

1 Catalase is an enzyme that breaks down hydrogen peroxide inside cells. Red blood cells contain catalase.

Some dogs have an inherited condition in which catalase is not produced. This condition is known as acatalasia and it is caused by a mutation in the gene for catalase.

(a) Define the terms *gene* and *gene mutation*.

gene.....

 gene mutation.....

[2]

(b) A geneticist was asked to investigate the inheritance of acatalasia in dogs.

The normal allele is represented by **B** and the mutant allele is represented by **b**.

The geneticist made the diagram in Fig. 3.1 to show the inheritance of acatalasia in a family of dogs. The shaded symbols indicate the dogs with acatalasia.

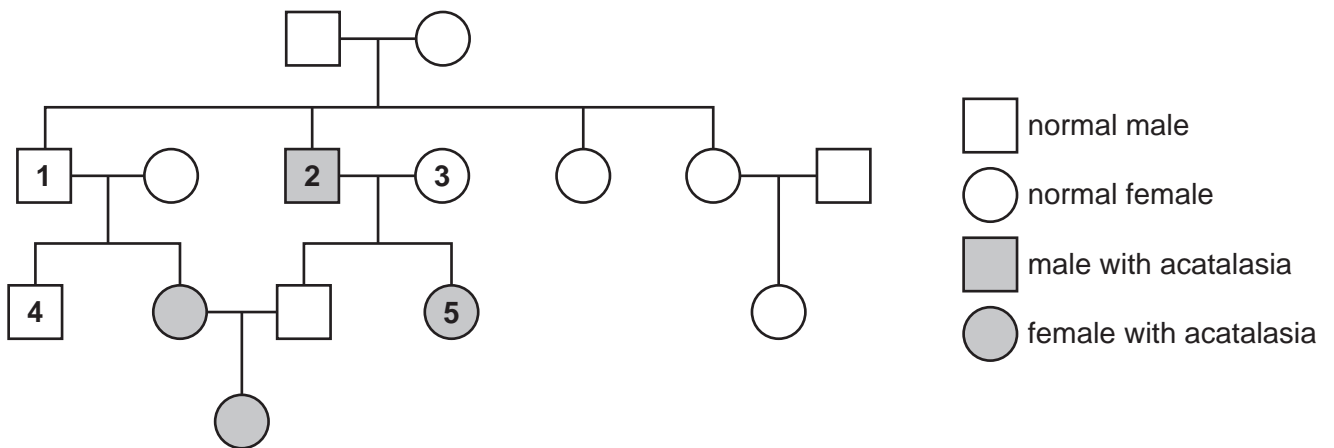


Fig. 3.1

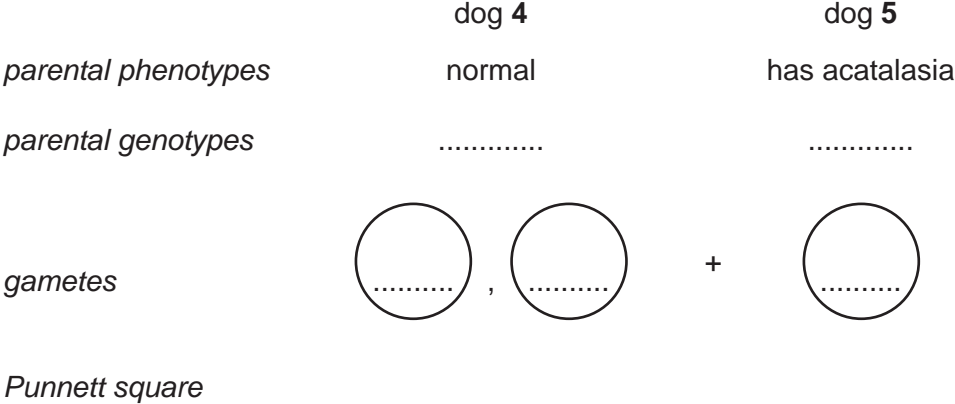
(i) State the genotypes of the dogs identified as 1, 2 and 3 in Fig. 3.1.

1
 2
 3

[3]

(ii) The geneticist crossed dog 4 with dog 5. Approximately half of the offspring had acatalasia and half the offspring did not have acatalasia.

Complete the genetic diagram to show how this is possible.



offspring genotypes.....

offspring phenotypes..... [3]

(iii) State the name given to the type of cross that you have completed in (b)(ii).

..... [1]

[Total: 9]

2 Anthocyanin is a red pigment found in carnation flowers. Some carnation plants have a gene for making anthocyanin.

(a) (i) A flower grower bred red carnations.

Describe how growers selectively breed plants.

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[3]

(ii) Explain the disadvantages of using sexual reproduction to breed red carnations.

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[2]

(b) Meiosis is necessary for sexual reproduction of carnation plants.

Define the term *meiosis*.

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.....

