Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Friday 11 October 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **WBI12/01**

Biology

International Advanced Subsidiary/Advanced Level
UNIT 2: Cells, Development, Biodiversity and Conservation

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Show all your working out** in calculations and **include units** where appropriate.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions labelled with an **asterisk** (*) marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 7 8 3 8 5 A 0 1 3 6

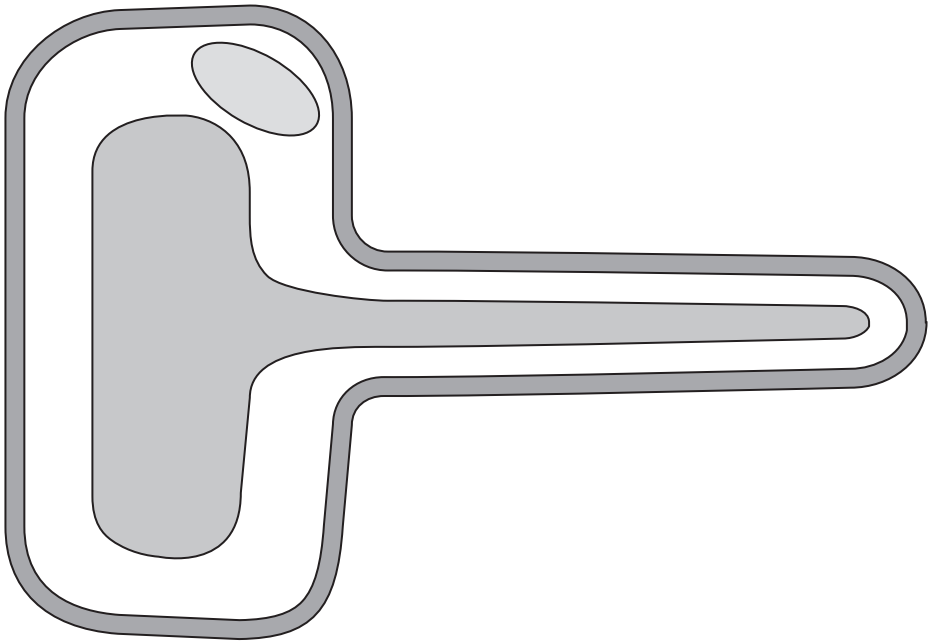
Pearson

Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in the box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The diagram shows an incomplete plant cell, as drawn by a student.



(a) (i) Label the **tonoplast** on the diagram.

(1)

(ii) Draw **and** label a **nucleolus** in this plant cell.

(1)

(b) Complete the table to show which of these structures would be present **or** absent in plant leaf cells.

(2)

Structure	**✓ if present** **× if absent**
amyloplast	
chloroplast	
Golgi apparatus	
plasmodesmata	

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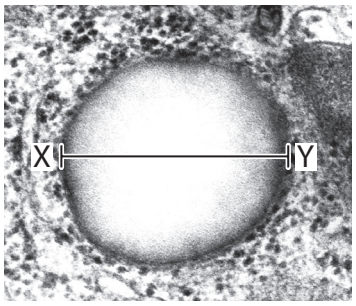
(c) The photograph shows a lysosome, as seen using an electron microscope.



(Source: © Science History Images / Alamy Stock Photo)

Magnification ×250 000

Calculate the actual width (X–Y) of this lysosome in μm.

Give your answer to **two** decimal places.

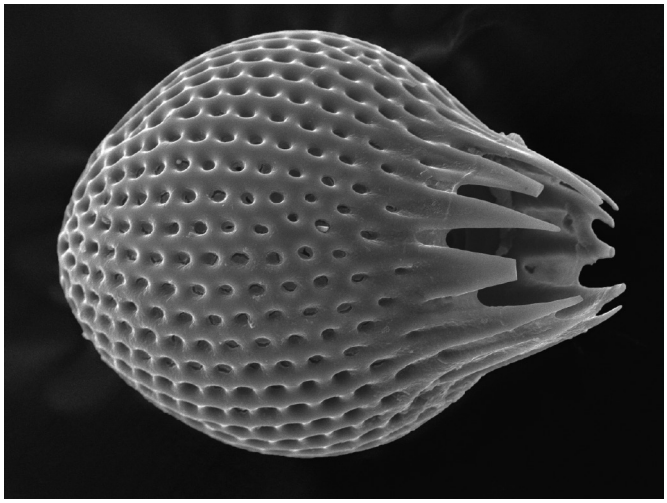
(1)

Answer ..... μm

(Total for Question 1 = 5 marks)

2 Diatoms are single-celled organisms important for many ocean food chains.

The photograph shows a diatom, as seen using a scanning electron microscope.



