1 Gregor Mendel investigated the genetics of peas.

He did not know about genes but showed that inherited characteristics can be dominant or recessive.

(a) Explain how Mendel used homozygous tall and homozygous short pea plants to show that the tall allele is dominant to the short allele.

(2)

.....

.....

.....

.....

(b) Figure 4 shows a strawberry plant that has produced several runners and new strawberry plantlets are growing at the end of each runner. This is asexual reproduction.

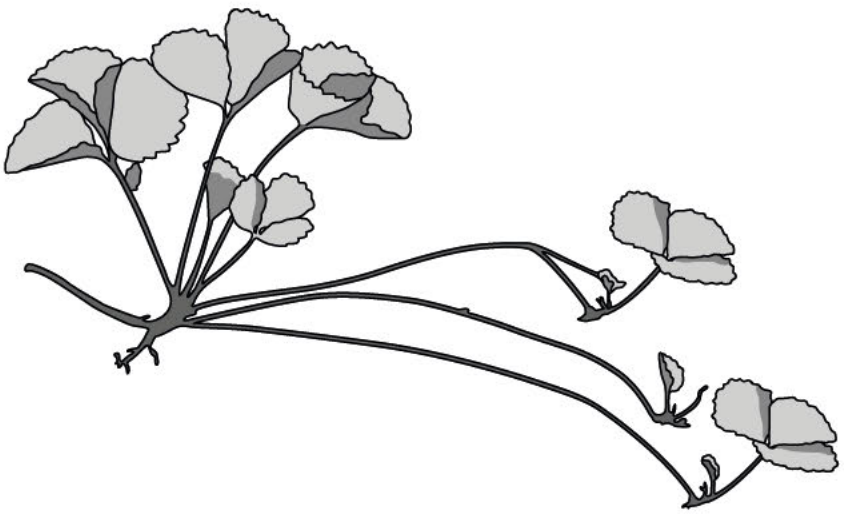


Figure 4

(i) Explain why asexual reproduction in strawberries is beneficial to strawberry farmers.

(2)

.....

.....

.....

.....

(ii) Strawberry fruits, containing seeds, are produced after a flower is fertilised.

Explain why seed production is an advantage to the strawberry plant.

(2)

.....

.....

.....

.....

(c) Duchenne muscular dystrophy is a sex-linked recessive genetic disorder caused by a mutation on a single gene on the X-chromosome.

The letter D can be used for the dominant allele and the letter d for the recessive allele.

Figure 5 shows the inheritance of Duchenne muscular dystrophy in a family.

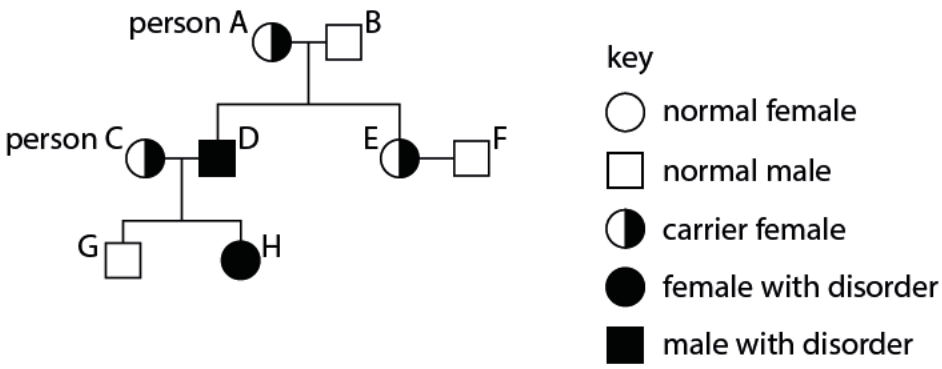


Figure 5

(i) What is the percentage chance of any child from person A inheriting the mutated allele?

(1)

☒ **A** 0%

☒ **B** 25%

☒ **C** 50%

☒ **D** 75%

(ii) Explain the conclusion that can be made about the genotype of person C.

(2)

.....

.....

.....

.....

(Total for Question 1 = 9 marks)

2 (a) DNA is composed of four different DNA nucleotides.

(i) Which diagram represents the arrangement of the sugar, phosphate and the base in a DNA nucleotide?

