Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier

Biology Paper 2H

H

8464/B/2H

Friday 7 June 2024 Afternoon

Time allowed: 1 hour 15 minutes

[Turn over]

JUN248464B2H01

On the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.

MATERIALS

For this paper you must have:

- **a ruler**
- **a scientific calculator.**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**

- **Do all rough work in this book. Cross through any work you do not want to be marked.**
- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 70.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

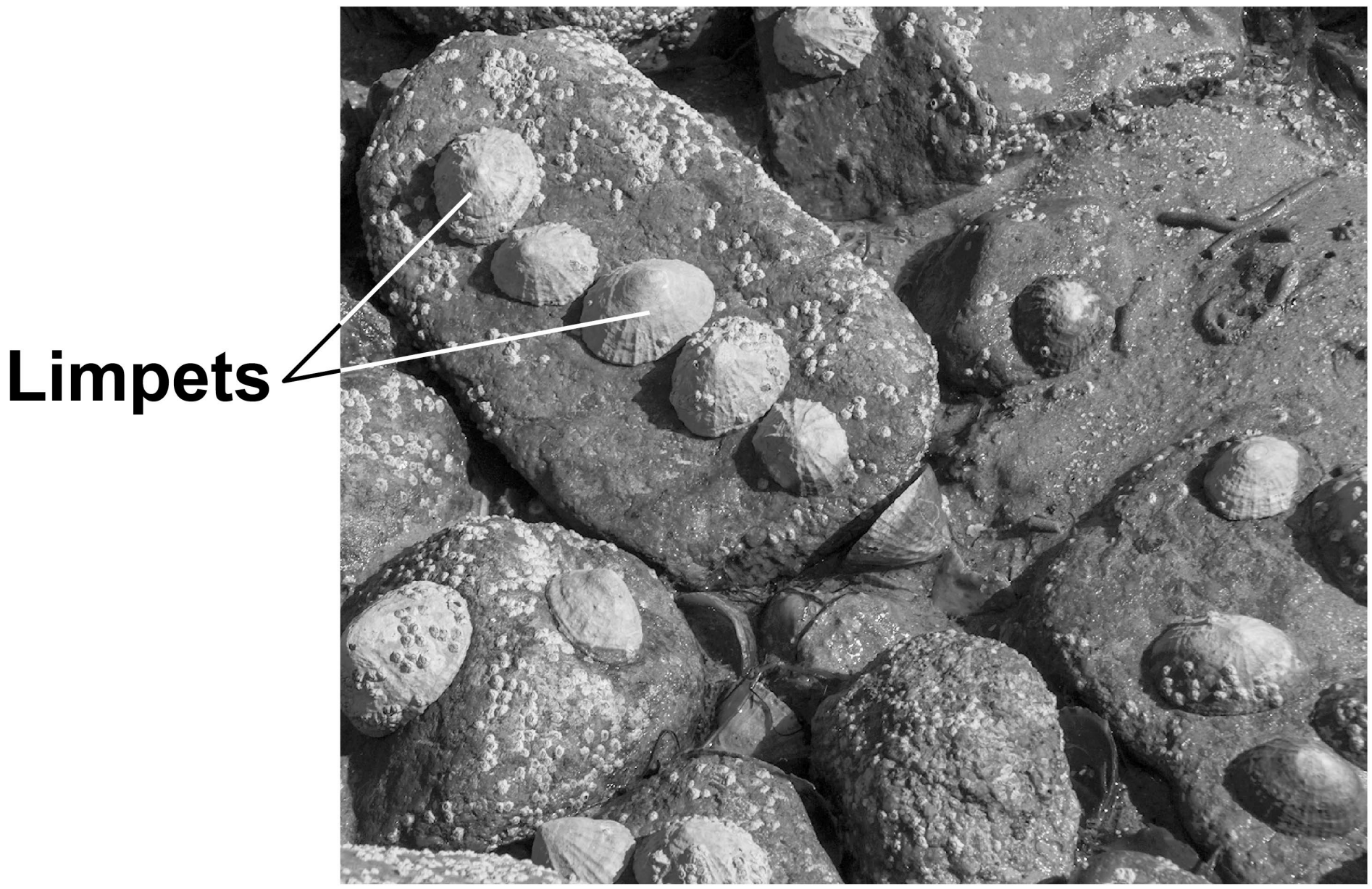
0 1

Limpets are small animals with shells.

