Mark scheme

Chromosomes, genes and proteins

Biology 0610 · Questions from Paper 3 and Paper 4

Total marks

91

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
7	8	11	11	8	9	9	7	11	10	**91**

Question 1 [7]

1(a)(i)	has two identical alleles (for a particular gene);	1	
1(a)(ii)	(one of the parent plants is white but) all of the offspring have red flowers ;	1	
1(b)	*parental genotypes: (red flower)* **Rr** ; (white flower) **rr** ; *parental gametes:* **R**, **r** and **r**, (**r**) ; *offspring genotypes:* **Rr** and **rr** ; *offspring phenotypes:* red and white ;	5	

Question 2 [8]

2	**(a) (i)**	Y in sperm and X in egg;	1	both correct for 1 mark
	(ii)	zygote;	1	
	(b)	male is XY and female is XX; idea of random assortment (at meiosis); sperm / male gametes are X or Y and eggs / female gametes are all X; idea of equal chance of an X or Y sperm fertilising an egg / random fertilisation;;	**max 3**	**A** information given in Punnett square
	(c) (i)	alleles must be identical / the same;	1	
	(ii)	sex / gender; blood group;	2	
			[Total: 8]	

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Question 3 [11]

3(a)(i)	five / 5 ;	1	
3(a)(ii)	black (fur / coat) ;	1	
3(a)(iii)	homozygous circled ; dominant circled ;	2	
3(b)	discontinuous ;	1	
3(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 <table><tr><td colspan="2"></td><td colspan="2">male</td></tr><tr><td colspan="2"></td><td>**A**</td><td>**a**</td></tr><tr><td rowspan="2">female</td><td>**A**</td><td>**AA**</td><td>**Aa**</td></tr><tr><td>**a**</td><td>**Aa**</td><td>**aa**</td></tr></table>
3(d)	use selective breeding ; breed / cross / mate, two white goats ; select offspring with white coats and breed again / do not breed the offspring with black coats **or** remove black goats ; *idea of* (breeding) over many generations ; correct ref**.** to homozygous dominant ;	3	

Question 4 [11]

4	**(a)**	have 2 alleles which are, the same / identical / homozygous;	[1]	
	(b) (i)	(two or more) alternative / different forms of a gene / AW;	[1]	
	(ii)	long is dominant / expresses itself in heterozygote AW; short is recessive / hidden in heterozygote AW;	[2]	
	(c) (i)	5;	[1]	
	(ii)	3:1;	[1]	
	(d)	Aa; A and a X A and a; (either order) AA Aa Aa aa; (any order so long as correct re “lines”) long long long short; (order must match genotypes)	[4]	allow ecf if a mistake is made, but each line must correspond to the previous one
	(e)	Aa / heterozygote;	[1]	
			[Total: 11]	

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Question 5 [8]

5(a)	<table><tr><td></td><td>I^A</td><td>I^O</td></tr><tr><td>I^B</td><td>I^AI^B</td><td>I^BI^O</td></tr><tr><td>I^O</td><td>I^AI^O</td><td>I^OI^O</td></tr></table> ;; *phenotypes of the children:* **AB**, **B**, **A**, **O** ; *probability…blood group O:* 0.25 / 25% / 1 in 4 ;	**4**	one mark for four correct gametes in Punnett square one mark for four correct offspring genotypes in Punnett square
5(b)	both / two, alleles are expressed in, heterozygote / phenotype / AW ; ref. to, blood group **AB** / I^AI^B ;	**2**	
5c)	*any two from:* phenotype is determined only by a gene ; no effect of environment on phenotype ; only, four / limited number of, phenotypes / (blood) groups / categories ; no intermediates between categories ;	**2**	

Question 6 [9]

