17. Inheritance

17.4 Monohybrid inheritance

Paper 3 and 4

Marking Scheme

Q1.

(a)(i)	a length of DNA ; that codes for a protein ;	**2**	
(a)(ii)	nucleus ;	**1**	**A** mitochondria
(b)	15 (people) ;	**1**	
(c)(i)	XX ;	**1**	
(c)(ii)	4 ;	**1**	
(c)(iii)	homozygous recessive ;	**1**	**R** each additional circle
(d)	*parental gametes:* A a x a a ; *offspring genotypes:* Aa (Aa) aa (aa) ; *offspring phenotypes:* unaffected (unaffected) albinism (albinism) ; *ratio* 1:1 ;	**4**	**A** ecf from previous step **A** 2:2 / 50:50 / 50%

Q2.

(a)	**term** / **definition** dominant — an allele that is expressed if it is present genotype — genetic make-up of an organism heterozygous — having two different alleles of a particular gene having two identical alleles of a particular gene phenotype — observable features of an organism	**4**	one mark for each correct line **R** each additional line

Q3.

(b)(i)	1 / one ;	**1**	
(b)(ii)	**D** ;	**1**	
(b)(iii)	3 / three ;	**1**	
(c)	four correct gamete alleles ; four correct offspring genotypes ; (probability …) 0 / zero ;	**3**	
(d)	pure ;	**1**	

		male	
		R	**R**
female	**R**	**RR**	**RR**
	r	**Rr**	**Rr**

Q4.

(a)(i)	gg ; yellow ; yellow ;	**3**	
(a)(ii)	top row both offspring Gg, bottom row both offspring gg ; 1:1 ;	**2**	
(b)(i)	2 ;	**1**	
(b)(ii)	**R** / **S** ;	**1**	
(b)(iii)	0% circled ;	**1**	

Q5.

(b)(i)	*parental genotypes:* **AA and Aa** ; *gametes:* **A A** (×) **A a** ; *offspring genotypes:* **AA**, **AA**, **Aa**, **Aa** ; *offspring phenotypes:* all normal wings ; *probability:* zero ;	**5**	ecf for each subsequent row

(b)(ii)	**AA** ;	**1**	**A** homozygous dominant
(b)(iii)	*Drosophila* ;	**1**	

Q6.

	number / genotype 1 – **bb** ; 2 – **Bb** ; 4 – **Bb** ; 14 – **bb** ;	**4**	

Q7.

(a)(i)	five / 5 ;	1	
(a)(ii)	black (fur / coat) ;	1	
(a)(iii)	homozygous circled ; dominant circled ;	2	
(b)	discontinuous ;	1	

(c)(i)	(male and female gametes) **A** and **a** ; (offspring) **AA**, **Aa**, **Aa** and **aa** ; (phenotypic ratio) 3 (white) : 1 (black) ;	3	ecf from the step before

		male	
		A	**a**
female	**A**	**AA**	**Aa**
	a	**Aa**	**aa**

Q8.

(b)(i)	<table><tr><th>individual</th><th>genotype</th></tr><tr><td>1</td><td>Tt ;</td></tr><tr><td>3</td><td>Tt ;</td></tr><tr><td>4</td><td>Tt ;</td></tr></table>	3	
(b)(ii)	*genotypes:* Tt and tt ; *genotype ratio:* 1 : 1 ;	2	

Q9.

(a)	*any two from:* parent 2, is homozygous recessive / has two alleles (for red-green colour blindness) ; only parent 2 can provide the X chromosome for male children ; males only have one X chromosome and they only need one recessive allele (to be red-green colour blind) ; red-green colour blindness is a sex-linked characteristic ;	2	

(b)	*parental genotypes:* parent 3 X^bY **and** parent 4 X^BX^b ; *gametes:* X^b , **Y/0/-** **and** X^B, X^b ; <table><tr><td>*offspring genotypes*</td><td>X^BX^b,</td><td>X^BY</td><td>X^bX^b</td><td>X^bY</td></tr><tr><td>*offspring phenotypes*</td><td>normal (colour vision) female</td><td>normal (colour vision) male</td><td>colour-blind female</td><td>colour-blind male</td></tr></table> ; ; *probability:* 0.5 / 50% ;	5	

Q10.

(a)	4 ; 3 ;	**2**	**A** 1, 4, 5 and 7 **A** 2, 4 and 5

(d)	*ref. to* I^A and I^B alleles ; I^A and I^B alleles both contribute to phenotype */ ref.* to **AB** blood group ;	**2**	
(e)	*gametes* I^A, I^o **and** I^B, I^o ; *genotypes* I^AI^o, I^AI^B, I^BI^o, I^oI^o ; *phenotypes* **A**, **AB**, **B**, **O** ; *probability* 0.25 / 25% / 1 in 4 ;	**4**	ecf from previous stage

Q11.