Limpets attach to rocks on sea shores.

FIGURE 1 shows limpets on rocks.

FIGURE 1



0 1 . 1

Limpets eat algae.

Limpets are prey for crabs.

Give the food chain for algae, crabs and limpets. [1 mark]

_____

_____

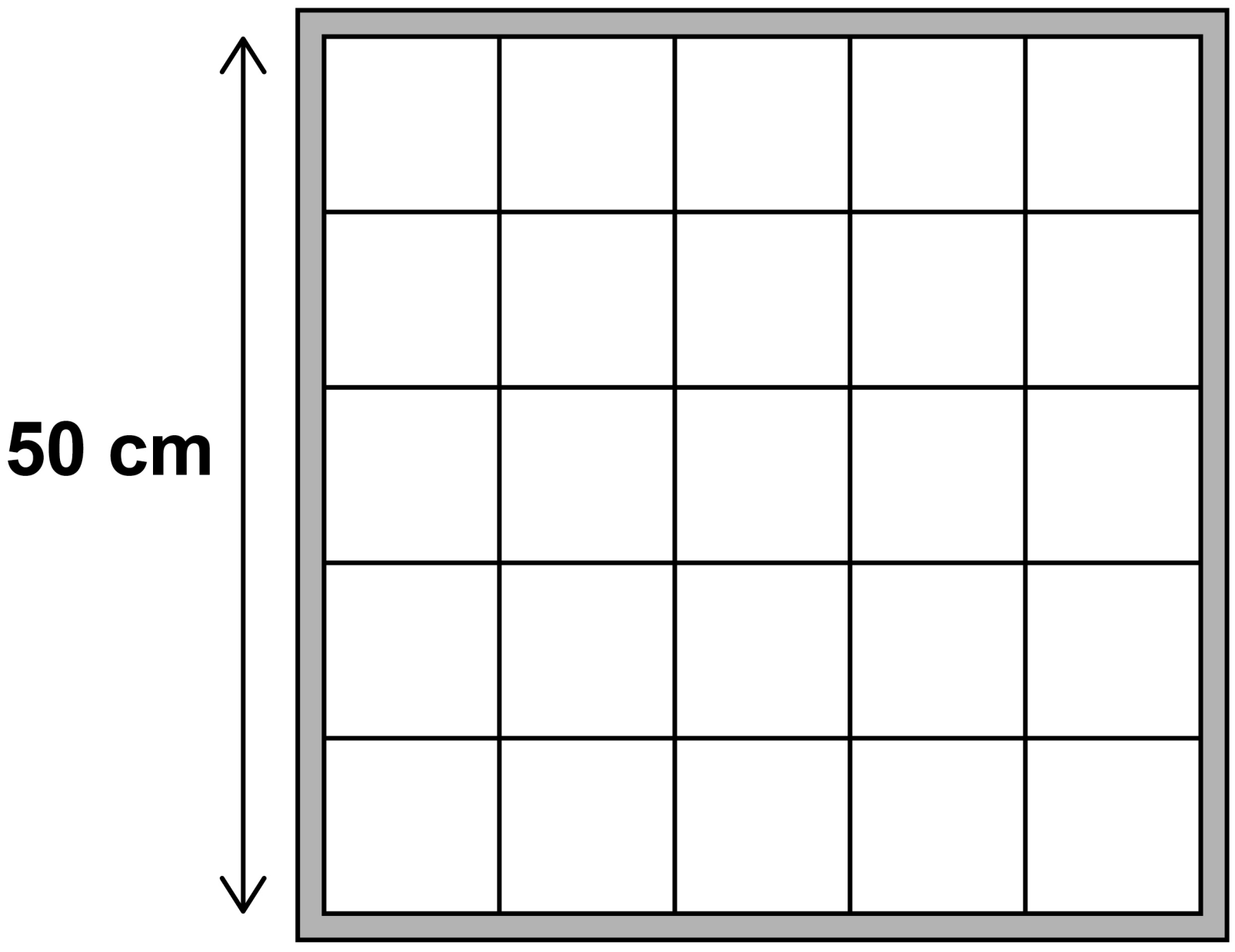
[Turn over]

Students estimated the population of limpets on a sea shore.

The students were given a square quadrat.