6 (a)	*gene* a length of DNA that codes for a protein ; *gene mutation* a change in base sequence of DNA ;	[2]	**R** chromosome / molecule of / genome
(b) (i)	1 **Bb** ; 2 **bb** ; 3 **Bb** ;	[3]	
(ii)	(Bb x bb) **B** , **b** + **b** , (**b**) ; *offspring genotypes* **Bb** and **bb** ; **A** heterozygous and homozygous recessive *offspring phenotypes* normal / carrier and acatalasia ;	[3]	<table><tr><td colspan="2"></td><td colspan="2">male gametes</td></tr><tr><td colspan="2"></td><td>**B**</td><td>**b**</td></tr><tr><td rowspan="2">female gametes</td><td>**b**</td><td>**Bb**</td><td>**bb**</td></tr><tr><td>(**b**)</td><td>(**Bb**)</td><td>(**bb**)</td></tr></table>
(iii)	test (cross) ;	[1]	
		[Total: 9]	

Question 7 [9]

7(a)	discontinuous ;	**1**	
7(b)	*chicken 2* – F^BF^B and F^BF^W ; *chicken 7* – F^WF^W and F^BF^W and F^BF^B ;	**2**	
7(c)	*phenotypes: (**5**)*(male) black and white (feathers) × *(**6**)*(female) black (feathers) ; *parental genotypes:* F^BF^W × F^BF^B ; *gametes:* F^B , F^W F^B , F^B ; *offspring genotypes:* F^BF^W, (F^BF^W) and F^BF^B, (F^BF^B) ; *offspring phenotype percentage:* 50(%) black and white and 50(%) black ;	**5**	ecf from previous step
7(d)	(ABO) blood group / AVP ;	**1**	

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Question 8 [7]

8(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**	
8(b)	*parental genotypes:* parent 3 **X^bY and** parent 4 **X^BX^b** ; *gametes:* **X^b** , **Y/0/- and** **X^B**, **X^b** ; *offspring genotypes*: **X^BX^b**, **X^BY**, **X^bX^b**, **X^bY** ; *offspring phenotypes*: normal (colour vision) female; normal (colour vision) male; colour-blind female; colour-blind male ; *probability:* 0.5 / 50% ;	**5**	

Question 9 [11]

9(a)(i)	letter in Fig. 3.1 / meiosis / mitosis **P** ✓ **Q** ✓ **R** ✓ **S** ✓ **T** ✓ ;;;	**3**	**R** rows with more than one tick 5 rows correct = 3 marks 3 rows or 4 rows correct = 2 marks 2 rows correct = 1 mark 1 row or no rows correct = 0 marks
9(a)(ii)	fertilisation ;	**1**	
9(a)(iii)	1 unspecialised / undifferentiated ; 2 mitosis ; 3 specialised / differentiated ; 4 expressed / AW ; 5 protein(s) / (poly)peptide(s) ;	**5**	
9(b)	*any two from:* 1 meiosis / **P** / haploid stage ; 2 formation of, gametes / egg / sperm ; 3 process **W** / fertilisation / fusion of nuclei (of gametes) OR zygote / embryo, formed ;	**2**	

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Question 10 [10]

10(a)	circle <u>one</u> pair of the inward pointing horizontal sections opposite each other **;**	**1**	
10(b)	21(%) **;**	**1**	
10(c)(i)	<u>gene</u> **;**	**1**	
10(c)(ii)	*any five from:* ribosomes make, proteins / polypeptides **;** mRNA is copied from, gene / DNA **;** DNA stays in the nucleus / mRNA is made in nucleus / mRNA leaves nucleus / mRNA moves to cytoplasm **;** mRNA passes through ribosome / AW **;** ribosome, assembles amino acids / translates mRNA (into a protein) / AW **;** (protein synthesis) uses energy **;** order of amino acids determined by <u>base sequence</u> of, mRNA / DNA / gene **;**	**5**	
10(c)(iii)	*any two from:* carriers **;** receptor(s) (proteins) **;** maltase / enzyme **;** AVP **;**	**2**	

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