

Please write clearly in block capitals.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE

COMBINED SCIENCE

Paper 1 Biology Extension

E

Thursday 24 October 2024

07:00 GMT

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a pencil and a ruler
- a scientific calculator.



Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.
- You are expected to use a scientific calculator where appropriate.

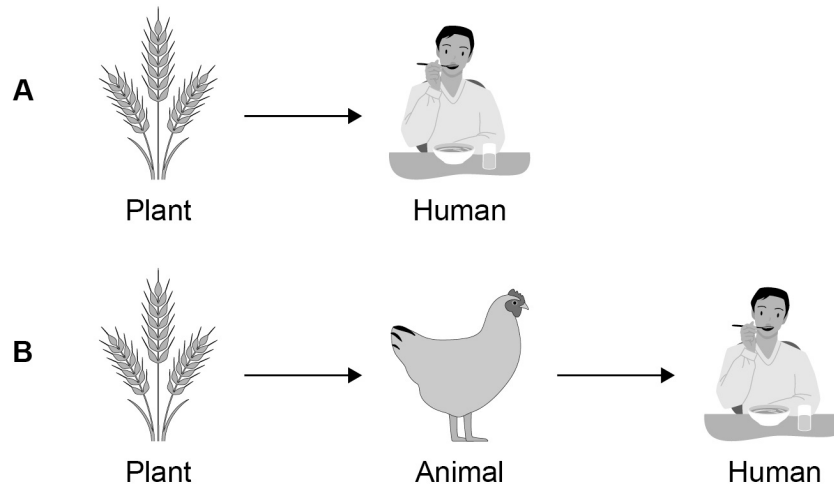
Answer **all** questions in the spaces provided.

0 1

Farmers produce food for humans.

Figure 1 shows two food chains.

Figure 1



0 1 . 1

What is the source of energy for both food chains in **Figure 1**?

[1 mark]

0 1 . 2

In food chain **A**, 10% of the energy transferred by the plants can be used by humans.

In food chain **B**, 1% of the energy transferred by the plants can be used by humans.

Explain why there is a difference in the percentage of energy that can be used by humans between the two food chains.

[2 marks]



People who grow crops use chemicals to help the crops grow bigger.

The chemicals include:

- fertiliser that contains nitrate ions
- herbicide that kills unwanted plants
- insecticide that kills insects that feed on the plants
- rooting powder that stimulates root growth.

0 1 . 3

Describe how each chemical helps the crops grow bigger.

[4 marks]

Fertiliser _____

Herbicide _____

Insecticide _____

Rooting powder _____

Question 1 continues on the next page

Turn over ►



Genetically modified (GM) crops have genes from a different species added to their cells.

0 1 . 4

Give **two** reasons why some crops are genetically modified.

[2 marks]

1 _____

2 _____

0 1 . 5

Give **one** reason why some scientists are concerned about people eating genetically modified (GM) crops.

[1 mark]

10

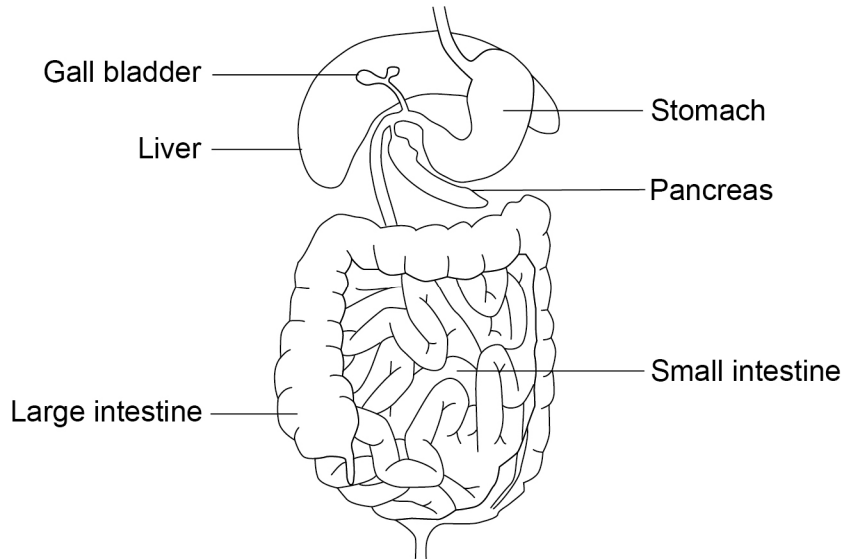


0 2

Enzymes break down food in the digestive system.

