PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 8: ORIGINS OF GENETIC VARIATION

TRANSFER OF GENETIC INFORMATION

SCORE	PERCENTAGE
/85	%

STEMUP

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(Total for question = 9 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	• only one copy (of this allele) is required to affect the phenotype (1)	**Accept** (allele that is) always expressed / expressed in heterozygotes	1 grad

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • there are two main peaks as there are only two different alleles (that are not codominant) (1) • environment affects the colour of the feathers (as there are intermediates) / (intermediates are due to) subjective scoring • grey owls have a selective / survival advantage (1)	**Accept** grey peak are homozygous (recessive) owls and brown peak, owls have a dominant allele **Accept** named environmental factors e.g. diet **Accept** converse **Accept** grey survive better due to camouflage	2 exp

Question Number	Answer	Additional Guidance	Mark
(iii)	• correct calculation of q (1) • correct calculation of p (1) • correct calculation of number of heterozygotes (1)	Example calculation 0.84 (accept any number of dp) 0.16 (accept any number of dp) 33 (**Accept** 32) Correct answer with no working gains full marks	3 exp

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • calculation difference (1) • calculation of percentage (1)	Example of calculation difference = 14 - 5 = 9 kg (9 ÷ 5) x 100 = 180 % Correct answer with no working gains full marks	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	there is no difference between GM and non-GM potato yields	ALLOW no significant difference	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: (2) • use Student's t-test to calculate the value of t (1) • correct answer	Example of calculation $2.9^2 \div 6 = 1.4017$ and $2.1^2 \div 6 = 0.735$ $\sqrt{}$ (1.4017 + 0.735) = 1.462 (12.0 – 5.0) ÷ 1.462 = t = 4.788 = 4.79 Correct answer with no working gains full marks	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(iv)	An answer that makes reference to the following: • $p < 0.05$ (1) • difference is not due to chance (1) • so GM potatoes have significantly greater yield than non-GM (1)	Allow ECF for incorrect value of t Allow 0.005	**(3)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • {4 / 9} is colour blind and the (mother / 2 / 6) is not (1) • therefore {mother / 2 / 6} must be {heterozygous / carrier} (1) **OR** • only males are colour blind and their X chromosome is from their mother (1) • none of the mothers are colour blind so they must be heterozygous / carriers (1) **OR** • if colour blindness were dominant {2 / 6 / mother} would have a dominant allele (1) • and {2 / 6 / mother} would therefore be colour blind (1)	**Accept** {4 / 9} is colour blind and the parents are not colour blind **Accept** {6 / 2} are not colour blind but have a son who is colour blind **Do not accept** both parents are heterozygous / carriers	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • parental genotypes of X^RY and X^RX^r (1) • offspring genotypes of X^RX^R, X^rX^R, X^RY, X^rY (1) • 0.25, ¼, 25% (1)	**Accept** different letters e.g. X^BX^b **Accept** TE for mp2 and mp3 for wrong parents if sex-linked **Accept** 25 % if cross is not sex-linked	**(3)**

Q4.

Question Number	Correct Answer	Additional guidance	Mark
(a)	A		**(1)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(i)	• 55% of 12 million = 6,600,000 (1) 91.4% of men have normal vision so: • 100 – 91.4 = 8.6% population with CB (1) • 8.6% of 6,600,000 = 567, 600 (1)	Correct answer gains full marks	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(ii)	An explanation that makes reference to one of the following: • males inherit one X chromosome (1) • recessive allele will always be expressed in males (1) **or** • females inherit 2 X chromosomes (1) • so if they inherit one recessive and one dominant allele, the recessive allele will not be expressed (1)		**(2)**

Question Number	Correct Answer	Additional guidance	Mark
(b)(iii)	An explanation that makes reference to the following: • the highest percentage of defects in cones are in the L and M cones (1) • L cone is sensitive to long wavelengths of light in the red part of the visible spectrum (1) • M cone is sensitive to medium wavelengths of light in the green/ red part of the visible spectrum (1) • therefore a defect in these cones will lead to a person not being able to see light in the red/green spectrum (1)	Accept manipulation of data regarding percentage of cone defects	**(4)**

