

3.3 Inheritance

Question Paper

Course	DP IB Biology
Section	3. Genetics
Topic	3.3 Inheritance
Difficulty	Medium

Time allowed: 60
Score: /48
Percentage: /100

Question 1a

- a) Human red blood cells can be categorised into different blood groups based on the structure of a surface glycoprotein (antigen). The ABO blood groups are controlled by a single gene with multiple alleles (A, B, O). The table below shows all the genotypes for all the possible blood groups.

Phenotype	Genotype
Blood Group A	$I^A I^A$ $I^A i$
Blood Group B	$I^B I^B$ $I^B i$
Blood Group AB	$I^A I^B$
Blood Group O	ii

A child has blood group AB and their father has blood group A.

Identify the possible phenotypes of the mother.

[2 marks]

Question 1b

- b) Suggest which pattern of inheritance is exhibited in the AB blood group.

[1 mark]

Question 1c

- c) A woman with a family history of colour-blindness and a man with normal colour vision wish to start a family but are concerned that all their children will be colour-blind. They decide to speak to a genetic counsellor

Suggest why the parents are concerned.

[2 marks]

Question 1d

- d) Genetic testing showed that the woman was carrying the gene for colour-blindness. The genetic counsellor provided information about the chances of having children with colour blindness.

Using the following symbols:

X^B = an X chromosome carrying the normal allele for colour vision

X^b = an X chromosome carrying the allele for colour blindness

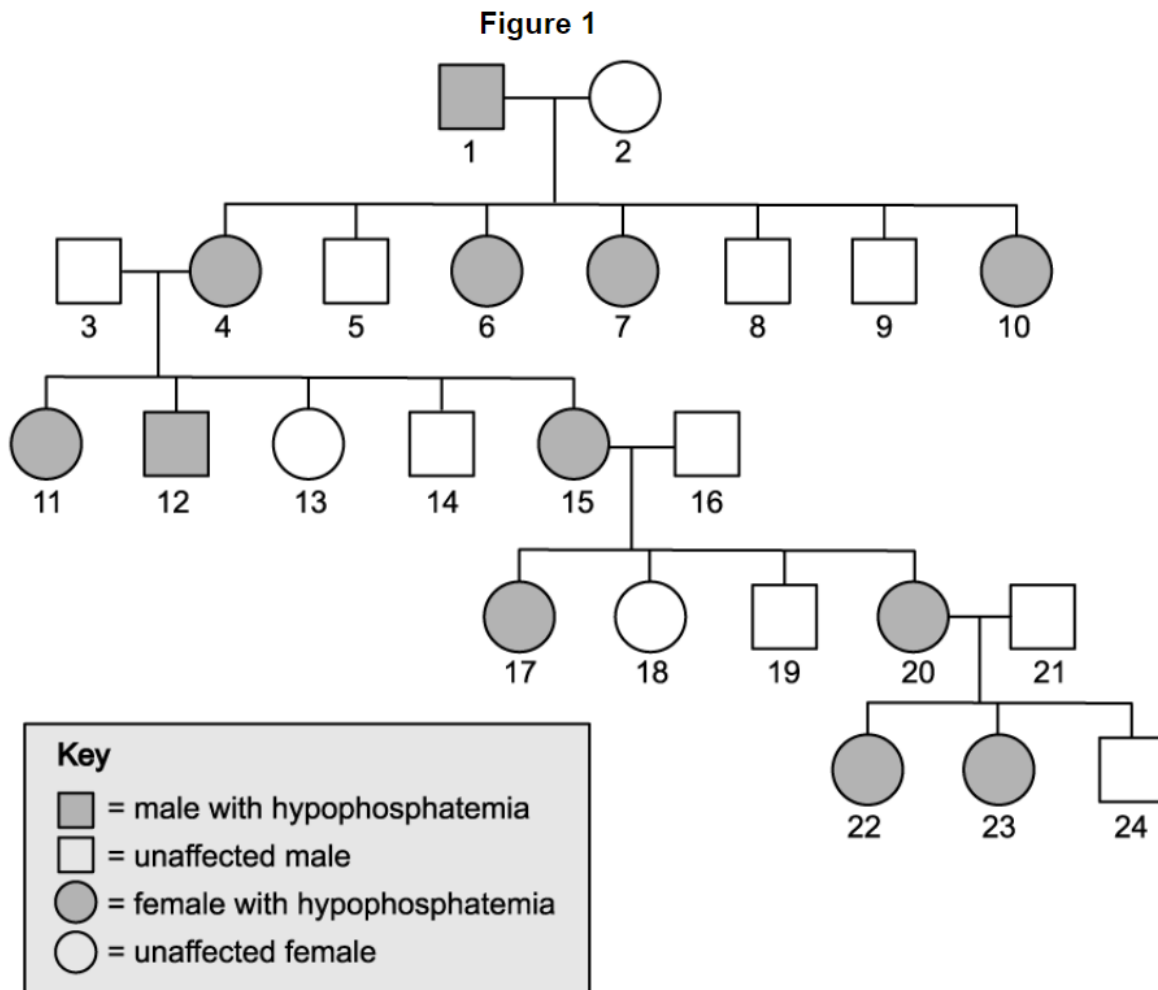
- i) Identify all the possible genotypes for female and male offspring.
- ii) Predict the probability of having a child with colour-blindness.

