

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

Question Number	Answer	Acceptable answers	Mark									
1a(ii)	<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>	(2)
	H	h										
H	HH	Hh										
h	Hh	hh										

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

Question Number	Answer	Acceptable answers	Mark
1b(i)	<p>An explanation linking two 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>	(2)

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

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

Total for question 1 = 10 marks

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

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	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 nor a carrier accept mother for B and father for A	(2)

Question Number	Answer	Acceptable answers	Mark																		
2(a)(iii)	<table border="1"> <tr> <td></td> <td>X^H</td> <td>Y</td> </tr> <tr> <td>X^H</td> <td>$X^H X^H$</td> <td>$X^H Y$</td> </tr> <tr> <td>X^h</td> <td>$X^H X^h$</td> <td>$X^h Y$</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>X^H</td> <td>X^h</td> </tr> <tr> <td>X^H</td> <td>$X^H X^H$</td> <td>$X^H X^h$</td> </tr> <tr> <td>Y</td> <td>$X^H Y$</td> <td>$X^h Y$</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	$X^H Y$	$X^h Y$	(3)
	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
2(b)	<p>An explanation linking the following</p> <p>aseptic conditions (1)</p> <p>prevent growth of unwanted organisms/prevent contamination (1)</p> <p>OR</p> <p>temperature /pH (1)</p> <p>provide optimal conditions for growth /prevent enzymes denaturing (1)</p> <p>OR</p> <p>nutrient levels (1)</p> <p>provide optimal conditions for growth (1)</p> <p>OR</p> <p>aeration/oxygen (1)</p> <p>for <u>aerobic</u> respiration/ provide optimal conditions for growth / prevent <u>anaerobic</u> respiration (1)</p>	<p>ignore sterile</p> <p>provide optimal conditions for enzymes/prevent micro-organisms being killed</p>	(2)

(Total for question 2 = 8 marks)

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

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

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

Question Number	Answer	Acceptable answers	Mark
3(a)(iv)	A 0%		(1)

Question Number	Answer	Acceptable answers	Mark
3(b)	<p>A description including the following points</p> <ul style="list-style-type: none"> • reference to mucus (1) • location described e.g. lungs / pancreas / reproductive system (1) • consequence described e.g. breathing difficulty / infection / weight loss due to blocking of enzymes / difficulty with digestion or absorption / infertility (1) 	<p>Accept 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>	(3)

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	D		(1)

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	substitution (1) $27 \div 40$ evaluation (1) 0.675×100 67.5 (%)	e.c.f from 3(a)(i) accept 68(%) for 2 marks give full marks for correct answer, no working	(2)

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

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	0.5 / 50% / 50/50 / $\frac{1}{2}$ / 2/4 / 2:2 / even chance	evens	(1)

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

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

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

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	D		(1)

Question Number	Answer	Acceptable answers	Mark
5(a)(iii)	<p>An explanation linking two of the following points:</p> <ul style="list-style-type: none"> • two of the offspring from generation II had CF (1) • the children with cystic fibrosis must have inherited 1 recessive allele from each parent / children must have 2 recessive alleles (1) • both parents must have 1 recessive allele / be carriers of the CF allele (1) 	<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>	(2)

Question Number	Answer	Acceptable answers	Mark									
5(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	(2)
	B	b										
B	BB	Bb										
b	Bb	bb										

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