A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

AS
BIOLOGY

Paper 2

7401/2

Friday 24 May 2019 Morning

Time allowed: 1 hour 30 minutes

For this paper you must have:
- **a ruler with millimetre measurements**
- **a scientific calculator.**

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

JUN197401201

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INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do not write on blank pages.**
- **Show all your working.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**

INFORMATION

- **The marks for the questions are shown in brackets.**
- **The maximum mark for this paper is 75.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

0 1 . 1 Describe the role of enzymes in the digestion of proteins in a mammal. [4 marks]

Scientists investigated how the diet of rabbits affected their digestion and absorption of protein. The scientists fed rabbits an identical mass of food but varied the percentage of protein in the food.

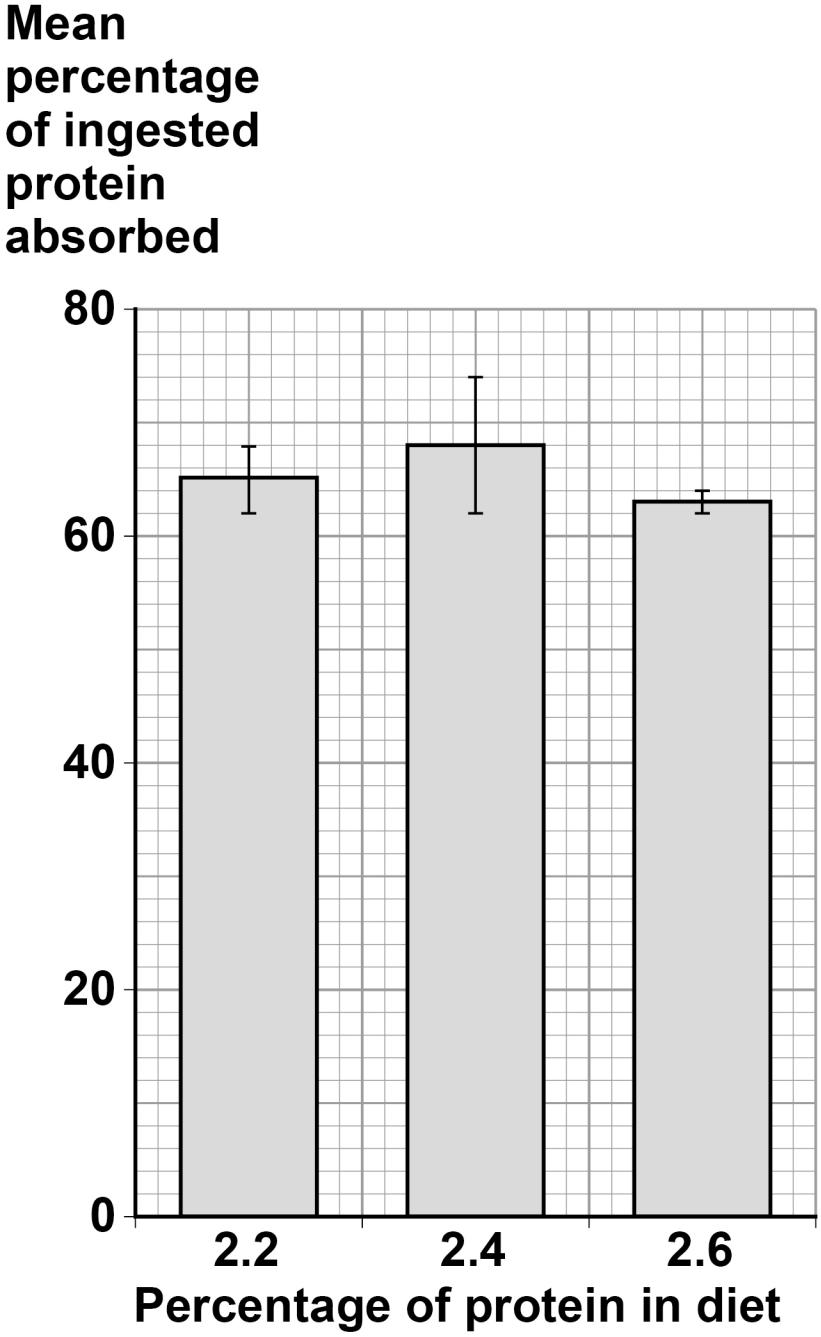
The scientists measured the mean mass of protein fed to the rabbits that was absorbed, which they then expressed as a percentage value.

The scientists' results are shown in FIGURE 1 on the opposite page.

The error bars show ± 2 standard deviations.

± 2 standard deviations cover 95% of the data.

