A

AQA

Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
BIOLOGY

H

Higher Tier Paper 2H

8461/2H

Friday 9 June 2023 Afternoon

Time allowed: 1 hour 45 minutes

[Turn over]

At 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 100.**
- **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

Answer ALL questions in the spaces provided.

0 1

Many different species can live together in the same habitat.

0 1 . 1

What name is given to all of the organisms living in the same habitat? [1 mark]

Tick (✓) ONE box.

- ☐ **A community**
- ☐ **A food chain**
- ☐ **A population**
- ☐ **An ecosystem**

[Turn over]

FIGURE 1, below and on the opposite page, shows four species of bird from the same habitat in the UK.

FIGURE 1

BRAMBLING (‘Fringilla montifringilla’)

BULLFINCH (‘Pyrrhula pyrrhula’)

CHAFFINCH (‘Fringilla coelebs’)

GOLDFINCH (‘Carduelis carduelis’)

[Turn over]

0 1 . 2

Which species of bird in FIGURE 1, on pages 6 and 7, do scientists think are most closely related? [1 mark]

Tick (✓) ONE box.

- ☐ **Brambling and chaffinch**
- ☐ **Brambling and goldfinch**
- ☐ **Bullfinch and chaffinch**
- ☐ **Bullfinch and goldfinch**

0 1 . 3

Scientists think the brambling and the bullfinch belong to different species.

What evidence is used by scientists to classify the brambling and the bullfinch as different species? [1 mark]

Tick (✓) ONE box.

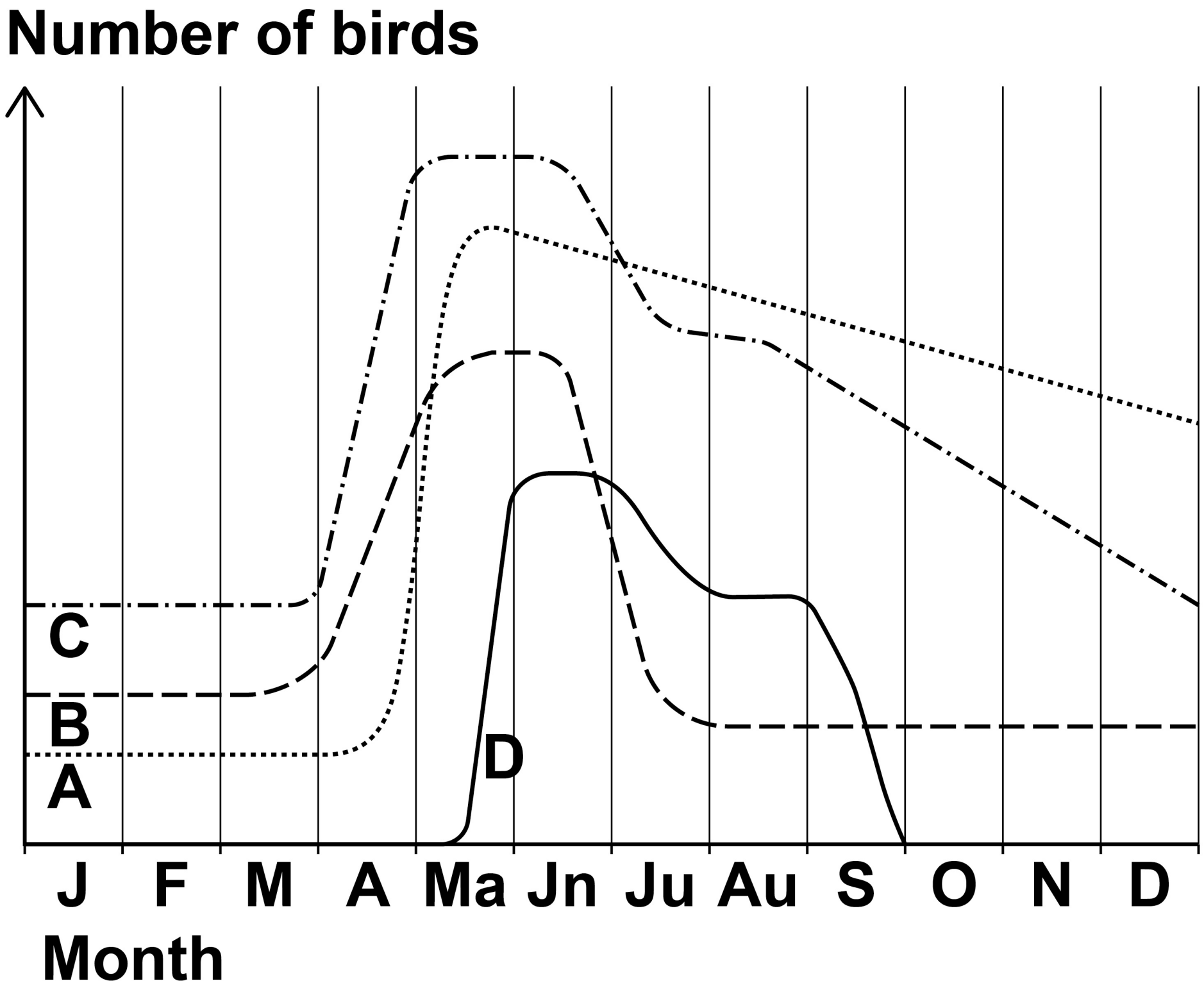
- ☐ **The brambling and the bullfinch are different sizes.**
- ☐ **The brambling and the bullfinch cannot breed together to give fertile offspring.**
- ☐ **The brambling and the bullfinch live in different parts of the habitat.**
- ☐ **The brambling eats mainly seeds and the bullfinch eats mainly insects.**

[Turn over]

Four other species of bird (A, B, C and D) live in a habitat in the UK.

FIGURE 2, below and on the opposite page, shows how the numbers of each species of bird varied during one year.

FIGURE 2



KEY

J = January
F = February
M = March
A = April
Ma = May
Jn = June
Ju = July
Au = August
S = September
O = October
N = November
D = December

[Turn over]

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Use information from FIGURE 2, on pages 10 and 11, to answer Questions 01.4 to 01.6

0 1 . 4

Describe what happens to the number of birds of species A during the year.
[3 marks]

0 1 . 5

In June and July, a disease affected the populations of some of the species.

Which species had the LOWEST resistance to the disease? [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

0 1 . 6

One species migrates between the UK and other countries.

Which species migrates between the UK and other countries?

Give a reason for your answer. [1 mark]

Species _____

Reason _____

_____

_____

_____

8

0	2

A person's eyes can focus on objects at different distances.

A person looks at a distant object.

The person then looks at a near object.

The person's eyes make adjustments so that the near object forms a clear image.

0 2 . 1

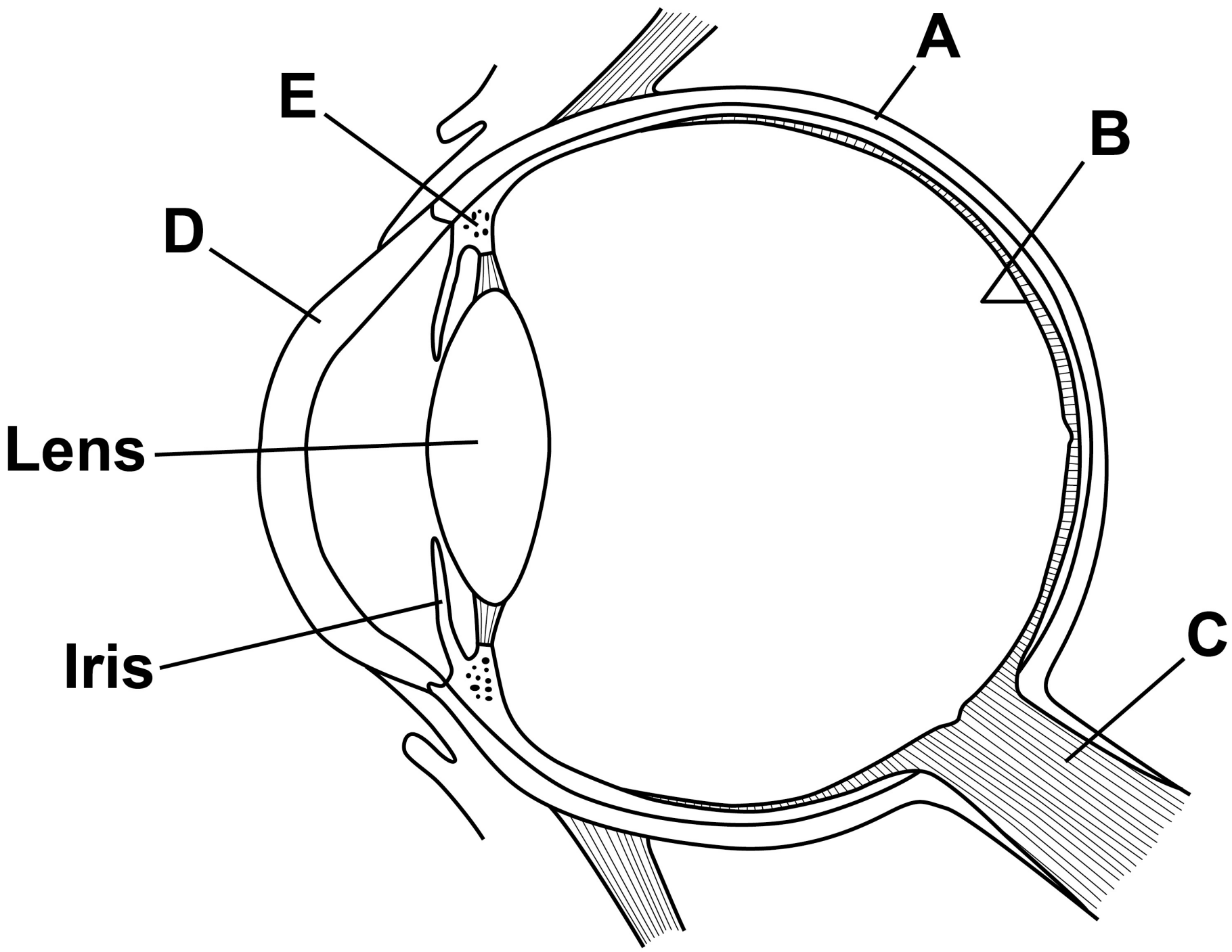
Which term describes the adjustment of focus from the distant object to the near object? [1 mark]