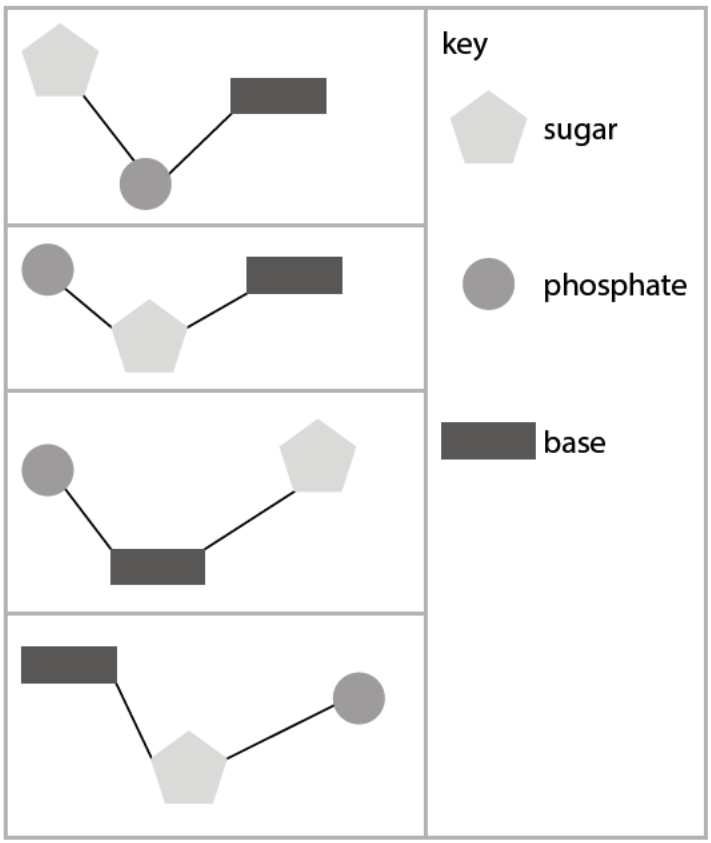
(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**



(ii) An allele starts with the DNA sequence ATGCATGTACCG.

Give the sequence of the complementary DNA sequence.

(1)

.....

.....

(iii) The length of one DNA nucleotide was measured at 3.3×10^{-10} metres.

Calculate the approximate length of a gene containing 250 nucleotides in nanometres.

(2)

..... nm

(b) The DNA of an organism determines its phenotype.

White tigers are produced because of a mutation of a single allele which usually produces the normal orange and yellow fur pigmentation.

The mutated allele is recessive.

Samba, a male white tiger, was bred with Rani. They had three offspring; two offspring have white fur and one has a normal fur pigmentation.

(i) State the genotype of Rani.

(1)

.....

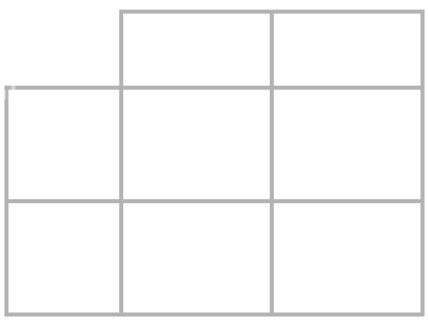
.....

(ii) The offspring with normal fur pigmentation was bred with a tiger that was heterozygous.

Use A/a to represent the alleles for fur pigmentation.

Predict, using the Punnett square, the percentage probability of the offspring from this cross having normal fur pigmentation.

(2)



percentage probability = ... %

(c) Explain how two parents with a dominant phenotype can produce offspring expressing a recessive characteristic.

(2)

.....

.....

.....

.....

(Total for Question 2 = 9 marks)

3 The images show a normal red blood cell and a red blood cell from someone who has sickle cell disease. Sickle cell disease is a genetic disorder caused by two recessive alleles.



Normal red blood cell



Red blood cell from someone who has sickle cell disease

(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

An individual with sickle cell disease is said to be

(1)

☒ **A** a carrier for sickle cell disease

☒ **B** heterozygous

☒ **C** homozygous dominant

☒ **D** homozygous recessive

(ii) Describe the main symptoms of sickle cell disease.

(3)

.....

.....

.....

.....

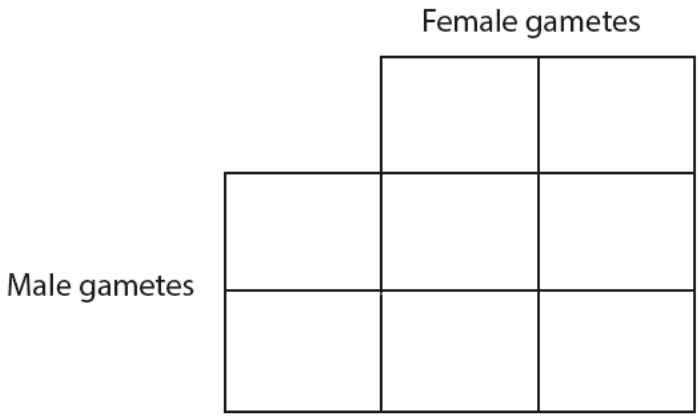
.....

.....