FIGURE 1



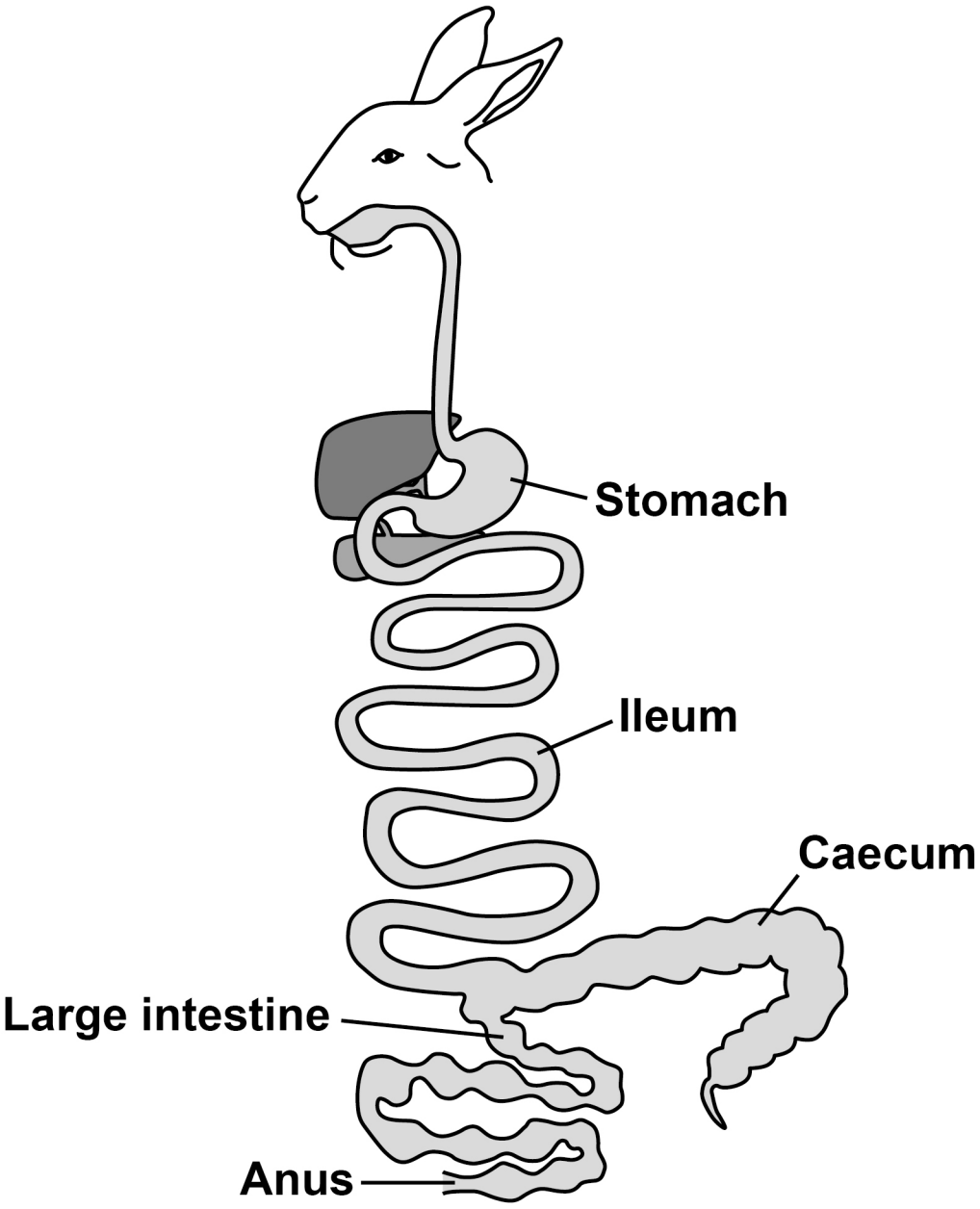
[Turn over]

0 1 . 2 **What can you conclude about the absorption of the products of protein digestion as the percentage of protein increased in the rabbits' food? [3 marks]**

[Turn over]

The digestive system of a rabbit is shown in FIGURE 2.

FIGURE 2



0 1 . 3 **The food eaten by a rabbit is digested mainly by microorganisms in its caecum.**
The caecum is a section of intestine attached between the ileum and the large intestine.
The resulting semi-digested material leaves the anus of a rabbit as soft, caecal droppings.
The rabbit then eats these caecal droppings.

Use this information and FIGURE 2, on the opposite page, to suggest how eating its own caecal droppings helps a rabbit's digestion and absorption of dietary protein. [3 marks]

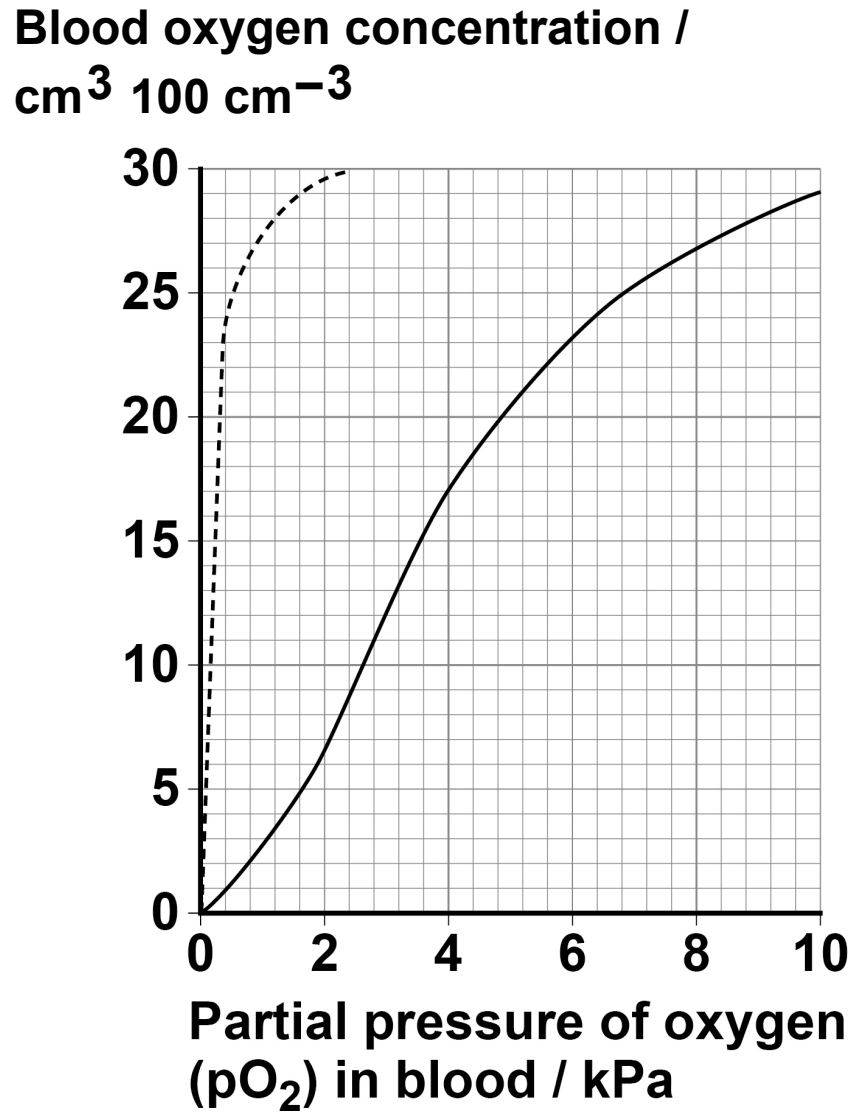
10

0 2 . 1 **Describe and explain the effect of increasing carbon dioxide concentration on the dissociation of oxyhaemoglobin. [2 marks]**

Seals are diving mammals. They fill their lungs with air before they dive and hold their breath during the dive.

