yield • resistant to herbicides so less competition for (sun)light / water / minerals / ions (from weeds) • larger / more grains per plant or higher yield so more food for people or more income for farmers • better nutritional content (vitamins / protein / low GI index) so will improve health <p>disagree (max 3 marks)</p> <ul style="list-style-type: none"> • may affect wild plants (if genes transfer) so making them herbicide resistant • use of herbicides may reduce biodiversity because other plants are killed • traditional varieties no longer grown so reduction in biodiversity • may affect health of people who eat the rice because not enough research done yet 	<p>each reason must be explained to gain credit</p> <p>allow improved survival in harsh conditions so can be grown in wider area</p> <p>allow (GM) seeds are expensive for farmers because they have to buy new seeds every year or because farmers have to buy specific herbicide</p> <p>if no explanations allow 1 mark for one agree reason and one disagree reason</p>	4	AO3 4.6.2.4
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	<p>(genetic variation in plants arising from) mutation for a beneficial characteristic</p> <p>such as to be flatter to withstand trampling / nibbling or to grow again quickly from the roots or poisons / thorns / taste to deter herbivores</p> <p>those with gene(s) for named adaptation more likely to survive and breed</p> <p>to pass on (favourable) genes repeated over many generations until the characteristic is in all / most of the population</p>	allow a named beneficial characteristic	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO1 4.4.4.1 4.4.4.2</p> <p>AO2 4.4.4.1 4.4.4.2</p> <p>AO1 4.4.4.1 4.4.4.2</p> <p>AO1 4.4.4.1 4.4.4.2</p>
Total			15	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	3.7		1	AO2 4.7.2.1
08.2	2		1	AO1 4.6.1.6
08.3	(different combinations of alleles cause) many / 22 values or in-between values or large range of values or there are not only two values	allow continuous variation allow there are not only 3 values if 3 is given in question 08.2	1	AO3 4.6.1.6 4.6.2.1
08.4	different protein made <u>active site</u> changed so substrate does not fit / bind	allow change in shape (of enzyme) or change in 3-D structure ignore denature allow description of substrate allow cannot form E-S complex ignore lock and key description	1 1 1	AO1 4.2.2.1 4.6.1.5
08.5	produces (some) offspring with high-fat milk or not all offspring have low-fat milk	ignore reference to alleles	1	AO3 4.6.1.6
08.6	takes less time (to obtain results) or more offspring at the same time	allow other sensible suggestion – eg allows screening or allow cow 7 to continue to produce eggs or avoid injury to cow 7 during mating or giving birth	1	AO3 4.5.3.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	<p>male gametes correct: d (and d)</p> <p>female gametes correct: D and d</p> <p>correct derivation of offspring genotypes from given gametes</p> <p>Dd identified as low-fat and dd identified as high-fat in offspring</p>	<p>max 3 marks if own symbols used with no key</p> <p>max 3 marks if alternative diagram to Punnett square used</p> <p>allow 1 mark if gametes are correct but gender not identified</p> <p>allow 2 × 2 or 2 × 1 derivation</p> <p>if DD offspring are produced, must also identify as low-fat</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO2 4.6.1.6</p>
08.8	<p>find female with low(est) fat in milk and high(est) milk yield</p> <p>find male whose female offspring have high(est) milk yield and low(est) fat in milk</p> <p>or</p> <p>find female with lowest fat in milk or cow 13 (1)</p> <p>find male whose female offspring have high(est) milk yield (1)</p> <p>cross the best (for both features) female with the best male</p> <p>select best offspring (for both features) from each generation and repeat for several generations</p>	<p>allow choose from 7, 9, 12, 13 which has the highest yield</p> <p>allow choose from 16 or 18 whose female offspring has the highest yield</p> <p>allow female with high(est) milk yield</p> <p>allow male whose female offspring have lowest fat in milk / male 16</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO3 4.6.2.3</p> <p>AO3 4.6.2.3</p> <p>AO2 4.6.2.3</p> <p>AO2 4.6.2.3</p>
Total			16	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	they survive in high temperatures		1	AO2 4.7.1.4
	they survive where it is acidic		1	
03.2	C		1	AO3 4.7.1.4
03.3	because it has (high / optimum) activity at high temperature or 65 °C and / or low pH or pH 3 or high acidity	mark dependent on C correct for question 03.2 allow it is the only enzyme that is active between 55 °C and 75 °C and / or below pH4	1	AO2 4.7.1.4
03.4	any three from: <ul style="list-style-type: none"> • based on DNA / chemical evidence (the three domains are) • (Archaea) –primitive / simple bacteria • Prokaryota / Bacteria – true / modern bacteria • Eukaryota – includes (protists, fungi,) plants and animals 	allow Eukaryota - includes organisms with cells having a nucleus if no other mark awarded allow for 1 mark mention of Archaea, Prokaryota / Bacteria and Eukaryota or three correct descriptions	3	AO1 4.6.4
03.5	(these microorganisms) live in extreme conditions	allow (most Archaea) are extremophiles	1	AO2 4.6.4
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.										
09.1	<table border="1"> <thead> <tr> <th>Classification group</th> <th>Name</th> </tr> </thead> <tbody> <tr> <td>Class</td> <td><i>Mammalia</i></td> </tr> <tr> <td>Order</td> <td><i>Primates</i></td> </tr> <tr> <td>Family</td> <td><i>Lemuroidea</i></td> </tr> <tr> <td>Species</td> <td><i>catta</i></td> </tr> </tbody> </table>	Classification group	Name	Class	<i>Mammalia</i>	Order	<i>Primates</i>	Family	<i>Lemuroidea</i>	Species	<i>catta</i>	all 4 correct = 2 marks 2 or 3 correct = 1 mark 0 or 1 correct = 0 marks	2	AO1 4.6.4
Classification group	Name													
Class	<i>Mammalia</i>													
Order	<i>Primates</i>													
Family	<i>Lemuroidea</i>													
Species	<i>catta</i>													
09.2	Lemur <i>catta</i>	ignore capitalisation / non-capitalisation of initial letters ignore italics / non-italics ignore underlining / non-underlining	1	AO2 4.6.4										
09.3	carried by (favourable) currents on masses of vegetation	allow description of currents from Figure 13 ignore swimming	1	AO2 4.6.3.2										

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	isolation of different populations		1	AO2 4.6.3.2
	habitat variation between lemur populations	allow examples – biotic (eg food / predators) or abiotic (eg temperature)	1	AO1 4.6.2.2 4.7.1.4
	genetic variation or mutation (in each population)		1	AO1 4.6.2.1 4.6.2.2 4.6.3.1 4.7.1.4
	better adapted survive (reproduce) and pass on (favourable) allele(s) to offspring	allow natural selection or survival of the fittest and pass on (favourable) allele(s) to offspring allow gene(s) / mutation as an alternative to allele(s)	1	AO1 4.6.2.2 4.6.3.1 4.7.1.1
	(eventually) cannot produce fertile offspring with other populations	allow cannot reproduce 'successfully' with other populations ignore cannot reproduce unqualified	1	AO1 4.6.3.1 4.6.2.2
Total			9	