

Mark scheme



Question	Answer/Indicative content	Marks	Guidance
1	C ✓	1 (AO2.1)	
	Total	1	
2	A ✓	1 (AO1.1)	
	Total	1	
3	A ✓	1 (AO2.1)	
	Total	1	
4	B ✓	1 (AO2.1)	ALLOW 19
	Total	1	
5	C ✓	1 (AO1.1)	
	Total	1	
6	C	1 (AO 2.2)	Examiner's Comments This question assessed the candidate's application of their knowledge and understanding of genotypes. All incorrect responses demonstrated equal weighting, confusing homozygous and heterozygous along with dominant and recessive genotypes.
	Total	1	
7	B	1 (AO 2.1)	Examiner's Comments This question assessed the candidate's application of their knowledge and understanding of gamete chromosome numbers. The main incorrect response was D, and candidates doubled the body cell diploid number provided instead of halving it to provide the haploid chromosome number.
	Total	1	
8	C	1 (AO 1.1)	Examiner's Comments This question proved to be the most challenging question in section A. Many candidates did not recognise the correct combination of

					gametes which will produce a male baby which is C - A sperm with one Y chromosome and an egg with one X chromosome. All incorrect responses demonstrated equal weighting.											
			Total	1												
9			D	1 (AO 1.1)	Examiner's Comments This question assessed knowledge and understanding of discontinuous variation. Roughly half of candidates achieved this mark. Those who didn't opted for a named example of continuous variation instead.											
			Total	1												
10			C ✓	1 (AO1.1)												
			Total	1												
11			C ✓	1 (AO1.1)												
			Total	1												
12			A ✓	1 (AO1.1)												
			Total	1												
13			B ✓	1 (AO1.1)												
			Total	1												
14	a		<p>man</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>D</td> <td>d</td> </tr> <tr> <td>woman</td> <td>d</td> <td>Dd</td> <td>dd</td> </tr> <tr> <td></td> <td>d</td> <td>Dd</td> <td>dd</td> </tr> </table> <p style="text-align: center;">✓</p> <p>50% / 0.5 / ½ ✓</p>		D	d	woman	d	Dd	dd		d	Dd	dd	2 (AO1 x 2.2) (AO1 x 3.1a)	ALLOW 1 in 2 or 1:1 ALLOW ecf for probability
	D	d														
woman	d	Dd	dd													
	d	Dd	dd													
	b		<p>smallest</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>nucleotide</td> </tr> <tr> <td>allele</td> </tr> <tr> <td>chromosome</td> </tr> </table> <p>largest</p> <p>✓</p>	nucleotide	allele	chromosome	1 (AO1.1)									
nucleotide																
allele																
chromosome																
	c		66000000 ÷ 500 = 132 000 ✓	1 (AO2.2)	ALLOW 0.132 million or 132 thousand or 1.32 x 10 ⁵											