FIGURE 3 shows the dissociation curves for seal oxyhaemoglobin and seal myoglobin. Myoglobin is an oxygen-carrying protein found in muscles.

FIGURE 3



0 2 . 2 **Use information in FIGURE 3 to explain how the seal's myoglobin dissociation curve shows the seal is adapted for diving.**
[2 marks]

0 2 . 3 **Scientists measured the oxygen carrying capacity of seal blood.**
They found the haemoglobin in a 190 kg seal contained 1.07×10^4 cm^3 oxygen.
When the seal dived, it used 5.2 cm^3 oxygen per minute per kg of body mass.

Use this information to calculate the maximum number of minutes the seal can remain under water. Assume that all of the oxygen attached to the haemoglobin is released during the dive. [2 marks]

Answer = _____ minutes

6

0 3 . 1 **Name the TWO scientists who proposed models of the chemical structure of DNA and of DNA replication. [1 mark]**

A scientist replicated DNA in a test tube. To do this, he mixed an enzyme with identical single-stranded DNA fragments and a solution containing DNA nucleotides.

0 3 . 2 **Name the enzyme used in this DNA replication. [1 mark]**

[Turn over]

0 3 . 3 **Use your knowledge of semi-conservative replication of DNA to suggest: [3 marks]**

1. the role of the single-stranded DNA fragments

2. the role of the DNA nucleotides.

5

0 4 . 1 **Describe and explain the role of antibodies in stimulating phagocytosis.**

Do NOT include details about the process of phagocytosis. [2 marks]

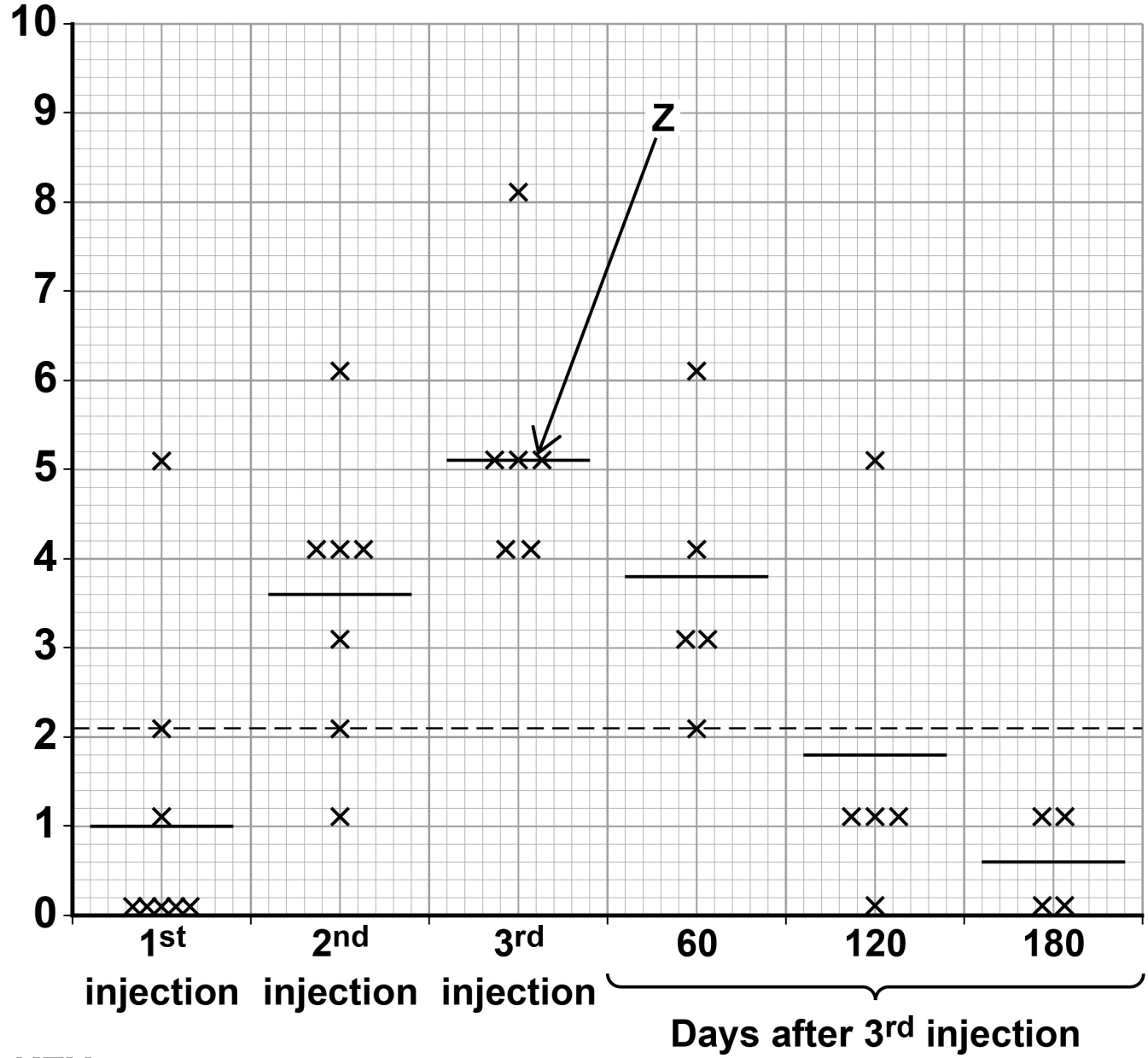
‘Meningococcus’ bacteria cause a disease called meningitis. Scientists investigated a new meningitis vaccine (MenG) by measuring changes in blood anti-meningitis antibody concentration in mice.

