

# GCSE Biology

## Worksheet: The understanding of genetics

|                       |                          |                              |                                   |
|-----------------------|--------------------------|------------------------------|-----------------------------------|
| TIME<br><b>30 min</b> | TOTAL<br><b>30 marks</b> | CALCULATOR<br><b>Allowed</b> | DIFFICULTY<br><b>Easy, Medium</b> |
|-----------------------|--------------------------|------------------------------|-----------------------------------|

**Topics:** The understanding of genetics

**NAME**

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**CLASS**

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**DATE**

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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
  - Answer all questions in the spaces provided.
  - In all calculations, show clearly how you work out your answer.
  - The marks for questions are shown in brackets.
-

0 1

Our understanding of genetics developed over about 100 years.  
Table 1 shows when some important discoveries were made.

**Table 1**

| Time               | Discovery (letter) |
|--------------------|--------------------|
| Mid-19th century   |                    |
| Late 19th century  |                    |
| Early 20th century |                    |
| Mid-20th century   |                    |

0 1 . 1

Complete Table 1. Write the correct letter in each box.

- A** The structure of DNA was determined.
- B** Gregor Mendel carried out breeding experiments on plants.
- C** Scientists observed that chromosomes and Mendel's 'units' behave in similar ways.
- D** The behaviour of chromosomes during cell division was observed.
- E** Genes were first inserted into bacteria by genetic engineering.

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**[4 marks]**

0 1 . 2

Mendel observed that the inheritance of each characteristic is determined by 'units'.

Which statement describes what Mendel found about these units?

Tick (✓) **one** box.

- They are passed on to offspring unchanged. ☐
- They blend together in the offspring. ☐
- They are changed by the environment during an organism's life. ☐
- They are passed on only by the male parent. ☐

[1 mark]

0 2

Our understanding of genetics developed over about 100 years, starting with the work of Gregor Mendel in the mid-19th century.

0 2 . 1

Mendel carried out breeding experiments.

Which type of organism did he use?

Tick (✓) **one** box.

- Bacteria ☐
- Fruit flies ☐
- Mice ☐
- Plants ☐

[1 mark]

0 2 . 2

Mendel observed that the inheritance of each characteristic is determined by 'units' that are passed on to offspring unchanged.

What do we now call these units?

.....

.....

.....

.....  
[1 mark]

0 2 . 3

Three later discoveries are given.

**X** The structure of DNA was worked out.

**Y** The behaviour of chromosomes during cell division was observed.

**Z** Scientists realised that genes are located on chromosomes.

Write the letters **X**, **Y** and **Z** in the order in which the discoveries were made.

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.....

.....

.....

[2 marks]

0 2 . 4

Give **one** reason why the importance of Mendel's work was not recognised until after his death.

.....

.....

[1 mark]

0 3

In pea plants, the allele for yellow seeds (**Y**) is dominant to the allele for green seeds (**y**).  
Two pea plants that are both heterozygous (**Yy**) were crossed.

0 3 . 1

Give the genotype of a plant that is homozygous recessive for this characteristic.

.....

.....

.....

.....  
[1 mark]

0 3 . 2

What is the expected ratio of yellow seeds to green seeds among the offspring?

.....

.....

.....

.....

**[1 mark]**

0 3 . 3

The cross produced 436 seeds.

Calculate the number of these seeds expected to be green.

.....

.....

.....

Number of seeds = .....

**[1 mark]**

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0 4

Gregor Mendel crossed pea plants that always produced purple flowers with pea plants that always produced white flowers. All of the offspring (the first generation) had purple flowers. Mendel then bred the first-generation plants with each other. Table 2 shows results like those Mendel obtained for the second generation.

Table 2

| Flower colour | Number of plants in the second generation |
|---------------|-------------------------------------------|
| purple        | 612                                       |
| white         | 198                                       |

0 4 . 1

Calculate the ratio of purple-flowered plants to white-flowered plants in the second generation.

Give your answer in the form  $x : 1$ , with  $x$  to 2 significant figures.

.....

.....

.....

.....

Ratio = ..... : 1

[2 marks]

0 4 . 2

No white flowers appeared in the first generation, but white flowers appeared again in the second generation.

Explain how this supports Mendel’s idea that ‘units’ are passed on to offspring unchanged.

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[2 marks]

0 4 . 3

In the early 20th century, scientists noticed that chromosomes behave in a similar way to Mendel's units.

Give **one** way in which chromosomes and Mendel's units behave in the same way.

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.....

[1 mark]

0 4 . 4

Mendel's work was not recognised as important until after his death. Suggest **two** reasons why.

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.....

[2 marks]

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0 5

Gregor Mendel carried out breeding experiments on pea plants for about eight years. Pea flowers normally pollinate themselves. In his experiments, Mendel:

- used plants that were 'pure-breeding', so that they always produced offspring like themselves
- removed the male parts of each flower before they were mature, then used a brush to transfer pollen from a plant he had chosen
- covered the flowers with small bags after pollinating them
- studied characteristics that had two clearly different forms, such as tall stems or short stems
- grew and recorded thousands of plants.

0 5 . 1

Explain why Mendel removed the male parts of the flowers and then covered the flowers with bags.