(Source: © AMI IMAGES / SCIENCE PHOTO LIBRARY)

(a) Diatoms contain a nucleus, mitochondria and chloroplasts.

(i) State the domain which contains diatoms.

(1)

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(ii) The nucleus in a diatom contains DNA.

Name **two processes** that take place in the nucleus of a diatom.

(2)

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2 .....

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(b) It is predicted that diatom populations will decrease in number due to global warming.

Scientists have suggested that this will cause a decrease in ocean biodiversity.

Describe how a **decrease** in biodiversity within an **ocean** habitat could be determined.

(3)

(Total for Question 2 = 6 marks)

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3 The photograph shows a Javanese edelweiss plant.

(Source: © Ciptor / Shutterstock)

(a) This plant is endemic to Indonesia.

State what is meant by the term **endemic**.

(1)

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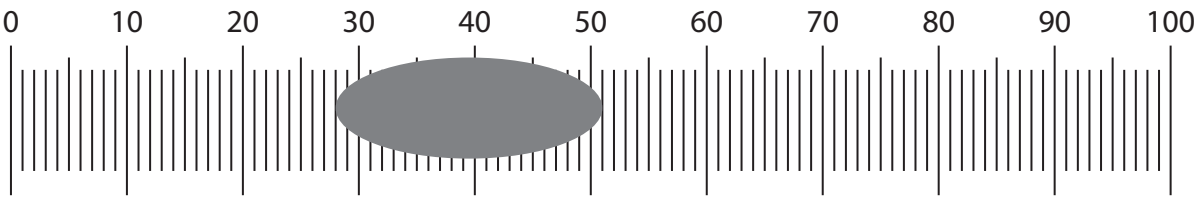
(b) A student used a microscope and a graticule to view a pollen grain from this plant.

Eyepiece graticule



One hundred eyepiece graticule divisions is 0.1 mm.

(i) Which is the length of this pollen grain?

(1)

- ☒ **A** 2.3 mm
- ☒ **B** 23 μm
- ☒ **C** 230 μm
- ☒ **D** 2300 nm

(ii) State what is meant by the term **magnification**.

(1)

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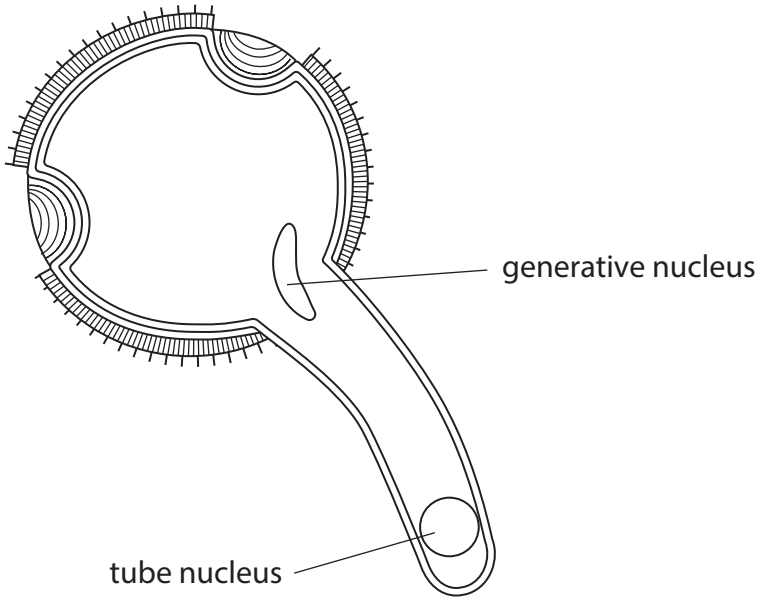
(c) The diagram shows a germinating pollen grain.



Describe the roles of the tube nucleus and the generative nucleus.

(4)

Tube nucleus .....

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Generative nucleus .....