Each mouse was given three separate MenG injections. The concentration of anti-meningitis antibody was measured in a sample of blood taken soon after each injection.

After the 3rd injection, the concentration of anti-meningitis antibody in the blood was also measured after 60 days, after 120 days and then after 180 days.

FIGURE 4, on the opposite page, shows the scientists’ results. Each plotted point in FIGURE 4 is the result for a different mouse.

FIGURE 4



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0 4 . 2 **The scientists discovered that the concentration of anti-meningitis antibody of the mouse labelled Z in FIGURE 4, on page 21, decreased after the 3rd injection at a constant rate of 0.027 arbitrary units per day.**

Use this information and FIGURE 4 to calculate the number of days after the 3rd injection the antibody concentration is higher than the protective antibody concentration for this mouse. [2 marks]

Answer = _____ days

[Turn over]

0 4 . 3 **Using FIGURE 4, on page 21, what can you conclude about the effectiveness of each injection on the immune response of these mice? [4 marks]**

[Turn over]

0 4 . 4 **The scientists hypothesised that memory B cells had formed in the mice 180 days after the 3rd injection.**

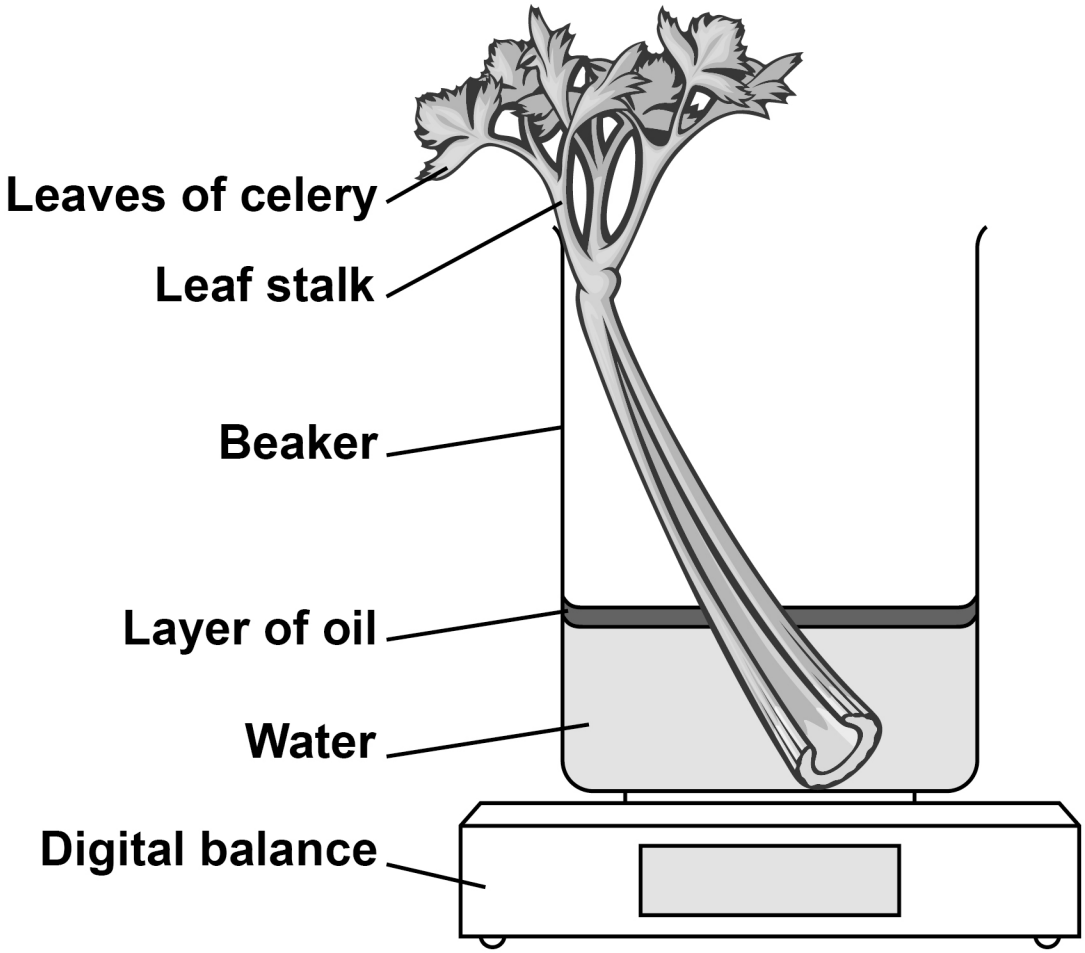
Suggest and explain a practical method the scientists could use to test this hypothesis. [2 marks]

10

[Turn over]

0 5 **A student used the apparatus shown in FIGURE 5 and a digital balance to determine the rate of water movement in a celery stalk in grams per hour per group of xylem vessels.**

FIGURE 5



0 5 . 1 **The student measured the time taken for water movement.**
Give TWO other measurements he made to calculate the rate of water movement.
[2 marks]

1 _____

_____

_____

_____

_____

2 _____

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[Turn over]

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0 5 . 2 **Give the reason for adding a layer of oil to the water in the beaker. [1 mark]**

_____

_____

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_____

[Turn over]