Figure 2 shows part of the human digestive system.

Figure 2



0 2 . 1

The organs in the digestive system have different functions.

Draw **one** line from each function to the organ that carries out the function.

[2 marks]

Function

Organ

Produces amylase, lipase
and protease

Produces bile

Gall bladder

Large intestine

Liver

Pancreas

Stomach



The enzyme lipase catalyses the breakdown of fat into glycerol and fatty acids.

A student investigated the effect of bile on the breakdown of fat in milk by lipase.

This is the method used.

1. Add a milk solution to a beaker.
2. Add 4.5 cm³ of 5% bile solution to the beaker.
3. Place the beaker into a water bath at 37 °C.
4. When the mixture reaches 37 °C, add 5 cm³ of lipase solution.
5. Use a pH probe to measure the pH of the mixture.
6. Record the pH every 2 minutes for 20 minutes.
7. Repeat steps 1 to 6 using water instead of bile solution in step 2.

0 2 . 2 The milk solution contains milk and sodium carbonate.

Sodium carbonate is an alkali.

Why is sodium carbonate added to the mixture?

[1 mark]

Tick (✓) **one** box.

To control the volume of the mixture

☐

To kill the bacteria in the milk

☐

To raise the pH for lipase to work

☐

0 2 . 3 The pH of the milk solution changes when fat is broken down into fatty acids.

Complete **Table 1** for the variables in the investigation.

Tick (✓) **one** box in each row.

[3 marks]

Table 1

Variable	Control variable	Dependent variable	Independent variable
Change in pH			
Temperature			
Use of bile solution			
Volume of milk solution			

Question 2 continues on the next page

Turn over ►



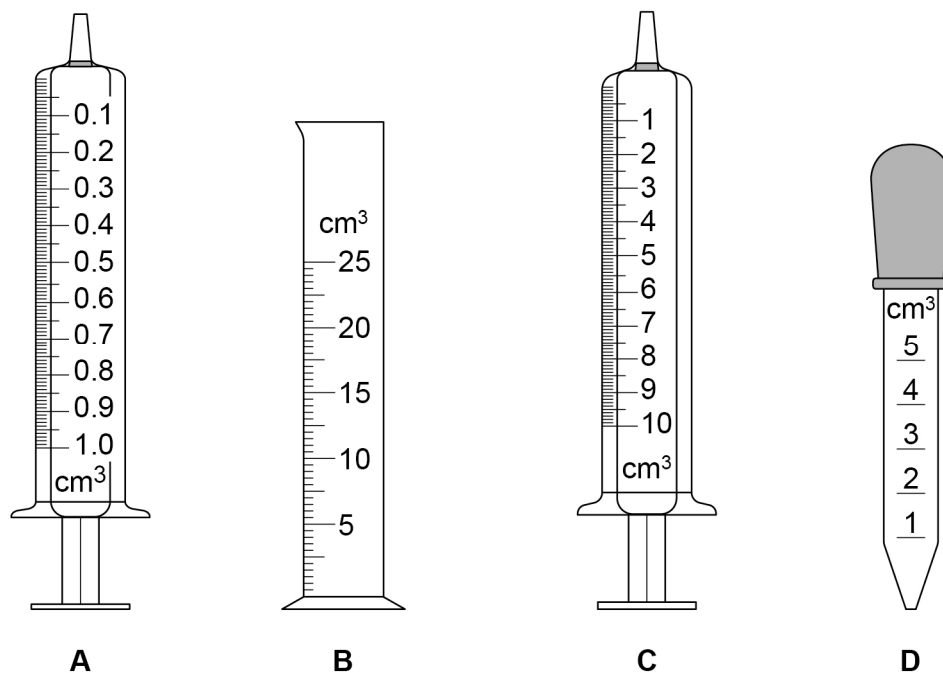
0 2 . 4

The student used different apparatus to measure the volumes of solutions during the investigation.

Figure 3 shows apparatus used to measure volumes of solution.

The apparatus are **not** drawn to scale.

Figure 3



Which apparatus would measure 4.5 cm³ of solution most accurately?