FIGURE 2 shows the quadrat.

FIGURE 2



0 1 . 2

Calculate the area of the quadrat in m^2.
[2 marks]

Area of quadrat = _____ m^2

0 1 . 3

The total area of the sea shore was 1800 m^2.

The students sampled 2% of the total area of the sea shore.

Calculate the number of times the students needed to use the quadrat for the 2% sample.

Use your answer from Question 01.2, on page 7. [2 marks]

Number of times = _____

0 1 . 4

Explain why throwing a quadrat is NOT a random method to estimate population size.

Do NOT refer to safety in your answer.

[2 marks]

0 1 . 5

Describe ONE method the students could use to plan where the quadrat should be randomly placed each time. [2 marks]

0 1 . 6

Suggest ONE hazard the students should be aware of when collecting data on the sea shore.

Do NOT refer to throwing quadrats in your answer. [1 mark]

_____

_____

_____

0 1 . 7

Populations of limpets are monitored to assess the impact of pollution in water.

Suggest ONE type of pollution in water that may affect the population of limpets. [1 mark]

_____

_____

_____

0 2

Potatoes are a food crop.

0 2 . 1

Potato plants are classified as eukaryota.

What type of classification group is eukaryota? [1 mark]

Tick (✓) ONE box.

- ☐ **Class**
- ☐ **Domain**
- ☐ **Kingdom**
- ☐ **Phylum**

0 2 . 2

Potato plants can reproduce by asexual reproduction.

Which statement is true for asexual reproduction? [1 mark]

Tick (✓) ONE box.

- ☐ **Meiosis occurs.**
- ☐ **Offspring are genetically identical.**
- ☐ **Pollen and egg cells are produced.**

0 2 . 3

Flowers of potato plants contain gametes for sexual reproduction.

How is a gamete different from other cells in a potato plant? [1 mark]

Tick (✓) ONE box.

- ☐ **A gamete contains one-quarter of the number of chromosomes.**
- ☐ **A gamete contains half of the number of chromosomes.**
- ☐ **A gamete contains double the number of chromosomes.**

0 2 . 4

Plants in the same genus as potatoes have been studied by scientists.

Describe ONE way a new plant species could be identified as being in the same genus as potatoes. [1 mark]

0 2 . 5

Scientists have collected and stored seeds from species in the same genus as potatoes.

In the future, these seeds may be used for genetic modification of potato plants.

Genetically modified potato plants could help supply food to the human population as the climate changes.

Explain why genetic modification of crop plants may be important for the human population to survive climate change.
[6 marks]

[Turn over]

18

10

BLANK PAGE

[Turn over]