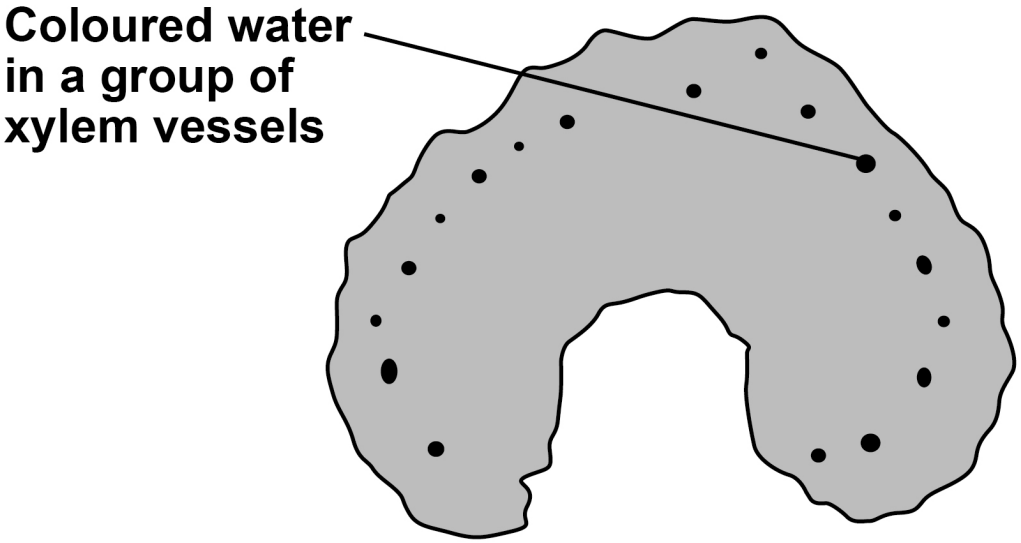
0 5 . 3 **A different student used coloured water to investigate the movement of water in leaf stalks of celery.**

During the procedure she:

- **cut equal lengths of stalk from each plant**
- **put the cut end of each stalk into coloured water**
- **left these stalks to take up the coloured water for 20 minutes**
- **used a sharp scalpel to cut slices from the stalks at 1 mm intervals until she reached a slice with no coloured water.**

FIGURE 6 shows a slice of leaf stalk with coloured water inside groups of xylem vessels.

FIGURE 6



Explain why coloured water moved up the stalks. [3 marks]

0 5 . 4 **The student used a sharp scalpel to cut the celery. Describe how she should ensure she handled the scalpel safely during this procedure. [2 marks]**

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[Turn over]

The student measured the distance the coloured water had travelled in eight celery stalks.
Her results are shown in TABLE 1.

TABLE 1

DISTANCE / mm							
70	35	40	35	30	80	42	44

0 5 . 5 **The student had to choose whether to summarise her measurements by calculating the mean, the median or the mode.**

Circle the most appropriate measure for this set of measurements.
Give a reason for your choice and find the value using the measurements from all eight stalks. [2 marks]

Mean* Median* Mode*

***circle one word.**

Reason: _____

_____

_____

_____

_____

Calculation:

Answer = _____

10

[Turn over]

0 6 **A scientist crossed a strain of the fungus 'Neurospora' producing pink spores with a strain of 'Neurospora' producing white spores.**

To cross these strains, he used aseptic techniques. He moved a small agar cube containing one strain of the fungus onto a new agar plate. Then he placed a second agar cube containing the other strain of fungus next to the first agar cube.

0 6 . 1 **Describe and explain THREE ways in which the scientist would ensure he used aseptic techniques to move each cube of agar onto a new agar plate. [3 marks]**

1 _____

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2 _____

_____

_____

_____

3 _____

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_____

[Turn over]

In the life cycle of 'Neurospora' most stages are haploid. Fusion of two haploid strains of this fungus produces diploid zygotes. Nuclear division in these zygotes occurs by meiosis.

0 6 . 2 **Give TWO differences between mitosis and meiosis. [2 marks]**

1 _____

_____

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_____

_____

_____

2 _____

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[Turn over]

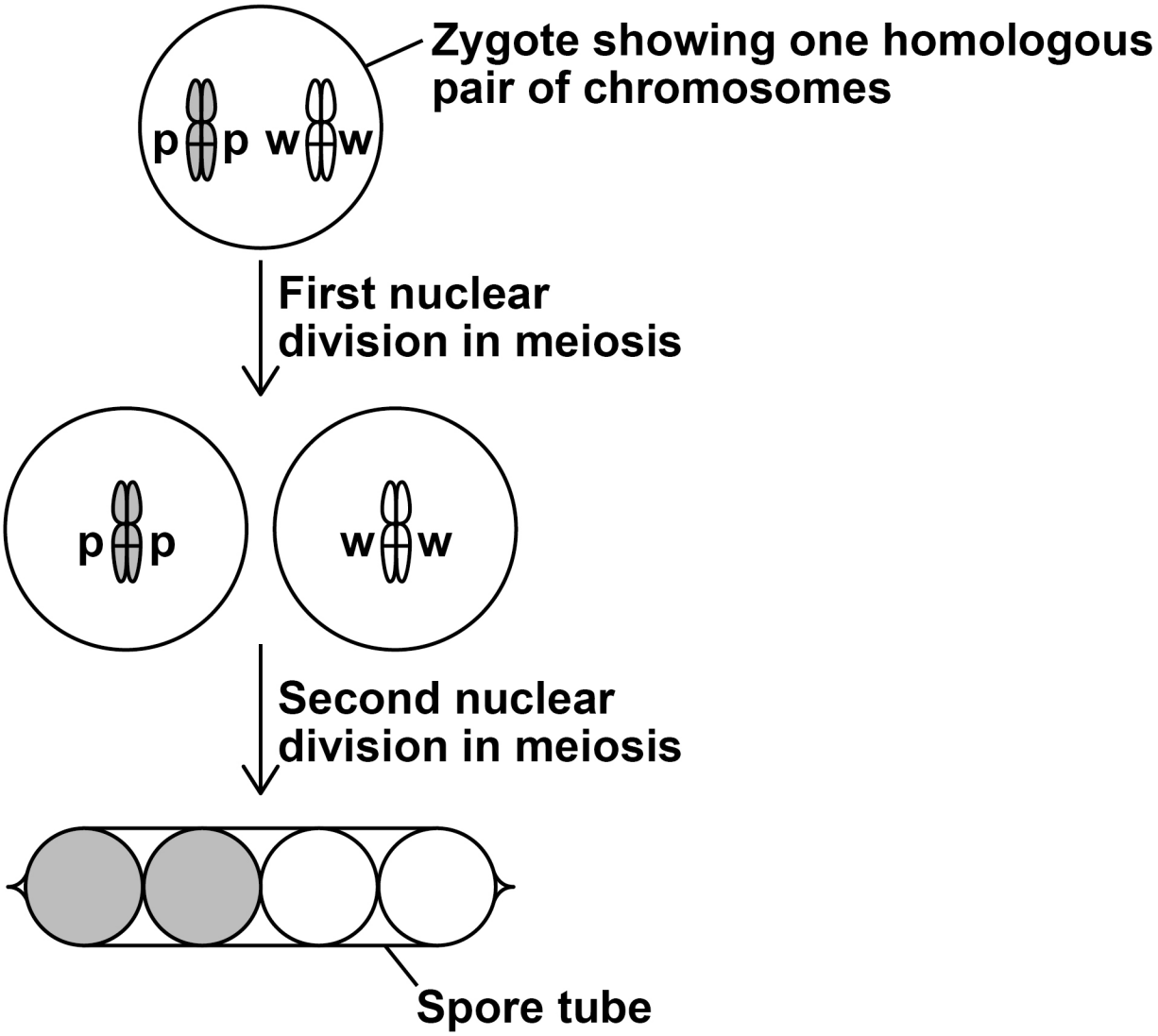
At the end of meiosis, this fungus produces cells called spores.

