

GCSE Biology (9 – 1)

Genetics

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/4
2	/7
3	/9
4	/15
5	/6
6	/7
7	/8
8	/3
Total	/59
%	
Grade	

Information

- The maximum mark for this paper is 59 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Genetics is the study of how characteristics are passed from parents to their offspring through genes. Below are **four** multiple choice questions. Circle the letter of the correct answer for each.

- a) Albinism is an inherited condition in which pigment does not develop in the skin, hair and eyes. The allele for albinism is **recessive**. What are the chances of albino parents having an albino child?

A	B	C	D
25%	75%	100%	10%

(1 mark)

- b) Identify the term that is given to the observable features of an organism?

A	B	C	D
Gene	Chromosome	Phenotype	Genotype

(1 mark)

- c) In fruit flies, the allele for grey body, **G**, is dominant over the allele for black body, **g**. The result of a mating between two flies is shown in the figure below.

Parent fruit flies: grey bodied male $\times$ black bodied female

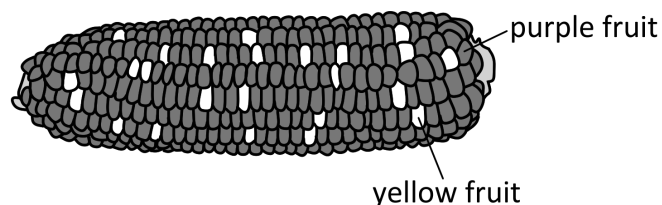
Offspring produced: 95 grey bodied flies + 88 black bodied flies

What were the genotypes of the parents?

A	B	C	D
GG $\times$ gg	GG $\times$ Gg	Gg $\times$ gg	Gg $\times$ Gg

(1 mark)

- d) The figure below shows a maize cob with purple and yellow fruits (corns). The allele for purple colour (**P**) is dominant to the allele for yellow colour (**p**).



Determine the genotypes of both of the parents of the maize plant.

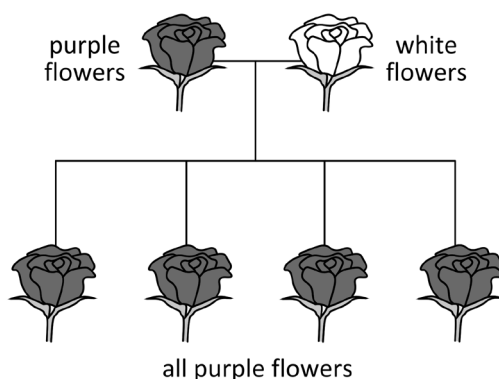
A	B	C	D
PP $\times$ pp	Pp $\times$ Pp	PP $\times$ Pp	pp $\times$ Pp

(1 mark)

(Total for Question 1 is 4 marks)

2. A botanist bred some pea plants that consistently produced purple flowers with some others that consistently produced white flowers.

All of the offspring from this cross had purple flowers, as shown in the figure below.



- a) Which allele was dominant and which was recessive and give a reason for your answer.

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(3 marks)

- b) The botanist used two of the offspring from the first cross in second cross.
The pea plants that were obtained from this second cross produced purple flowers and white flowers in a ratio of 3 : 1.

Calculate the number of pea plants with purple flowers that we would expect from this ratio if the number of pea plants produced from the second cross is 540.

Number of purple coloured flowers:

(2 marks)

- c) What percentage of the 540 pea plants are expected to have white flowers?

..... %

(2 marks)

(Total for Question 2 is 7 marks)

3. This question deals with inheritance of blood groups.

Two siblings are dealing with a situation involving organ transplant.

One sibling, with blood group AB, has total kidney failure and is being treated using dialysis.

The healthy sibling has agreed to donate one of their kidneys to their unwell sibling.

Before the transplant operation both siblings need to have a blood test to determine their blood groups.

The father of the siblings has blood group A and their mother has blood group B.

The siblings have another sibling, a sister who has blood group O.