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(Total for Question 3 = 7 marks)

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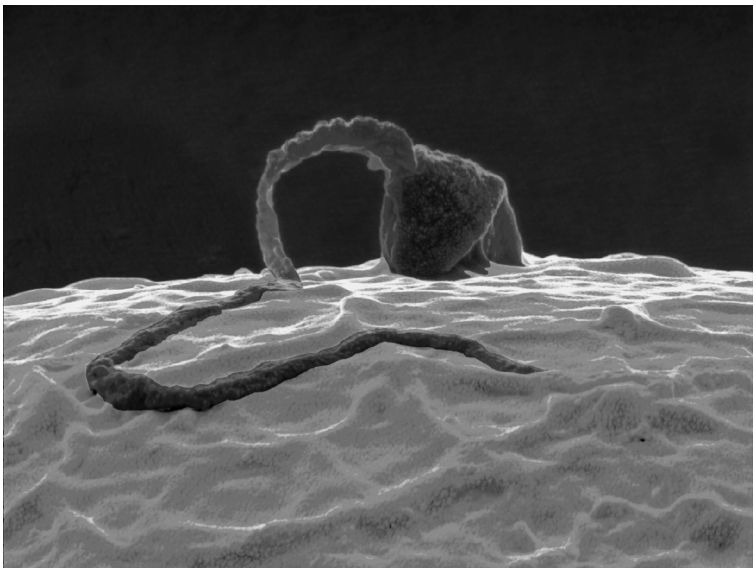
QUESTION 4 BEGINS ON THE NEXT PAGE.

4 The photograph shows a sperm cell beginning to enter an egg cell.



(Source: © THIERRY BERROD, MONA LISA PRODUCTION / SCIENCE PHOTO LIBRARY)

(a) A sperm cell swims by rotating its flagellum.

Which of the following statements about sperm cells are correct?

1. sperm cells are diploid

2. the flagellum rotates using energy

3. sperm cells have a streamlined shape to increase resistance

(1)

☒ **A** 1, 2 and 3

☒ **B** 1 and 2 only

☒ **C** 2 and 3 only

☒ **D** 2 only

(b) Describe how the nucleus of a sperm cell enters an egg cell.

(3)

(c) Cortical granules in the egg cell contain enzymes.

These enzymes prevent more than one sperm entering the egg cell.

(i) Describe the role of the rough endoplasmic reticulum and the Golgi apparatus in the production of these enzymes.

(3)

(ii) Suggest how these enzymes will prevent more than one sperm nucleus entering the egg cell.

(3)

(Total for Question 4 = 10 marks)

5 The Grandidier's baobab is endemic to Madagascar.

Fruit bats transfer pollen from one baobab tree to another.

The population of fruit bats in Madagascar is decreasing.

The photographs show one Grandidier's baobab tree in a field of rice and a Madagascan fruit bat.

(Source: © Graham, David / Alamy Stock Photo)

(Source: © John Dambik / Alamy Stock Photo)

(a) (i) This species of tree is endangered.

Identify **two** reasons why this species of tree is endangered.

Use the information above and the photographs to support your answer.

(2)

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2 .....

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(ii) Give **two** reasons how education could help conserve the Grandidier's baobab.

(2)

1 .....

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2 .....

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(b) Calcium ions are used to make molecules in plants.

(i) Explain the role of **one** named molecule that uses calcium ions.

(2)

Name of molecule .....

Role of molecule .....

.....

.....

(ii) Water is also important to plants.
Which of the following would transport water **down** the stem of a plant?

(1)

☒ **A** phloem

☒ **B** sclerenchyma

☒ **C** vacuole

☒ **D** xylem

(c) The photograph shows pods on a soybean plant.

(Source: © B Christopher / Alamy Stock Photo)

The effect of magnesium ions on the number of pods per soybean plant was investigated.