[2]

(c) Carnation plants show co-dominance for the anthocyanin gene. There are two alleles:

- F^A – allele for anthocyanin pigment (red flowers)
- F^N – allele for no anthocyanin pigment (white flowers)

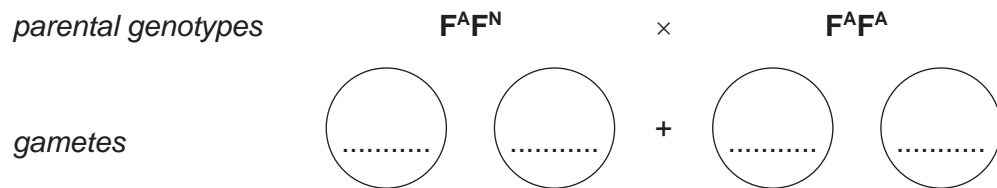
(i) State the genotype of a carnation plant that is heterozygous for this gene.

..... [1]

(ii) Describe the phenotype of a heterozygous carnation plant for this gene.

.....
 [1]

(iii) The breeder crossed a $F^A F^N$ carnation plant with a $F^A F^A$ carnation plant. Predict, using a genetic diagram, the proportion of pure breeding carnation plants in the offspring.



Punnett square

offspring genotypes

offspring phenotypes

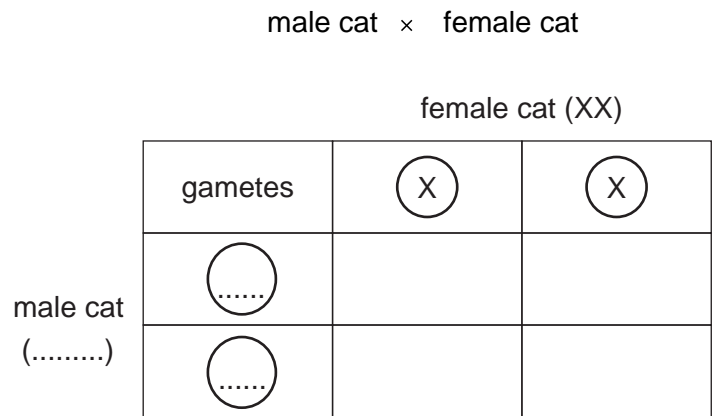
proportion of pure breeding carnation plants

[4]

[Total: 13]

3 (a) Sex in cats is determined in the same way as in humans.

Complete the diagram below to show how sex is determined in cats.



offspring ratio..... [3]

(b) A scientist investigated the inheritance of fur colour in cats.

The gene for coat colour is located on the X chromosome. The gene has two alleles:

- **B** black
- **b** orange.

The X chromosome with the allele for black is represented by X^B .
The X chromosome with the allele for orange is X^b .

A female cat can be a mixture of these colours, described as calico.

Fig. 3.1 shows the inheritance of this condition in a family of cats.

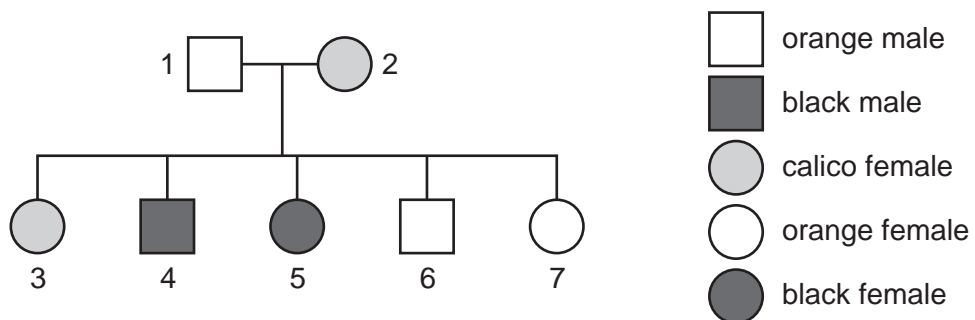


Fig. 3.1

(i) State the genotypes of cats 1, 4, and 5 in Fig. 3.1.

cat 1

cat 4

cat 5 [3]

(ii) Coat colour in cats is an example of discontinuous variation.

Explain why coat colour is an example of discontinuous variation.

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..... [3]

[Total: 9]

4 Fig. 5.1 shows the nematode, *Caenorhabditis elegans*.



Fig. 5.1

(a) (i) State the genus of this nematode.

.....[1]

(ii) State two **structural** features of nematodes.

1

2

[2]

(b) Nematodes feed on dead and decaying material. Explain why this gives nematodes an important role in ecosystems.

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.....[3]

(iii) Explain why **meiosis** occurs at **P** and **mitosis** occurs at **Q**.

meiosis at **P**.....
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.....

mitosis at **Q**
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.....[3]

(d) *C. elegans* was one of the first organisms to have its genome sequenced.

An organism's genome is the sum of all its genetic material. Gene sequencing identifies all the component parts of the DNA that makes up the genome.

State where DNA is located in a cell.

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.....[2]

[Total: 14]