

# Genetics test

## HL - model

## answers

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### Multiple choice questions

1. In Guinea pigs the allele for tufts of fur called “rosette”, (R) is dominant to the smooth fur allele (r). In a different gene the allele for dark eyes (D) is dominant over the allele for red eyes. (d)

A cross is performed between a rosette fur female with dark eyes and a smooth fur and red eyed male.

Which of the following pairs of offspring genotypes are both recombinant genotypes.

A. RrDd and RrDd

B. rrDd and Rrdd

C. Rrdd and RrDd

D. rrDd and RrDd

(1)

2. In Guinea pigs the allele for tufts of fur called “rosette”, (R) is dominant to the smooth fur allele (r). In a different gene on a different chromosome the allele for dark eyes (D) is dominant over the allele for red eyes. (d)

If two rosette Guinea pigs with the genotypes RrDd and Rrdd are crossed together, what ratio of phenotypes is expected in the offspring?

A. 9 rosette dark eyed : 3 rosette red eyed : 3 smooth dark eyed : 1 wrinkled red eyed

B. 3 rosette dark eyed : 3 rosette red eyed : 1 smooth dark eyed : 1 smooth red eyed

C. 3 rosette dark eyed : 1 rosette red eyed : 3 smooth dark eyed : 1 smooth red eyed

D. 1 rosette dark eyed : 1 rosette red eyed : 1 smooth dark eyed : 1 smooth red eyed

(1)

3. Two genes A and B are linked together as a genotype shown below in linkage notation.

The genes are so close together on the chromosome that crossing over very rarely occurs. Which of the following statements is true of the gametes produced by an organism with this genotype?

A. All of the gametes will be Ab and aB.

B. There will be an equal number of gametes Ab, aB, ab and AB.

C. There will hardly any Ab or ab gametes.

D. There will be a lot more aB gametes than AB gametes. (1)

4. The diagram below illustrates pairs of homologous chromosomes during prophase I of meiosis? How many chromosomes, chromatids and chiasmata are shown?

	Number of chromosomes	Number of chromatids	Number of chiasmata
A.	2	4	2
B.	4	4	2
C.	4	4	4
<b>D.</b>	<b>4</b>	<b>8</b>	<b>4</b>

(1)

5. The diagram below shows a cell undergoing meiosis. What is this stage of meiosis?

- A. Anaphase I
- B. Prophase I
- C. Anaphase II**
- D. Telophase II

(1)

6. In Morgan's experiments with *Drosophila* flies he crossed a white eyed male with a wild type (red eyed) fly. All of the offspring, both males and females, had red eyes.

What can be concluded from this experiment?

- A. Most genes are linked.
- B. The eye colour gene is sex linked.
- C. The red eye allele is dominant.**

D. The inheritance is caused by multiple alleles

(1)

7. Which row of the table describes the behaviour of chromosomes in metaphase I and anaphase II of meiosis?

	<b>Metaphase I</b>	<b>Anaphase II</b>
A.	Individual chromosomes line up at the equator	Separation of homologous chromosomes
B.	Tetrads (homologous pairs) line up at the equator	Separation of homologous chromosomes
C.	Individual chromosomes line up at the equator	Separation of sister chromatids
<b>D.</b>	<b>Tetrads (homologous pairs) line up at the equator</b>	<b>Separation of sister chromatids</b>

(1)

8. The diagram below shows a cell in meiosis. What can be deduced from this diagram?

	<b>Stage of meiosis shown</b>	<b>Haploid number of chromosomes in this species</b>
A.	Metaphase I	4

B. Metaphase II 4

C. Metaphase I 2

D. Metaphase II 2

(1)

9. Which of the following can result in the continuous variation of a characteristic?

A. Most genes are linked.

B. Rates of mutation are high.

C. The inheritance is polygenic.

D. The inheritance is caused by multiple alleles.

(1)

10. Speciation can be caused by which of the following:

A. More genes in a population are linked.

B. Allele frequencies change over time in isolated populations.

C. The gene pool of a population is mixed by interbreeding.

D. The environment varies so little.

(1)

## Structured answer questions

11. Compare and contrast the position of chromosomes in metaphase I and metaphase II of meiosis in an organism with a diploid chromosome number of 4 (i.e.  $2n = 4$ )

.....  
.....

