

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL AS BIOLOGY (9610)

Unit 2 Biological Systems and Disease

Monday 11 May 2026

08:00 UK Time

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

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.
- 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).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

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

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



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

0 1

Eukaryotic cells have a cell cycle that includes interphase and mitosis.

0 1 . 1

Give **two** processes that occur in a cell during interphase.

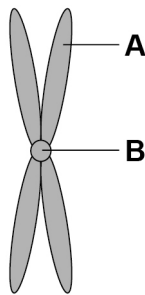
[2 marks]

1 _____

2 _____

Figure 1 shows a chromosome during prophase.

Figure 1



0 1 . 2

Name the structures labelled **A** and **B** in **Figure 1**.

[1 mark]

A _____

B _____

0 1 . 3

Describe what happens during metaphase.

[1 mark]

Question 1 continues on the next page

Turn over ►

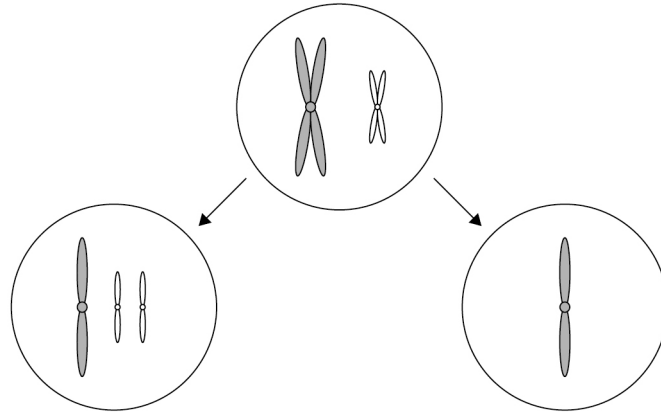


Sometimes there are problems during mitosis. One problem is called nondisjunction.

When nondisjunction occurs, the daughter cells are different from those expected in normal mitosis.

Figure 2 shows nondisjunction during mitosis.

Figure 2



0 1 . 4

Identify the stage of mitosis when nondisjunction occurs.

Give evidence from **Figure 2** in your answer.

[2 marks]

Stage of mitosis _____

Evidence _____



Nondisjunction during mitosis can result in cancer.

Retinoblastoma is a type of cancer caused by nondisjunction.

Normally, retinoblastoma is prevented by a tumour suppressor gene called *RB1*.

0 1 . 5

Describe how nondisjunction can result in retinoblastoma.

Use information from **Figure 2**.

[2 marks]

Question 1 continues on the next page

Turn over ►



Retinoblastoma occurs in the eye, where it causes sight problems.

An early symptom is an increase in the size of the eye due to growth of a tumour.

Scientists use mice to investigate gene therapy as a treatment for retinoblastoma. Gene therapy involves putting a functioning copy of the *RB1* gene into the cells of the eye.

The scientists:

- collect tumour cells from a patient with retinoblastoma
- put 4×10^5 tumour cells into each eye of ten mice
- treat the right eye **only** of each mouse with gene therapy
- measure the diameter of each mouse's eyes, every week for 4 weeks
- calculate the mean diameter of eyes treated with gene therapy and the mean diameter of the eyes not treated with gene therapy every week.

0 1 . 6

Suggest **two** reasons why the scientists use 4×10^5 tumour cells for each eye.

[2 marks]