0 3

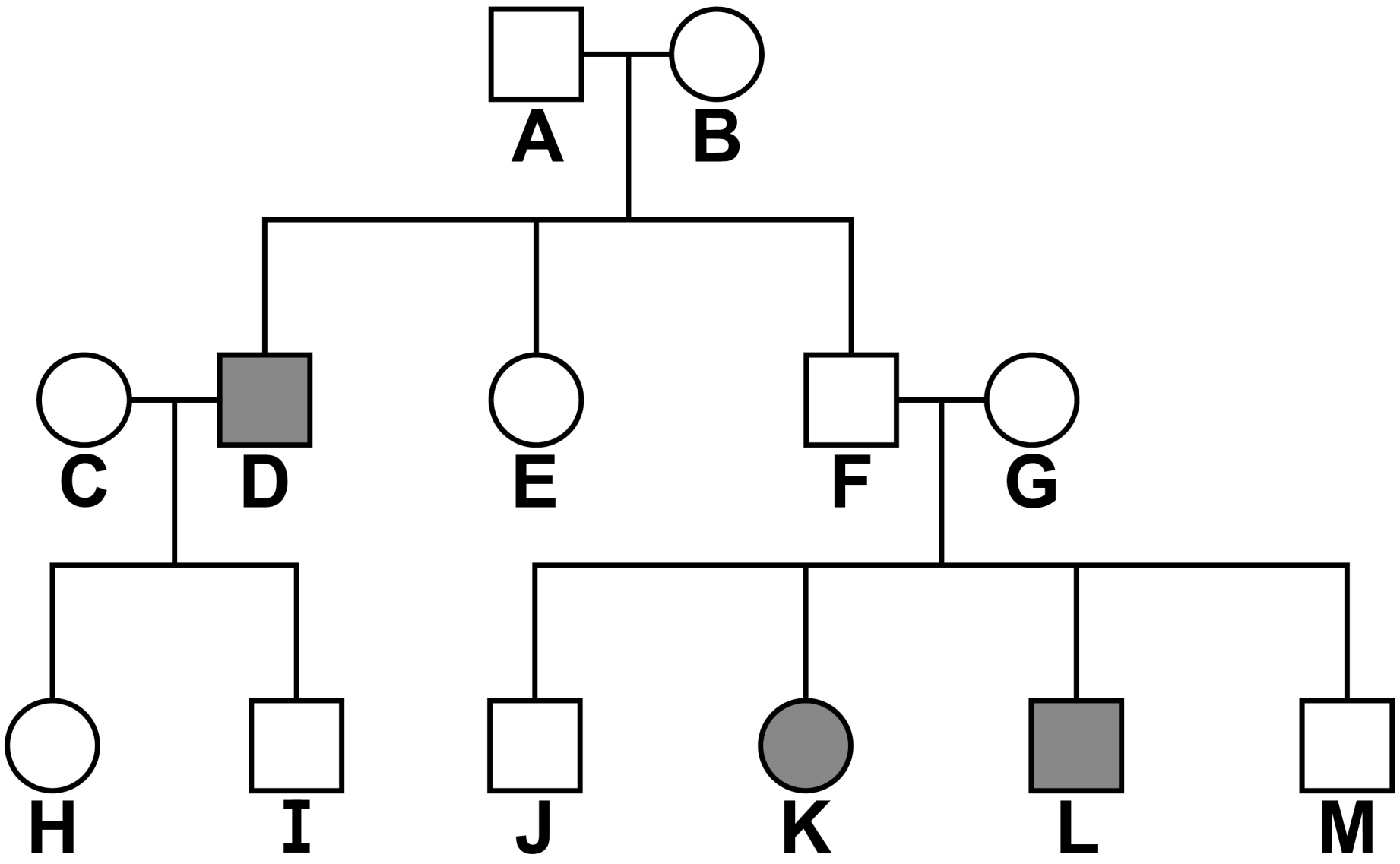
AKU is a genetic disorder.

FIGURE 3, on the opposite page, shows the inheritance of AKU in one family.

0 3 . 1

Describe how FIGURE 3 shows that the allele for AKU is recessive. [1 mark]