Tick (✓) ONE box.

- ☐ **Accommodation**
- ☐ **Adaptation**
- ☐ **Hyperopia**
- ☐ **Myopia**

FIGURE 3 shows the eye.

FIGURE 3



0 2 . 2

Which structure in FIGURE 3 is where the image is focused? [1 mark]

Tick (✓) ONE box.

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**
- ☐ **E**

[Turn over]

0 2 . 3

Which structure in FIGURE 3, on page 18, is a muscle that contracts when focusing on a near object? [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

☐ **E**

0 2 . 4

What happens to the shape of the lens when focusing on a near object?
[1 mark]

0 2 . 5

The eyes can function in dimly-lit areas and in brightly-lit areas.

The iris contains muscles.

Describe how muscles in the iris help the person to see clearly when moving from a dimly-lit area to a brightly-lit area.
[2 marks]

BLANK PAGE

[Turn over]

0 2 . 6

It is important to be able to react quickly.

Many people think that drinking coffee decreases reaction time.

Plan an investigation to test the effect of drinking coffee on reaction time.

You should include:

- **the test for reaction time that you would use**
- **how to make the investigation valid.**

[4 marks]

[Turn over]

10

0 3

Reproduction can produce offspring which are:

- **genetically different**

OR

- **genetically identical.**

Farmers grow tomato plants in greenhouses.

The tomatoes are sold in supermarkets.

0 3 . 1

Suggest ONE advantage of growing tomato plants that are genetically different. [1 mark]

0 3 . 2

Suggest ONE advantage of growing tomato plants that are genetically identical. [1 mark]

0 3 . 3

Scientists can grow genetically identical tomato plants using tissue culture.

What is tissue culture? [1 mark]

0 3 . 4

Genetically identical tomato plants growing in the same garden do NOT all grow to the same height.

Give ONE reason why. [1 mark]

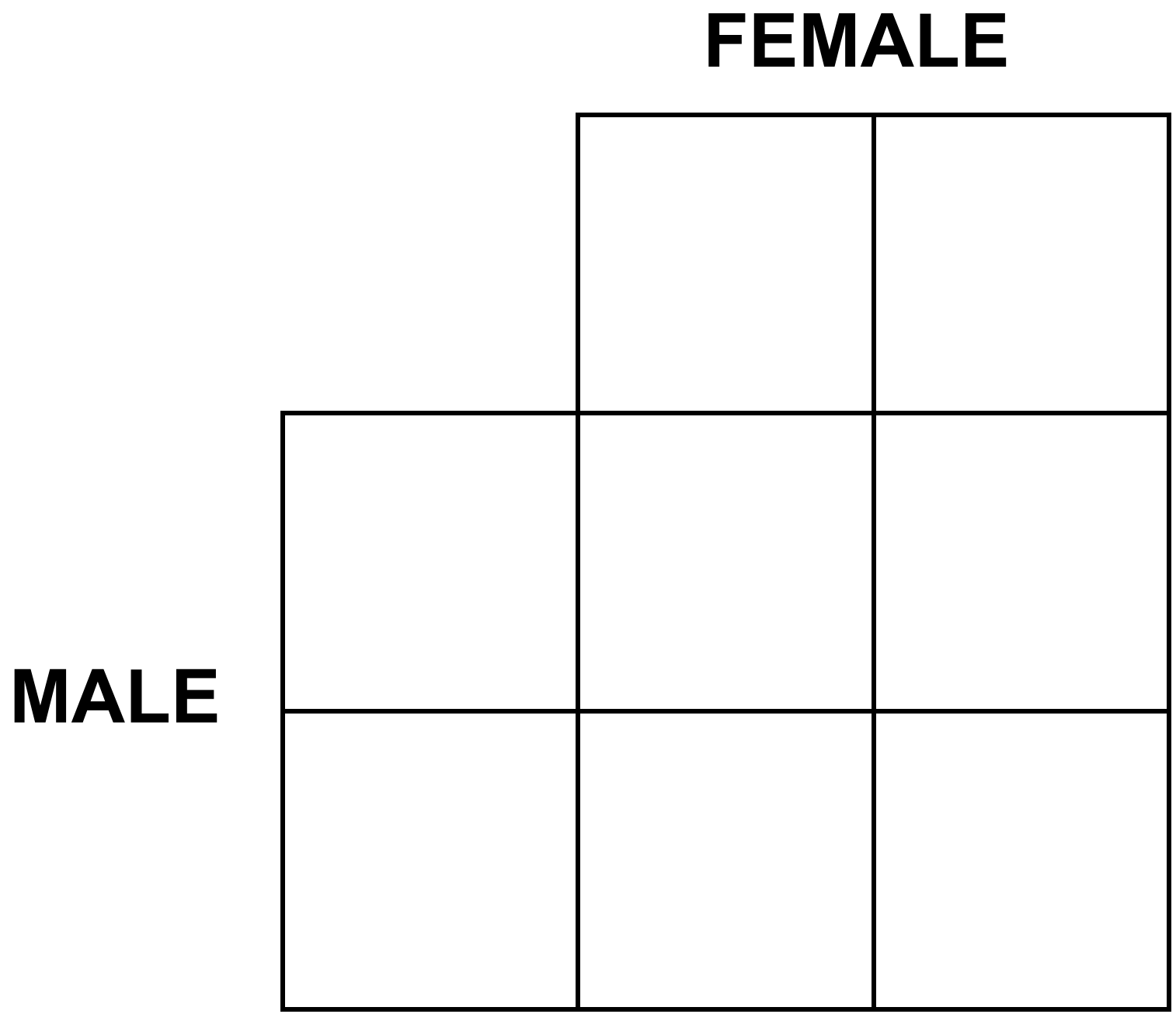
The sex of dogs is determined by X and Y chromosomes in the same way as in humans.

0 3 . 5

Complete the Punnett square diagram in FIGURE 4, on the opposite page, to show the inheritance of sex in dogs.

Use the symbols X and Y. [3 marks]

FIGURE 4



[Turn over]

0 3 . 6

A female dog gave birth to six offspring.

Why would you expect there to be three male offspring and three female offspring?

Use your answer to Question 03.5, on page 29. [1 mark]

Farmers keep chickens for:

- meat production
- egg production.

Some varieties of chicken grow more quickly and are more suitable for meat production.

Other varieties of chicken produce more eggs.

A farmer keeps two varieties of chicken, A and B.

