

**M1.(a)** Both alleles are expressed / shown (in the phenotype).

*Accept: both alleles contribute (to the phenotype)*

*Neutral: both alleles are dominant*

1

(b) Only possess one allele / Y chromosome does not carry allele / gene / can't be heterozygous.

*Accept: only possess one gene (for condition)*

*Neutral: only 1 X chromosome (unqualified)*

1

(c) 1.  $X^G X^B$ ,  $X^B X^B$ ,  $X^G Y$ ,  $X^B Y$ ;

*Accept: equivalent genotypes where the Y chromosome is shown as a dash e.g.  $X^G-$ , or is omitted e.g.  $X^G$*

*Reject: GB, BB, GY, BY as this contravenes the rubric*

2. Tortoiseshell female, black female, ginger male, black male;

3. (Ratio) 1:1:1:1

*2 and 3. Award one mark for following phenotypes tortoiseshell, black, (black) ginger in any order with ratio of 1:2:1 in any order.*

*Allow one mark for answers in which mark points 1, 2 and 3 are not awarded but show parents with correct genotypes i.e.  $X^G X^B$  and  $X^B Y$  or gametes as  $X^G$ ,  $X^B$  and  $X^B$ , Y*

*3. Neutral: percentages and fractions*

*3. Accept: equivalent ratios e.g. for 1:1:1:1 allow 0.25 : 0.25 : 0.25 : 0.25*

3

(d) (i) Correct answer of 0.9 = 2 marks;

Incorrect answer but shows  $q^2 = 0.81 =$  one mark.

*Note: 0.9% = one mark*

2

(ii) Homozygous dominant increases and homozygous recessive decreases.

1

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- M2.(a)**
1. Cut (DNA) at same (base) sequence / (recognition) sequence;  
*Accept: cut DNA at same place*
  2. (So) get (fragments with gene) **R** / required gene.  
*Accept: 'allele' for 'gene' / same gene* 2
- (b)
1. Each has / they have a specific base sequence;
  2. That is complementary (to allele r or R).  
*Accept description of 'complementary'* 2
- (c)
1. Fragments L from parent rr, because all longer fragments / 195 base pair fragments;  
*Ignore: references to fragments that move further / less, require identification of longer / shorter or 195 / 135*  
*Accept: (homozygous) recessive*
  2. Fragments N from parent RR, because all shorter fragments / 135 base pair fragments;  
*1 and 2 Accept: A3 for 195 and A4 for 135*  
*2. Accept: (homozygous) dominant*
  3. (M from) offspring heterozygous / Rr / have both 195 and 135 base pair fragments.  
*Accept: have both bands / strips*  
*Reject: primer longer / shorter* 3
- (d)
1. (Cells in mitosis) chromosomes visible;
  2. (So) can see which chromosome DNA probe attached to. 2
- (e) (i)
1. For comparison with resistant flies / other (two) experiments / groups;  
*Ignore: compare results / data / no other factors*

2. To see death rate (in non-resistant) / to see effect of insecticide in non-resistant / normal flies.

*Accept: 'pesticide' as 'insecticide'*

*Accept to see that insecticide worked / to see effect of enzyme*

2

- (ii) (PM must be involved because)
1. Few resistant flies die (without inhibitor);
  2. More inhibited flies die than resistant flies;
  3. (PM) inhibited flies die faster (than resistant flies);
- (Other factors must be involved because)
4. Some resistant flies die;
  5. But (with inhibitor) still have greater resistance / die slower than non-resistant flies.

*Accept: (with inhibitor) die slower than non-resistant flies*

4 max

[15]

**M3.(a)** (Genes / loci) on same chromosome.

1

- (b)
1. GN and gn linked;
  2. GgNn individual produces mainly GN and gn gametes;
  3. Crossing over produces some / few Gn and gN gametes;
  4. So few(er) Ggnn and ggNn individuals.

4

(c) (Grey long:grey short:black long:black short) =1:1:1:1

1

- (d)
1. Chi squared test;
  2. Categorical data.

2

[8]

- M4.(a)** (Recessive) allele is always expressed in females / females have one (recessive) allele / males need two recessive alleles / males need to be homozygous recessive / males could have dominant and recessive alleles / be heterozygous / carriers;

*Accept: Y chromosome does not carry a dominant allele.*

*Other answers must be in context of allele not chromosome or gene.*

1

- (b) (i) 1. 1, (2) and 5;

*Accept: for 1 mark that 1 and 2 have slow (feather production) but produce one offspring with rapid (feather production).*

*Neutral: any reference to 3 being offspring of 1.*

2. 1 must possess / pass on the recessive allele / 1 must be a carrier / heterozygous / if slow (feather production) is recessive all offspring of (1 and 2) would be slow (feather production) / if rapid (feather production) was dominant 1 would have rapid (feather production);

*Reject: both parents must be carriers / possess the recessive allele.*

*Reject: one of the parents (i.e. not specified) must be a carrier / heterozygous.*

2

- (ii)  $5 = X^fY / X^fY \cdot / f / f \cdot / fY$  ;

$7 = X^F X^f$  **and**  $X^F X^F$  (either way round) /

**or**  $X^f X^F$  **and**  $X^F X^F$  (either way round) /

**or**  $X^F X^f$ ,  $X^f X^F$  **and**  $X^F X^F$  (in any order);

*Note: allow  $5 = X^f Y$ ,  $X^f Y$ .*

*Accept: for both 5 and 7 a different letter than F. However, lower case and capital letter must correspond to that shown in the answer. For example accept  $7 = X^R X^r$  and  $X^R X^R$ .*

2

- (iii)  $X^F X^f$  **and**  $X^f Y$  **or**  $X^f X^F$  **and**  $X^f Y$

**or**  $X^F X^f$  **and**  $X^f Y \cdot$  **or**  $X^f X^F$  **and**  $X^f Y \cdot$  /

**or**  $Ff$  **and**  $fY$  /

**or**  $Ff$  **and**  $fY \cdot$  /

or Ff and f- /

or Ff and f;

*Accept: a different letter than F. However, lower case and capital letter must correspond to that shown in the answer.*

*Accept: each alternative either way round.*

1

(c) Correct answer of 32 (%) = 3 marks;;;

*Accept: 0.32 = 2 marks*

If incorrect answer, allow following points

1.  $p^2 / q^2 = 4\% / 0.04 /$  or  $p / q = 0.2$ ;

2. Shows understanding that  $2pq =$  heterozygotes / carriers;

*Accept: answer provided attempts to calculate  $2pq$ . This can be shown mathematically i.e. 2 x two different numbers.*

3

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