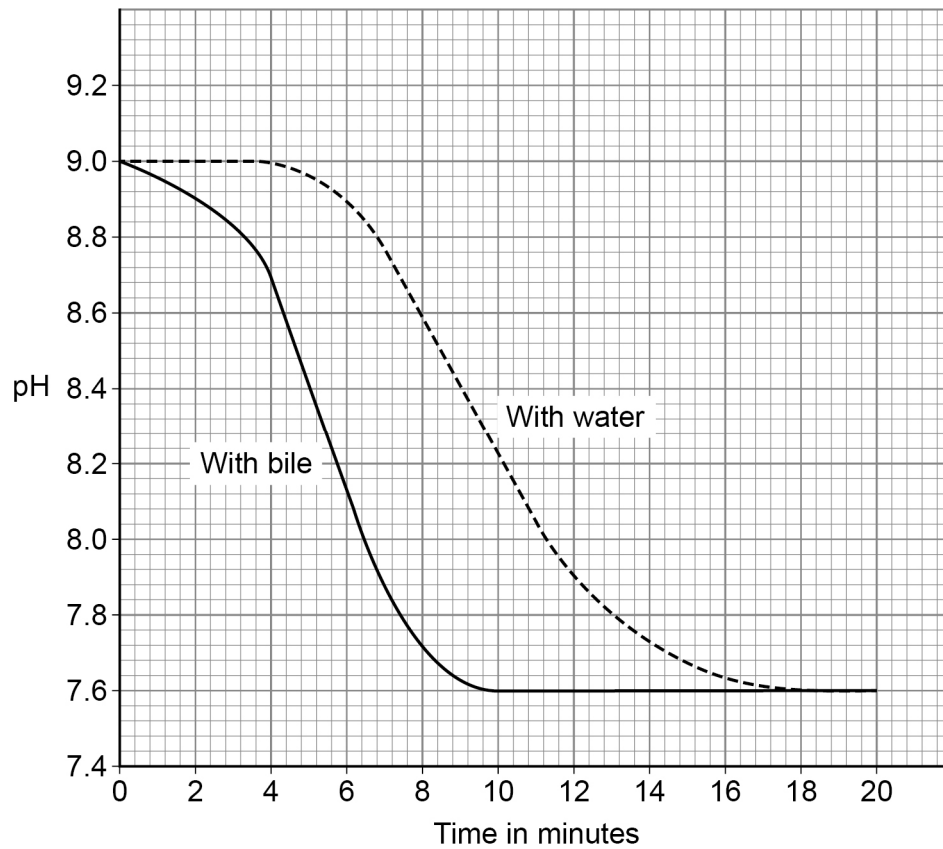
[1 mark]

Tick (✓) **one** box.

A	☐
B	☐
C	☐
D	☐

Figure 4 shows the results.

Figure 4



0 2 . 5

The student concluded:

‘The results show that bile is essential for the breakdown of fat.’

Evaluate the student’s conclusion.

Use **Figure 4**.

[2 marks]

Question 2 continues on the next page

Turn over ►



Figure 5 shows the effect of bile on a large fat droplet.

Figure 5

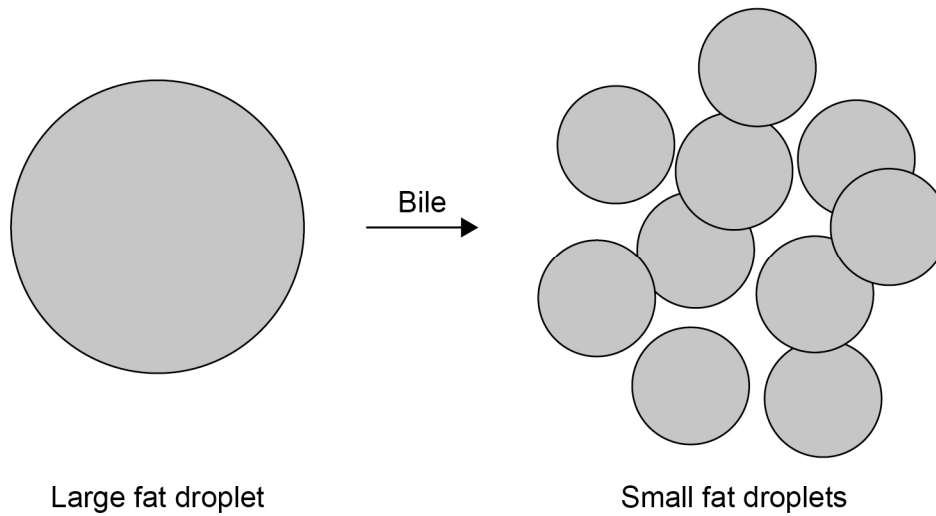


Table 2 shows the volume and surface area of fat droplets.