FIGURE 3

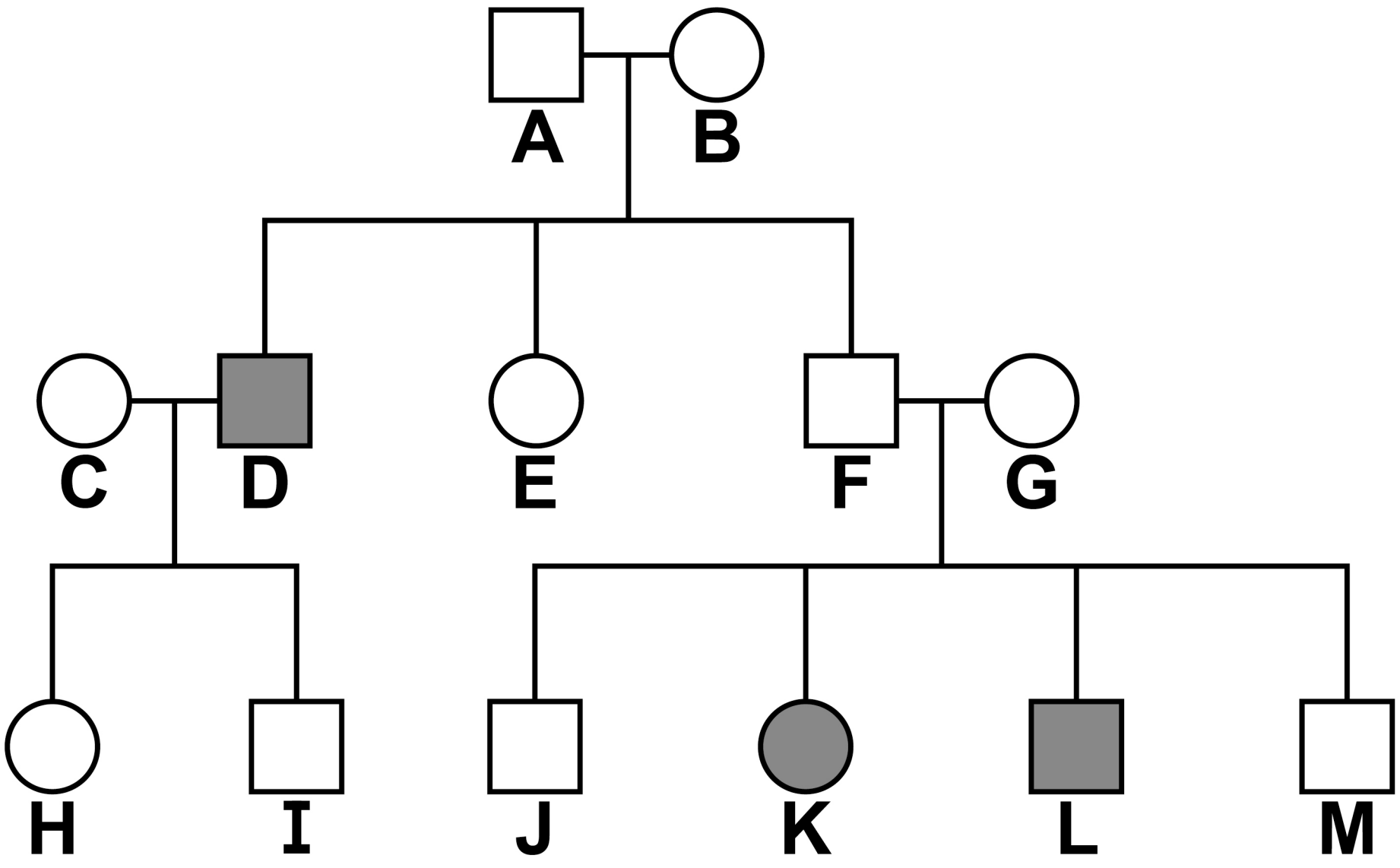


KEY

- Male who has AKU
- Female who has AKU
- Male who does NOT have AKU
- Female who does NOT have AKU

[Turn over]

REPEAT OF FIGURE 3



KEY

Male who has AKU

Female who has AKU

Male who does NOT have AKU

Female who does NOT have AKU

0 3 . 2

Which person is DEFINITELY heterozygous for AKU? [1 mark]

Tick (✓) ONE box.

- ☐ **C**
- ☐ **D**
- ☐ **E**
- ☐ **G**

0 3 . 3

A female who has AKU and a male who is heterozygous for AKU plan to have a child.

Determine the probability that the child will have AKU.

You should:

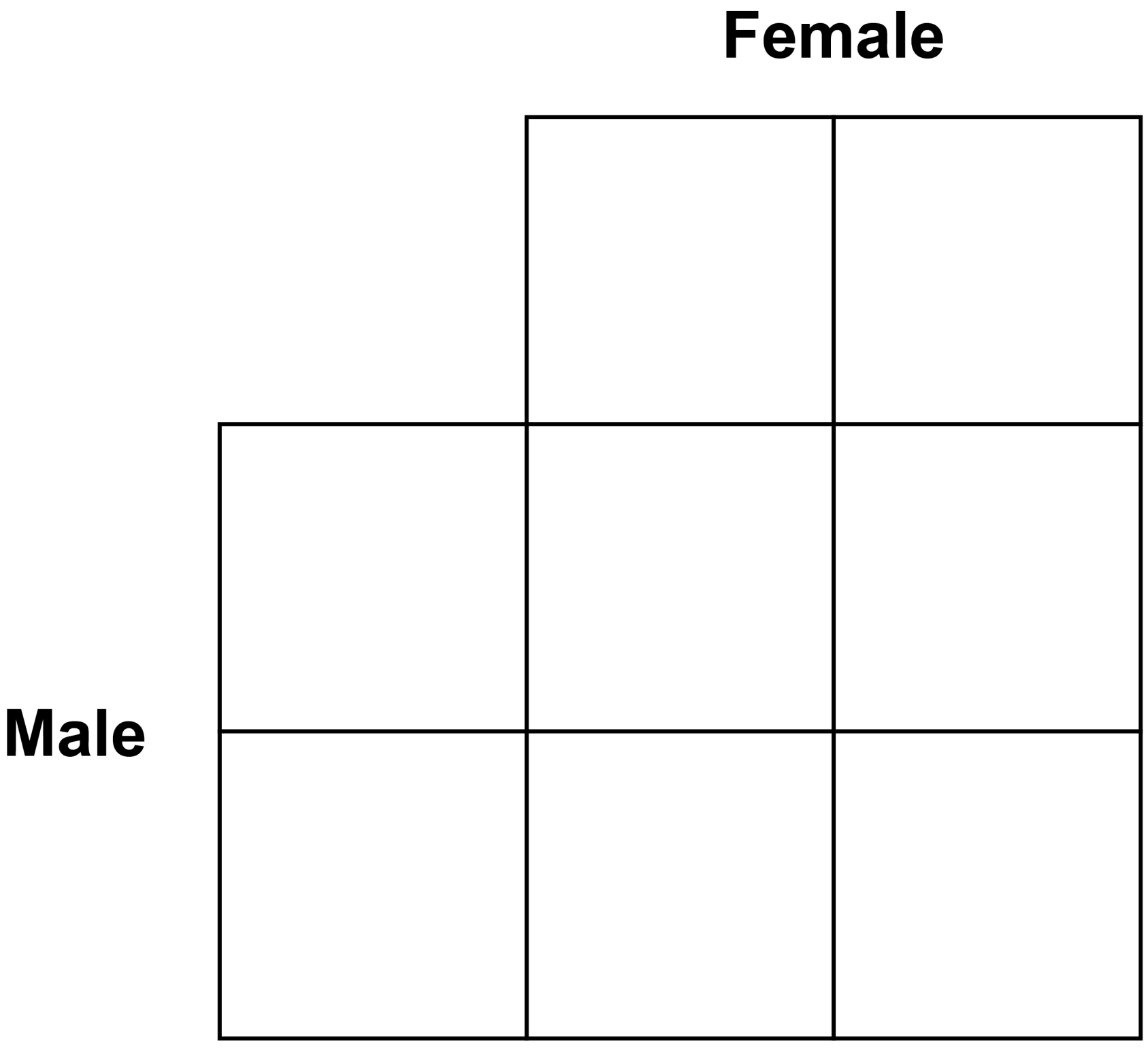
- **complete FIGURE 4, on the opposite page**
- **identify the phenotype of each offspring genotype**
- **use the symbols:**

  A = dominant allele

  a = recessive allele.

[5 marks]

FIGURE 4



Probability that the child will have AKU =

_____

[Turn over]

0 3 . 4

A mutation is a change in a gene.

People who have AKU have a mutation that causes the production of a non-functioning enzyme.

Enzymes are proteins.

Suggest how a mutation can result in the production of a non-functioning enzyme.
[2 marks]

0 3 . 5

Some people have In Vitro Fertilisation (IVF) treatment to increase the chance of becoming pregnant.

Describe how the process of IVF can result in pregnancy. [4 marks]

28

0 3 . 6

Embryos can be screened to detect inherited disorders.

Give TWO arguments AGAINST embryo screening.

Do NOT refer to religion in your answer.
[2 marks]

1 _____

_____

_____

2 _____

_____

[Turn over]

15

0 4

Rat populations can increase rapidly.

When rat populations are large there is competition between rats.

0 4 . 1

When rats compete, the basal metabolic rate of the rats increases.

Basal metabolic rate is controlled in the same way in humans and in rats.

Describe how basal metabolic rate is increased. [2 marks]

0 4 . 2

The size of a rat population can increase quickly.

One female rat and one male rat can produce 20 offspring every 2 months.

Warfarin is a poison that has been used to control rat populations.

Rat populations can become resistant to warfarin by the process of evolution.

A population of rats was given warfarin for 4 months.

TABLE 1, on page 32, shows information about resistance to warfarin in the rat population for a year after warfarin was first given.

[Turn over]

TABLE 1

Number of months since warfarin was first given	Was warfarin being given?	Percentage (%) of rat population resistant to warfarin
0	Yes	1
2	Yes	24
4	Yes	81
6	No	99
8	No	92
10	No	85
12	No	70

Rats with resistance to warfarin have a smaller mean mass than rats that are NOT resistant to warfarin.