(e)(i)	parents of 5 and 7 / parents of people with cystic fibrosis / 2 and 3, do not have cystic fibrosis ; parents / 2 and 3 must be, heterozygous / carriers (of the mutant allele) ;	**2**	

(e)(ii)	1 correct parental genotype **aa** ; 2 correct parental genotype **Aa** ; 3 correct gametes from the parental genotypes ; 4 correct offspring genotypes from their gametes / parental genotypes (in any order) ; 5 correct offspring phenotypes **and** correct probability ;	**5**	*MP1 and MP2 parents may be either way round but following rows must match* **ecf** from MP1 and MP2 **ecf** from MP3 **ecf** from MP4 **expected answer:** *parental genotypes* **aa** × **Aa** *gametes* **a a** + **A a** *offspring genotypes* **Aa (Aa)** **aa (aa)** *offspring phenotypes* without cystic fibrosis / with cystic fibrosis *probability* 50% / 1 in 2 / 0.5

Q12.

(c)(i)	only males, are colour-blind / colour-blindness is more common in males / no females are colour-blind / person **1** and **2** had two male colour-blind children (but no female colour-blind children) ;	**1**	

(c)(ii)	X^AX^a ;;	**2**	MP1 correct sex chromosomes MP2 correct alleles
(c)(iii)	1 correct genotype for person **3**, i.e. $(X)^A(X)^a$; 2 correct genotype for person **4**, i.e. X^AY ; 3 correct gametes from the parental genotypes ; 4 correct offspring genotypes from their gametes / parental genotypes (in any order) ; 5 correct offspring correct probability ;	**5**	MP3 **ecf** from MP1 and MP2 MP4 **ecf** from MP3 MP5 **ecf** from their offspring genotype **expected answer:** *genotype* (person **3**) X^AX^a × (person **4**) X^AY *gametes* X^A, X^a + X^A, Y *offspring genotypes* X^AX^A, X^AX^a, X^AY, X^aY *offspring phenotypes* female with normal colour vision female with normal colour vision male with normal colour vision male with colour blindness) *probability* 0.25 / 25% / 1 in 4 / ¼

Q13.

(a)	selection of suitable letter and case for alleles, e.g. R and r ; *parental phenotypes:* *red fruit* x *red fruit* parental genotypes: Rr ; x Rr ; gametes: R r x R r ; offspring genotypes: (1)RR and (2)Rr and (1)rr ; expected ratio: 3 (red fruit) : 1 (yellow fruit) ;	**6**	
(b)	(perform a) test cross ;	**1**	

Q14.

(b)(i)	P^RP^R ; P^RP^W ; P^RP^R, P^RP^W, P^WP^W ;	**3**	
(b)(ii)	codominance ;	**1**	

Q15.

(a)	transmission of genetic information from generation to generation ;	**1**
(b)(i)	1 correct use of X and Y in responses for individual 5 and individual 8 ; 2 correct X allele given for individual 5: **X^bY / b** ; 3 correct X allele given for individual 8: **X^BY / B** ;	**3**
(b)(ii)	*any three from:* colour blindness is a sex-linked characteristic ; she is, heterozygous for the gene / **Bb** ; she has, normal allele / **B**, so has normal colour vision ; but has passed on the, recessive allele / **b,** to her sons / 5 and 7 ; she has two **X** chromosomes which have the gene for colour vision ; father / 4, passes on his **Y** chromosome ;	**3**

Q16.

(b)(i)	transmission of genetic information from generation to generation ;	**1**
(b)(ii)	two of the same letter both lower case ;	**1**
(b)(iii)	0.25 / 25% / $\frac{1}{4}$;	**1**
(b)(iv)	*any two from:* perform a test cross ; by breeding with, homozygous recessive / king cheetah ; if any of the offspring of the test cross are king cheetahs it confirms 17 is heterozygous ; DNA testing ;	**2**

Q17.

(d)(i)	X^BX^b ;	**1**	
(d)(ii)	X^bY ;	**1**	
(d)(iii)	solid shaded square on Fig. 4.2 ;	**1**	
(d)(iv)	one X chromosome from each parent / an X from father ; mother does not have any colour-blind alleles / father passes on one colour-blind allele ; (all female offspring are) heterozygous / X^BX^b ;	**2**	

Q18.

(c)	the allele for dwarfism is, recessive / **t** ; both parents are heterozygous (so do not express the allele) ;	**2**	

Q19.

(c)(i)	(**P**) X^HX^h ; (**Q**) X^hY ; (**R**) X^HY ;	**3**	
(c)(ii)	0.25 / 25% / 1 in 4 / ¼ ;	**1**	
(c)(iii)	gene is located on, a sex chromosome / X or Y / X / Y ; characteristic is more common in, males / one sex (than the other) ;	**2**	