Reason 1 _____

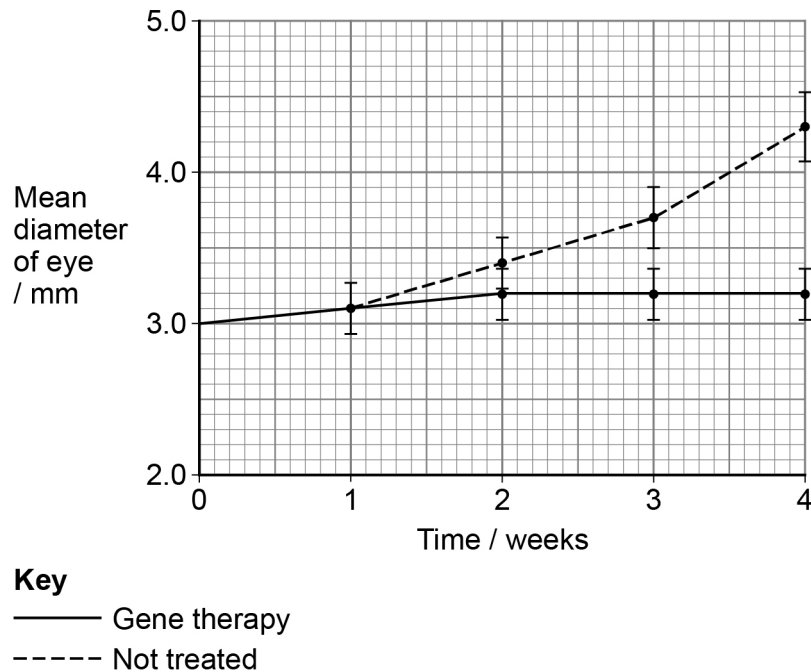
Reason 2 _____



Every week, the scientists compare the mean diameter of eyes treated with gene therapy and the mean diameter of the eyes not treated.

Figure 3 shows the scientists' results. Values are mean $\pm$ standard error.

Figure 3



0 1 . 7

The change in mean volume of the eyes from the start to the end of the investigation can be calculated.

Calculate the change in mean volume of the eyes for the mice **not treated** with gene therapy.

A mouse eye has a spherical shape.

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

Use $\pi = 3.14$

Give your answer to 3 significant figures.

[3 marks]

Change in mean volume = _____ mm³

Turn over ►



[4 marks]

17



0 2

Research shows that smoking cigarettes is harmful to health.

Standard cigarettes are made of tobacco. The smoke breathed in from tobacco cigarettes contains carbon monoxide and nicotine.

0 2 . 1

Carbon monoxide decreases the amount of oxygen that can be transported in the blood.

A person who smokes finds it harder to do the same amount of exercise as a similar person who does not smoke.

Suggest why.

[2 marks]

0 2 . 2

Nicotine in tobacco cigarettes (TC) increases the risk of thrombosis.

Describe the effect of thrombosis.

[3 marks]

Question 2 continues on the next page

Turn over ►

Recently, some people have switched from TC to electronic cigarettes (EC).

EC heat a liquid containing nicotine to turn it into a vapour to breathe in. This is also known as vaping.

Scientists compare the effect of smoking TC with smoking EC. The scientists measure changes in blood pressure and heart rate.

The scientists include a control group in the investigation.

People in the control group pretend to smoke using an empty tube, the same size and shape as a TC.

0 2 3

Why do the scientists include a control group?

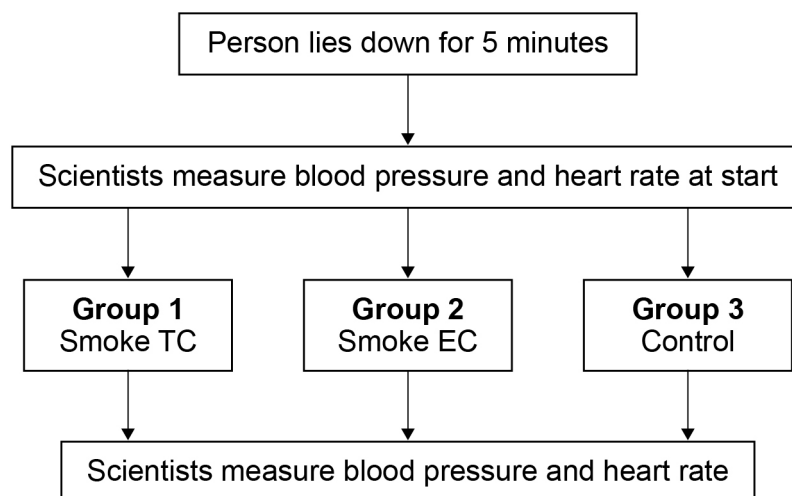
[1 mark]

The scientists:

- select 36 healthy people, aged 25–45 who smoke TC regularly
- put the people into 3 groups at random
 - **Group 1** smoke TC
 - **Group 2** smoke EC
 - **Group 3** pretend to smoke (control group).