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to the following: • {independent / random} assortment of chromosomes (1) • {crossing over / recombination / chiasmata formation} between homologous chromosomes (1)	**Accept** correct descriptions of crossing over between homologous chromosomes	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • CC, Cc^{ch}, Cc^{h}, Cc (1)	**Accept** alleles in different order e.g. $c^{h}C$	**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • parents identified as Cc^{h}, Cc^{ch} (1) • F_1 that are crossed identified as $c^{ch}c^{h} \times c^{ch}c^{h}$ (1) • F_2 identified as $c^{ch}c^{ch}$, $c^{ch}c^{h}$, ($c^{ch}c^{h}$), $c^{h}c^{h}$ (1)	**Accept** all mps from Punnett squares **Accept** any clear indication that $c^{ch}c^{h} \times c^{ch}c^{h}$ are crossed	**(3)**

Q6.

Question Number	Indicative content
*	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content: **(P)** • genotypes of the parents are NNGG and nngg • F_1 generation are all NnGg / heterozygous • the ratios are not in 9:3:3:1 ratio **(L)** • genes are linked / genes on same autosome / genes on same chromosome • crossing over has occurred / chiasmata • (most) gametes are NG and ng on one chromosome • smaller number of gametes as nG and Ng on one **(A)** • correct use of genetic diagrams • correct genotypes of F_2 • the normal wing and black body are recombinants / vestigial wing and grey body are recombinants • small number of recombinants suggest genes are closer together

Level	Marks	
0	0	No awardable content
1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context. **minimum 1 comment from P or L: 1 mark**
2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts to provide the explanation being presented. Lines of argument occasionally supported through the application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows some linkages and lines of reasoning with some structure. **minimum 3 comments from P AND L**
3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to provide the explanation being presented. Line(s) of argument supported throughout by sustained application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows a well-developed and sustained line of reasoning which is clear, coherent and logically structured. **minimum 2 comments from P AND 2 from L plus A with no major errors**

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	X^BY FF and X^BY Ff	**Accept** alleles in any combination	1

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to following: • male cats only have one X chromosome / female cats have two X chromosomes (1) • so can have {X^B and X^o / both fur colour alleles} (1)	**Accept** males only have one fur colour allele / only X^B or X^O	2

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • correct parental genotypes X^BX^o ff x X^oYFf • correct gametes X^Bf, X^of and X^oF and X^of, (X^oF), YF, Yf • correct F_1 • correct probability (0.125/12.5% / $^1/_8$)	**ECF** for mp 3 only	**4**

Q8.

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td></td><td>
A genetic diagram that makes reference to the following:

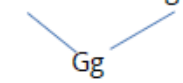
• parent genotype HhPp x HhPp (1)

<table>
<tr><th>Gametes</th><th>HP</th><th>Hp</th><th>hP</th><th>hp</th></tr>
<tr><td>HP</td><td>HHPP hairy purple</td><td>HHPp hairy purple</td><td>HhPP hairy purple</td><td>HhPp hairy purple</td></tr>
<tr><td>Hp</td><td>HHPp hairy purple</td><td>HHpp hairy green</td><td>HhPp hairy purple</td><td>Hhpp hairy green</td></tr>
<tr><td>hP</td><td>HhPP hairy purple</td><td>HhPp hairy purple</td><td>hhPP smooth purple</td><td>hhPp smooth purple</td></tr>
<tr><td>hp</td><td>HhPp hairy purple</td><td>Hhpp hairy green</td><td>hhPp smooth purple</td><td>hhpp smooth green</td></tr>
</table>
• gametes formed all correct (1)
• genotypes all correct (1)
• phenotypes and ratios correct (1)
</td><td></td><td>(4)</td></tr>
</table>

Q9.