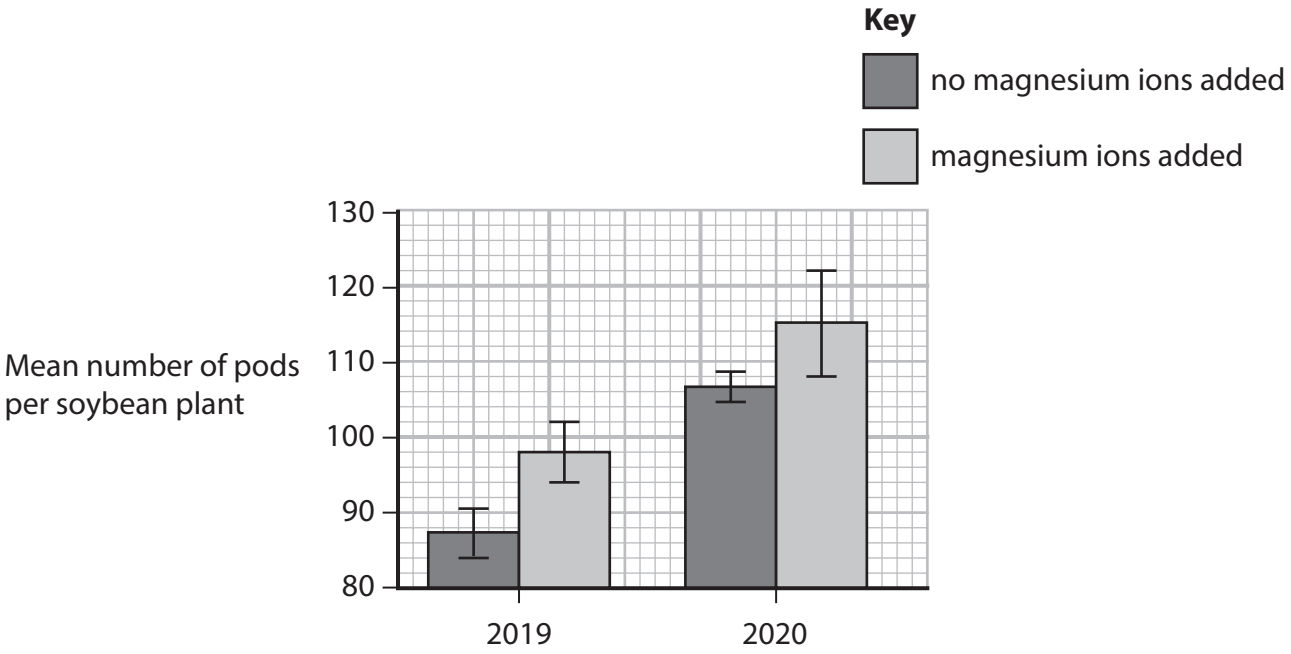
In 2019, soybean plants were grown in two fields.

One field had no magnesium ions added to the soil and the other field had magnesium ions added to the soil.

The mean number of pods per soybean plant was determined for both fields.

In 2020, the investigation was repeated using the same fields.

The graph shows the results of this investigation.



Give **two** conclusions that can be made using this data.

(2)

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2 .....

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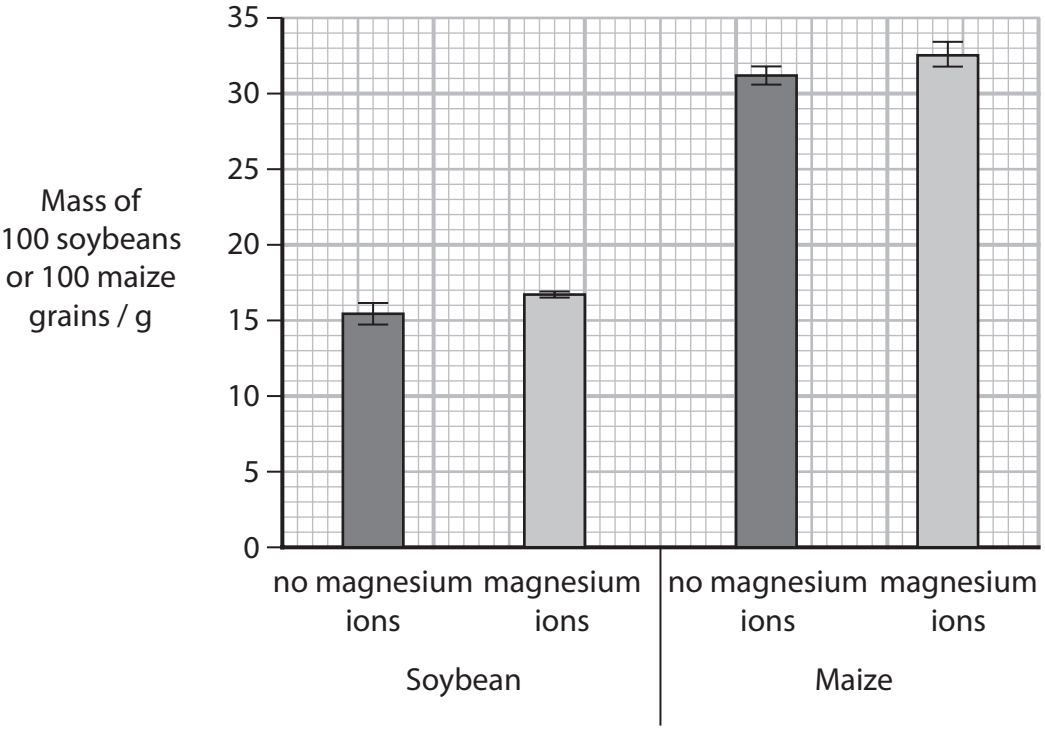
(d) In another investigation, the effect of magnesium ions on the mass of soybeans and maize grains was studied.