Figure 4 shows the scientists' method.

Figure 4



0 2 . 4

The scientists select people who smoke cigarettes regularly instead of people who do not smoke cigarettes for the investigation.

Suggest why.

[1 mark]

Table 1 shows the scientists' results.

Table 1

	Mean blood pressure / mmHg	Mean heart rate / beats minute ⁻¹
At start	117	64
Group 1 (TC)	129	76
Group 2 (EC)	133	75
Group 3 (Control)	117	64

0 2 . 5

Compare the effect of TC and EC on blood pressure and heart rate.

[3 marks]

10

Turn over ►

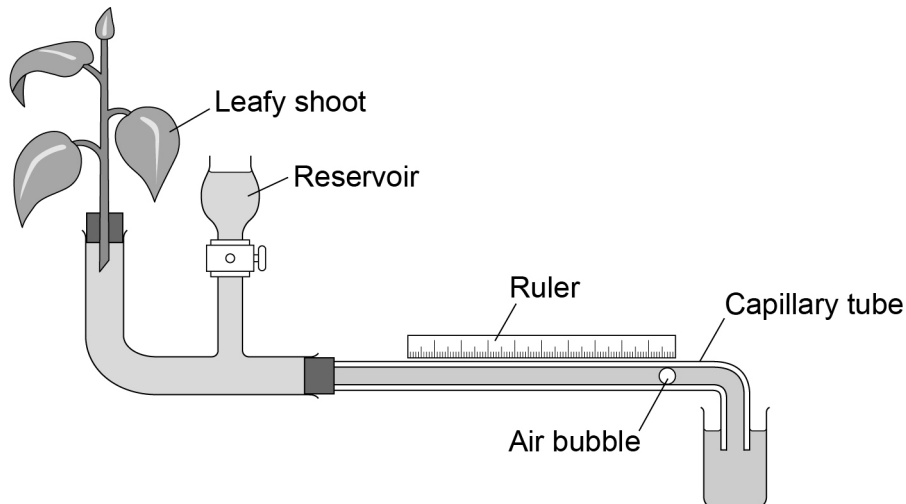


0 3

Students investigate the rate of transpiration in plants.

Figure 5 shows a potometer. A potometer can be used to estimate the rate of transpiration of a leafy shoot.

Figure 5



The students set up the potometer correctly so this is **not** a source of error in the investigation.

0 3 . 1

The students use the potometer in **Figure 5** to estimate the rate of transpiration of the leafy shoot.

Describe how.

[3 marks]



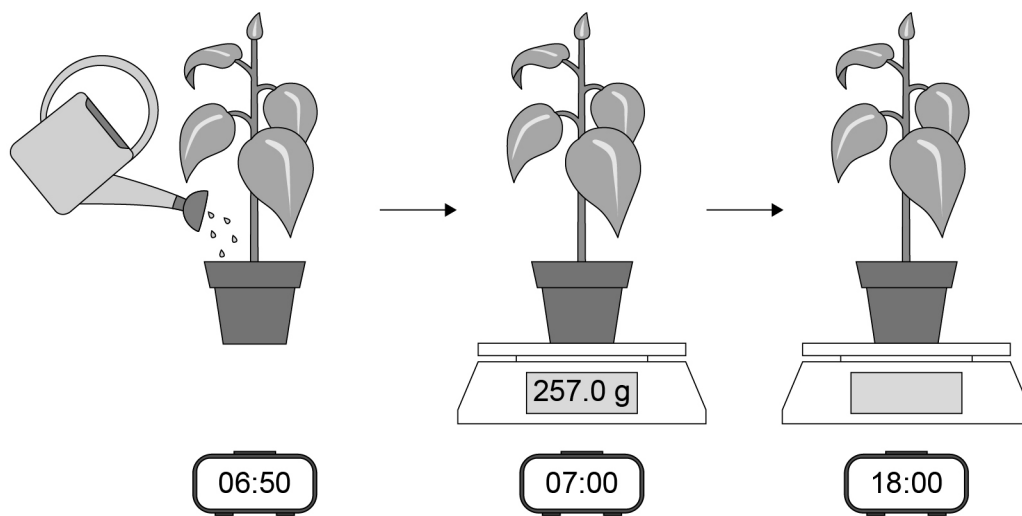
People often grow plants in pots of soil. The students estimate the rate of transpiration using plants in pots.

