

Question Number	Answer	Acceptable answers	Mark
<b>1a(i)</b>	answers must be in this order.  dominant  HH		<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark									
<b>1a(ii)</b>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>H</td> <td>h</td> </tr> <tr> <td>H</td> <td>HH</td> <td>Hh</td> </tr> <tr> <td>h</td> <td>Hh</td> <td>hh</td> </tr> </table>		H	h	H	HH	Hh	h	Hh	hh	<p>1 mark for correct gametes 1 mark for correct offspring</p> <p>If incorrect gametes allow 1 mark for correct Punnett square based on selected gametes</p>	<b>(2)</b>
	H	h										
H	HH	Hh										
h	Hh	hh										

Question Number	Answer	Acceptable answers	Mark
<b>1a(iii)</b>	75% / $\frac{3}{4}$ / 0.75	<p>accept error carried forward from their Punnett square</p> <p><b>accept:</b> 3 : 1</p>	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1b(i)</b>	<p>An explanation linking <b>two</b> of the following:</p> <p>Huntington's disease is caused by a dominant <u>allele</u> / CF is caused by a recessive <u>allele</u> (1)</p> <p>only one allele for Huntington's disease needs to be inherited to have the disease / would have the disease if heterozygous (or homozygous dominant)(1)</p> <p>two alleles (recessive) need to be inherited to have CF / be homozygous recessive for CF (1)</p>	<p>Ignore refs to gene for allele against this marking point</p> <p>Ignore refs to gene for allele against this marking point</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1b(ii)</b>	<b>A</b> <input checked="" type="checkbox"/> mucus		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1b(iii)</b>	An explanation linking <b>two</b> of the following:  (thick / sticky / more) mucus (1)  builds up in the tubes (of the reproductive system) (1)  (the mucus) blocks the flow of sperm (1)	<b>Reject: mucus in lungs/intestine</b>  accept sperm duct / vas deferens	<b>(2)</b>

Total for question 1 = 10 marks

Question Number	Answer	Acceptable answers	Mark
<b>2(a)(i)</b>	XX	ignore any superscript or subscript letters/symbols reject XY	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(a)(ii)</b>	An explanation linking two of the following  they did not inherit the (haemophilia) allele (1)  (allele is) located on X chromosome (1)  males receive X chromosome from their mother/Y chromosome from father (1)  B is homozygous dominant/ neither X chromosome from B has the allele for haemophilia (1)	ignore gene throughout  accept have the dominant/normal allele  accept disorder is located on the X chromosome  ignore mother is unaffected accept mother neither affected <b>nor</b> a carrier  accept mother for B and father for A	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark																		
<b>2(a)(iii)</b>	<table border="1"> <tr> <td></td> <td><math>X^H</math></td> <td>Y</td> </tr> <tr> <td><math>X^H</math></td> <td><math>X^H X^H</math></td> <td><math>X^H Y</math></td> </tr> <tr> <td><math>X^h</math></td> <td><math>X^H X^h</math></td> <td><math>X^h Y</math></td> </tr> </table> <p>a Punnett square showing the gametes of individuals C and D (1)</p> <p>a Punnett square showing the genotypes of the offspring (1)</p> <p>25% / 0.25 / 1 in 4 probability of a child having haemophilia (1)</p>		$X^H$	Y	$X^H$	$X^H X^H$	$X^H Y$	$X^h$	$X^H X^h$	$X^h Y$	<table border="1"> <tr> <td></td> <td><math>X^H</math></td> <td><math>X^h</math></td> </tr> <tr> <td><math>X^H</math></td> <td><math>X^H X^H</math></td> <td><math>X^H X^h</math></td> </tr> <tr> <td>Y</td> <td><math>X^H Y</math></td> <td><math>X^h Y</math></td> </tr> </table> <p>reject if allele shown on Y chromosome</p> <p>50% of males have haemophilia</p> <p>Punnett square must be interpreted correctly</p>		$X^H$	$X^h$	$X^H$	$X^H X^H$	$X^H X^h$	Y	$X^H Y$	$X^h Y$	<b>(3)</b>
	$X^H$	Y																			
$X^H$	$X^H X^H$	$X^H Y$																			
$X^h$	$X^H X^h$	$X^h Y$																			
	$X^H$	$X^h$																			
$X^H$	$X^H X^H$	$X^H X^h$																			
Y	$X^H Y$	$X^h Y$																			



Question Number	Answer	Acceptable answers	Mark
<b>3a(i)</b>	homozygous recessive	Accept in any order: homozygous recessive (alleles)	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark									
<b>3(a)(ii)</b>	<p style="text-align: center;">female gametes</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">e</td> <td style="text-align: center;">e</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> <tr> <td style="text-align: center;">e</td> <td style="text-align: center;">ee</td> <td style="text-align: center;">ee</td> </tr> </table> <p>male gametes</p> <p>correct gametes in male/female gametes headings (1)</p> <p>correct offspring genotypes (1)</p>		e	e	E	Ee	Ee	e	ee	ee		<b>(2)</b>
	e	e										
E	Ee	Ee										
e	ee	ee										