The spores are produced in narrow tubes that restrict their movement. As a result, each tube contains a single line of spores. The spores are coloured either pink or white.

The spore colour gene is located on a pair of homologous chromosomes. Each zygote produced in this cross has one chromosome with a pink allele (p) and one chromosome with a white allele (w).

This is shown in FIGURE 7 on the opposite page.

FIGURE 7



KEY

Pink spores **White spores**

[Turn over]

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0 6 . 3 **There are seven chromosomes in a spore nucleus.**

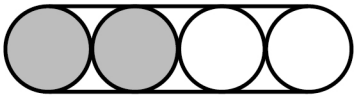
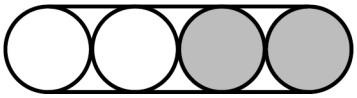
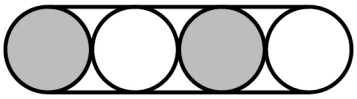
Place a tick (✓) in the box next to the number that represents the number of CHROMATIDS present in the zygote shown in FIGURE 7 on page 43. [1 mark]

- ☐ **7**
- ☐ **14**
- ☐ **21**
- ☐ **28**

[Turn over]

The scientist recorded the arrangement of coloured spores inside many narrow tubes. His results are shown in TABLE 2.

TABLE 2

Type of spore tube	Arrangement of coloured spores	Number of narrow tubes
1		81
2		78
3		10

0 6 . 4 Using all the information in this question, what can you conclude from the scientist's results about the movement of chromosomes in meiosis in this fungus? [3 marks]

9

0 7 **Scientists investigated changes in the mass of fish from three populations of the same species. The fish they used had a life cycle of one year.**

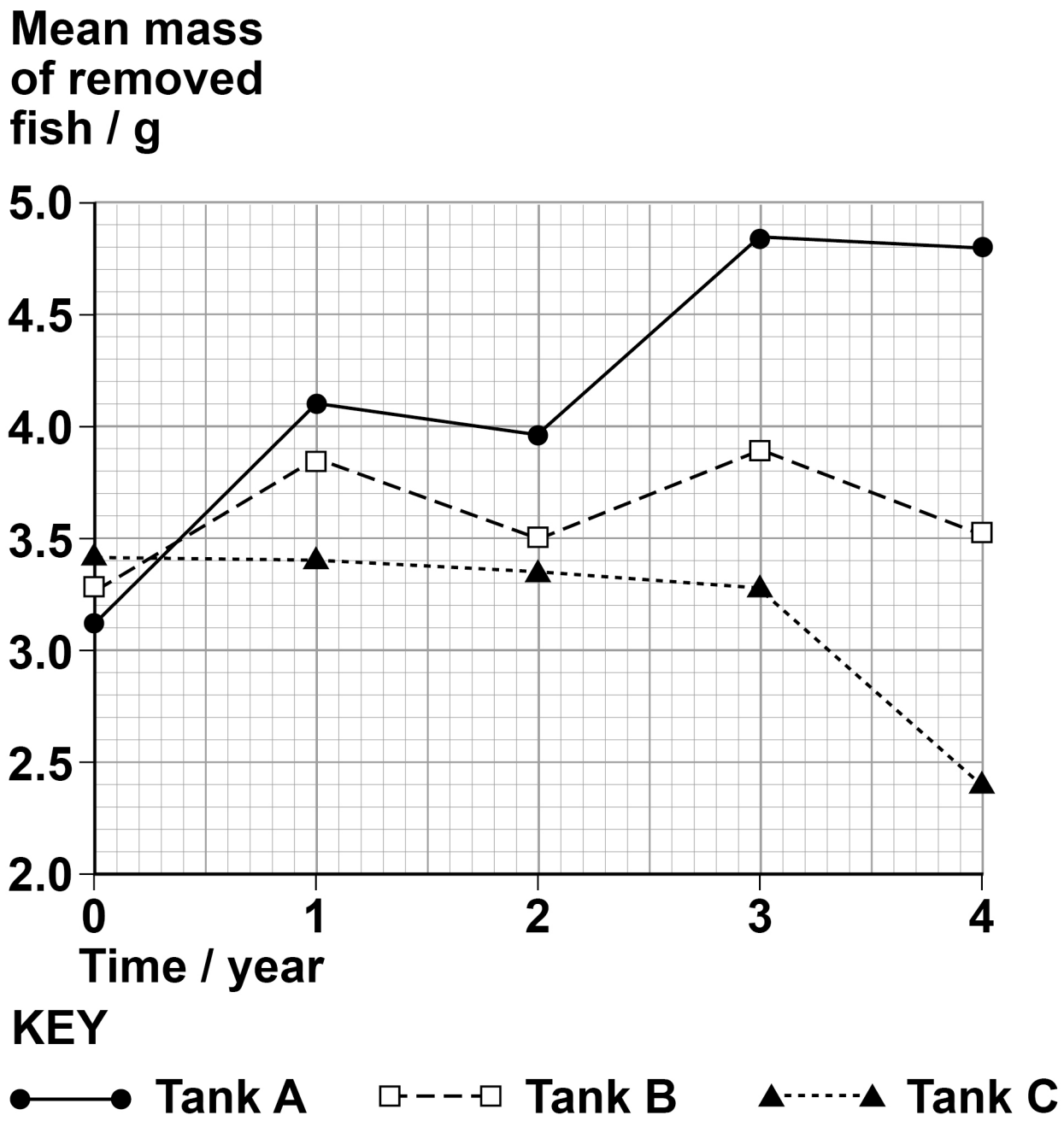
The scientists set up three fish tanks, each containing a separate population. Each year the scientists removed all the fish from each tank and determined the mean mass of the fish removed. They then put back 10% of each population in the following way.