The students:

- collect ten plants of the same species and size, each growing in a pot of soil
- put all the plants outside in the same area
- give each pot the same volume of water in the morning at 06:50
- measure the starting mass of each pot at 07:00
- measure the mass of each pot at 18:00

Figure 6 shows the steps in the students' method.

Figure 6



0 3 . 2 There is a problem with the way the equipment in **Figure 6** is set up.

This means that the students' estimate for the rate of transpiration will be higher than the true value.

Identify the problem and how to correct the problem.

[2 marks]

Problem _____

How to correct the problem _____

Turn over ►



The students correct the problem with the equipment and do the experiment again.

0 3 . 3

The students calculate the mean mass of the ten plants at 07:00

Predict how the mean mass changes by 18:00

[1 mark]

0 3 . 4

The students use their results to calculate the mean rate of transpiration between 07:00 and 18:00

At some times of the day, the actual rate of transpiration will be higher than the mean.

Explain why.

[2 marks]

8

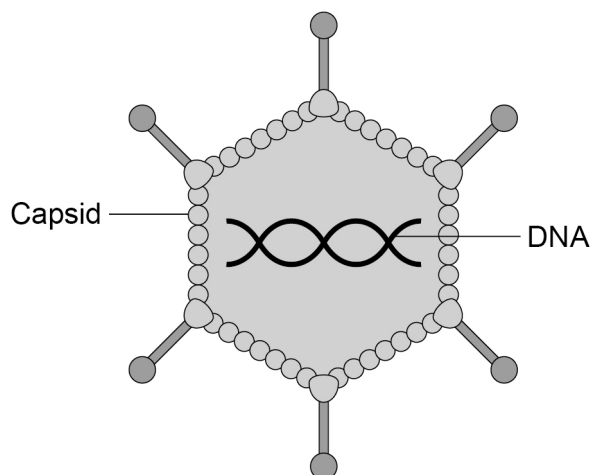


0	4
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Adenoviruses are a group of viruses that infect humans. Adenoviruses enter human cells and replicate.

Figure 7 shows the structure of an adenovirus.

Figure 7



0	4	.	1
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Human immunodeficiency virus (HIV) is a different type of virus that also infects humans.

Give **two** differences between the structure of HIV and the structure of the adenovirus shown in **Figure 7**.

[2 marks]