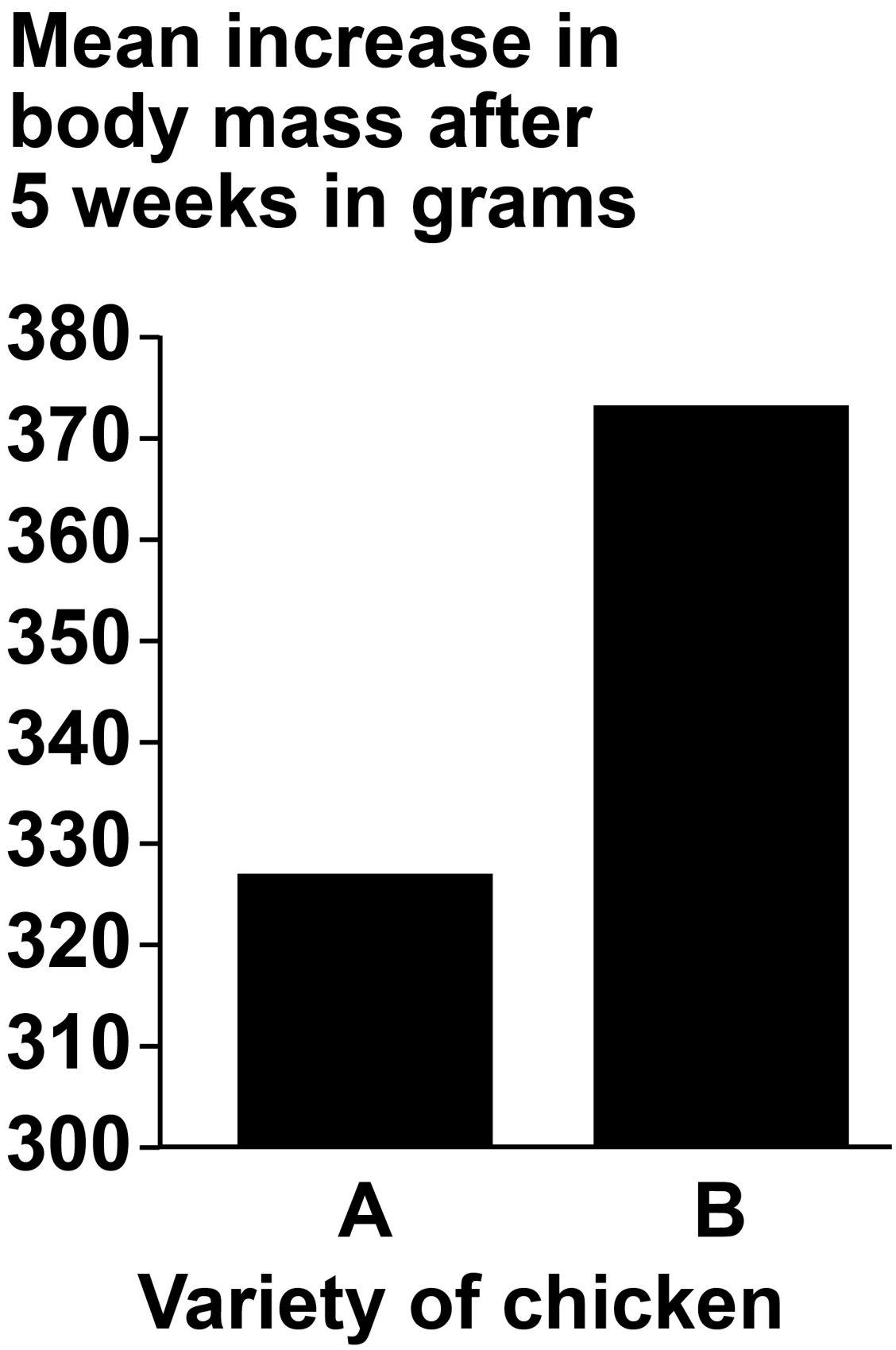
The farmer investigated the growth rates and egg-production rates of both varieties.

FIGURE 5, on pages 32 and 33, shows the results.

[Turn over]

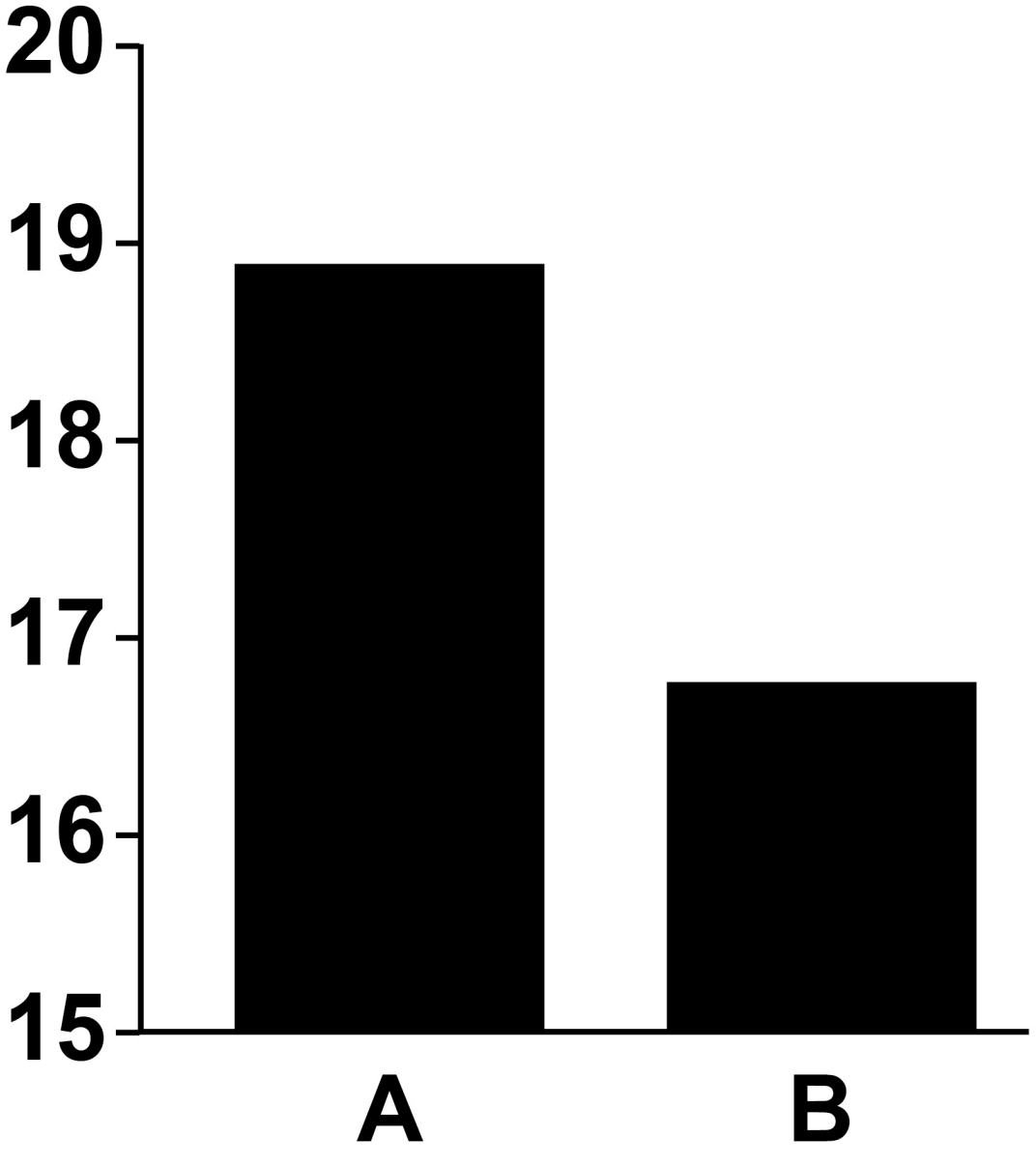
FIGURE 5

GROWTH



EGG PRODUCTION

Mean number of eggs laid per month



Variety of chicken

[Turn over]

0 3 . 7

Suggest TWO control variables the farmer should have used in this investigation. [2 marks]

1

2

0 3 . 8

FIGURE 5, on pages 32 and 33, shows mean values from 500 chickens of each variety.

Give the reason the farmer used a large number of chickens. [1 mark]

_____

_____

_____

0 3 . 9

The farmer wants to produce a new variety of chicken that is good for BOTH meat production AND egg production.

Describe how selective breeding of chicken varieties A and B can produce the new variety of chicken. [4 marks]

[Turn over]

15

0 4

Organic substances decay into simpler substances.

0 4 . 1

The leaves fall off many trees in autumn.

The dead leaves contain carbon compounds and nitrogen compounds.

Describe how carbon AND nitrogen in compounds in the leaves are recycled and used by living trees.

You should include a description of:

- **how the leaves are broken down**
- **how substances are taken in and used by the trees.**

[6 marks]

[Turn over]

BLANK PAGE

[Turn over]

Students investigated the effect of temperature on the decay of milk.

This is the method used.

1. Place 25 cm^3 of fresh milk into each of three beakers.
2. Keep one beaker of milk at 5 °C.
3. Keep one beaker of milk at 15 °C.
4. Keep one beaker of milk at 25 °C.
5. Record the pH of the milk in each beaker every day for 4 days.