Tank A – put back only the largest fish.
Tank B – put back fish at random.
Tank C – put back only the smallest fish.

During each year the fish were left to grow and reproduce.

The scientists' results are shown in FIGURE 8 on the opposite page.

FIGURE 8



[Turn over]

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0 7 . 1 **What type of selection were the scientists modelling in this investigation by putting back only the largest or only the smallest fish in Tank A and Tank C? Give a reason why.**
[2 marks]

Type of selection _____

_____

Reason _____

_____

_____

_____

_____

_____

[Turn over]

0 7 . 2 Explain the purpose of TANK B (on page 49). [2 marks]

0 7 . 3 **Calculate the ratio of the mean mass of fish removed from Tank A (on page 49) to the mean mass of fish removed from Tank C (on page 49) at 1 year AND at 4 years.**

How much greater is the ratio at 4 years compared with the ratio at 1 year? [2 marks]

Ratio at 1 year = _____

Ratio at 4 years = _____

How much greater at 4 years =

_____

[Turn over]

0 7 . 4 **Sea fishing is regulated in law. The size of the mesh used in some fishing nets is controlled so that small fish can escape but large fish are captured. This regulation is designed to protect populations of wild fish.**

Using all the information in this question, evaluate whether the scientists' investigation supports the use of these types of nets in sea fishing. [3 marks]

9

0 8 . 1 **The genetic diversity of species is measured by comparing differences in the base sequence of DNA or differences in the base sequence of mRNA.**

Give TWO other ways in which genetic diversity between species is measured.
[2 marks]

1 _____

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2 _____

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_____

Scientists investigated differences between 260 North American bird species by comparing the base sequence of a gene in mitochondrial DNA. They compared the gene base sequence of each bird with all of the other 259 species. For each comparison they calculated the percentage difference in base sequence.

0 8 . 2 FIGURE 9 shows the base sequence for part of the gene in two species.

FIGURE 9

Species 1	A	G	C	T	G	C	C	T	A	G	A
Species 2	A	T	G	T	G	G	C	A	A	G	A

Calculate the percentage difference in base sequence for these base sequences.
[1 mark]

Answer = _____ %

[Turn over]

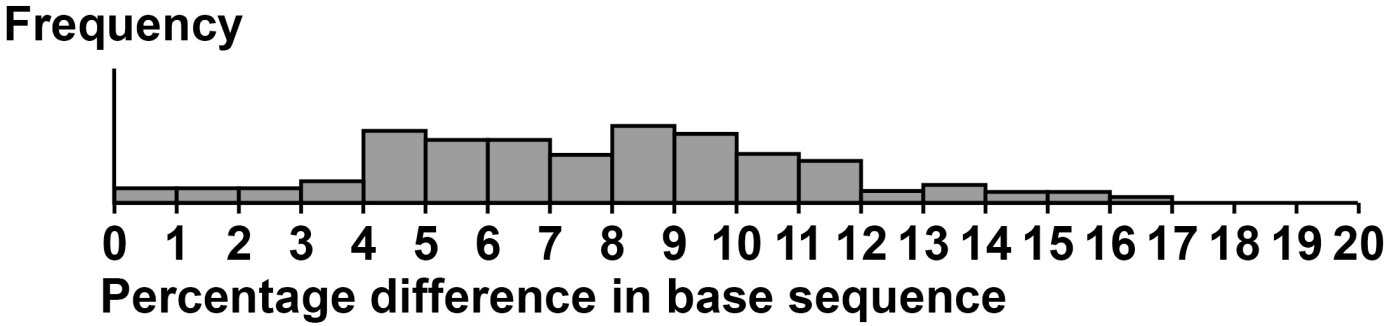
The scientists compared base sequences in:

- birds of the same species
- birds of different species in the same genus
- birds of different species in the same family.

