16.2 The Roles of Genes in Determining the Phenotype

Question Paper

Course	CIE A Level Biology
Section	16. Inheritance
Topic	16.2 The Roles of Genes in Determining the Phenotype
Difficulty	Easy

Time allowed: 30

Score: /22

Percentage: /100

Question 1a

In cats, a gene found on the X chromosome determines fur colour. One allele **G** codes for ginger fur and the other allele **B** codes for black fur. Heterozygous female cats will have both ginger and black fur, a phenotype known as tortoiseshell.

Identify and explain the type of allele interaction in this example.

[2 marks]

Question 1b

Using the information given in part (a), state why it is not usually possible for a male cat to have tortoiseshell fur.

[1 mark]

Question 1c

A female tortoiseshell cat was crossed with a black male cat.

Use a genetic diagram to calculate the percentage of their offspring that are likely to be black male cats.

[3 marks]

Question 1d

The presence of another gene at a locus on a different chromosome results in cats with completely black fur.

Identify the term used to describe this type of allele interaction.

[1 mark]

Question 2a

In guinea pigs, the allele for black hair (**B**) is dominant to the allele for white hair (**b**) and the allele for long hair (**L**) is dominant to the allele for short hair (**l**). A double homozygous guinea pig with long, black hair was bred with another double homozygous guinea pig with long white hair.

State the genotypes of the **two** parent guinea pigs.

[2 marks]

Question 2b

Use a genetic diagram to show the ratio of different phenotypes which could result from the cross discussed in part (a).

[3 marks]

Question 2c

Fur colour in mice is controlled by two genes. One gene (**B/b**) controls the expression of a specific fur colour, while production of hair pigment is controlled by another gene (**C/c**). The allele for black fur (**B**) is dominant to the allele for brown fur (**b**). Mice that possess the homozygous recessive genotype (**cc**) will lack hair pigment making them albino. This is an example of epistasis.

Scientists completed an investigation on a group of 20 mice into the incidence of albinism but found that their results did not achieve the same ratios as expected.

Suggest **two** reasons why their ratios may not have matched up to the expected ratios.

[2 marks]

Question 2d

In order to establish whether there was a significant difference between the actual results and the expected results, a statistical test is required.

Identify which statistical test the scientists should use.

[1 mark]

Question 3a

In some plant species height is partially controlled by the *L*e gene. The gene codes for an enzyme that is involved in a pathway that forms active gibberellin, the hormone which helps plants grow. The allele for tall plants (*L*e) is dominant to the allele for short plants (*l*e).

State the phenotype of a plant that is heterozygous for the *L*e gene.

[1 mark]

Question 3b

Plants that are homozygous for the recessive allele *l*e are dwarves.

Explain the reason for this.

[2 marks]

Question 3c

Huntington's disease is a genetic condition that is characterised by neurological degeneration. Individuals with Huntington's disease have abnormal alleles of the *HTT* gene.

Describe how a gene, such as *HTT*, can affect the phenotype of an individual.

[2 marks]

Question 3d

A person that is heterozygous for the abnormal *HTT* allele will most likely develop Huntington's disease.

Explain the reason for this.

[2 marks]