**Comparisons:**

chromosomes are condensed / coiled up / visible in both metaphase I and metaphase II;

chromosomes are arranged on the equator of the spindle in both;

**Contrasts**

(homologous) chromosomes are in pairs in metaphase I but arranged as single chromosomes in metaphase II;

crossing over / chiasmata visible in metaphase I but not metaphase II;

.....  
..... (3 marks)

12. Describe with aid of a diagram how the unique composition of alleles on any single chromosome in a gamete is promoted by the formation of chiasmata by crossing over.

Chromosomes contain alleles of many genes.

Each chromosome has a unique mix of alleles because of crossing over.

Pieces of DNA can be exchanged by none sister chromatids

In prophase I on meiosis

Labelled Diagram - showing chiasmata

[2 max] if no diagram is shown.

.....  
... (3 marks)

13. Wolves (*Canis lupus*) sometimes have black coats and yellow-green eyes but they usually have agouti-grey coats and amber-brown eyes. Each of these traits is thought to be controlled by a

single gene located on different chromosomes. Assume that the agouti-grey coat colour allele (A) is dominant over the black allele(a) and the amber-brown eyes allele (B) is dominant to the yellow-green eyes allele (b).

a) Suppose a male wolf with black fur and yellow-green eyes mates with a female who is heterozygous for both genes. Use a Punnet square to predict the F1 offspring phenotype ratio.

**One mark for each row and a mark for a correct punnet square**

Parent genotypes = AaBb x aabb

Gametes AB Ab aB ab and ab

	ab
AB	AaBb (Agouti grey / dark eyes)
Ab	Aabb (Agouti grey / yellow-green eyes)
aB	aaBb (Black fur / dark eyes)
ab	aabb (Black fur / yellow-green eyes)

The phenotype ratio is 1:1:1:1

.....  
 ..... ( 4marks)

b) On the Kenai National Wildlife Refuge in Alaska a study of 64 wolves captured by on the reserve from 1976 to 1981 found 67% grey and 33% black. A similar study of 125 wolves were live-captured between 1982 and 2000 of which 87% were agouti-grey, but only 13% were black. During the same period across the whole of Alaska 75% of the 14,702 records of wolves were agouti-grey and this has remained constant.

b i) Evaluate the evidence from the studies mentioned above in support of the hypothesis that the frequency of black coloured wolves in the reserve is declining.

.....  
.....  
.The data supports the hypothesis that the frequency of black wolves is declining because the numbers of black wolves captured is lower in 1982-2000 than in 1976-1981

The data is limited because the number of wolves is low, compared to the 14702 caught in Alaska /

The data is limited because there are only two different studies / it is not possible to say what happens between 1982 and 2000 for example. / it is best to have five or more values to test for a correlation.

.....  
..... (2 marks)

b ii) An ecologist has suggested that the number of black wolves in the refuge before 1981 had been higher than the overall Alaskan percentage because wolf hunting was banned in the refuge until 1981. Suggest a possible explanation for this hypothesis that there are more black wolves because hunting is banned.

.....  
.....  
Black wolves are more visible in the snow

Hunters shoot more black wolves than agouti grey wolves. / Prey can see the black wolves more easily so run away making it harder for black wolves to catch food.

.....  
..... (2 marks)

c) Assuming that the percentage of black wolves is declining between 1981 and today, is this an examples of directional selection, stabilizing selection or disruptive selection?

.....  
.....  
Directional selection - towards there being more agouti grey wolves.

(1 mark)

d) Explain the concept of a gene pool.



.....  
.....

A gene pool is the set of all the genes/alleles in an interbreeding population.

(1 mark)

e) How does selection (your answer to part c) affect the alleles in the gene pool of the wolves?

.....  
.....

Hunters kill more black wolves than agouti grey wolves

So the black fur alleles are removed from the gene pool / there are fewer black alleles in the gene pool.

There are then proportionally more agouti fur alleles

.....  
..... (2 marks)

14. In strawberry poison dart frogs there is a wide range of skin colours that have been shown to be under polygenic control, while skin patterns are probably controlled by a single gene.

a) Describe how polygenic control of a phenotype works using the example of strawberry poison dart frog skin colour.

.....  
.....

Polygenic control results in continuous variation in a phenotype, ie a range of colours from blue to red.

More than one gene each partly controls the phenotype.

Each gene has a similar influence on the genotype.

The more dominant alleles an organism possesses the more strongly the colour is expressed.

.....  
..... (3 marks)

b) Distinguish between the range of phenotypes produced in polygenic inheritance and single gene inheritance.

There are many different genotypes possible with polygenic inheritance, but in single gene inheritance there are usually just two (or three / four e.g. blood groups.)

.....  
..... (2 mark)

TOTAL = 35 marks