TABLE 1, on the opposite page, shows the results.

TABLE 1

TIME IN DAYS	pH of milk		
	5 °C	15 °C	25 °C
0	6.8	6.8	6.8
1	6.5	6.1	5.3
2	6.2	5.5	4.9
3	5.9	5.1	4.8
4	5.6	4.8	4.8

0 4 . 2

Suggest ONE improvement the students could have made to the method.

[1 mark]

REPEAT OF TABLE 1

TIME IN DAYS	pH of milk		
	5 °C	15 °C	25 °C
0	6.8	6.8	6.8
1	6.5	6.1	5.3
2	6.2	5.5	4.9
3	5.9	5.1	4.8
4	5.6	4.8	4.8

0 4 . 3

Complete FIGURE 6, on the opposite page.

You should:

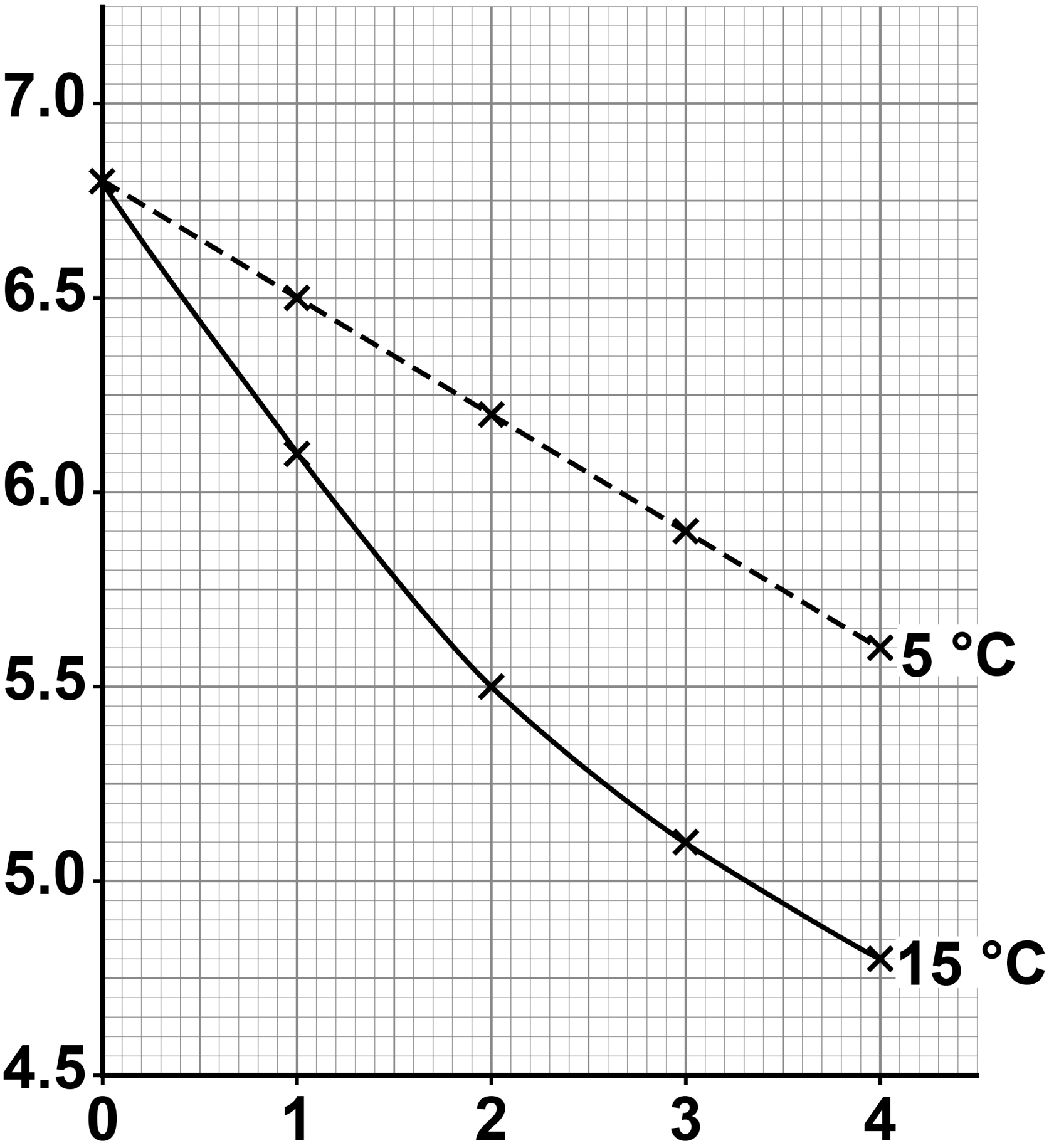
- **plot the data for 25 °C from TABLE 1**
- **draw a line of best fit.**

[3 marks]

FIGURE 6 shows the results at 5 °C and at 15 °C.

FIGURE 6

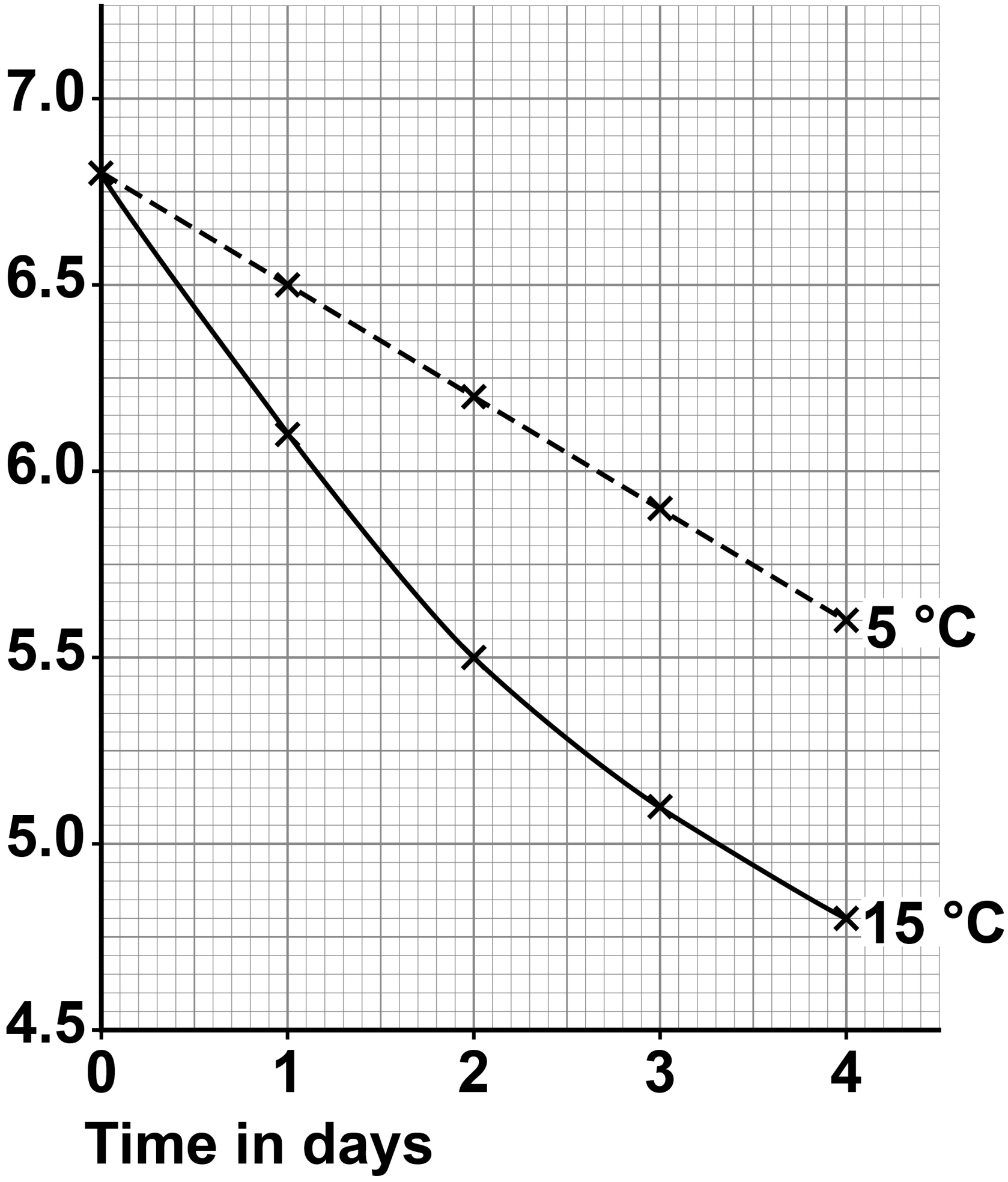
pH of milk



[Turn over]

FIGURE 7 shows the results for 5 °C and at 15 °C again.

