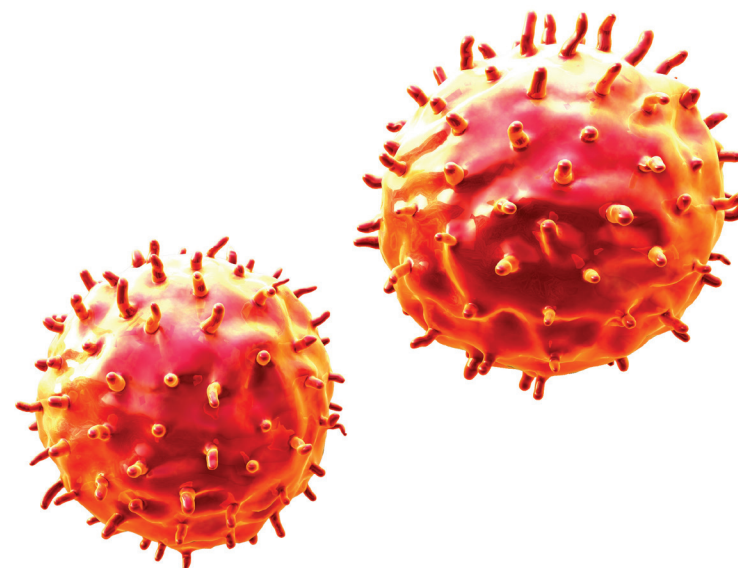


Interactive Example Candidate Responses

Paper 4 (May / June 2016), Question 3

Cambridge IGCSE™
Biology 0610



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- 3 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... a length of DNA that codes for a protein.

gene mutation... a change in base sequence of DNA.

[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.

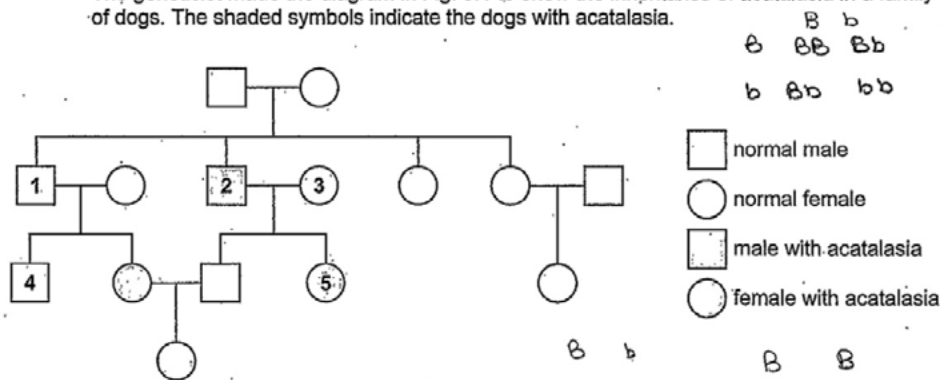


Fig. 3.1

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

1 ~~bb~~ Bb

2 bb

3 Bb

[3]

Select page

Your Mark

3(a)

3(b)(i)

3(b)(ii)

3(b)(iii)

Q3 Mark scheme

(a)	<i>gene</i> a length of DNA that codes for a protein ; R chromosome/molecule of/genome <i>gene mutation</i> a change in <u>base</u> sequence of DNA ; 2 marks																	
(b)(i)	1 Bb ; 2 bb ; 3 Bb ; 3 marks																	
(b)(ii)	(Bb x bb) B , b + b , (b) ; <table border="1" data-bbox="1489 590 2150 750"> <tr> <td colspan="2"></td><th colspan="2">male gametes</th></tr> <tr> <td colspan="2"></td><th>B</th><th>b</th></tr> <tr> <th rowspan="2">female gametes</th><th>b</th><td>Bb</td><td>bb</td></tr> <tr> <th>(b)</th><td>(Bb)</td><td>(bb)</td></tr> </table> offspring genotypes Bb and bb ; A heterozygous and homozygous recessive offspring phenotypes normal/carrier and acatalasia ; 3 marks					male gametes				B	b	female gametes	b	Bb	bb	(b)	(Bb)	(bb)
		male gametes																
		B	b															
female gametes	b	Bb	bb															
	(b)	(Bb)	(bb)															
(b)(iii)	test (cross) ; 1 mark																	

- (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.

dog 4 dog 5

parental phenotypes normal has acatalasia

parental genotypes Bb bb

gametes B b b

Punnett square

	B	b
b	Bb normal	bb acatalasia
b	Bb normal	bb acatalasia

offspring genotypes..... Bb, bb

offspring phenotypes..... normal, acatalasia. [3]

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

test cross.

[1]

[Total: 9]

Your
Mark

3(a)

3(b)(i)

3(b)(ii)

3(b)(iii)

Q3	Mark scheme													
(a)	<p><i>gene</i> a length of DNA that codes for a protein ;</p> <p>R chromosome/molecule of/genome</p> <p><i>gene mutation</i> a change in <u>base</u> sequence of DNA ;</p> <p>2 marks</p>													
(b)(i)	<p>1 Bb ;</p> <p>2 bb ;</p> <p>3 Bb ;</p> <p>3 marks</p>													
(b)(ii)	<p>(Bb x bb)</p> <p>B , b + b , (b) ;</p> <table><tr><td colspan="2" rowspan="2"></td><th colspan="2">male gametes</th></tr><tr><th>B</th><th>b</th></tr><tr><th rowspan="2">female gametes</th><th>b</th><td>Bb</td><td>bb</td></tr><tr><th>(b)</th><td>(Bb)</td><td>(bb)</td></tr></table> <p><i>offspring genotypes</i> Bb and bb ;</p> <p>A heterozygous and homozygous recessive</p> <p>offspring phenotypes normal/carrier and acatalasia ;</p> <p>3 marks</p>			male gametes		B	b	female gametes	b	Bb	bb	(b)	(Bb)	(bb)
				male gametes										
		B	b											
female gametes	b	Bb	bb											
	(b)	(Bb)	(bb)											
(b)(iii)	<p>test (cross) ;</p> <p>1 mark</p>													

- 3 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... a strand of DNA that codes for protein.

gene mutation... a copy of a gene that is different to the original

[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.