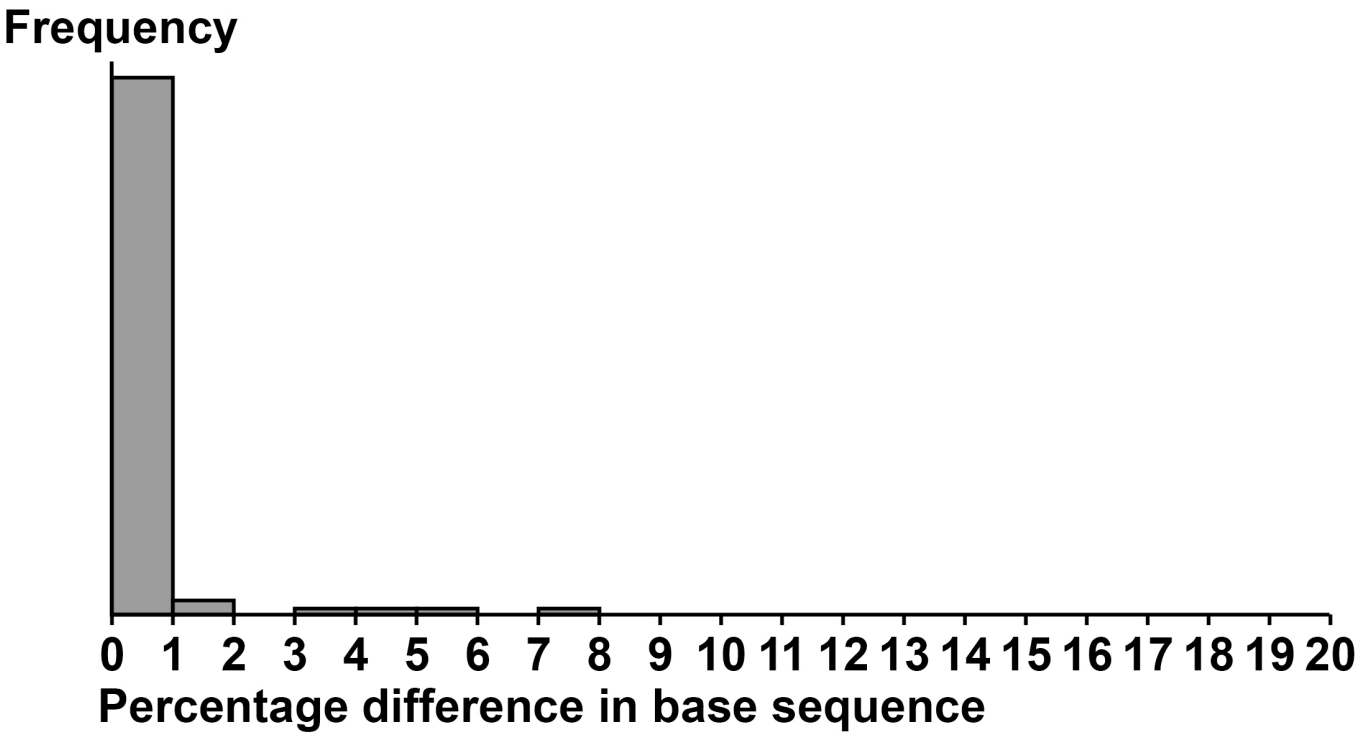
The scientists' results are shown in FIGURE 10.

FIGURE 10

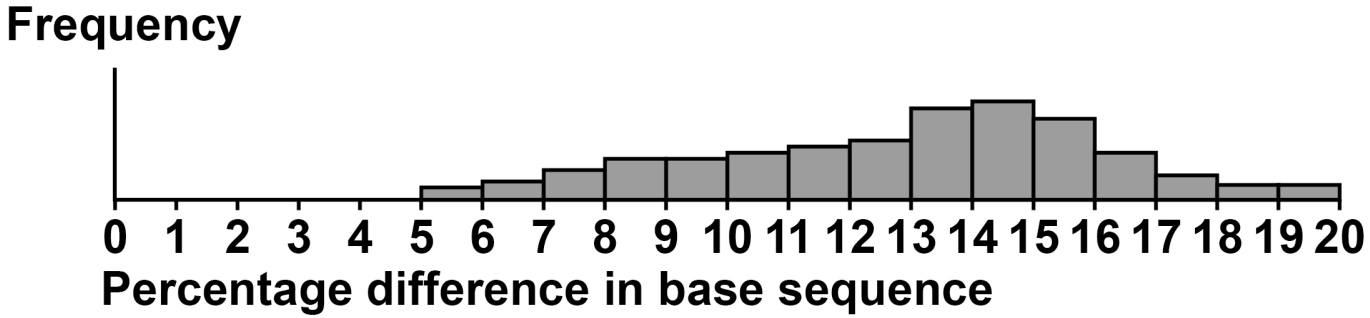
HISTOGRAM A



HISTOGRAM B



HISTOGRAM C



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0 8 . 3 **Complete TABLE 3 by writing A, B or C in the box to correctly match the statement to each histogram shown in FIGURE 10 on pages 58 and 59. [1 mark]**

TABLE 3

STATEMENT	HISTOGRAM
Base sequences of birds of the same species.	
Base sequences of birds of the same genus.	
Base sequences of birds of the same family.	

[Turn over]

0 8 . 4 **To calculate the percentage difference in base sequences, the scientists first counted the number of bases and the number of base differences.**

What statistical test should the scientists use to test whether the number of base differences between birds in histogram A (on page 58) and birds in histogram C (on page 59) is statistically significant?

Place a tick (✓) in the box against the statistical test you would use.

Justify your answer. [2 marks]

☐ **Chi-squared**

☐ **Correlation coefficient**

☐ **Student's t-test**

Justification _____

_____

_____

_____

_____

_____

6

[Turn over]

0 9 . 1 **Describe the roles of iron ions, sodium ions, and phosphate ions in cells. [5 marks]**

[Turn over]

0 9 . 2 **The movement of substances across cell membranes is affected by membrane structure. Describe how. [5 marks]**

10

END OF QUESTIONS

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For Examiner's Use	
Question	Mark
1	
2	
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4	
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7	
8	
9	
TOTAL	