

1 (a)	<p><i>gene</i> a length of DNA that codes for a protein ;</p> <p><i>gene mutation</i> a change in <u>base</u> sequence of DNA ;</p>	[2]	R chromosome / molecule of / genome
(b) (i)	<p>1 Bb ;</p> <p>2 bb ;</p> <p>3 Bb ;</p>	[3]	

Question	Mark	Guidance													
<p>(ii)</p> <p>(Bb x bb)</p> <p>B , b + b , (b) ;</p> <p><i>offspring genotypes</i> Bb and bb ;</p> <p>A heterozygous and homozygous recessive</p> <p><i>offspring phenotypes</i> normal / carrier and acatalasia ;</p>	[3]	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2" rowspan="2"></td> <td colspan="2" style="text-align: center;">male gametes</td> </tr> <tr> <td style="text-align: center;">B</td> <td></td> </tr> <tr> <td rowspan="2" style="text-align: center; vertical-align: middle;">female gametes</td> <td style="text-align: center;">b</td> <td style="text-align: center;">Bb</td> <td></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>			male gametes		B		female gametes	b	Bb		(b)	Bb	(bb)
		male gametes													
		B													
female gametes	b	Bb													
	(b)	Bb	(bb)												
(iii) test (cross) ;	[1]														
	[Total: 9]														

Question		Marks	Guidance Notes
2 (a) (i)	1 cross / breed, (parent) plants with <u>desired</u> feature ; 2 (grow seeds and) chose offspring for (desired) feature(s) ; 3 cross (offspring) plants showing features with, original variety / self / each other ; 4 keep / many generations of, crossing and selecting ; 5 any detail ; e.g. bagging flowers / transfer of pollen (with paintbrush) / detail of seed collection	[max 3]	
(ii)	1 two parents / gametes, are required ; 2 variation in offspring / offspring might not all be red ; 3 time consuming ; 4 AV ; e.g. harvesting seeds / finding pollinators, can be difficult / limited number of seeds / wasteful in context of unused pollen	[max 2]	1 cost / energy
(b)	1 <u>reductio</u> / <u>nuclear division</u> ; 2 chromosome <u>number</u> is halved ; 3 (diploid to) haploid ; 4 results in <u>genetically</u> different, cells / gametes / AW ;	[max 2]	
(c) (i)	$F^A F^N$;	[1]	
(ii)	pink (flowers) ;	[1]	ecf from (c)(i)
(iii)	<i>gametes:</i> F^A , F^N , F^A , F^A ; <i>offspring genotype:</i> $F^A F^A$, $F^A F^N$; <i>offspring phenotype:</i> red, pink ; <i>proportion of pure breeding carnation plants:</i> 50% / 1:1 / 0.5 / half ;	[4]	
		[Total:13]	

Question		Mark	Guidance									
3 (a)	<table border="1" data-bbox="470 311 1261 616"> <thead> <tr> <th data-bbox="470 311 775 414">gametes</th> <th data-bbox="775 311 1016 414">X</th> <th data-bbox="1016 311 1261 414">X</th> </tr> </thead> <tbody> <tr> <td data-bbox="470 414 775 511">X</td> <td data-bbox="775 414 1016 511">XX</td> <td data-bbox="1016 414 1261 511"></td> </tr> <tr> <td data-bbox="470 511 775 616">Y;</td> <td data-bbox="775 511 1016 616">XY</td> <td data-bbox="1016 511 1261 616">XY;</td> </tr> </tbody> </table> <p data-bbox="322 654 1057 684">offspring ratio = 1:1/50:50/50% male, 50% female/2:2 ;</p>	gametes	X	X	X	XX		Y;	XY	XY;	[3]	
gametes	X	X										
X	XX											
Y;	XY	XY;										
(b) (i)	<p data-bbox="322 715 515 760">cat 1 $X^bY;$</p> <p data-bbox="322 760 515 805">cat 4 $X^BY;$</p> <p data-bbox="322 805 515 851">cat 5 $X^BX^B;$</p>	[3]										
(ii)	<p data-bbox="322 896 1043 1032">distinct, phenotypes / coat colours / categories ; no (continuous) range of colour / AW ; controlled by genes ; not affected by the, environment / AW / named example ;</p>	[3]	<p data-bbox="1500 896 1910 926">A only orange, black and calico</p> <p data-bbox="1500 957 1641 987">A inherited</p>									
		[Total: 9]										

4	(a) (i)	<i>Caenorhabditis</i> ;	[1]	
	(ii)	thread-like bodies / filamentous / filament-like ; unsegmented body ; hydrostatic skeleton ; body, tapers / is pointed, at, one / both, ends ; through gut / mouth and anus ; relatively large pharynx / sucking mouthparts ;	max [2]	
	(b)	prevents accumulation of dead matter / removes (organic) waste ; recycles nutrients / named nutrient(s) ; releases (carbon as) carbon dioxide ; (carbon dioxide) for photosynthesis ; decreases particle size of food for decomposers ; ref to energy flow in, food chain / food web / ecosystem ;	max [3]	R energy cycling / recycling
	(c) (i)	gametes from same individual ; self-fertilisation / described ; only new source of variation is mutation ; variation produced by meiosis ;	max [2]	
	(ii)	6 ;	[1]	

<p>(iii)</p>	<p>P meiosis</p> <p>reduction division / chromosome number is halved ;</p> <p>prevents doubling of chromosome number, with each generation / when gametes fuse together / at fertilisation ;</p> <p>ref to haploid (cells / gametes / sex cells) ; gamete / sex cell, production ;</p> <p>Q mitosis</p> <p>growth is taking place ; producing (genetically) identical cells ; more diploid cells ;</p>	<p>max [3]</p>	<p>producing haploid gametes = 2</p>
<p>(d)</p>	<p>in chromosomes ; in the nucleus ; in mitochondria ;</p>	<p>max [2]</p>	<p>A in plasmids ;</p>