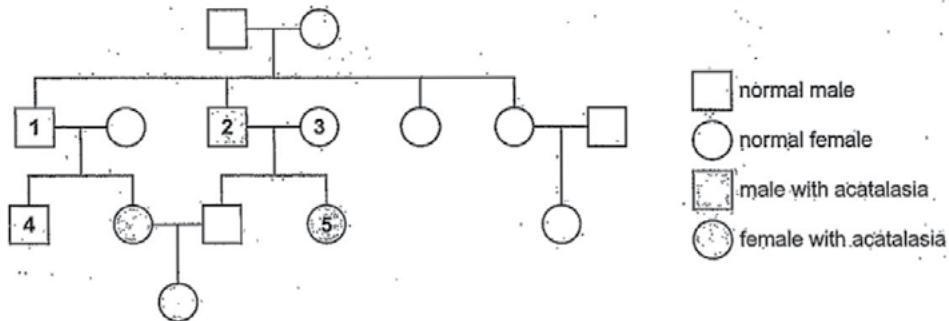


Fig. 3.1

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

1 **BB** ; normal male
2 **b** ; male with acatalasia
3 **BB** ; normal female

[3]

Your
Mark

3(a)

3(b)(i)

3(b)(ii)

3(b)(iii)

Q3 Mark scheme

(a)	<i>gene</i> a length of DNA that codes for a protein ; R chromosome/molecule of/genome <i>gene mutation</i> a change in <u>base</u> sequence of DNA ; 2 marks																	
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		male gametes																
		B	b															
female gametes	b	Bb	bb															
	(b)	(Bb)	(bb)															
(b)(iii)	test (cross) ; 1 mark																	

- (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.

dog 4 dog 5

parental phenotypes normal has acatalasia

parental genotypes BB bb

gametes B B + b

Punnett square

	<u>B</u>	<u>B</u>
<u>b</u>	<u>Bb</u>	<u>Bb</u>

offspring genotypes..... Bb [3]

offspring phenotypes..... [3]

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

Selective breeding [1]

[Total: 9]

Your
Mark

3(a)

3(b)(i)

3(b)(ii)

3(b)(iii)

Q3	Mark scheme															
(a)	<i>gene</i> a length of DNA that codes for a protein ; R chromosome/molecule of/genome <i>gene mutation</i> a change in <u>base</u> sequence of DNA ; 2 marks															
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		male gametes														
		B	b													
female gametes	b	Bb	bb													
	(b)	(Bb)	(bb)													
(b)(iii)	test (cross) ; 1 mark															

- 3 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... features transported from parents

gene mutation... features transported from parents the get changed

[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.

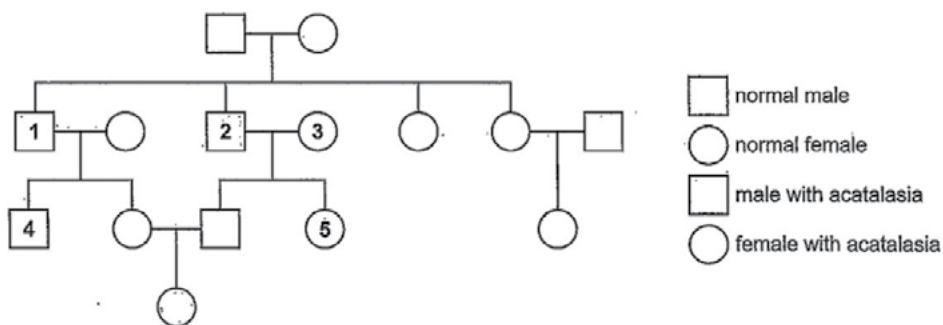


Fig. 3.1

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

1 normal male
2 male with acatalasia
3 normal female

[3]

Select
page

Your
Mark

3(a)

3(b)(i)

3(b)(ii)

3(b)(iii)

Q3 Mark scheme

(a)	<i>gene</i> a length of DNA that codes for a protein ; R chromosome/molecule of/genome <i>gene mutation</i> a change in <u>base</u> sequence of DNA ; 2 marks																	
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		B	b															
female gametes	b	Bb	bb															
	(b)	(Bb)	(bb)															
(b)(iii)	test (cross) ; 1 mark																	

- (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.



Punnett square

4	5		
4	5 ⁴	55 ⁴	
5	4 ⁵	44 ⁵	

offspring genotypes... 4⁵

offspring phenotypes... 5⁴ [3]

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

Punnett square [1]

[Total: 9]

Your
Mark

3(a)

3(b)(i)

3(b)(ii)

3(b)(iii)

Q3	Mark scheme															
(a)	<p><i>gene</i> a length of DNA that codes for a protein ;</p> <p>R chromosome/molecule of/genome</p> <p><i>gene mutation</i> a change in <u>base</u> sequence of DNA ;</p> <p>2 marks</p>															
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		male gametes														
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	(b)	(Bb)	(bb)													
(b)(iii)	<p>test (cross) ;</p> <p>1 mark</p>															

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