The graph shows the results of this investigation.



Comment on the results from this investigation.

(4)

(Total for Question 5 = 13 marks)

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6 In animal cells the nucleus can divide by mitosis or meiosis.

(a) In the cell cycle, the time between two divisions of mitosis is called interphase.

(i) Describe what happens to DNA during interphase.

(2)

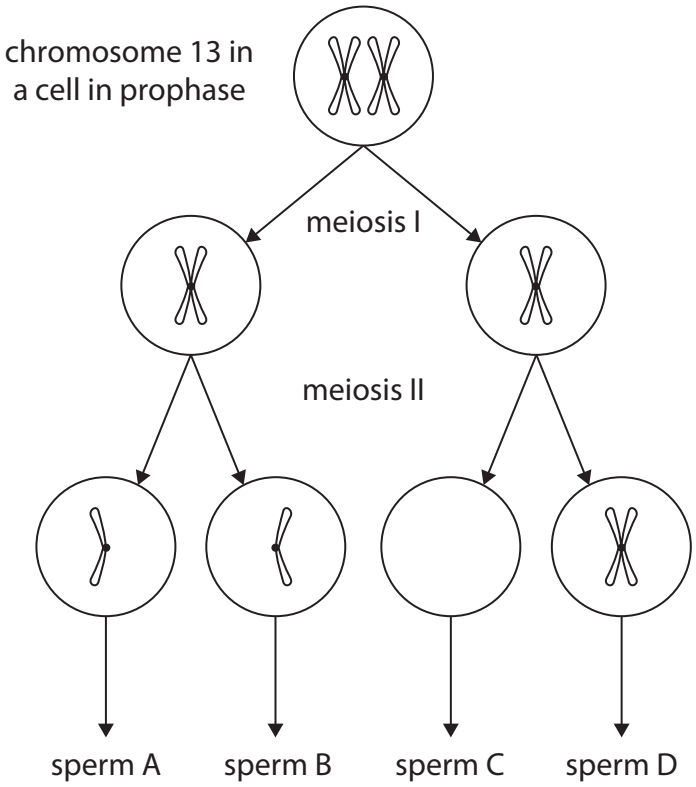
(ii) Name the stage of mitosis that follows prophase.

(1)

(b) A person with Patau syndrome had three copies of chromosome 13 in each body cell.

This occurred due to an error in meiosis in the formation of his father's sperm cells.

The diagram shows what happened to chromosome 13 during the formation of the father's sperm cells.



(i) A zygote is formed at fertilisation.

Explain how an error in meiosis could result in the production of a zygote with three copies of chromosome 13.

(4)

(ii) The zygote would develop into a morula and then into a blastocyst.

Which row in the table is correct?

(1)

		the zygote is:	cells in the blastocyst inner mass are:
☒	**A**	pluripotent	pluripotent
☒	**B**	pluripotent	totipotent
☒	**C**	totipotent	pluripotent
☒	**D**	totipotent	totipotent

(c) An individual can also develop Patau syndrome if part of chromosome 13 becomes attached to a different chromosome during prophase I.

Suggest a reason why part of chromosome 13 can become attached to a different chromosome when a gamete is formed.

(1)

(d) Methylation of DNA can alter the expression of certain genes on chromosome 13.