1 _____

2 _____

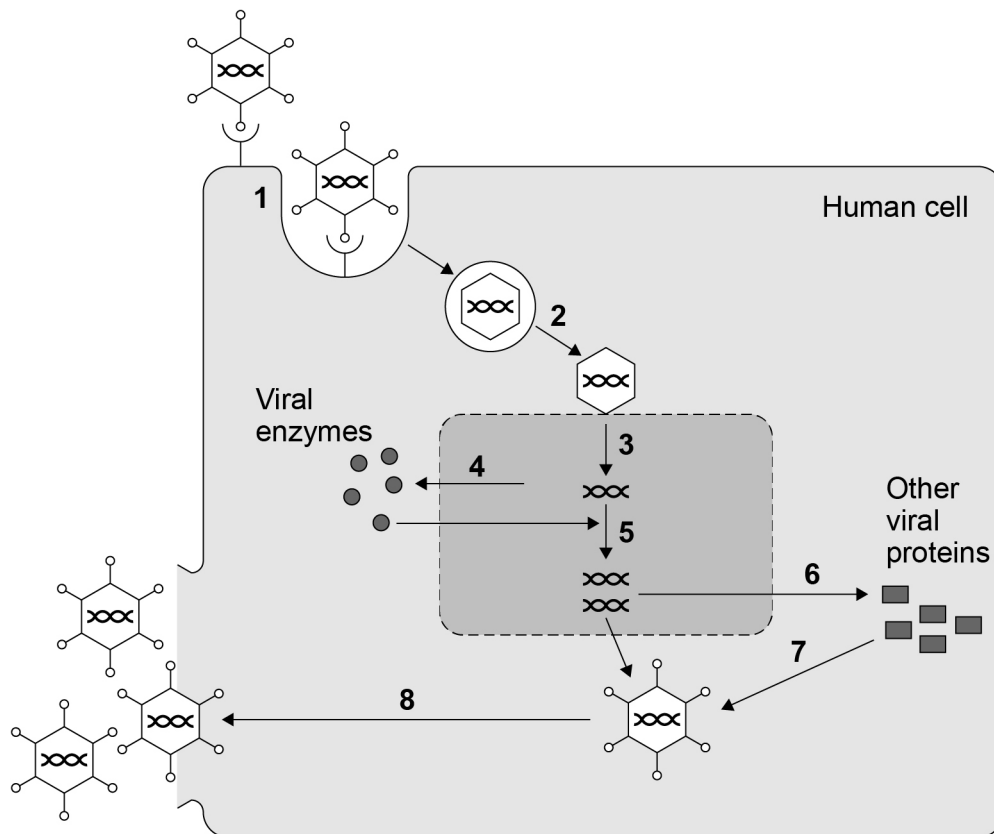
Turn over ►



Figure 8 shows the replication cycle of adenovirus inside a human cell.

The numbered list describes what happens at each stage of the cycle.

Figure 8



1. Adenovirus binds to receptor on cell surface and moves inside cell
2. Adenovirus moves to nuclear membrane
3. Adenovirus releases viral DNA into nucleus
4. Transcription and translation of viral enzymes
5. Replication of viral DNA
6. Transcription and translation of other viral proteins
7. New adenovirus particles made
8. New adenovirus particles break out of cell

0 4 . 2

The replication cycle of adenovirus uses different enzymes at different stages. These enzymes include:

- DNA polymerase
- protease.

Give **one** number from **Figure 8** for **each** enzyme to show when that enzyme is used. **[1 mark]**

DNA polymerase _____

Protease _____

0 4 . 3

The replication of HIV needs **two other** enzymes **not** used by adenovirus.

Explain why HIV needs these other named enzymes but adenovirus does not.

[4 marks]

Name of enzyme 1 _____

Why HIV needs enzyme 1 _____

Why adenovirus does **not** need enzyme 1 _____

Name of enzyme 2 _____

Why HIV needs enzyme 2 _____

Why adenovirus does **not** need enzyme 2 _____

0 4 . 4

Both HIV and adenovirus produce other viral proteins that are **not** enzymes.

Give the function of **one** of the other viral proteins in these viruses.

[1 mark]