Smaller rats are often at a disadvantage when competing against larger rats.

Explain the trends in the data when warfarin was being given and when warfarin was no longer given.

Use TABLE 1. [6 marks]

BLANK PAGE

[Turn over]

0 5

Otters are mammals that live in river ecosystems.

FIGURE 5 shows an otter.

FIGURE 5

0 5 . 1

Define the term ‘ecosystem’. [1 mark]

_____

_____

_____

[Turn over]

0 5 . 2

Otters are an important species for the stability of the river community.

Describe TWO ways animal species may be important for the stability of a whole community. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

Sewage was accidentally added to a river.

The sewage moved with the river water and affected:

- the number of bacteria in the water
- the concentration of dissolved oxygen in the water.

Samples of river water were analysed at different distances from where the sewage was added.

TABLE 2, on page 40, shows the results.

[Turn over]

TABLE 2

Distance from where sewage was added in km	Number of bacteria × 1000/mm^3	Concentration of dissolved oxygen in mg/dm^3
0.0	4	5.4
1.0	75	4.8
2.0	125	4.3
3.0	145	3.8
4.0	160	3.3
5.0	216	2.7

0 5 . 3

The number of bacteria at 5.0 km was greater than the number of bacteria where the sewage was added.

Calculate how many times greater.

[1 mark]

Number of times greater = _____

[Turn over]

REPEAT OF TABLE 2

Distance from where sewage was added in km	Number of bacteria × 1000/mm^3	Concentration of dissolved oxygen in mg/dm^3
0.0	4	5.4
1.0	75	4.8
2.0	125	4.3
3.0	145	3.8
4.0	160	3.3
5.0	216	2.7

0 5 . 4

A student concluded:

‘number of bacteria ∝ concentration of dissolved oxygen’

Explain why the student’s conclusion is NOT correct.

Use TABLE 2. [2 marks]

0 5 . 5

Otters:

- **live in water and on the land**
- **eat mainly fish.**

The concentration of dissolved oxygen has decreased in a river where otters live.

Explain how the decrease in the concentration of dissolved oxygen in the river water will affect the population of otters. [3 marks]

[Turn over]

9

0 6

Hormones are released from endocrine glands.

0 6 . 1

Which gland releases hormones to control other glands? [1 mark]

Tick (✓) ONE box.

☐ **Adrenal**

☐ **Pituitary**

☐ **Thyroid**

Several hormones can affect blood glucose concentration.

0 6 . 2

Adrenaline can increase blood glucose concentration.

What is ONE other effect of adrenaline? [1 mark]

Tick (✓) ONE box.

- ☐ **Decreased breathing rate**
- ☐ **Decreased metabolic rate**
- ☐ **Increased blood flow to muscles**
- ☐ **Increased FSH production**

[Turn over]

0 6 . 3

Cells in the pancreas detect changes in blood glucose concentration.

What type of cell in the body detects changes? [1 mark]

BLANK PAGE

[Turn over]

Scientists investigated whether blood glucose concentration affects reaction time.

The reaction times of ten people with Type 1 diabetes were measured.

This is the method used.

1. **Tell one person to drink a glucose solution.**
2. **Monitor the person's blood glucose concentration.**
3. **Record the person's reaction time when the person's blood glucose concentration is:**
   - **16 mmol/dm^3**
   - **6 mmol/dm^3**
   - **3 mmol/dm^3**
4. **Repeat steps 1 to 3 for the nine other people.**

0 6 . 4

People with Type 1 diabetes were selected for the investigation instead of people who did NOT have diabetes.

Explain why. [2 marks]

0 6 . 5

Control variables between the different people in the investigation included:

- **age**
- **sex**
- **food and drink consumed before and during the test.**

Suggest TWO OTHER control variables that should be used in the investigation. [2 marks]

1 _____

_____

2 _____

_____

_____

0 6 . 6

It was important for the scientists to monitor the health of each person during the investigation.