Methylation of DNA can be passed on during mitotic cell division.

(i) Explain how DNA methylation can alter the expression of some genes.

(2)

(ii) Explain why epigenetic changes to genes, such as DNA methylation, are passed on by mitosis.

(2)

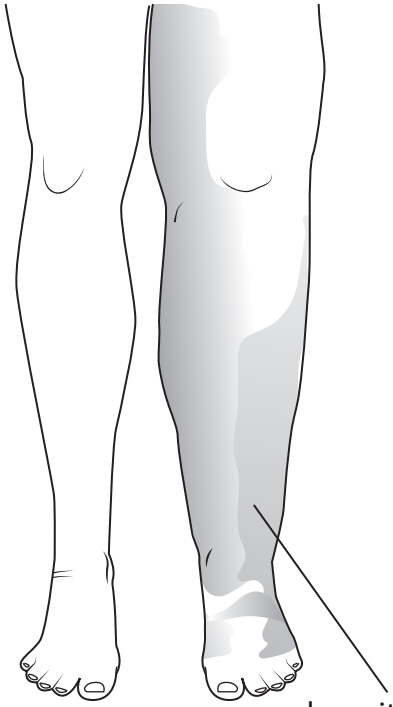
(Total for Question 6 = 13 marks)

7 Cellulitis is an infection of the skin.

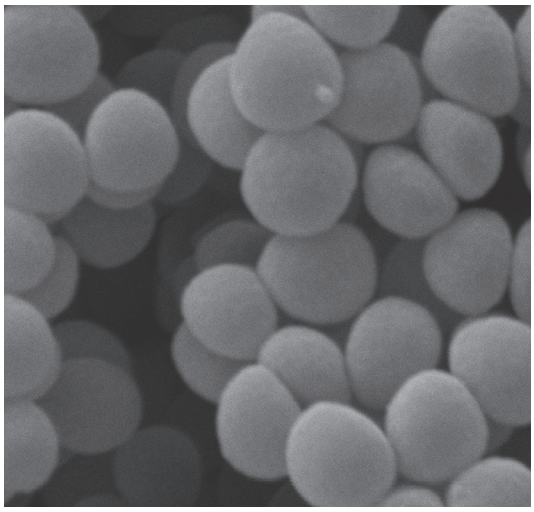
It is caused when bacteria living on the skin surface enter through a cut in the skin.

This results in swelling and redness of the infected area.

The images show a patient with cellulitis in one leg and one of the types of skin bacteria that cause cellulitis.



leg with cellulitis



(Source: © Louis Lau / Alamy Stock Photo)

bacteria

(a) This type of bacteria has a capsule, but not a flagellum.

(i) Suggest **one** advantage of having a capsule to this type of bacteria.

(1)

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(ii) Suggest why this type of bacteria does **not** need a flagellum.

(1)

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(iii) Which of the following structures would be found in a bacterial cell?

1. cell membrane

2. cell wall

3. ribosomes

(1)

☒ **A** 1 and 2 only

☒ **B** 1 and 3 only

☒ **C** 2 and 3 only

☒ **D** 1, 2 and 3

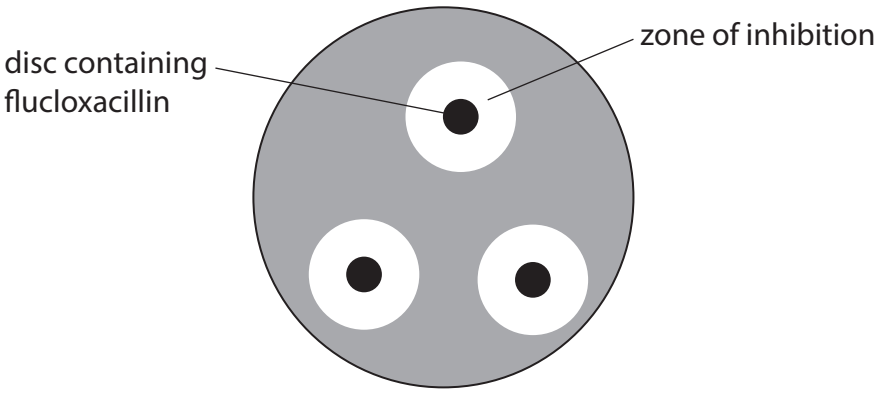
(b) The antibiotic flucloxacillin is the current treatment for cellulitis.

