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Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

2002

XVIII

1583

Time allowed

44 Minutes

Score

137

Percentage

%

Biology

**AQA
AS & A LEVEL**

Mark Scheme

3.7 Genetics, populations, evolution and ecosystems

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1. Use 1 in 400 to find frequency of homozygous recessive / q^2

OR

1 in 400 gives frequency of 0.0025;

Note - convention has recessive allele as q and dominant allele as p but allow reversal (since outcome is the same) as long as this is consistent throughout

2. Find square root of q^2 / find square root of 0.0025;
3. Use of $p + q = 1.0$ / determine frequency of both alleles / both p and q / find $p = 0.95$ and $q = 0.05$;
4. Use of $2pq$ to find carriers / heterozygotes;

The question requires a description but credit working where correct as alternative since this shows the stages

[3]



- 2 (a) 1. Allows (valid) comparison;
2. Number / sample size may vary; 2
- (b) 1. Increased chance of (severe malaria) with blood group A / decreased chance of (severe malaria) with sickle cell;
Accept: converse for mild malaria i.e. increased chance of mild malaria with sickle cell / decreased chance of mild malaria with blood group A.
Accept: if answer is comparative e.g. greatest risk of severe malaria with blood group A.
2. One mark for one of the following:
almost equal chance with blood group O / slightly greater chance of mild malaria with O / slightly lower chance of severe malaria with O / 2.5 x / 2.48 x / more than twice the chance of severe with blood group A / (almost) 50% / half the chance of severe malaria with sickle cell / twice the chance of mild malaria with sickle cell;
Neutral: answers which only refer to or use ratios. 2
- (c) 1. Individuals with the **Hb^c** (allele) reproduce;
2. Pass on **Hb^c** (allele) which increases in frequency;
3. **Hb^A Hb^A** individuals less likely to survive / reproduce / frequency of **Hb^A** (allele) decreases; 3

[7]



3 (a) 0.32.

Correct answer = 2 marks

Accept 32% for 1 mark max

Incorrect answer but identifying 2pq as heterozygous = 1 mark

2

- (b) 1. Mutation produced *KDR minus* / resistance allele;
2. DDT use provides selection pressure;
3. Mosquitoes with *KDR minus* allele more likely (to survive) to reproduce;
4. Leading to increase in *KDR minus* allele in population.

4

- (c) 1. Neurones remain depolarised;
2. So no action potentials / no impulse transmission.

2

- (d) 1. (Mutation) changes shape of sodium ion channel (protein) / of receptor (protein);
2. DDT no longer complementary / no longer able to bind.

2

[10]



- 4 (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⁻ / f / f⁻ / fY ;

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

or X^fX^F **and** X^FX^F (either way round) /

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

Note: allow 5 = X^fY, X^fY⁻.

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^RX^r and X^RX^R.

2

(iii) X^FX^f **and** X^fY **or** X^fX^F **and** X^fY

or X^FX^f **and** X^fY⁻ **or** X^fX^F **and** X^fY⁻ /

or Ff **and** fY /

or Ff **and** fY⁻ /

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. $p^2 / q^2 = 4\% / 0.04 / \text{or } p / q = 0.2;$

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

[9]

5 (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

[8]