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[2 marks]

0 5 . 2

Suggest why Mendel studied characteristics with two clearly different forms, rather than characteristics such as the mass of the seeds.

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[1 mark]

0 5 . 3

Explain why Mendel grew thousands of plants.

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[2 marks]

0 5 . 4

Suggest **one** reason why pea plants were a good choice for Mendel's experiments.

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[1 mark]

0 6

In pea plants, the allele for purple flowers (**P**) is dominant to the allele for white flowers (**p**). A scientist repeated one of Gregor Mendel's experiments. The scientist crossed pure-breeding plants with purple flowers with pure-breeding plants with white flowers. All of the offspring had purple flowers. The scientist then allowed the offspring to pollinate themselves. In the next generation there were 375 plants with purple flowers and 129 plants with white flowers.

0 6 . 1

Calculate the ratio of plants with purple flowers to plants with white flowers. Give your answer in the form  $x : 1$ , with  $x$  to 2 significant figures.

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Ratio = ..... : 1

[2 marks]

0 6 . 2

Calculate the percentage of the offspring that had white flowers. Give your answer to 3 significant figures.

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Percentage = ..... %

[1 mark]

0 6 . 3

The expected ratio is 3 : 1. Explain why the ratio the scientist obtained was not exactly 3 : 1.

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[1 mark]

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### END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

# Mark scheme

## GCSE Biology · Worksheet: The understanding of genetics · 30 marks

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### Question 1 (5 marks)

#### 01.1 [4 marks]

**Answer:** B, D, C, A

- mid-19th century: B (1)
  - late 19th century: D (1)
  - early 20th century: C (1)
  - mid-20th century: A (1)
- 

#### 01.2 [1 mark]

**Correct:** They are passed on to offspring unchanged.

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## Question 2 (5 marks)

02.1 [1 mark]

**Correct:** Plants

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02.2 [1 mark]

**Answer:** Genes

- genes (1)

**Notes:** Allow alleles.

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02.3 [2 marks]

**Answer:** Y, Z, X

- Y first (1)
- Z before X (1)

**Notes:** Y, Z, X scores 2 marks.

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02.4 [1 mark]

- his work was published in a little-known journal / was not widely read (1)
- other scientists did not understand his (mathematical) work (1)
- genes / chromosomes / DNA had not been discovered, so there was no mechanism to explain his results (1)
- he was not a well-known scientist (1)

Any 1 of the points above.

**Notes:** Allow 'he was a monk'.

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### Question 3 (3 marks)

03.1 [1 mark]

**Answer:** yy

- yy (1)

**Notes:** The letters must be lower case.

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03.2 [1 mark]

**Answer:** 3 : 1

- 3 : 1 (1)

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03.3 [1 mark]

**Answer:** 109

- $436 \div 4 = 109$  (1)
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## Question 4 (7 marks)

### 04.1 [2 marks]

**Answer:** 3.1 : 1

- $612 \div 198$  (1)
- 3.1 (: 1) (1)

**Notes:** 3.09 : 1 scores 1 mark.

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### 04.2 [2 marks]

- the unit (gene) for white was present in the first-generation plants but was hidden / not expressed (1)
  - (because it was passed on unchanged) it could produce white flowers again / it had not been blended / mixed / lost (1)
- 

### 04.3 [1 mark]

- both are in pairs (in body cells) (1)
- one of each pair goes into each gamete / sex cell (1)
- offspring receive one of each pair from each parent (1)

Any 1 of the points above.

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### 04.4 [2 marks]

- his work was published in a little-known journal / was not widely read (1)
- other scientists did not understand his (mathematical) work / did not accept his ideas (1)
- genes / chromosomes / DNA had not been discovered, so there was no mechanism to explain his results (1)
- he was not a well-known scientist (1)

Any 2 of the points above.

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## Question 5 (6 marks)

### 05.1 [2 marks]

- removing the male parts stopped the flowers pollinating themselves (1)
- the bags stopped pollen from other plants (carried by insects or wind) reaching the flowers, so Mendel knew which plants were the parents (1)

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### 05.2 [1 mark]

- each plant could be placed in one group or the other without doubt, so the offspring could be counted / seed mass varies continuously (1)

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### 05.3 [2 marks]

- which gametes fuse is a matter of chance, so small samples could give misleading ratios (1)
- large numbers give ratios closer to the true / expected ratio, so patterns (e.g. 3 : 1) can be seen clearly (1)

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### 05.4 [1 mark]

- they produce many seeds / offspring (1)
- they grow quickly / produce a new generation every year (1)
- they are easy to grow (1)
- they have many characteristics with two clear forms (1)
- they can be self-pollinated or cross-pollinated in a controlled way (1)

Any 1 of the points above.

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## Question 6 (4 marks)

### 06.1 [2 marks]

**Answer:** 2.9 : 1

- $375 \div 129$  (1)
- 2.9 (: 1) (1)

**Notes:** An answer of 2.91 (not given to 2 significant figures) scores 1 mark.

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### 06.2 [1 mark]

**Answer:** 25.6%

- $129 \div 504 \times 100 = 25.6$  (%) (1)

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### 06.3 [1 mark]

- fertilisation is random / which gametes fuse is due to chance, so the numbers vary from the expected ratio (1)
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