Suggest ONE reason why. [1 mark]

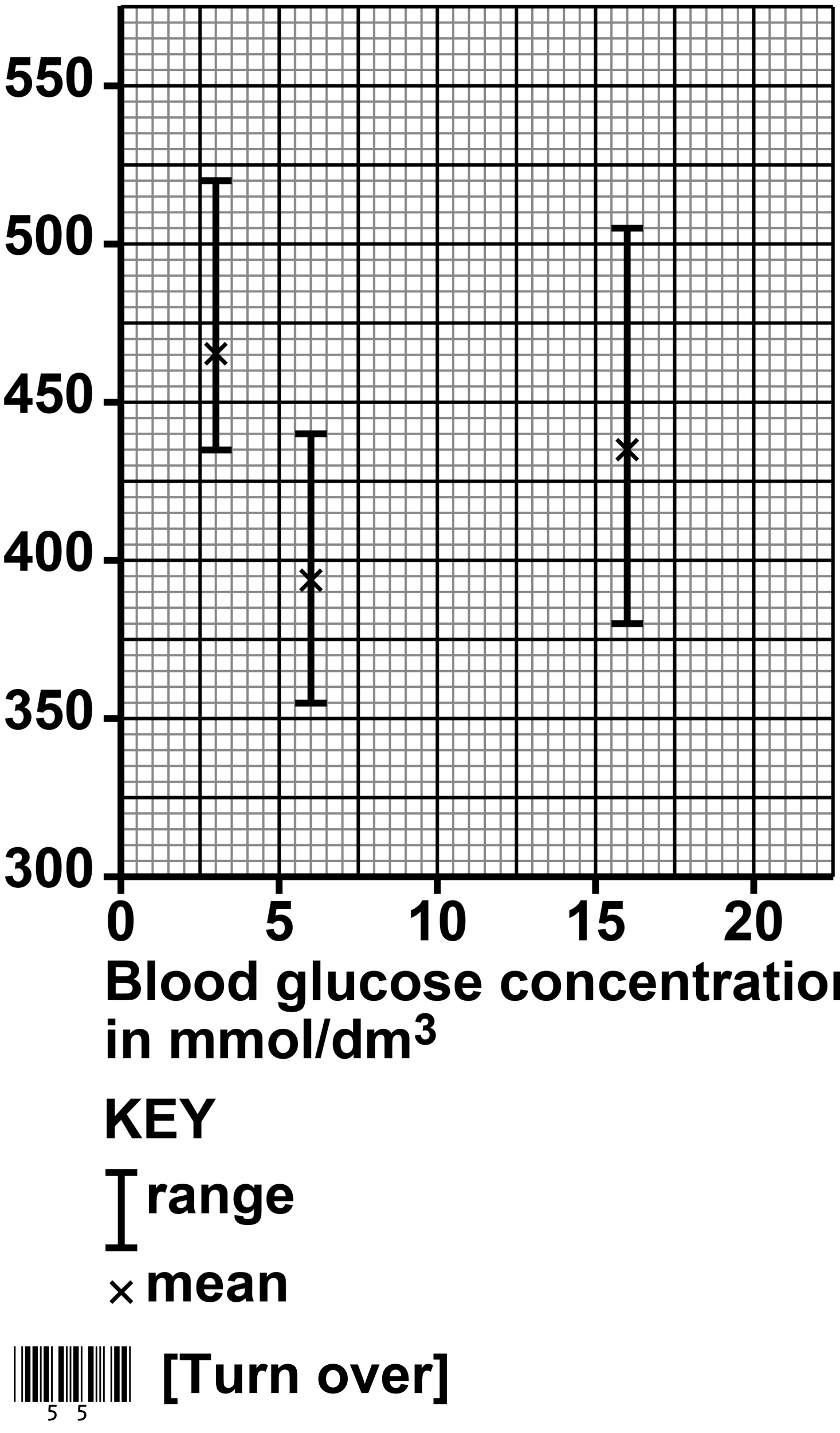
FIGURE 6, on the opposite page, shows the results.

0 6 . 7

People who do NOT have diabetes usually have a blood glucose concentration in the range of 4.0 mmol/dm^3 to 7.8 mmol/dm^3.

Describe how the results in FIGURE 6 show the importance of homeostasis.
[2 marks]

FIGURE 6



[Turn over]

0 6 . 8

Describe how blood glucose concentration is maintained within narrow limits in people who do NOT have diabetes. [5 marks]

[Turn over]

0 6 . 9

The scientists gave the hypothesis:

‘Optimum blood glucose concentration increases the production of chemicals that diffuse across synapses.’

Describe how an increase in the chemicals could decrease reaction time. [2 marks]

END OF QUESTIONS

17

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	