Table 2

Fat	Radius of one droplet in arbitrary units	Total volume of fat in arbitrary units	Total surface area of fat in arbitrary units
One large droplet	10.00	4190	X
Ten small droplets	4.64	4190	2710

0 2 . 6 Calculate value **X** in **Table 2**.

Use the formula:

$$\text{Surface area} = 4\pi r^2$$

Use $\pi = 3.14$

[2 marks]

X = _____ arbitrary units



0 2 . 7 Adding bile affects the breakdown of fats by enzymes.

Explain the effect of bile on the breakdown of fats.

Use **Figure 5** and **Table 2**.

[3 marks]

14

Turn over for the next question

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0 3

Some disorders are inherited.

The gene for one inherited disorder has two alleles, **T** and **t**.

0 3 . 1

A person will **not** develop the disorder if they inherit at least one **T** allele.

What word describes the **T** allele?

[1 mark]

Tick (✓) **one** box.

Dominant

☐

Genotype

☐

Mutated

☐

Recessive

☐**0 3 . 2**

How are genes passed from parents to their offspring?

[1 mark]

Tick (✓) **one** box.

By antibodies

☐

By blood cells

☐

By gametes

☐

By stem cells

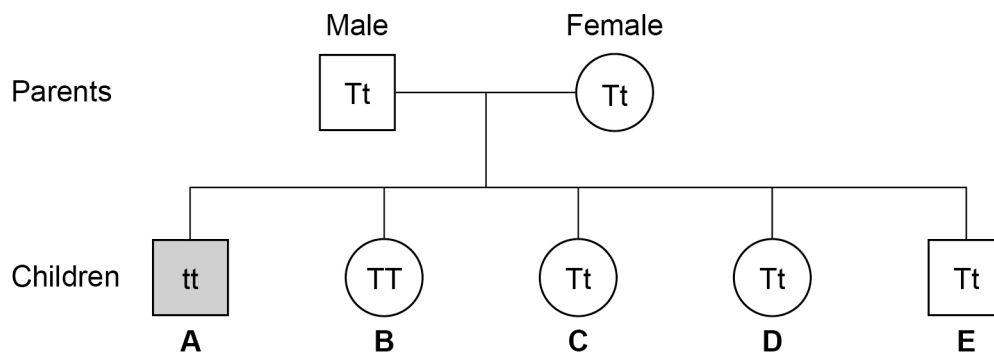
☐

Question 3 continues on the next page

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Figure 6 shows the inheritance of the disorder in one family.

Figure 6



Key

-  male with the disorder
-  female with the disorder
-  male **without** the disorder
-  female **without** the disorder

0 3 . 3 Which children in **Figure 6** are homozygous?

[1 mark]

0 3 . 4 Twins that develop from a single fertilised egg are genetically identical.

Which children in **Figure 6** could be identical twins?

[1 mark]

Child _____

Child _____



0 3 . 5

Child **B** in **Figure 6** becomes an adult and has offspring.

Explain why **none** of the offspring of child **B** will develop the disorder.

[2 marks]

0 3 . 6

A blood test can determine if a person is a carrier of the disorder.

Suggest why some people have the blood test before deciding to have children.

[1 mark]

7

Turn over for the next question

Turn over ►



0 4

Figure 7 shows changes in some of the characteristics of horses over time.

Figure 7

Date	50 million years ago	35 million years ago	26 million years ago	3 million years ago
Name	<i>Eohippus</i>	<i>Mesohippus</i>	<i>Merychippus</i>	<i>Equus</i>
Appearance				
Height in cm	38	52	100	135
Foot				
Skull				

0 4 . 1

There is a scientific theory that natural selection leads to changes in the characteristics of a species over time.

Complete the sentence.

[1 mark]

The theory that natural selection leads to changes over time

is called the theory of _____.



The adaptations include:

- | | | | |
|---|---|---|---|
| 0 | 4 | . | 2 |
|---|---|---|---|

[5 marks]

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Police horses are used by some police forces.

The horses are trained how to behave and react in a wide range of situations.

0 4 . 3

Describe how classic conditioning and habituation can be used to train police horses.

