

- 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)

they inherited the same allele from both parents

- (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)

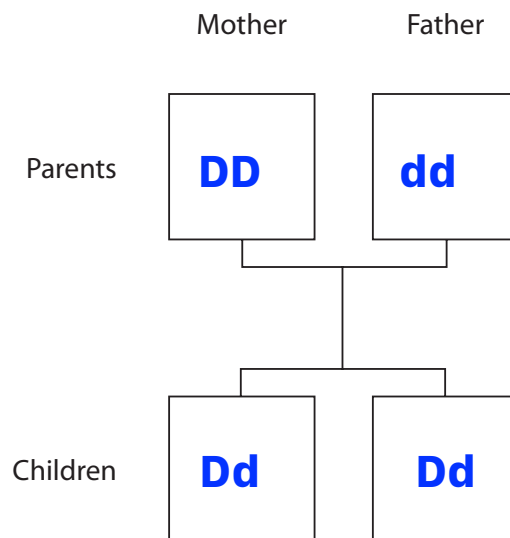
1 **DD**

2 **Dd**

- (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)

0%

- (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)

$$190,000,000 \times (12/100) = 22800000$$

Answer

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

(1)

only a small number of people were tested.

(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)

The phenotypes of both alleles are expressed.

- (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

IA IA IB IB

Gametes

IA IA IB IB

Genotypes of the offspring

IA IB, IA IB, IA IB, IA IB

(Total for Question = 4 marks)

- 1 Mendel crossed together pure breeding pea plants with purple flowers and pure breeding pea plants with white flowers. The offspring plants all had purple flowers.

(a) Explain which phenotype is dominant.

(2)

Purple is the dominant phenotype because all the offspring had purple flowers even though they inherited the white and purple alleles.

- (b) In a second cross, the purple offspring plants were self-pollinated (pollen from a flower put on the stigma of the same flower).

Suggest how Mendel made sure that all the purple offspring plants were self-pollinated.

(2)

Keeping them in an enclosed, air tight tank to prevent pollen from other plants reaching them.

- (c) (i) Use a genetic diagram to show the ratio of plants expected by crossing the purple offspring plants in part (b).

Show the parental genotypes and gametes, and the offspring genotypes and phenotypes. Use **F** and **f** to represent the alleles.

(4)

Parent genotypes

Ff. Ff

Gametes

F f F f

Offspring genotypes

FF fF Ff ff

Offspring phenotypes

Purple, purple, purple, white

- (ii) The plants actually produced in this cross were 36 purple and 8 white flowered plants.

Calculate the ratio of purple to white flowered plants.

(1)

36:8 = 4.5 : 1

Answer

- (iii) Suggest why the actual ratio of phenotypes differs from the one predicted by your genetic diagram.

(2)

The genetic diagram only shows the probability of the phenotypes. It is possible by chance to end up with more or fewer of each phenotype, therefore the actual ratio can differ from the predicted ratio.

(d) A student suggested that purple flowers are more likely to be visited by bees than white flowers.

Use your knowledge of natural selection to suggest how this might affect the number of purple and white flowers in the wild.

(5)

If purple flowers are more likely to be visited by bees then purple flowers' pollen will be spread to other flowers more frequently than white flowers' pollen. This means purple flowers will be more successful at propagating their genes and reproducing and the proportion of purple flowers will increase over time as they out-compete white flowers for access to bees. The proportion of white flowers will decrease.

(Total for Question = 16 marks)