FIGURE 7



0 4 . 4

The rate of pH change increases with an increase in temperature.

The rate of pH change at 5 °C is 0.3 pH units per day.

Calculate how many times faster the rate of pH change is at 15 °C than the rate of pH change at 5 °C, at DAY 2.

You should draw a tangent on FIGURE 7.
[4 marks]

Rate at 15 °C is _____ times faster.

0 4 . 5

Milk contains lipids.

The lipids are broken down when the milk decays.

Explain why the pH changes more quickly when the temperature is higher. [3 marks]

0 5

Homeostasis is the regulation of the body's internal conditions.

Many internal conditions are controlled by hormones.

Homeostasis works by negative feedback control.

0 5 . 1

FIGURE 8, on page 52, shows how the concentration of substance Q in the blood is controlled by negative feedback.

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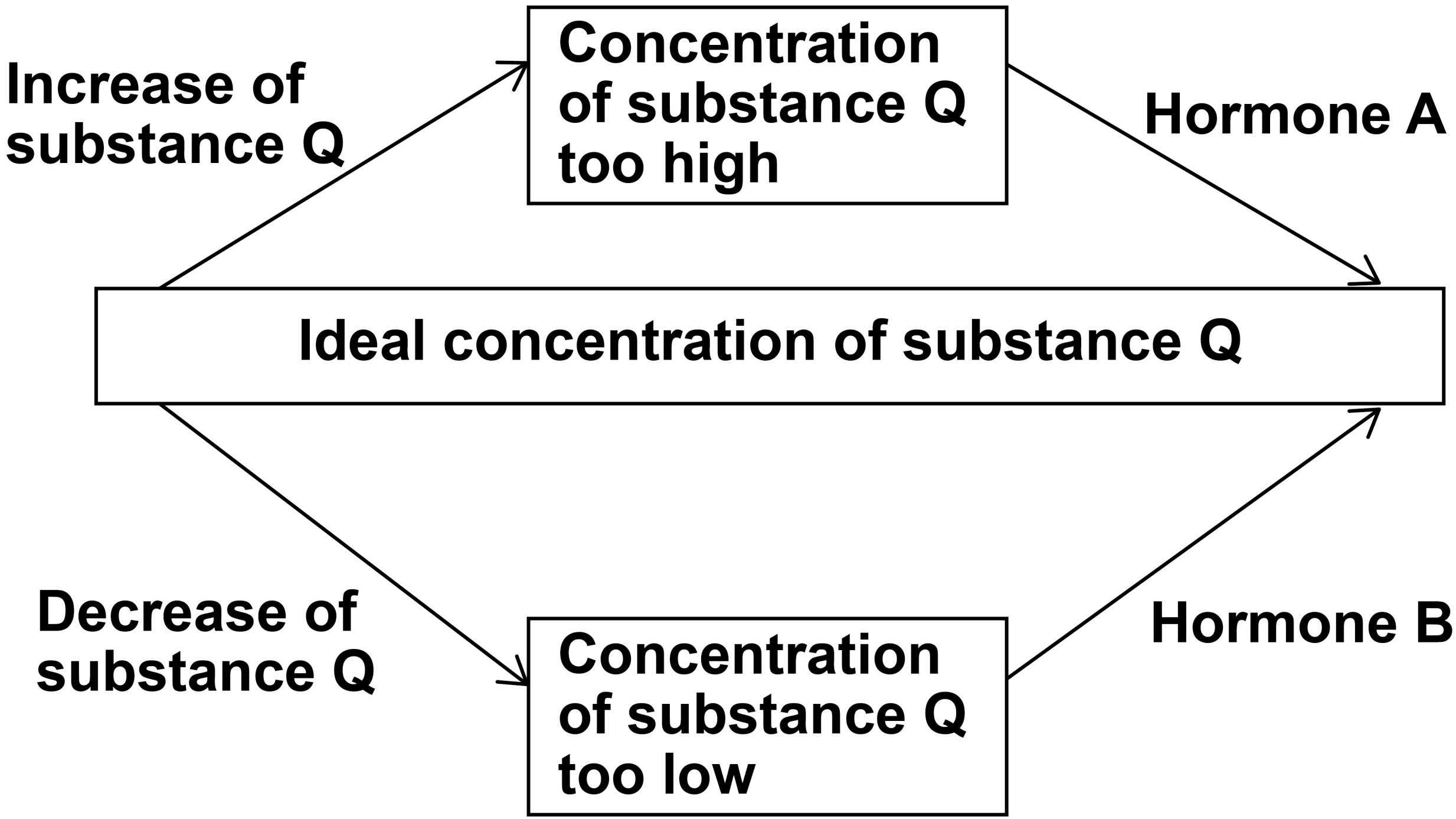
[Turn over]

FIGURE 8


Increase of substance Q
Concentration of substance Q too high
Hormone A
Ideal concentration of substance Q
Decrease of substance Q
Concentration of substance Q too low
Hormone B

0 5 3

Explain how the concentration of substance Q in the blood is controlled by negative feedback.

Use information from FIGURE 8. [3 marks]

5

0 5 . 2

Thyroxine is a hormone produced by the thyroid gland.

A decrease in body temperature causes an increase in thyroxine production.

Explain how the production of thyroxine causes an INCREASE in body temperature. [2 marks]

BLANK PAGE

[Turn over]

0 5 . 3

ADH is a hormone made by the pituitary gland.

ADH controls how much water is reabsorbed from the kidney tubules.

TABLE 2 shows effects of ADH.

TABLE 2

Concentration of ADH in the blood in nanograms /dm^3	Concentration of dissolved substances in urine in arbitrary units	Rate of urine production in cm^3/ minute
0.0	50	20.0
1.25	700	8.8
2.50	980	3.9
3.75	1110	1.8
5.00	1170	0.9

The concentration of ADH in a man's blood was 3.75 nanograms/dm^3.

The concentration of ADH in his blood decreased to 1.25 nanograms/dm^3.

Explain how the decrease in the concentration of ADH would cause the changes to the urine shown in TABLE 2. [4 marks]

9

5 8

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[Turn over]

0 6

This question is about the effects of deforestation and agriculture.

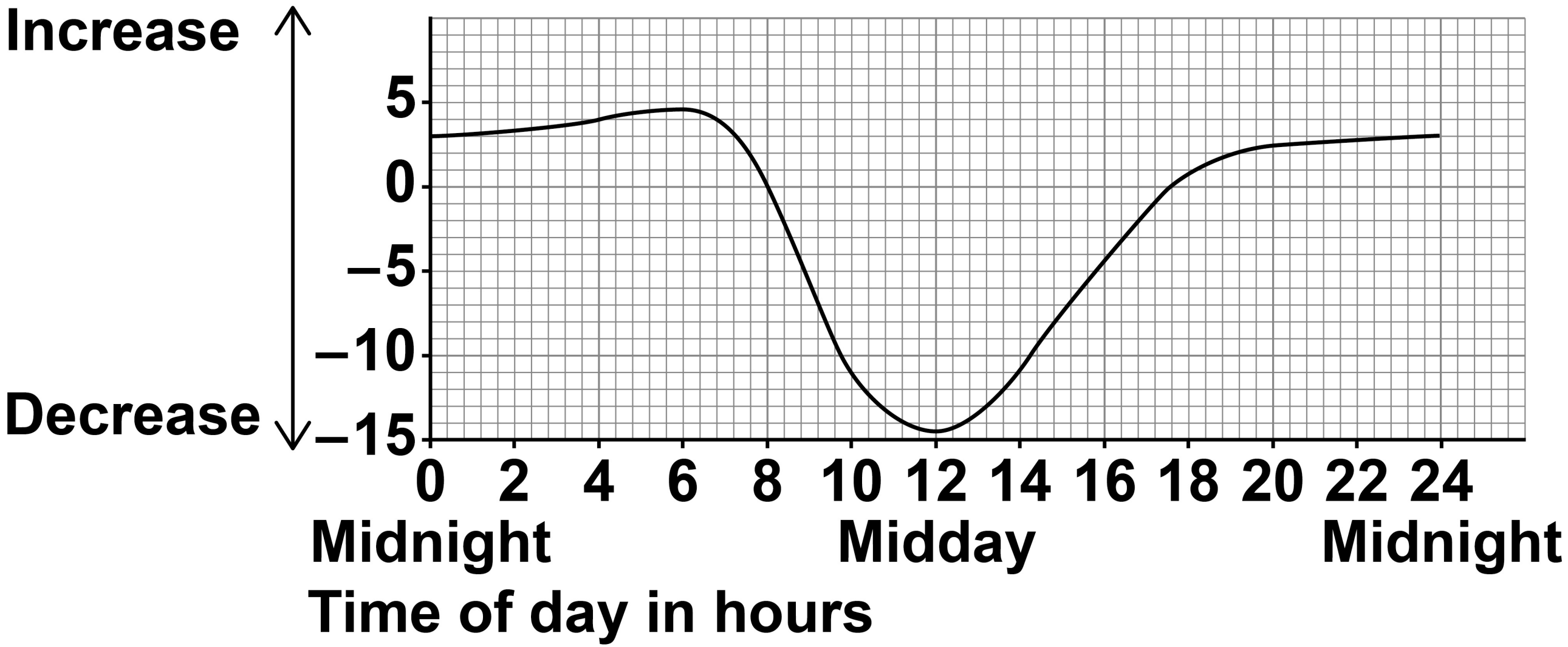
The processes of photosynthesis and respiration affect the carbon dioxide concentration in the air.