[3 marks]

Question 2a

- a) Hypophosphatemia is a sex-linked inherited condition which results in abnormally low levels of phosphate in the blood which can cause the disease rickets. It is caused by a dominant allele.

The diagram below shows the inheritance of hypophosphatemia in one family.



State the evidence that suggests that hypophosphatemia is a sex-linked, dominant inherited disease.

[2 marks]

Question 2b

b) Using the following symbols,

X^H = an X chromosome carrying the allele for hypophosphatemia

X^h = an X chromosome carrying the normal allele

Y = a Y chromosome

Identify all the possible genotypes of each of the following persons from the diagram in part (a):

1 :

4 :

5 :

13 :

[2 marks]

Question 2c

c) Person 20, from the diagram in part (a), is pregnant for the fourth time. As the family has a history of hypophosphatemia, a test was carried out to discover the sex of the embryo.

Describe what possible observations of the chromosomes would be expected when determining the sex of an embryo.

[2 marks]

Question 2d

- d) State the probability that the child Person 20 is pregnant with will be a male with hypophosphatemia.

Explain your answer by drawing a genetic diagram, using the following symbols:

X^H = an X chromosome carrying the allele for hypophosphatemia

X^h = an X chromosome carrying the normal allele

Y = a Y chromosome

[4 marks]

Question 3a

- a) A horticulturist investigated the inheritance of flower colour in *Camellia japonica*, a widely cultivated ornamental plant commonly known as Japanese camellia. The horticulturist crossed a homozygous parent with red flowers and a homozygous parent with white flowers. All of the F1 generation had the same colour flowers. Using the following symbols:

C^R = Red flowers

C^W = White flowers

Sketch a genetic diagram / Punnett square to deduce all the genotypes in this cross.

[2 marks]

Question 3b

- b) Each of the F1 generation plants had flowers that were patterned red and white. The horticulturist undertook a self-cross with these F1 hybrids.
- i) State all the possible phenotypes of the F2 hybrids
- ii) Deduce the probability of obtaining a white flower.

[2 marks]

Question 3c

- c) Describe, with a reason, what pattern of inheritance is exhibited in the horticulturist's experiment.