A student investigated the antimicrobial properties of flucloxacillin.

An agar plate had the type of bacteria which causes cellulitis spread over the surface of the agar.

Three discs containing the **same** concentration of flucloxacillin were placed onto the plate, as shown in the diagram.

The plates were incubated for 24 hours at 25°C.



The table shows the student's results.

Diameter of zone of inhibition / mm
11.0
7.5
8.5
Mean ($\bar{x}$) = 9.0

Standard deviation can be calculated by using the formula:

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

The table shows some of the calculations done by the student.

x	$x - \bar{x}$	$(x - \bar{x})^2$
11.0	2.0	4.0
7.5		
8.5	–0.5	0.25
		$\sum(x - \bar{x})^2 =$

(i) Calculate the standard deviation for this set of data.

Use the student's table and formula to help you.

(3)

Answer ..... mm

(ii) Which of the following explains why the student would want to calculate the standard deviation(s) (SD) for this experiment?

(1)

☒ **A** to see how widely the diameter values differ from the mean diameter

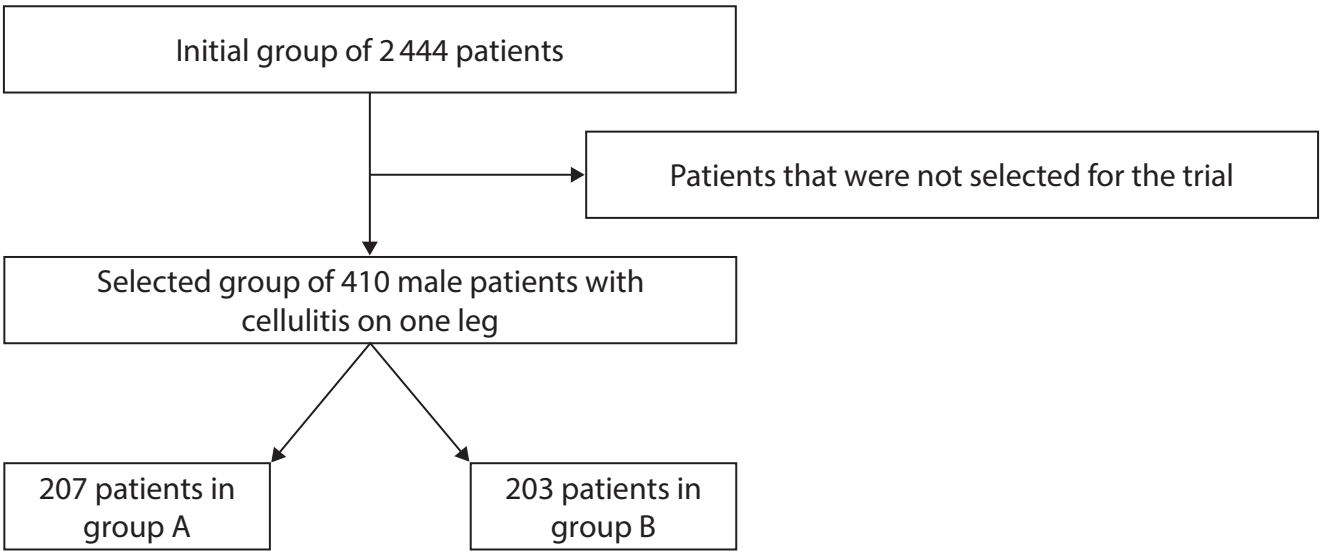
☒ **B** to see if the observed results differ from the expected results

☒ **C** to see if there is a correlation between different concentrations and zone of inhibition diameter

☒ **D** to see which is the most frequently occurring number

(c) The effectiveness of treating cellulitis with flucloxacillin alone was compared with a treatment that used both flucloxacillin and clindamycin.

The diagram shows how two groups of patients with cellulitis were selected from an initial group of 2 444 patients.



(i) Which percentage of the initial group of patients were placed in **group B**?

(1)

- ☒ **A** 8.3 %
- ☒ **B** 8.5 %
- ☒ **C** 49.5 %
- ☒ **D** 50.5 %

(ii) Suggest how this study could be carried out as a double-blind trial.

Use the diagram to support your answer.