FIGURE 9, on the opposite page, shows the changes in the carbon dioxide concentration in the air in a tropical rainforest during one day.

The data are mean daily values over a whole year.

FIGURE 9

Change in CO_2 concentration in the air in arbitrary units



Question 6 continues on page 63.

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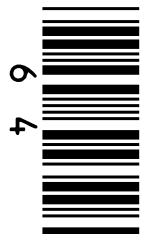
0 6 . 1

Explain what causes the changes in the carbon dioxide concentration in the air:

- **from 0 to 6 hours**
- **from 8 to 12 hours.**

Use information from FIGURE 9, on page 61. [4 marks]

0 to 6 hours



8 to 12 hours

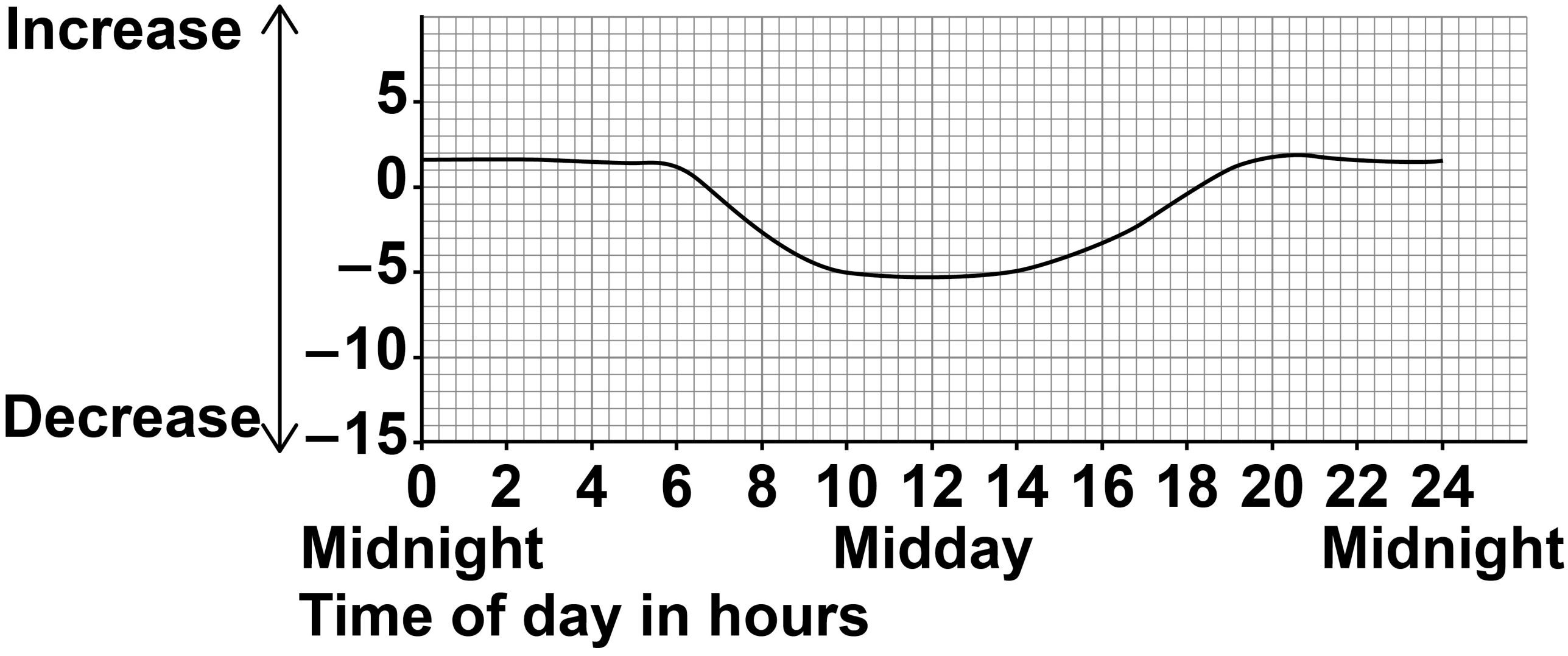
An area of rainforest is cut down and replaced with a field of maize plants.

Only one crop of maize is grown each year.

FIGURE 10, on page 66, shows the changes in the carbon dioxide concentration in the air in the field of maize during one day.

The data are mean daily values over the 6-month growing period.

FIGURE 10


Change in CO_2 concentration in the air in arbitrary units
Increase
Decrease
5
0
–5
–10
–15
0 2 4 6 8 10 12 14 16 18 20 22 24
Midnight
Midday
Midnight
Time of day in hours

The maize grows for only 6 months of the year.

Explain why replacing rainforest with maize will increase the carbon dioxide concentration in the air after one year.

Use information from FIGURE 9, on page 61, and FIGURE 10. [2 marks]

A tropical rainforest can contain over 1000 different tree species.

Large areas of tropical rainforest have been cut down during the last 100 years so crops can be grown.

Scientists studied the regeneration of different areas of tropical rainforest.

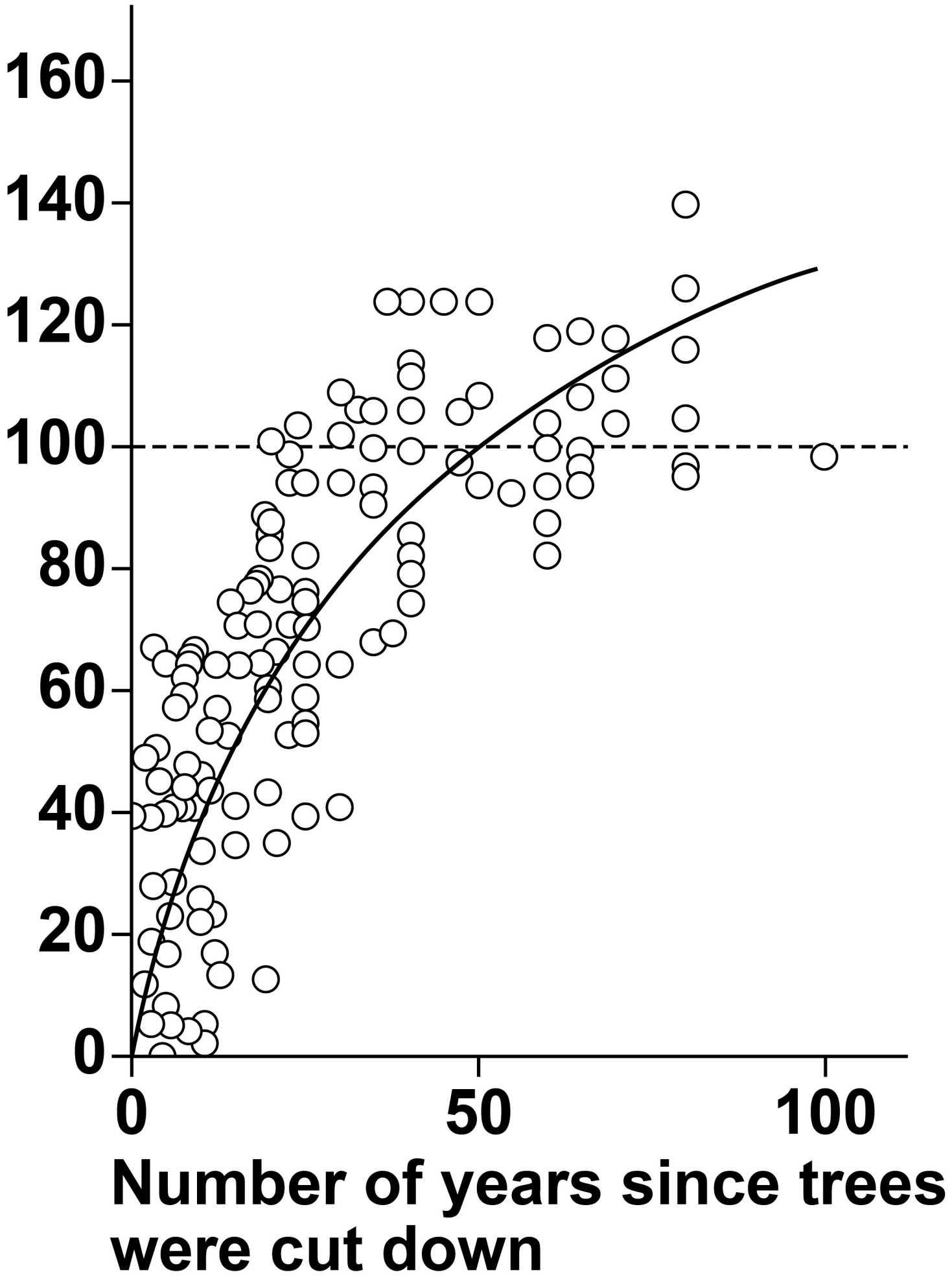
The scientists:

- **investigated areas of rainforest that had been cut down at different times during the previous 100 years**
- **recorded the number of tree species that re-grew in each area**
- **compared each area with a control area next to it. The control areas were undisturbed rainforest which had never been cut down.**

FIGURE 11, on page 70, shows the scientists' results.