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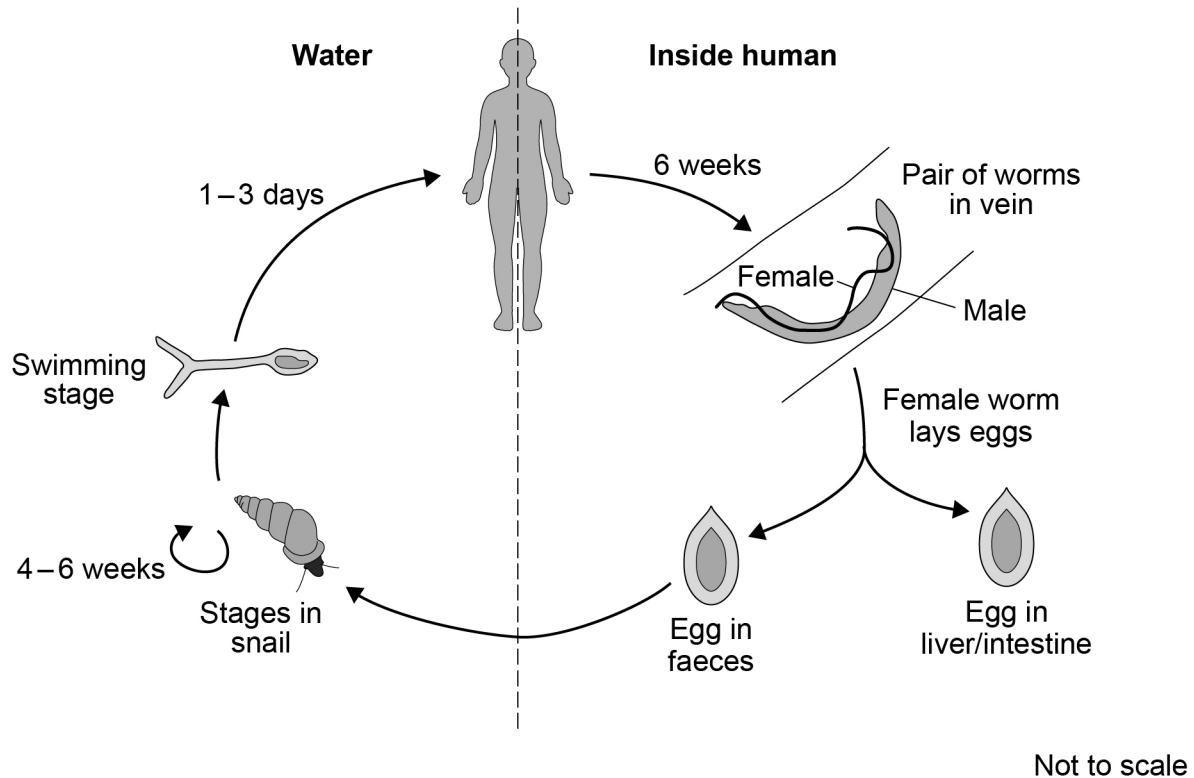


0 5

Schistosomiasis is a disease affecting 200 million people across parts of Asia. People can develop schistosomiasis after they are exposed to water containing human faeces.

Figure 9 shows the life cycle of the organism causing schistosomiasis. The swimming stage of the organism can enter the human body through the skin.

Figure 9



0 5 . 1

Suggest **one** way that schistosomiasis infections can be reduced.

Use **Figure 9**.

[1 mark]

Turn over ►



Adult worms live as a male–female pair of worms in a vein inside the human body.

Scientists estimate:

- one female worm can produce 2198 eggs per day
- female worms lay eggs for an average of 4.5 years
- 47% of the eggs will be egested in human faeces.

0 5 . 2

Calculate the number of eggs a human egests if infected with one pair of worms.

Give your answer in standard form.

[3 marks]

Total number of eggs egested = _____

0 5 . 3

Pairs of worms live in the veins around the liver and intestines.

Suggest and explain **two** reasons why the pairs of worms live in veins instead of arteries.

[2 marks]

1 _____

2 _____



The symptoms of schistosomiasis include pain and diarrhoea.

Scientists are developing a vaccine to prevent schistosomiasis.

The vaccine contains a protein found on the surface of the worms.

0 5 . 4

Suggest why the scientists use this protein in the vaccine.

[2 marks]

The vaccine reaches the first stage of clinical trials. This clinical trial occurs in a country where schistosomiasis is **not** found.

The scientists:

- ask 10 healthy women who do **not** have schistosomiasis to join the clinical trial
- give the women the vaccine at the start (time = 0), at 30 days and at 60 days
- monitor any side effects of the vaccination.