		Total	4													
1 5	a	<p>clots the blood ✓</p> <p>prevents bleeding / allows wounds to heal / forms a scab ✓</p>	2 (AO 1.1)	<p>IGNORE clump blood</p> <p>ALLOW prevents pathogens getting into the body</p> <p>Examiner's Comments</p> <p>There was some confusion in the responses describing the role of platelets whereby candidates thought platelets had a role in the specific immune response. Only higher ability candidates gained a mark here.</p>												
	b	<table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td></td> <td style="text-align: center;">Rr</td> </tr> <tr> <td></td> <td style="text-align: center;">R</td> <td style="text-align: center;">r</td> </tr> <tr> <td style="text-align: center;">Rr</td> <td style="text-align: center;">R</td> <td style="text-align: center;">Rr</td> </tr> <tr> <td style="text-align: center;">Rr</td> <td style="text-align: center;">r</td> <td style="text-align: center;">Rr</td> </tr> </table> <p>ratio 3 : 1 ✓</p>			Rr		R	r	Rr	R	Rr	Rr	r	Rr	3 (AO 2.1) (AO 3.2b)	<p>correct gametes = one mark</p> <p>correct genotypes of offspring = 1 mark</p> <p>ALLOW ECF for ratio</p> <p>ALLOW 3 in 4</p> <p>Examiner's Comments</p> <p>The majority of candidates achieved two or three marks correctly identifying the gametes and genotypes. Most went onto correctly identifying the ratio if they achieved the gametes mark. Very few candidates achieved the error carried forward mark.</p>
		Rr														
	R	r														
Rr	R	Rr														
Rr	r	Rr														
	c	<p>Any three from:</p> <p>variation with some rats resistant and some who are not ✓</p> <p>(resistant rats) more likely to survive/less likely to be killed ORA ✓</p> <p>(resistant rats more likely) reproduce ORA ✓</p> <p>pass on the allele / gene for resistance ORA ✓</p>	3 (AO 2.1)	<p>IGNORE selective breeding</p> <p>ALLOW mutation for resistance</p> <p>ALLOW offspring produced / breed together</p> <p>ALLOW pass on advantageous gene</p> <p>IGNORE trait is passed on / genes are passed on</p> <p>Examiner's Comments</p> <p>Candidates had to apply their knowledge of natural selection to explain why the percentage of resistant rats was increasing. There were a range of marks given for this question. Most none scoring responses were too vague and not using key terms. Most candidates did not appreciate that there was variation for resistance within the population.</p>												
	d	<p>Any two from:</p> <p>(stops/less) respiration ✓</p> <p>(no/less) energy/ATP ✓</p> <p>key process interrupted e.g. cell metabolism/protein synthesis/chemical reactions/active transport ✓</p>	3 (AO 2.1)	<p>Examiner's Comments</p> <p>This question was one of the most challenging application of knowledge and understanding questions. The most common awarded mark was appreciation that energy release would be affected. A lot of responses were very general and would say the rat can't breathe or can't get any oxygen.</p>												

			Total	11										
1 6	a	i	(the allele) is recessive ✓	1 (AO 2.1)	<p>ALLOW neither dominant</p> <p>Examiner's Comments</p> <p>Candidates need to apply their knowledge and understanding of genetics to achieve this mark. It differentiated well with the higher ability candidates' understanding that the allele is recessive. The majority of candidates referred to the number of eyes, and that they need two to become stronger / dominant, which did not gain credit.</p>									
		ii	The retina is damaged/doesn't function ✓	1 (AO 1.1)	<p>ALLOW retina detects light / focuses the image / contains light receptors</p> <p>Examiner's Comments</p> <p>This was a well differentiated question. The majority of lower ability candidates did not gain the mark as common answers were too generalised such as 'it affects the eyes'.</p>									
	b		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td><i>R</i></td> <td><i>r</i></td> </tr> <tr> <td><i>R</i></td> <td><i>RR</i></td> <td><i>Rr</i></td> </tr> <tr> <td><i>r</i></td> <td><i>Rr</i></td> <td><i>rr</i></td> </tr> </table> <p style="text-align: right;">✓✓</p> <p>probability = 0.25 / ¼ / 25% / 1 in 4 / 1:3 ✓</p>		<i>R</i>	<i>r</i>	<i>R</i>	<i>RR</i>	<i>Rr</i>	<i>r</i>	<i>Rr</i>	<i>rr</i>	3 (AO 2 × 1.2) (AO 3.2b)	<p>All genotypes correct = 2 marks Three genotypes correct =1 mark One / two genotypes correct =0 marks</p> <p>Examiner's Comments</p> <p>The majority of candidates achieved 2 or 3 marks correctly identifying the genotypes in the offspring. Some candidates couldn't work out the probability...</p>
	<i>R</i>	<i>r</i>												
<i>R</i>	<i>RR</i>	<i>Rr</i>												
<i>r</i>	<i>Rr</i>	<i>rr</i>												
	c		<p>mutation:</p> <p>change in a gene / DNA / deletion of a base / addition of a base / change in order of bases ✓</p> <p>gene:</p> <p>a section/length of DNA ✓ OR codes for a protein ✓</p>	2 (AO 2 × 1.1)	<p>AW nucleotide for base</p> <p>ALLOW codes for the order/sequence of amino acids IGNORE codes for a characteristic</p> <p>Examiner's Comments</p> <p>There were some good answers here demonstrating their knowledge and understanding of the meaning of the terms mutation and gene. Mutation was the most common credited answer.</p>									
			Total	7										