[Turn over]

FIGURE 11


Percentage of the number of tree species compared to control area
160
140
120
100
80
60
40
20
0
0
50
100
Number of years since trees were cut down
KEY
○ Result for each study area

0 6 . 3

The values plotted in FIGURE 11 are percentages of the results for the control areas.

Explain why the scientists presented their results as PERCENTAGES.
[2 marks]

During the 100 years, the biodiversity of trees in the regenerating rainforest increases.

0 6 . 4

Give ONE other conclusion you can make from FIGURE 11, on page 70.
[1 mark]

0 6 . 5

Give TWO reasons why an increase in the diversity of trees in the rainforest leads to an increase in animal diversity.
[2 marks]

1

2

11

0 7

Hormones are important for regulating the menstrual cycle.

During the menstrual cycle, eggs mature inside follicles in the ovaries.

A 27-year-old woman was infertile.

A doctor tested a sample of the woman's blood.

The test did NOT detect any follicle stimulating hormone (FSH) in the woman's blood.

The doctor gave the woman daily injections of FSH for 7 days.

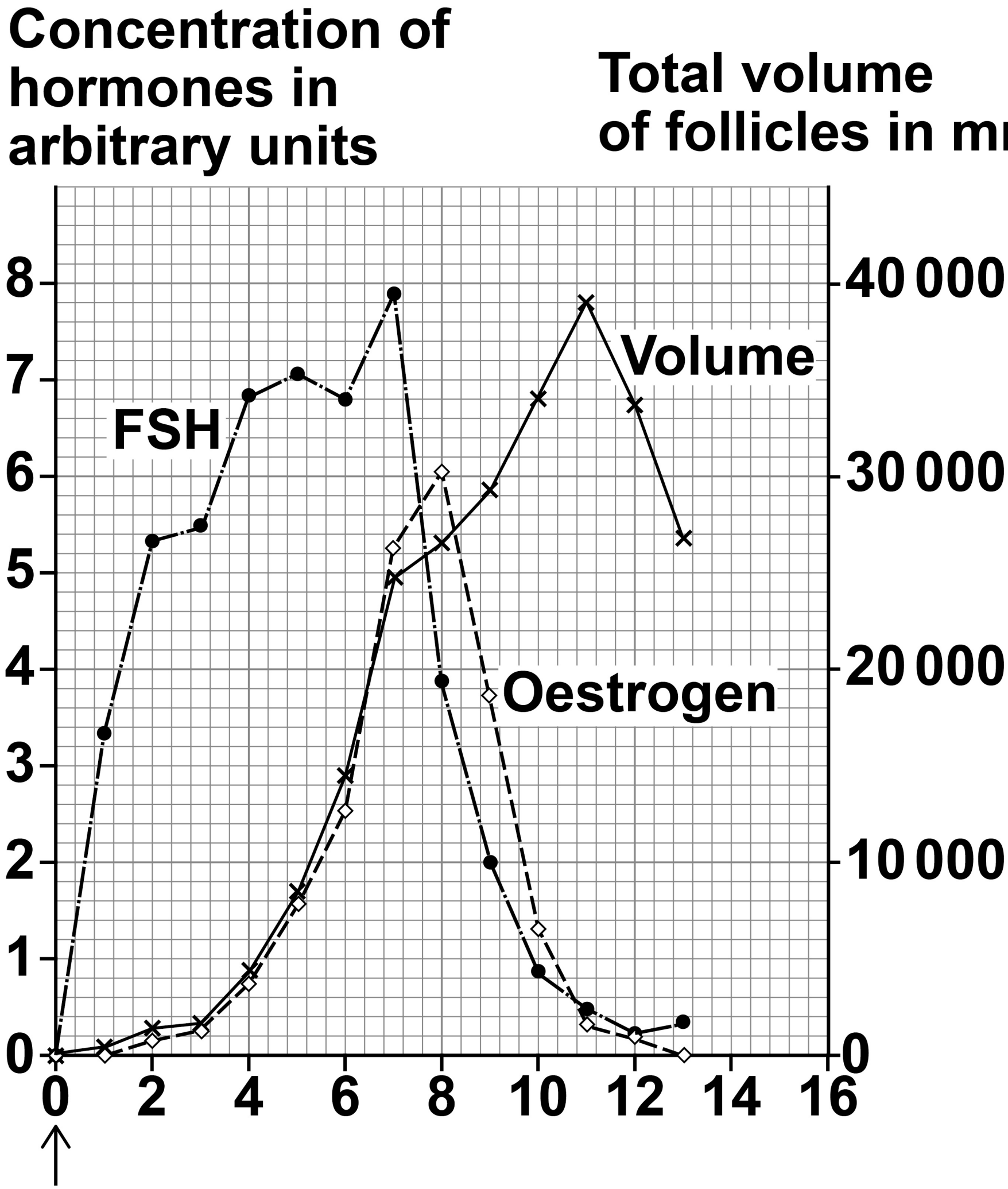
The doctor measured:

- the concentration of FSH in the woman's blood
- the concentration of oestrogen in the woman's blood
- the volumes of developing follicles in the ovaries.

FIGURE 12, on page 76, shows the results.

[Turn over]

FIGURE 12


Concentration of hormones in arbitrary units
Total volume of follicles in mm3
FSH
Volume
Oestrogen
0
1
2
3
4
5
6
7
8
0
10 000
20 000
30 000
40 000
0
2
4
6
8
10
12
14
16
Start of FSH injections
Time in days

0 7 . 1

Give evidence from FIGURE 12 that the follicles in the ovaries release oestrogen. [1 mark]

0 7 . 2

Injection of FSH caused the development of a number of follicles.

The mean diameter of the follicles on day 11 was 22 millimetres.

Calculate the number of follicles in the woman's ovaries on day 11.

Assume each follicle is a sphere.

Volume of a sphere = $\frac{4}{3}\pi r^3$

r = radius
π = 3.14

Give your answer to the nearest whole number. [5 marks]

Number of follicles (to the nearest whole number) = _____

[Turn over]

0 7 . 3

Before treatment with FSH, the woman had underdeveloped breasts.

Explain why the lack of FSH in the woman's blood caused underdeveloped breasts. [2 marks]

BLANK PAGE

[Turn over]

0 7 . 4

Usually males and females both produce FSH.

The woman had inherited a faulty gene for FSH production from each of her parents.

The woman's parents both produce FSH.

Show how the WOMAN'S PARENTS could have a child that does NOT produce FSH.

On the opposite page, you should:

- **draw a Punnett square diagram**
- **identify the phenotype of each offspring genotype**
- **use the symbols below:**
  H = allele for making FSH
  h = allele for NOT making FSH

[3 marks]

[Turn over]

0 7 . 5

The woman continues to have injections of FSH.

The woman has a child with a man who is heterozygous for the FSH gene.