(1)

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(iii) The table shows the mean difference in circumference for the infected and non-infected legs at 5 and 10 days after treatment began.

Group	Mean difference in circumference between infected leg and non-infected leg / cm	
	After 5 days	After 10 days
A	2.18	1.77
B	2.04	1.42

Comment on the results of this investigation.

(4)

(Total for Question 7 = 13 marks)

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8 A group of horses with the same specific characteristics is called a breed.

The photograph shows a horse of the rare breed Akhal-Teke that originated in Turkmenistan.

The Akhal-Teke population is in danger from inbreeding.

(Source: © Heat Design / Alamy Stock Photo)

(a) A scientist suggested that the Akhal-Teke breed is the same as an older breed known as the Turkoman horse.

Describe **one** piece of information that would need to be collected in order to determine if the scientist was correct.

Give a reason for your answer.

(2)

Information

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Reason

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(b) A scientist calculated the heterozygosity index of a population of 5 457 Akhal-Teke horses to be 0.661.

How many of these horses are heterozygotes?

(1)

- ☒ **A** 1 850
- ☒ **B** 3 607
- ☒ **C** 5 457
- ☒ **D** 8 255

(c) The images show two other rare breeds of horse, the Caspian and the Arabian.

Caspian

(Source: © Irina Mavritsina / Alamy Stock Photo)

Arabian

(Source: © Juniors Bildarchiv GmbH / Alamy Stock Photo)

The Caspian breed was thought to be extinct until a small population was discovered in mountainous regions in 1965.

The Arabian breed is found in sandy deserts.

(i) The Caspian breed has small hooves in proportion to its mass, whereas the closely-related Arabian breed has large hooves in proportion to its mass.

Suggest **one** reason for this difference.

(1)

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(ii) The table shows some information about one gene for a population of 400 Caspian horses.

Genotype	two copies of the dominant allele	heterozygous	two copies of the recessive allele
Part of Hardy–Weinberg equation	p^2	2pq	q^2
Number of individuals	46		

Complete the table to show how many horses would have the heterozygous genotype and how many would have the homozygous recessive genotype.

Use the equation:

$$p^2 + 2pq + q^2 = 1$$

(3)

*(d) Breeding programmes have been set up for both the Akhal-Teke and Caspian breeds.

Sperm samples have been taken from male horses from both the Akhal-Teke and Caspian populations.

Some of these male horses have since died.

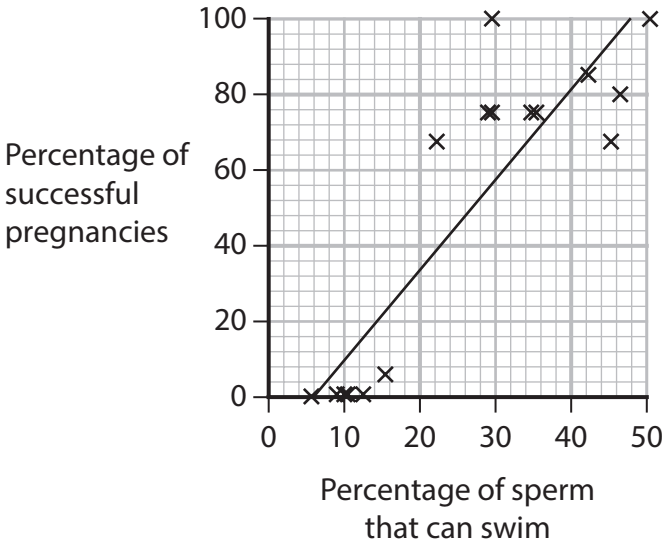
All of the sperm samples have been frozen.

The effect of freezing and thawing sperm cells was investigated.

The table shows the characteristics of two types of sperm cell samples.

Type of sample	Percentage of sperm cells that can swim	Sperm cell survival / hours	Percentage of sperm cells with damaged DNA
Fresh sperm cells	50.7	117.7	28.7
Frozen and thawed sperm cells	26.9	48.5	39.3

The graph shows the effect of the percentage of sperm cells that can swim on the number of successful pregnancies.



The correlation coefficient of the data shown in the graph is +0.90.

Discuss the advantages and disadvantages of using frozen sperm in breeding programmes for these endangered breeds.

Use all of the information in Question 8 to support your answer.

(6)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

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