1 (a) What is meant by the term **gene**?

(2)

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(b) A gene is made from 1000 base pairs. The table shows the percentage of each base found in the gene.

(i) Complete the table by giving the name of the missing base.

(1)

Percentage of base	Name of base
29	adenine
21	
29	thymine
21	cytosine

(ii) Calculate how many cytosine bases you would expect to find in this gene.

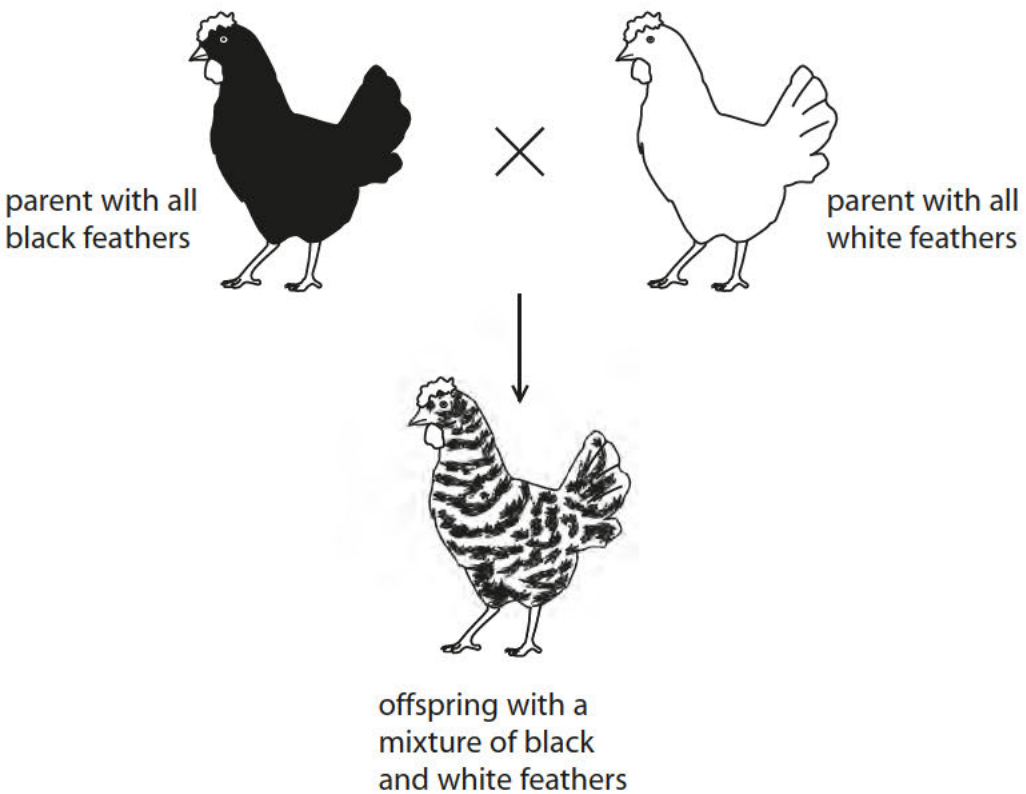
(1)

Answer .....

(c) The photograph shows a chicken with a mixture of black feathers and white feathers.



In chickens the inheritance of feather colour is controlled by codominant alleles. The allele for black feathers is C^B, and the allele for white feathers is C^W. The diagram shows a parent with all black feathers and a parent with all white feathers. It also shows one of their offspring with a mixture of black and white feathers.



(i) Complete the table by writing the genotype of the chickens shown in the diagram.

(1)

Chicken	Genotype
parent with all black feathers	
parent with all white feathers	
offspring with a mixture of black and white feathers	

(ii) Two of the offspring with a mixture of black and white feathers mated. What is the probability that their offspring would also have a mixture of black and white feathers?

(1)

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(Total for Question = 6 marks)

2 Most simple genetic crosses, such as those studied by Mendel, investigate phenotypes determined by a pair of alleles, where one allele is dominant over the other allele.