0 5 . 5

The scientists find that the vaccine:

- does **not** cause any serious side effects
- does cause some minor side effects, such as redness at the site of the vaccination.

Suggest why the scientists monitor for **minor** side effects.

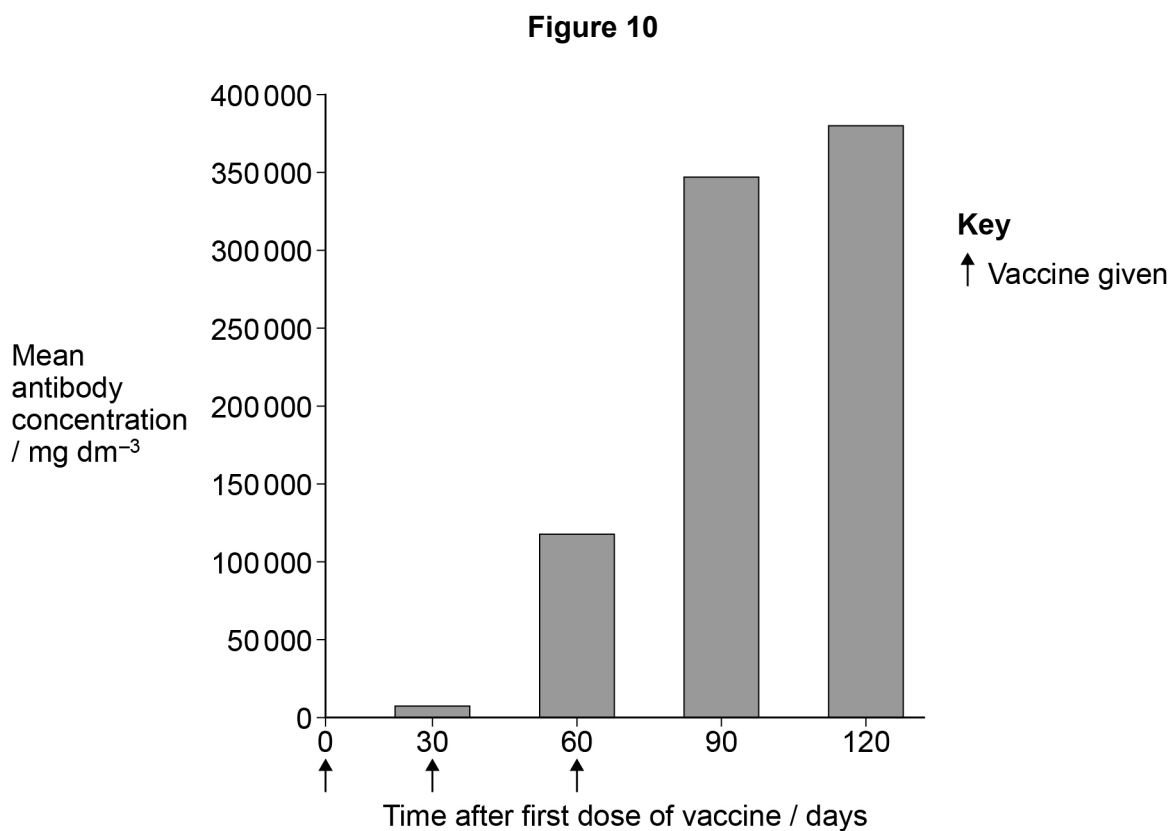
[1 mark]

Turn over ►



The scientists measure antibody concentration in the women's blood at the start (time = 0) and at 30, 60, 90 and 120 days.

Figure 10 shows the scientists' results.



0 5 . 6 The scientists want to read values from **Figure 10** and use the values in calculations.

Suggest more appropriate units to use for the y-axis of **Figure 10**.

Give the reason for this change.

[2 marks]

More appropriate units _____

Reason _____



0 5 . 7 Evaluate the use of the vaccine to prevent schistosomiasis.