(b) (A female with the genotype (**Dd**) and a male with the genotype (**DD**) for sickle cell disease are about to start a family.

Complete the Punnett square to show the possible genotypes of their offspring for sickle cell disease.

(2)



(ii) State the percentage chance that a child from these individuals will be

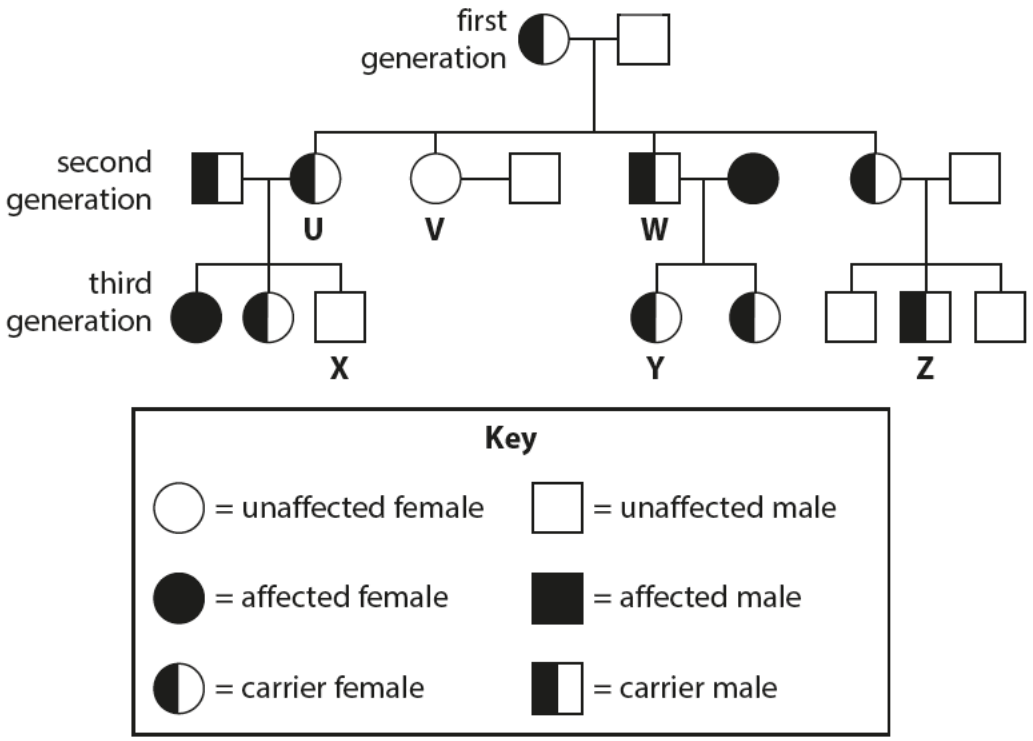
(2)

1. a carrier of sickle cell disease ..... %

2. an individual with sickle cell disease ..... %

(Total for Question 3 = 8 marks)

4 The family pedigree shows the inheritance of sickle cell disease through three generations.



(a) (i) Calculate the percentage of the offspring from the first generation who are heterozygous for sickle cell disease.

(1)

.....%

(ii) Explain why the offspring produced by the first generation parents are not the same as those predicted in a Punnett square.

(2)

.....

.....

.....

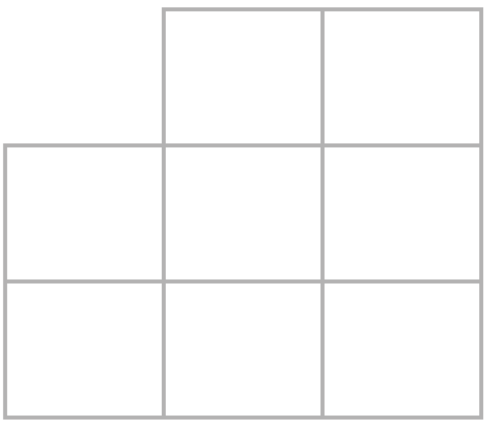
.....

(iii) Person **W** and his partner have a third child.

State the probability that this child will have sickle cell disease.

Complete the Punnett square to show this.

(2)



probability .....

(iv) Complete the sentence by putting a cross (☒) in the box next to your answer.

The genotype of person **V** is

(1)

☒ **A** homozygous dominant

☒ **B** homozygous recessive

☒ **C** heterozygous

☒ **D** carrier

*(b) Explain why it is important that individuals **X**, **Y** and **Z** have pedigree analysis completed before they consider having children.

You should use diagrams and mathematical calculations to illustrate your answer.

(6)

(Total for Question 4 = 12 marks)

5 Cystic fibrosis (CF) is a recessive genetic disorder.

The recessive allele is shown as **f** and the dominant allele as **F**.