Mendel crossed homozygous tall pea plants with homozygous dwarf pea plants. All the offspring were tall.

(a) Use a genetic diagram to show the parent genotypes, the gametes formed and the genotypes of the offspring.

(3)

(b) Mendel then made sure that the tall offspring plants could only self-pollinate, rather than being pollinated by other plants. The seeds produced grew to give new plants with a 3 : 1 phenotypic ratio.

(i) Suggest how Mendel made sure that the pea plants self-pollinated.

(2)

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(ii) Give the genotypes of the offspring he obtained from the self-pollinated pea plants.

(1)

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(c) What is meant by the term **dominant allele**?

(1)

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(d) Some phenotypes are controlled by codominant alleles.

What is meant by the term **codominant alleles**?

(2)

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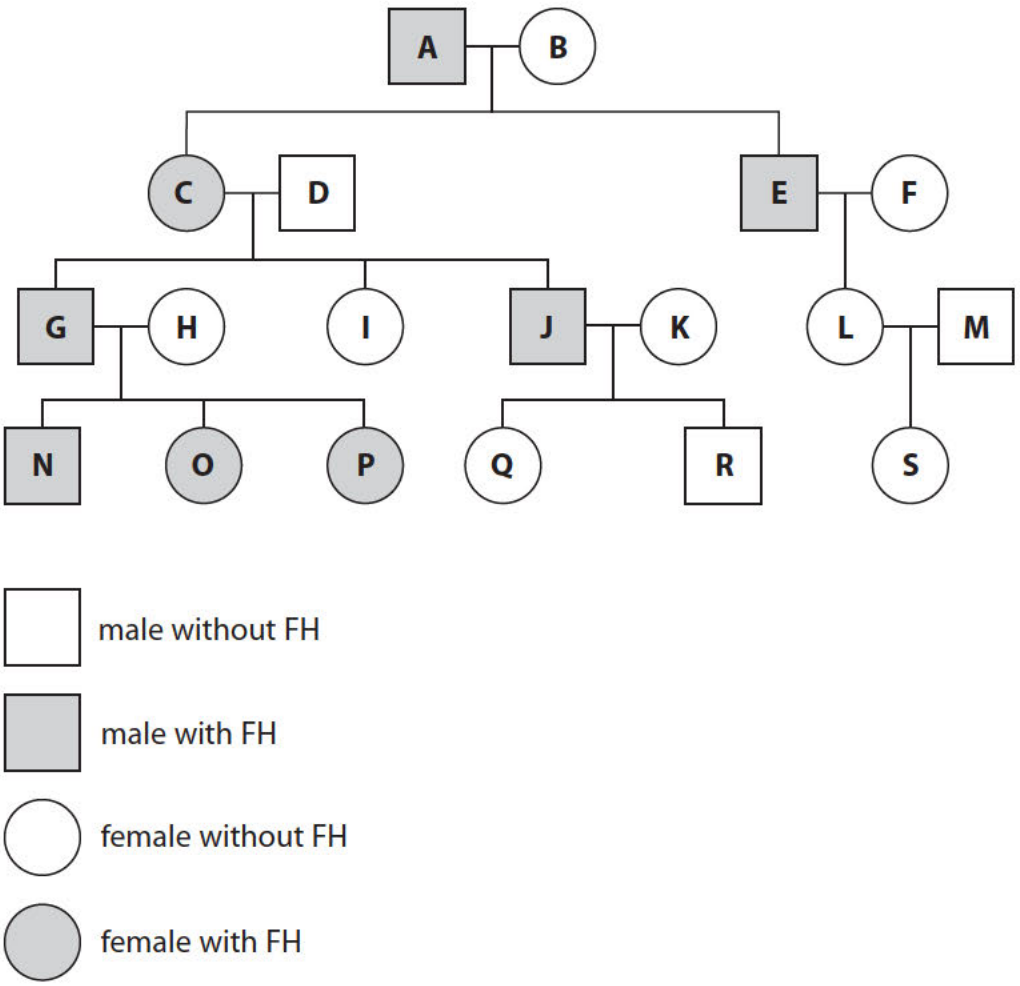
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(Total for Question = 9 marks)

3 Familial hypercholesterolemia (FH) is an inherited condition caused by a dominant allele. People with the condition have high levels of cholesterol in their blood. This increases the risk of dying from blocked arteries.