Question Number	Answer	Acceptable answers	Mark
<b>3a(iii)</b>	<p>Any <b>one</b> of the following</p> <ul style="list-style-type: none"> <li>• 1/2</li> <li>• 0.50</li> <li>• 2/4</li> <li>• 50 %</li> <li>• 1:1 / 2:2</li> </ul>	<p>Accept if 2 correct answers are given e.g. ½, 50%</p> <p>evens chance</p>	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(a)(iv)</b>	A 0%		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(b)</b>	<p>A description including the following points</p> <ul style="list-style-type: none"> <li>• reference to mucus (1)</li> <li>• location described e.g. lungs / pancreas / reproductive system (1)</li> <li>• consequence described e.g. breathing difficulty / infection / weight loss due to blocking of enzymes / difficulty with digestion or absorption / infertility (1)</li> </ul>	<p><b>Accept</b> three symptoms described (3) Ignore: references to symptoms of sickle cell</p> <p>Accept – airways for lungs</p> <p>Accept fertility problems for infertility</p> <p>Symptoms may include</p> <p>diabetes (1) malnutrition (1) incontinence in females (1) sinusitis (1) nasal polyps (1) arthritis (1)</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a)(i)</b>	D		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a)(ii)</b>	substitution (1) 27 ÷ 40  evaluation (1) 0.675 x 100 67.5 (%)	e.c.f from 3(a)(i)  accept 68(%) for 2 marks give full marks for correct answer, no working	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark												
<b>4(b)(i)</b>	gametes  <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td colspan="2" style="text-align: center;">Female</td> </tr> <tr> <td></td> <td style="text-align: center;"><b>b</b></td> <td style="text-align: center;"><b>b</b></td> </tr> <tr> <td style="text-align: center;"><b>B</b></td> <td style="text-align: center;">Bb</td> <td style="text-align: center;">Bb</td> </tr> <tr> <td style="text-align: center;"><b>b</b></td> <td style="text-align: center;">bb</td> <td style="text-align: center;">bb</td> </tr> </table> Male gametes  gametes in male/female gametes headings (1)  offspring genotypes (1)		Female			<b>b</b>	<b>b</b>	<b>B</b>	Bb	Bb	<b>b</b>	bb	bb		<b>(2)</b>
	Female														
	<b>b</b>	<b>b</b>													
<b>B</b>	Bb	Bb													
<b>b</b>	bb	bb													

Question Number	Answer	Acceptable answers	Mark
<b>4(b)(ii)</b>	0.5 / 50% / 50/50 / ½ / 2/4 / 2:2 / even chance	evens	<b>(1)</b>



Question Number	Answer	Acceptable answers	Mark
<b>4(b)(iii)</b>	homozygous recessive homozygous recessive	Accept any reasonable spelling of the term Reject heterozygous	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4 (c)</b>	<p>an explanation linking <b>three</b> of the following</p> <ul style="list-style-type: none"> <li>• speciation (1)</li> <li>• different geographical area may have different selection pressures / environmental conditions (1)</li> <li>• those individuals of a species suited /adapted / to this environment will survive and <b>breed</b> (1)</li> <li>• adaptations/genes passed down to the offspring</li> <li>• new species unable to breed with original (1)</li> </ul>	<p>named environmental conditions e.g. clima</p> <p>Accept survival of the fittest</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(a)(i)</b>	2 / two	(offspring) 2 and 3	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(a)(ii)</b>	D		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(a)(iii)</b>	<p>An explanation linking <b>two</b> of the following points:</p> <ul style="list-style-type: none"> <li>two of the offspring from generation II had CF (1)</li> <li>the children with cystic fibrosis must have inherited 1 recessive allele from each parent / children must have 2 recessive alleles (1)</li> <li>both parents must have 1 recessive allele / be carriers of the CF <b>allele</b> (1)</li> </ul>	<p>ORA if homozygous dominant then no CF offspring</p> <p>Ignore: references to genes</p> <p>ORA if homozygous recessive offspring would have CF</p>	<b>(2)</b>

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<b>5(b)</b>	<p>correct gametes (1)</p> <p>correct offspring (1)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <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> </table>		B	b	B	BB	Bb	b	Bb	bb	Accept bB instead of Bb	<b>(2)</b>
	B	b										
B	BB	Bb										
b	Bb	bb										

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<b>5(c)</b>	<p>An explanation linking <b>two</b> of the following:</p> <ul style="list-style-type: none"> <li>• pedigree analysis will determine the likelihood that their offspring could inherit the CF allele(1)</li> <li>• if heterozygous there is a 50% chance (that the CF allele) will be passed on / if 2 heterozygous parents 25% chance the offspring will have CF(1)</li> <li>• if either parent is homozygous dominant there is 0% chance that their offspring could have the disease(1)</li> </ul>	<p>Accept to see if they are a carrier of the CF allele</p> <p><b>Accept</b> ratios rather than percentages 2 in 4 chance</p>	<b>(2)</b>