Use **Figure 10** and the information provided.

[3 marks]

14

Turn over for the next question

Turn over ►

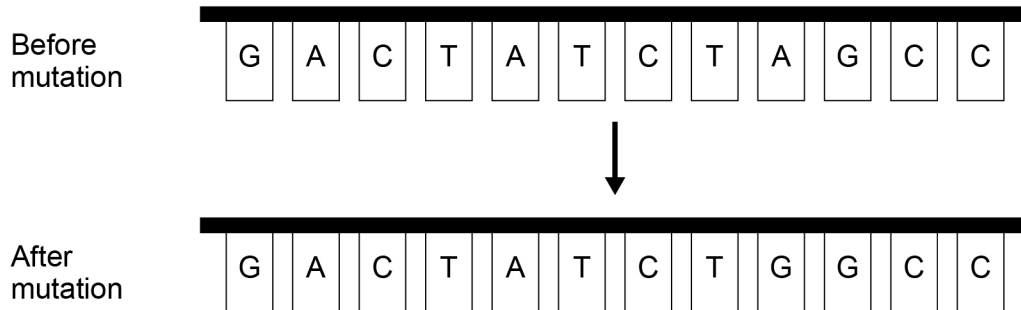


0 6

Mutations change DNA base sequences.

Figure 11 shows a DNA base sequence before and after a mutation.

Figure 11



0 6 . 1

Draw a circle around the mutation in **Figure 11**.

[1 mark]

0 6 . 2

Name the type of mutation in **Figure 11**.

[1 mark]

0 6 . 3

The DNA base sequence in **Figure 11** codes for part of a polypeptide.

The primary structure of the polypeptide does **not** change as a result of the mutation.

Explain why.

[2 marks]

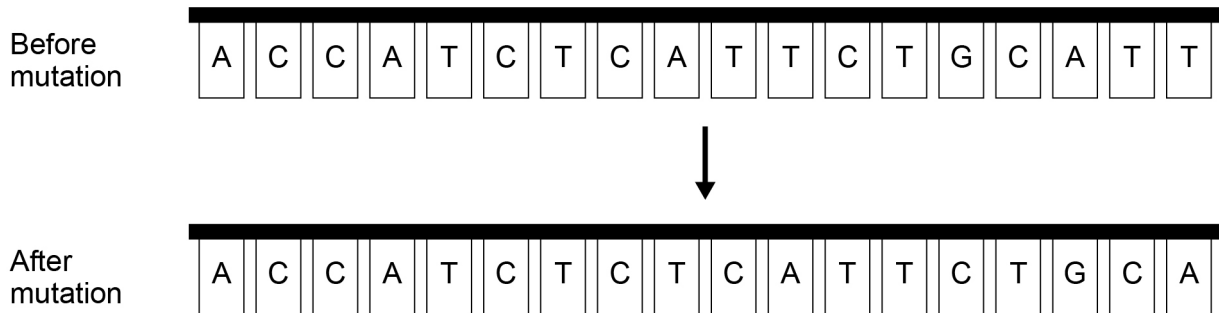


The transport of ions across a cell surface membrane requires channel proteins.

Cystic fibrosis (CF) is a genetic disease caused by a mutation in a gene coding for a channel protein.

Figure 12 shows the DNA base sequence for part of the gene before and after one mutation that results in CF.

Figure 12



0 6 . 4

Describe the mutation in **Figure 12**.

[1 mark]

0 6 . 5

Explain the effect of the mutation in **Figure 12** on the structure and function of the channel protein.

[3 marks]



The human digestive system consists of several different organs and glands. The functions of the digestive system include:

- digestion of food
- absorption of the products of digestion.

Describe the roles of **five named** organs or glands in these processes.

[5 marks]

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Aphids are insects that feed on plant sap. Mass flow in a plant allows the aphids to feed on sap.

Describe the process of mass flow in a plant and how mass flow helps aphids to feed on sap.

[5 marks]

[illegible]

10

END OF QUESTIONS



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