Patterns of Inheritance

Question Paper 2

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Genetics, evolution and ecosystems
Topic	Patterns of inheritance
Booklet	Question Paper 2

Time allowed: **43 minutes**

Score: **/32**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Domestic chickens have been bred for many years to increase the number of eggs laid by the females. It is useful to be able to identify the young female chicks on the day after they hatch, as only the females need to be kept for laying eggs.

Unlike mammals, where the sex chromosomes are known as X and Y, in chickens the sex chromosomes are known as Z and W.

- Male chickens have two Z chromosomes (ZZ).
- Female chickens have one Z chromosome and one W chromosome (ZW).

(a) Some genes for feather colour and pattern in chickens are carried on the Z chromosome but not on the W chromosome. One such example is the gene for striped feathers (barring).

State the name given to this type of inheritance. **[1]**

(b) Inheritance of the barring pattern can be used to identify female chicks when they are one day old.

The phenotypes associated with the two alleles of the barring gene are shown in Table 1.1.

Allele	Adult phenotype	Day-old chick phenotype
dominant **B**	black feathers striped with white bars (barred)	black body with a white spot on head
recessive **b**	black feathers (non-barred)	black body and head

Table 1.1

(i) State the **adult phenotypes and sex** of the following individuals: **[3]**

Z^BZ^b .....

Z^BW .....

Z^bW .....

(ii) A cross was carried out between a barred female and a non-barred male.

Complete the genetic diagram to show the parental genotypes, their gametes and the F1 genotypes. State the phenotypes of the offspring as **day-old chicks**. **[5]**

Parent phenotypes	**Barred female**	**Non-barred male**
Parent genotypes	.....	.....
Gametes	.....	.....
F1 genotypes	.....	.....
F1 day-old chick phenotypes		
male		
female		

(c) The autosomal gene **I / i** shows epistasis over **all** other genes affecting feather colour in chickens.

Individuals carrying the dominant allele **I** have white feathers.

Chickens that are not white have the genotype **ii**.

(i) State the precise term used to describe the genotype **ii**. **[1]**

(ii) Predict the colour(s) of the offspring of a cross between a male homozygous barred chicken and a white female chicken with the genotype **II**. **[1]**

[Total: 11]

A long-term breeding experiment to investigate the **genetic** basis of tame (friendly) behaviour was carried out in a population of silver foxes. The foxes were bred each year and the resulting young foxes assessed each month between the ages of 1 and 8 months to see how tame they were.

Table 6.1 shows how the foxes were put into categories according to their tameness.

Table 6.1

tameness class	description of behaviour towards humans
3	Not tame – these foxes run away from humans or bite when handled.
2	Neutral – these foxes allow handling by humans but show no emotionally friendly response.
1	Tame – these foxes are friendly to humans. They wag their tails and whine for attention.
elite	Very tame – these foxes are eager for human contact. They whimper to attract attention and sniff and lick humans.

The tamest 5% of the male foxes and the tamest 20% of the female foxes in each generation were used for breeding to produce the next generation. This was repeated for over forty generations.

(a) (i) State the name given to the process in which only a certain percentage of adult foxes were chosen by humans to breed in each generation.

[1]

(ii) Suggest why 20% of the female foxes were used for breeding but only 5% of the male foxes.

[2]

(b) Table 6.2 shows the number of foxes in the elite tameness class during the long-term experiment.

Table 6.2

number of generations	foxes in elite class (%)
10	18
20	35
35	75

Discuss what the results shown in Table 6.2 suggest about the **causes of the variation** in tameness behaviour in silver foxes.

[3]

(c) As tameness increased in the silver fox population over the years, it was noticed that other phenotypic traits also became more common.

Table 6.3 compares the frequency of these traits in a control group of silver foxes that had not been used in this long-term breeding experiment and in the tame population of foxes.

Table 6.3

phenotypic trait	animals showing trait (per 100 000)		percentage increase in trait
	control population	tame population	
white patch of fur on head	710	12400	1646
floppy ears	170	230	35
short tail	2	140	6900
curly tail	830	9400	1033

Students were asked to suggest a variety of genetic hypotheses to explain why these traits become more common in tame foxes. Their suggestions were:

linkage **epistasis** **inbreeding** **genetic drift**

Select **one** hypothesis from the list and explain how it could account for the data in Table 6.3.

[2]

(d) Similar changes in tameness, colour and body shape are believed to have occurred in the 11 000 year period during which the grey wolf species, *Canis lupus*, evolved into the domesticated dog species, *Canis familiaris*.

Suggest how different types of isolating mechanism allowed dogs to evolve separately to wolves.

[3]

(e) Interbreeding between members of the wolf species and some dogs has been reported. However, there are some large breeds of dogs that cannot breed successfully with small dog breeds.

Use this information and your own knowledge to explain the problems of classifying wolves and different dog breeds according to:

- the biological species concept
  and
- the phylogenetic species concept.

[4]

[Total:15]

For centuries, artificial selection has been used to improve the quality of crop plants used for human consumption.

Explain, with reference to selective breeding, why it is important to maintain viable wild populations of crop plant species.

[6]