[3 marks]

Question 4a

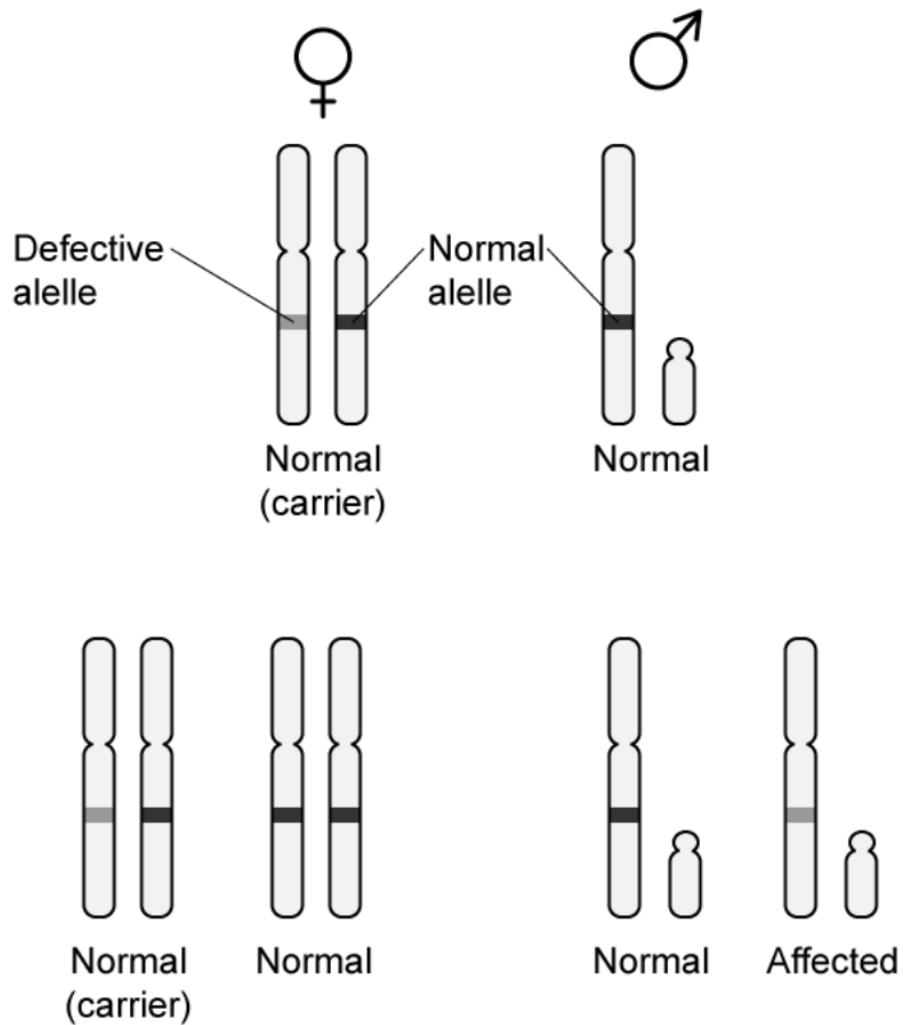
- a) FG syndrome is a recessive disorder that can cause a characteristic facial appearance, developmental delays and hyperactivity. FG syndrome is a rare X-linked genetic disorder that occurs almost exclusively in males, it is caused by a mutation in the *MED12* gene on the X chromosome.

Suggest why FG syndrome occurs almost exclusively in males.

[2 marks]

Question 4b

b) The diagram below shows the familial inheritance of an X-linked recessive disease.



Describe the patterns of inheritance that hold true for X-linked conditions.

[3 marks]

Question 4c

- c) Haemophilia is due to a sex-linked recessive gene X^h whereas the normal gene is X^H . A haemophiliac man and a woman, who does not have haemophilia, have two children. Their first child is male and has haemophilia.

Deduce what this tells us about the mother.

[1 mark]

Question 4d

- d) Their second child is female.

Deduce, with a reason, the probability that their daughter will also have haemophilia.

[2 marks]

Question 5a

One mark is available for clarity of communication throughout this question.

- a) Radiation and mutagenic chemicals can cause mutations in DNA that result in new alleles.

Explain how mutations in DNA can affect the final protein product.

[3 marks]

Question 5b

- b) Outline the consequences of radiation after the Chernobyl power plant accident.

[5 marks]

Question 5c

- c) Outline the inheritance of colour-blindness.

[7 marks]