Explain why the probability that the child will be able to produce FSH is 0.5.
[3 marks]

14

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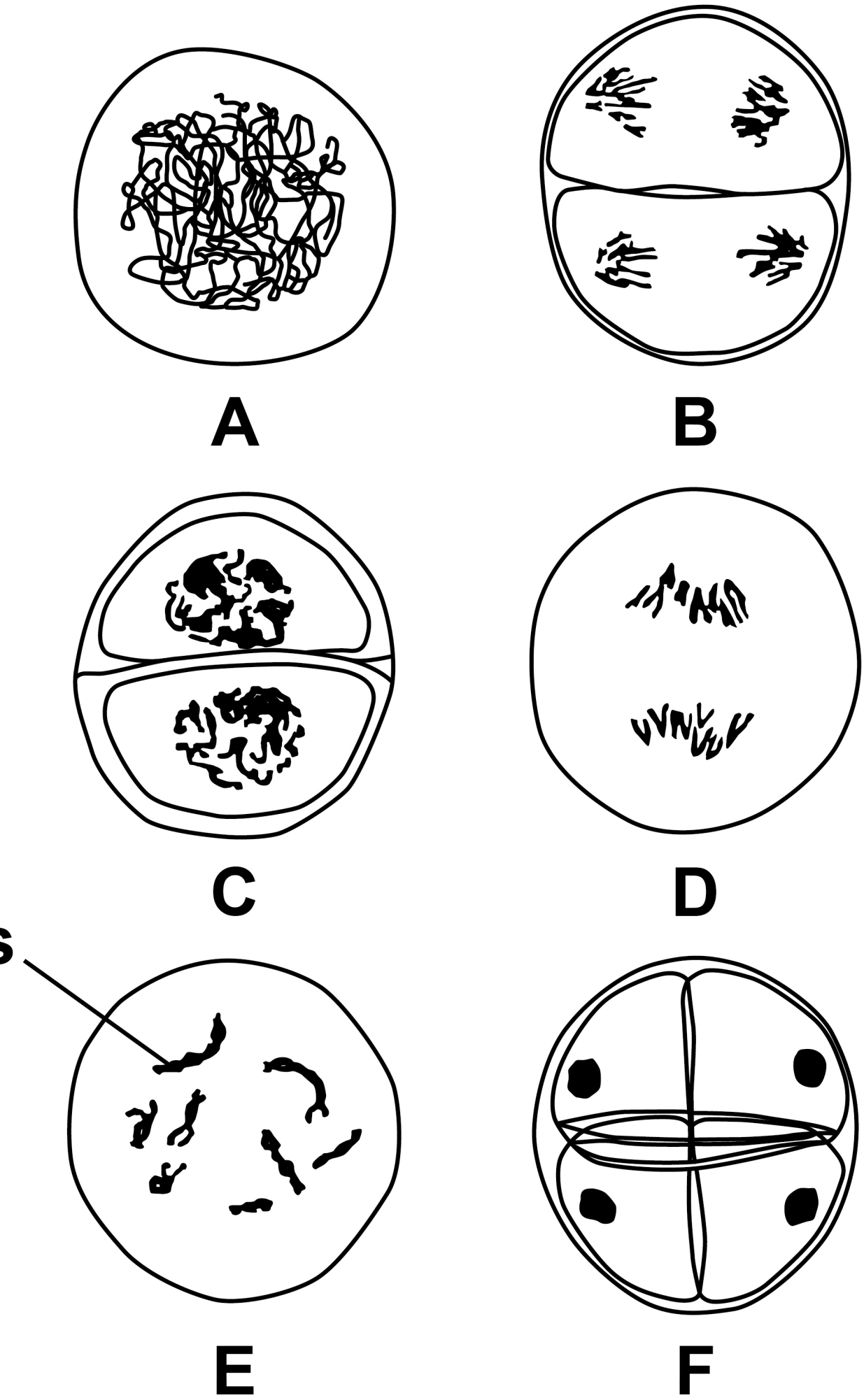
[Turn over]

0 8

FIGURE 13 shows six stages in the process of meiosis.

FIGURE 13



0 8 . 1

In FIGURE 13, A is the first stage and F is the final stage.

Stages B to E are NOT in the correct order.

Give the correct order of stages A to F.
[1 mark]

A → ____ → _____ → _____ → ____ → F

[Turn over]

At the end of meiosis the number of chromosomes is different from the number of chromosomes at the start of meiosis.

0 8 . 2

Give the number of chromosomes in ONE cell in FIGURE 13, on page 86:

- **at the start of meiosis**
- **at the end of meiosis.**

[2 marks]

Start _____

End _____

0 8 . 3

Explain why the change in the number of chromosomes is important. [3 marks]

0 8 . 4

Meiosis produces cells that are genetically different.

Describe how meiosis produces cells that are genetically different. [2 marks]

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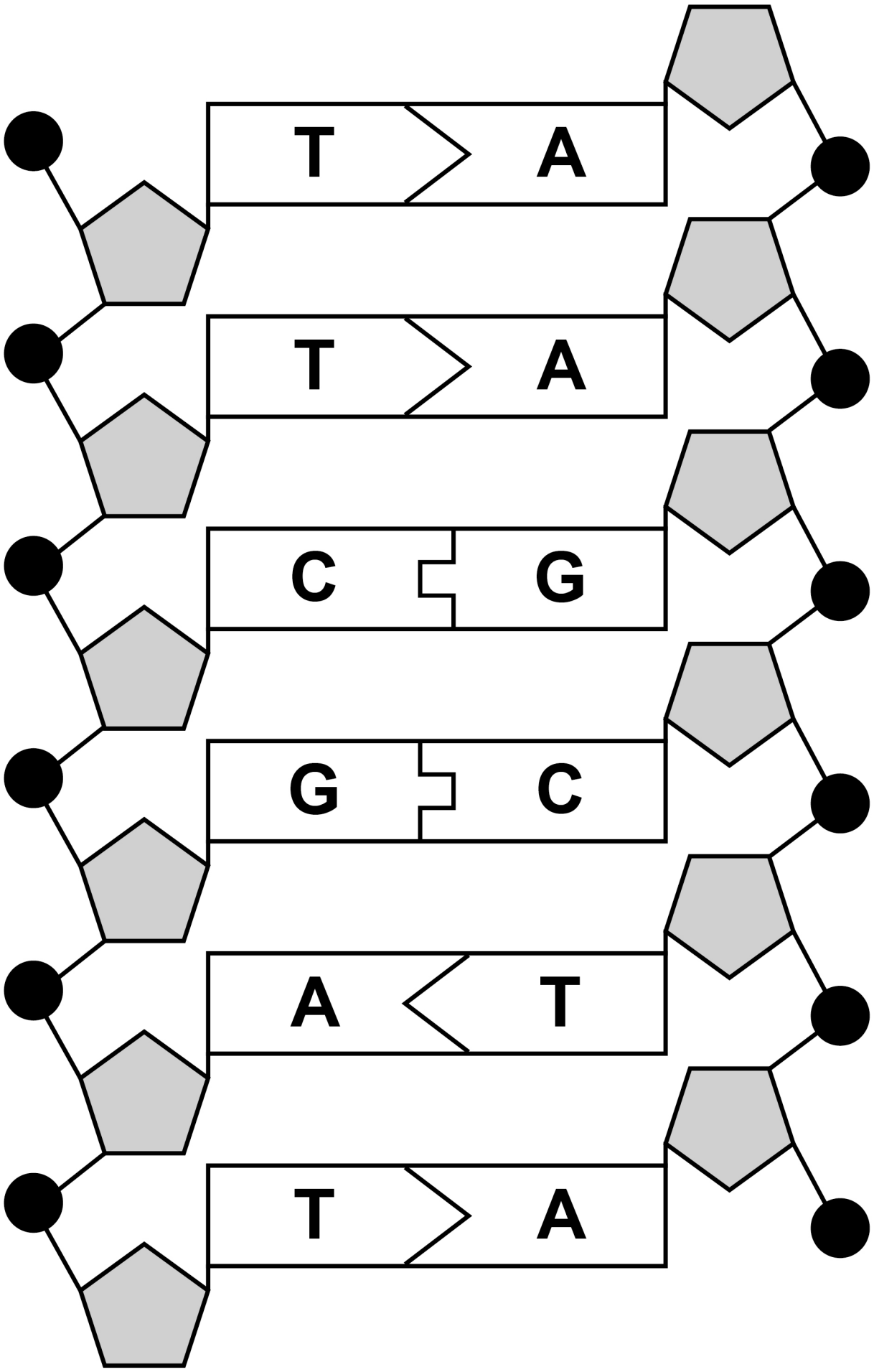
[Turn over]

Chromosomes contain DNA.

FIGURE 14 shows part of a DNA molecule.

FIGURE 14



0 8 . 5

What type of substances are labelled A, C, G and T in FIGURE 14? [1 mark]

0 8 . 6

DNA is made of nucleotides.

How many nucleotides are shown in FIGURE 14? [1 mark]

0 9

A wide variety of species exists on Earth.

Most scientists accept Darwin's theory of evolution by natural selection as the explanation for this variety of species.

Explain how our understanding of evolution has developed due to:

- **fossil evidence**
- **increased understanding of the mechanisms of genetics.**

[6 marks]

[Turn over]

END OF QUESTIONS

6

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	
7	
8	
9	
TOTAL	