1 7	a	<table border="1"> <thead> <tr> <th>Continuous</th> <th>Discontinuous</th> </tr> </thead> <tbody> <tr> <td>height</td> <td>sex blood group eye colour</td> </tr> </tbody> </table> <p style="text-align: right;">✓✓</p>	Continuous	Discontinuous	height	sex blood group eye colour	<p>2 (AO1.1)</p> <p>All four correct = 2 marks Three correct = 1 mark Two or less correct = 0 marks</p> <p><u>Examiner's Comments</u></p> <p>There was some confusion in the answers, mixing up continuous and discontinuous variation. Lower ability candidates did not gain marks here.</p>
Continuous	Discontinuous						
height	sex blood group eye colour						
	b	<p>sperm cell 23 ✓</p> <p>zygote 46 ✓</p> <p>body cell 46 ✓</p>	<p>3 (AO1.1)</p> <p><u>Examiner's Comments</u></p> <p>The majority of candidates achieved full marks here for correctly identifying the number chromosomes in each of the cell types.</p>				
Total			5				
1 8	a	<p>male sex chromosomes are XY ✓</p> <p>female sex chromosomes are XX ✓</p>	<p>2 (AO 2 × 1.1)</p> <p><u>Examiner's Comments</u></p> <p>The majority of candidates did not recall that males have XY and females have XX sex chromosomes. This question was a good differentiator. Most common errors were linking gametes or chromosome number of gametes to male and female respectively. This is shown in Exemplar 3, which achieved 0 marks.</p> <p>Exemplar 3</p> <p>Male23..... Female23.....</p>				
	b i	51.2 (%) ✓	<p>1 (AO 2.2)</p> <p><u>Examiner's Comments</u></p> <p>ALLOW 51 / 51.22 or correct rounding</p> <p>This question differentiated well, with the higher ability candidates more likely to correctly calculate the percentage.</p>				
	ii	210 (%) ✓	<p>1 (AO 2.2)</p> <p><u>Examiner's Comments</u></p> <p>ALLOW 209</p> <p>This answer was correctly calculated by half of the candidates.</p>				
	ii i	<p>in the whole population, there are more females / less males ✓</p> <p>however more males are born (than females) ORA ✓</p>	<p>2 (AO 2 × 3.1a)</p> <p>IGNORE less males alive</p> <p>IGNORE there are less males over the whole population than at birth</p> <p>If no other mark scored, credit ratio of males has decreased from</p>				

				birth	
				Examiner's Comments	
				The most common mark scored was that in the whole population there are more females (than males). Of those candidates that didn't score, the vast majority did not compare males against females and stated the number for males at birth compared to the whole population. Exemplar 4 scored full marks.	
				Exemplar 4	
				because  at birth there are more males than females but through the whole population there's more than males. 	
			Total	6	
19	a	change in base sequence of DNA (1)	1		
		change in order of amino acids (1)	1		
		protein shape changes (1)	1		
		reference to shape not being suited to function e.g. change in enzymes active site shape (1)	1		
	b	heterozygous (1)	1		
		does not have Wolfram's syndrome (1)	1		
	c	i Tim's and Lucy's genotypes Nn (1)	1	allow correctly completed punnet square	
		i correct genotypes of offspring (NN, Nn, Nn, nn) (1)	1		
		ii baby may be nn (1)	1		
		ii one in four chance of baby being affected (1)	1		
		ii pancreas produces insulin (1)	1		
		ii insulin controls blood glucose level (1)	1		
		Total	12		
20		A	1		
		Total	1		
21		A	1		

		Total	1	
2 2		A	1	
		Total	1	
2 3		C	1	
		Total	1	
2 4		all genetically identical / all have the same genes (1)	1	all clones (1)
		Total	1	
2 5		A	1	
		Total	1	
2 6		C	1	
		Total	1	