[2 marks]

Classic conditioning _____

Habituation _____

0 4 . 4

Some horses have characteristics that make them suitable to be police horses.

Suggest **two** useful characteristics for a police horse.

[2 marks]

1 _____

2 _____

10

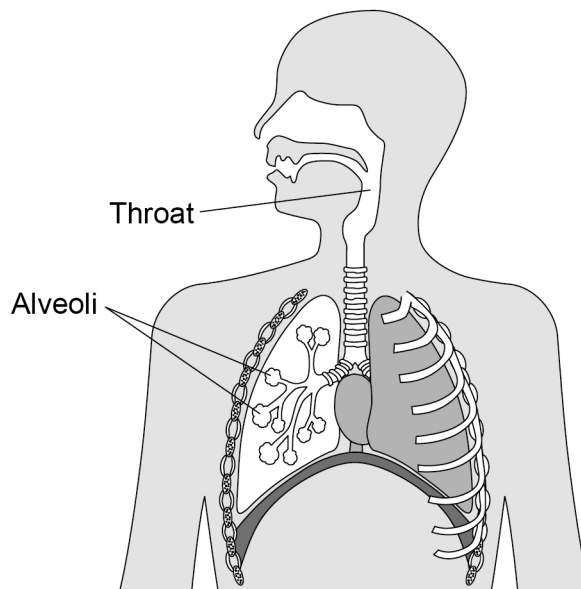


0 5

Exchange of gases between the air and the blood takes place in the breathing system.

Figure 8 shows the human breathing system.

Figure 8

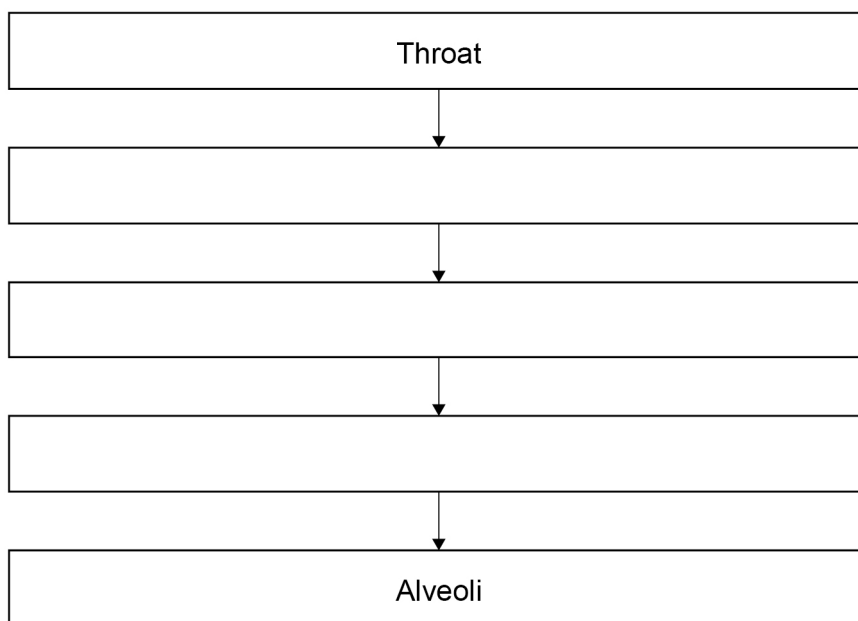
**0 5****. 1**

Complete **Figure 9**.

You should give the name of each structure air passes through as it moves from the throat to the alveoli.

[3 marks]

Figure 9



Turn over ►



0	5	.	2
---	---	---	---

The exchange surface in the lungs has a large surface area.

Describe other ways the exchange surface in the lungs is specialised for fast diffusion of gases between the alveoli and the blood.

Do **not** refer to surface area.

[3 marks]

0	5	.	3
---	---	---	---

Substances can pass through cell membranes by diffusion or by active transport.

Describe **two** differences between diffusion and active transport.

[2 marks]

1

2



0	5	.	4
---	---	---	---

Substances required by the body are absorbed into cells in the kidney tubule by active transport.

Kidney tubule cells have a large surface area.

Explain **one** other way the cells are adapted so that active transport can continue at a high rate.

Do **not** refer to surface area.

[3 marks]

11

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0 6

Humans maintain a constant body temperature.