- a) Explain how this girl has blood group O when both of her parents have different blood groups.
You must use the space below for a punnet square diagram to help your answer.

Use the symbols I^A , I^B and I^O to represent the alleles involved in the inheritance of blood groups.

Parental phenotype	Blood group A		Blood group B
Parental genotype		×	
Gametes		×	
Sisters genotype			
Sisters phenotype			

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(4 marks)

- b) State the three different **genotypes** that could have been produced from the cross of these two parents.

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(3 marks)

- c) Identify which genotype shows **codominance** and explain what is meant by this term.

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(2 marks)

(Total for Question 3 is 9 marks)

4. A scientist is investigating the inheritance of eye colour in fruit flies (*Drosophila*).
In fruit flies, red eyes (R) are dominant to brown eyes (r).

The figure shows a species of *Drosophila* fruit fly.



- a) Define the term allele.

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(2 marks)

- b) Explain the difference between a homozygous genotype and a heterozygous genotype.

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(2 marks)

The scientist performs a cross between a heterozygous red-eyed fruit fly and a brown-eyed fruit fly.

- c) Complete the genetic diagram below for this cross.

Parental phenotype	Red eye		Brown eye
Parental genotype		×	
Gametes		×	
Possible genotypes			
Possible phenotypes			

(4 marks)

- d) From this cross, what is the probability of an offspring having brown eyes?

Probability:

(1 mark)

In a different investigation, the scientist crosses two heterozygous red-eyed fruit flies. They expect a phenotypic ratio of 3 red eyed : 1 brown eyed offspring.

The scientist collects the offspring from this cross and counts them. The results are shown in the table below.

Phenotype	Number of offspring
Red eyes	156
Brown eyes	44
Total	200

- e) Calculate the expected number of brown-eyed offspring from a total of 200 offspring if the ratio was exactly 3 : 1. Show your working.

Expected number of brown eyed offspring:

(2 marks)

- f) The observed number of brown-eyed offspring is slightly different from the expected number calculated in (e).

Suggest **one** reason, other than experimental error, why observed ratios in genetic crosses may differ from expected ratios.

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(1 mark)

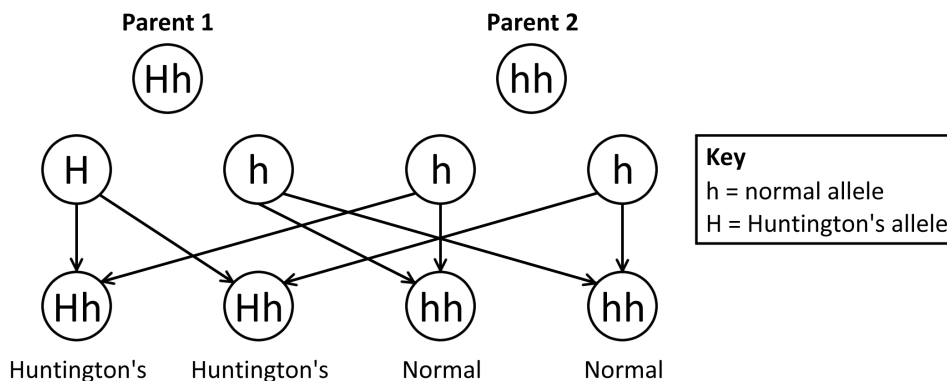
- g) Eye colour in fruit flies is determined by genes. Outline the process by which a gene codes for a specific protein, such as an enzyme involved in producing eye pigment.

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(3 marks)

(Total for Question 4 is 15 marks)

5. Huntington's disease is a genetic disorder. The genetic diagram shows the inheritance of this disorder.



a. Complete the Punnett square to show the potential offspring of two parents heterozygous for Huntington's disease.