(a) (i) What is the genotype of a person with cystic fibrosis?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** **FF**

☒ **B** **Ff**

☒ **C** **fF**

☒ **D** **ff**

(ii) Explain why a person with cystic fibrosis (CF) may lose body mass.

(2)

.....

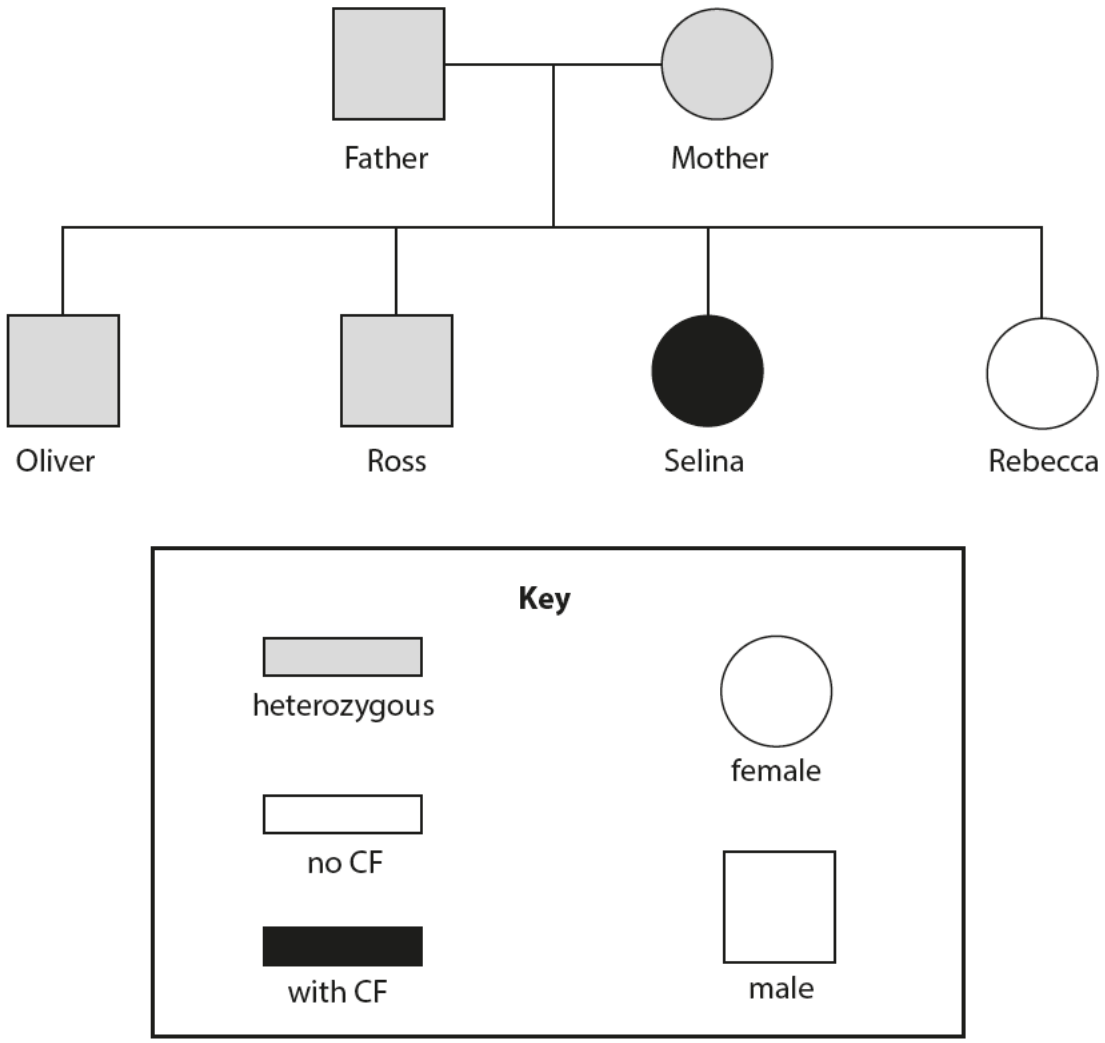
.....

.....

.....

(b) The family pedigree shows the inheritance of cystic fibrosis (CF).

Both parents are heterozygous for CF.



(i) State what is meant by the term **heterozygous**.

(1)

.....

.....

(ii) Explain why Rebecca does not have CF.

(2)

.....

.....

.....

.....

*(c) Sickle cell disease is another genetic disorder caused by a recessive allele **(d)**.

Explain the inheritance of sickle cell disease in a family with a heterozygous father and a homozygous recessive mother.

You should use a genetic diagram or Punnett square and percentage outcomes in addition to your explanation.

(6)

(Total for Question 5 = 12 marks)