Fish and insects **cannot** maintain a constant body temperature.**0 6 . 1**Suggest **two** advantages of having a constant body temperature.**[2 marks]**

1 _____

2 _____

0 6 . 2

Some of the organs in the body have receptors that are sensitive to stimuli.

Complete **Table 3**.**[3 marks]****Table 3**

Stimulus	Organ with receptors sensitive to the stimulus
Blood glucose concentration increases	
The concentration of water in the blood decreases	
The position of the body changes	

Question 6 continues on the next page**Turn over ►**

Question 6 continues on the next page

Turn over ►



There are several different types of temperature receptor in the skin.

0 6 . 4 The G2 gene codes for a temperature receptor called TR2.

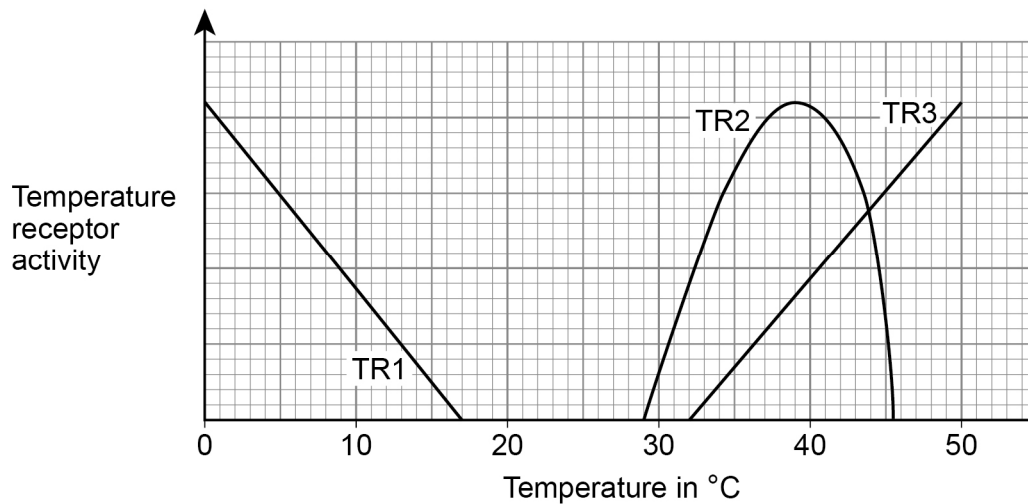
What type of molecule is the TR2 receptor?

[1 mark]

Different temperature receptors are stimulated at different temperatures.

Figure 11 shows the temperature receptor activity for three different temperature receptors.

Figure 11



0 6 . 5 What temperature is **TR2** at maximum activity?

[1 mark]

Temperature = _____ °C

0 6 . 6 Determine the temperature range for **TR2** activity.

[1 mark]

Temperature range = from _____ °C to _____ °C



0 6 . 7 Temperature receptors are either cold receptors or heat receptors.

Describe the evidence from **Figure 11** that shows **TR1** is a cold receptor and **TR3** is a heat receptor.

[1 mark]

0 6 . 8 Describe the evidence from **Figure 11** that suggests there are more than three different types of temperature receptor.

[1 mark]

16

Turn over for the next question

Turn over ►



0	7
---	---

Cells contain genetic material.

0	7	.	1
---	---	---	---

Describe **one** difference in the arrangement of genetic material in plant cells and bacterial cells.

[1 mark]

0	7	.	2
---	---	---	---

Bacteria reproduce by dividing into two.

Bacteria divide every 20 minutes.

There are 100 bacteria in a population.

Calculate the number of bacteria in the population after 2 hours.

Give your answer in standard form.

[3 marks]

Number of bacteria (standard form) = _____



Plant cells divide by mitosis to produce new cells for growth.

0 7 . 3

Explain why plant cells make more of the genetic material called DNA before mitosis.