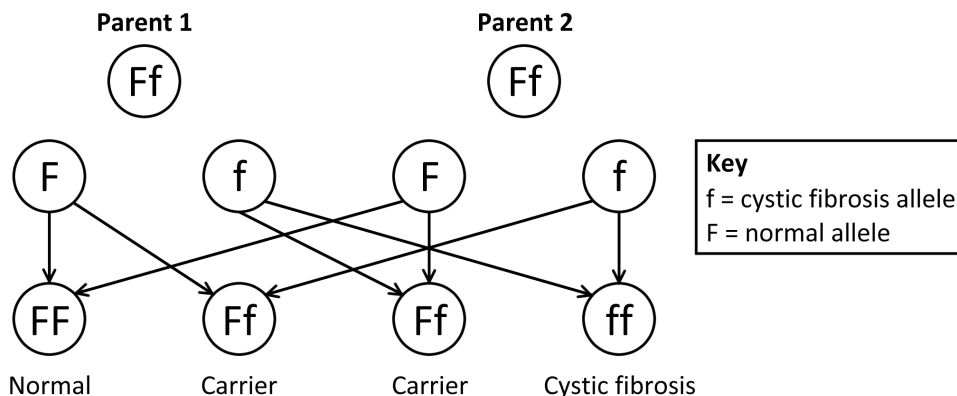
(3 marks)

b) State the probability that a child of two parents, heterozygous for Huntington's disease, will have the disease.

Probability:

(1 mark)

The genetic diagram shows the inheritance of cystic fibrosis.



c) Explain why, if both sets of parents are heterozygous, the chance of inheriting Huntington's disease is greater than the chance of inheriting cystic fibrosis.

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(2 marks)

(Total for Question 5 is 6 marks)

6. Sickle cell anaemia is a genetic disorder that primarily affects haemoglobin, the protein in red blood cells responsible for carrying oxygen. The faulty haemoglobin causes red blood cells to become stiff, sticky, and take on a crescent or "sickle" shape, especially when oxygen levels are low.

The gene for making haemoglobin exists in two alternative forms:

H^A codes for the normal form of haemoglobin.

H^S codes for the abnormal form of haemoglobin.

- a) State the name for the alternative forms of a gene.

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(1 mark)

A child has sickle cell anaemia. The parents do not have this disorder.

- b) Complete the genetic diagram below to show how the child could have inherited sickle cell anaemia. Provide an explanation with your answer.

Parental phenotype			
Parental genotype		×	
Gametes		×	

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 (5 marks)

- c) From this cross, what is the probability of an offspring having sickle cell anaemia?

Probability:
(1 mark)

(Total for Question 6 is 7 marks)

7. Gregor Mendel is often called the 'father of modern genetics' due to his groundbreaking work on inheritance.

a) Mendel concluded that 'factors' (now known as genes) are responsible for inherited characteristics and that these factors can be dominant or recessive.

i. Explain what is meant by a **dominant allele**?

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(1 mark)

ii. Explain what is meant by a **recessive allele**?

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(1 mark)

b) One of Mendel's experiments involved crossing tall pea plants with dwarf pea plants.
All the first generation (F1) offspring were tall. When he then crossed two of these F1 tall pea plants together, the second generation (F2) contained both tall and dwarf plants.

i. Using **T** to represent the allele for tallness and **t** to represent the allele for dwarfness.
State the genotype of the original true-breeding tall parent plant and the original true-breeding dwarf parent plant.

Tall parent: Dwarf parent: (1 mark)

ii. What was the genotype of all the F1 generation plants? (1 mark)

iii. Explain why some dwarf plants appeared in the F2 generation.

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(2 marks)

- c) Despite the significance of his findings, Mendel's work was not widely accepted or understood by scientists at the time it was published in the 1860s.

Suggest **two** reasons why his work was not recognised until many years later.

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(2 marks)

(Total for Question 7 is 8 marks)

8. The biological sex of a human is determined by X and Y chromosomes.

- a) Complete the Punnett square diagram in the figure below to show the inheritance of biological sex in humans. Use the symbols X and Y.

(2 marks)

- b) A woman is pregnant with **non-identical** twins.

Explain why it is possible for non-identical twins to be different sexes, whereas identical twins are always the same sex.

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(1 mark)

(Total for Question 8 is 3 marks)