Question Number	Answer	Additional Guidance	Mark
	An answer that includes the following: Feature: shape (of abdomen / body) • pointed in female, rounded in male (1) OR Feature: banding pattern (on abdomen) • five bands on female, three bands on male / more bands on female (1)	Refer to both or use a comparative term Accept longer in female / shorter in male Accept description of pattern eg 2 narrow bands and one wide in male and five narrow in female / spots on female / dark tip on male	**Exp (1)**

Q10.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that includes the following: • genetic diagram showing (parents), gametes and genotypes of offspring (1) • ratio of **named phenotypes** of offspring (1)	Accept any upper and lower case symbol eg Gg, not Gb Accept punnet square or  diagram 3 grey (bodied) : 1 black (bodied) 75% grey (bodied) : 25% black (bodied) ¾ grey (bodied) : ¼ black (bodied)	**Exp (2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that includes the following: • each parent produces four types of gametes; LA, La, lA, la (1) • correctly laid out Punnett square (1) • ratio of **named phenotypes** given (1)	 Accept 4 x 4 grid with gametes shown and 16 cells 9 Long winged, normal antennae (accept 9/16) 3 long winged, bushy antennae (accept 3/16) 3 vestigial winged, normal antennae (accept 3/16) 1 vestigial winged, bushy antennae (accept 1/16)	**Exp (3)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that includes the following: • gene for eye colour is sex linked (1) • females have two alleles for eye colour and males have only one (1) • cross 1: Parents are RR / X^RX^R rY / X^rY (1) • cross 2: Parents are rr / X^rX^r RY / X^RY (1)	Accept gene for eye colour is only on X chromosome Accept from diagram Accept allele for eye colour is sex linked Accept description or symbols in genetic diagram eg RR and RY / X^RX^R and X^RY Accept as part of answer for mp3 or 4 Accept males have one X chromosome, females have two and gene for eye colour is on X chromosome If they write Y^R, lose mp 2, 3, 4	Exp (4)

Q11.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer the makes reference to the following: • there is no difference between the number of expected and observed phenotypes		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • -15 225 0.25		(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer the makes reference to the following: • 3		(1)

Question Number	Answer	Additional Guidance	Mark
(iv)	An answer that makes reference to the following: • the {null hypothesis / H_o} is {accepted / not rejected} (1) • critical value is 7.815 (1) • there is a more than {0.05 / 5%} probability that the difference is due to chance / no significant difference / not significant (1)	**ACCEPT** clear indication in table **ACCEPT** for critical value is 6.251 **ACCEPT** (for critical value of 6.251) there is a more than {0.1 / 10%} probability that the difference is due to chance / no significant difference	**(3)**

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • in cross 3 V 4 both parents must be {carriers / heterozygous} (1) • to produce individual {8 /9 / offspring with long fur / offspring with long and short fur} (1)	**Accept** In cross 1 v 2 parent 2 must be heterozygous **Accept** To produce individual 6 / cat with long fur	**2**

Q13.

Question Number	Answer	Additional Guidance	Mark
	AABB and AaBB and AABb and AaBb (in any order)		**1**

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	D X^HY and X^HX^h A is incorrect because 4 must have inherited a haemophiliaallele from 1 B is incorrect because 1 does not have haemophiliaC is incorrect because 1 does not have haemophilia		1
(ii)	An answer that makes reference to: • correct genotypes for 4 and 5 (X^hY and X^HX^h) (1) • correct gametes (1) • correct (genotypes of F_1 and) 0.25 / 25 % (1)	ecf for correct gametes only (mp2)	3

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • Prpr (1)	Allow $C^{Pr}C^{pr}$	(1)
(ii)	an answer that makes reference to the following: • number of each calculated (1) • number of each phenotype identified (1)	26:52:26 / 26:51:26 / 1 : 2 : 1 26 dark purple, 52 light purple, 26 white	(2)
(iii)	An answer that makes reference to thefollowing: • O – E calculated for each phenotype (1) • square the values for O-E and divide by E (1) • calculated (1)	Example calculation 5, 1, -6 0.961538462, 0.019231, 1.38462 2.37 / 2.4 / 2.365 Correct answer with no working gains full marks Allow ecf for expected numbers from cii	(3)

Question Number	Answer	Additional Guidance	Mark
(iv)	An explanation that makes reference to the following: • critical value (at p = 0.05) is 5.991 (1) • calculated value is less than the critical value (1) • p > 0.05 so the conclusion is likely to be valid (1)	Allow correct number indicated in table Allow 2.37 is less than 5.991 (gets mp1 &2) p> 0.05 / 5% that differences between observed and expected are due to chance(so it is valid) Allow p> 0.05 so purple colour is controlledby a single gene with two codominant alleles	**(3)**