[3 marks]

Question 7 continues on the next page

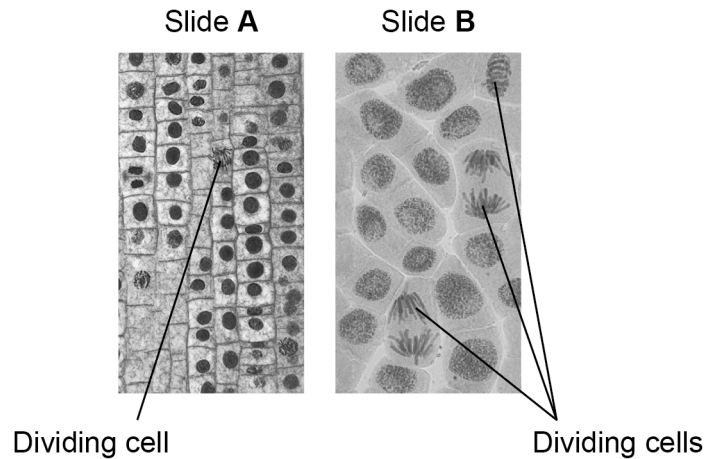
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Dividing cells from garlic roots placed on glass slides can be seen using a microscope.

Figure 12 shows root cells seen through a microscope at different magnifications.

Figure 12



Slide **A** is $\times 100$ magnification and slide **B** is $\times 400$ magnification.

Dividing cells are randomly distributed in the root tissue.

Chromosomes are visible in dividing cells.

0 7 . 4

Mitotic index is used to estimate the rate of mitosis in a tissue.

Mitotic index is calculated using the equation:

$$\text{Mitotic index} = \frac{\text{number of cells with visible chromosomes}}{\text{total number of cells}}$$

There are **three** cells with visible chromosomes in slide **B**.

Calculate the mitotic index for slide **B**.

Give your answer to 2 decimal places.

[3 marks]

Mitotic index (2 decimal places) = _____



0	7	.	5
---	---	---	---

The different magnifications shown in **Figure 12** can be used to determine the mitotic index.

Give **one** advantage of using each magnification in **Figure 12** to determine the mitotic index.

[2 marks]

Advantage of $\times 100$ magnification _____

Advantage of $\times 400$ magnification _____

Question 7 continues on the next page

Turn over ►



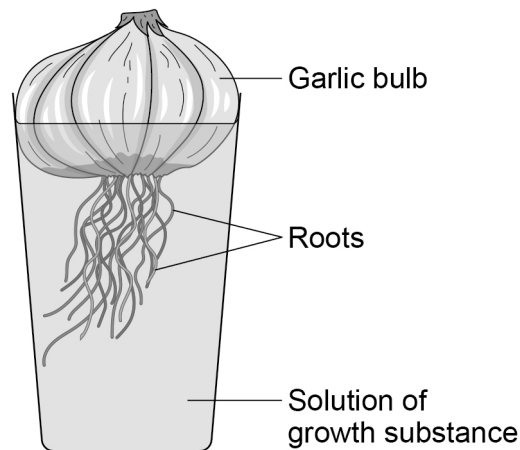
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0	7	.	6
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Growth substances are chemicals that affect the rate of growth of plant roots.

Figure 13 shows a garlic bulb growing with its roots in a growth substance.

Figure 13



Plan an investigation to show how different concentrations of growth substance affect the rate of growth of garlic roots.

[6 marks]

[illegible]

0 8

Thalassaemia is an inherited condition.

0 8 . 1

Genetic counsellors:

- are experts in genetics
- study inheritance of medical conditions within families
- work in hospitals.

Suggest **two** reasons why genetic counsellors speak to people who have a history of thalassaemia in their family.

[2 marks]

1 _____

2 _____

0 8 . 2People with thalassaemia do **not** produce enough haemoglobin.

A symptom of thalassaemia is severe tiredness.

Explain how thalassaemia causes severe tiredness.

[4 marks]

Turn over ►

One cure for thalassaemia is transplanting healthy human stem cells into the patient.

0 8 . 3 What is a human stem cell?

[1 mark]

0 8 . 4 Name **one** part of an adult human body that produces stem cells.

[1 mark]

Healthy stem cells can be removed from a person who does **not** have thalassaemia.

The stem cells are then transplanted into the patient.

0 8 . 5 Explain how the transplanted stem cells enable the patient to produce more haemoglobin.

[2 marks]



0 8 . 6

In a new medical trial:

- stem cells are removed from a patient with thalassaemia
- the stem cells are genetically modified into healthy stem cells
- the healthy stem cells are transplanted back into the patient.

Suggest **two** benefits of using genetically modified stem cells from the patient rather than stem cells from another person.

[2 marks]

1 _____

2 _____

0 8 . 7

Describe how therapeutic cloning may be used to treat some conditions that are **not** inherited.

[2 marks]

14

END OF QUESTIONS

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[illegible]

[illegible]

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