The diagram shows the pattern of inheritance in several generations of a family with familial hypercholesterolemia.



(a) (i) Person A is heterozygous for FH. Use this information to complete the table.

(2)

Genotype	Number of people with the genotype
Homozygous recessive	
Homozygous dominant	

(ii) Person G and person H have three children who all have FH.

What is the probability of G and H having three children who all have FH?

(1)

(b) An artery supplies the leg muscles with blood.

Explain what will happen to the muscle cells in the leg if cholesterol builds up in this artery.

(5)

(Total for Question = 8 marks)

4 (a) Lactose is a sugar found in milk. It is digested by an enzyme called lactase. Some people cannot make lactase. The condition they have is called lactose intolerance.

The condition is caused by a recessive allele. This means that only people with the homozygous recessive genotype can be lactose intolerant.

(i) What is meant by the term **homozygous**?

(1)

.....

(ii) State the two possible genotypes of an individual who is **not** lactose intolerant.

Use the symbols **D** for the dominant allele and **d** for the recessive allele.

(2)

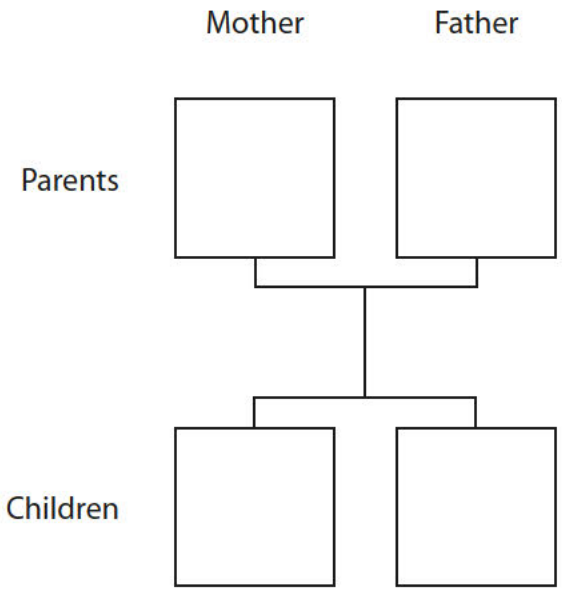
1 .....

2 .....

(b) (i) A homozygous dominant mother and a homozygous recessive father have two children.

In the boxes below give the genotypes of the parents and their children.

(2)



(ii) What is the probability that the children are lactose intolerant?

(1)

.....

(c) People from different countries were tested to find out if they were lactose intolerant. The table shows the number of people who were tested in each country and the percentage who were lactose intolerant.

Country	Number of people tested	Percentage who were lactose intolerant
A	160	4
B	315	12
C	134	18
D	20	75
E	59	89
F	71	93
G	134	98
H	24	100

(i) The population size of country B is 190 million.

Calculate the number of people in this country likely to be lactose intolerant.

Show your working.

(2)

Answer .....

(ii) Suggest a reason why the value of 100% for country H may not be correct.

(1)

.....

(Total for Question = 9 marks)

5 Human blood group is an example of a phenotype determined by alleles that show codominance.

The table shows the different blood groups and their genotypes.

Blood group	Genotypes
A	$I^A I^A$ **or** $I^A I^O$
B	$I^B I^B$ **or** $I^B I^O$
AB	$I^A I^B$
O	$I^O I^O$

(a) Explain what is meant by the term **codominance**.

(1)

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.....

(b) A man with blood group A married a woman with blood group B. They had four children, each with a different blood group.

Use a genetic diagram to show this cross.

(3)

Genotypes of the parents

Gametes

Genotypes of the offspring

(Total for Question = 4 marks)