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Forename(s) _____

Candidate signature _____
I declare this is my own work.

INTERNATIONAL AS
BIOLOGY (9610)

Unit 2 Biological Systems and Disease

Wednesday 12 January 2022 07:00 GMT 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	

Do not write outside the box

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

0 1 The digestive system is made of glands and organs.

0 1 . 1 Name an enzyme secreted by the salivary glands.

[1 mark]

0 1 . 2 The liver secretes bile salts into the small intestine through the bile duct.

Describe how bile salts help in the digestion of lipids.

[2 marks]

0 1 . 3 The pancreas is also involved in the digestion of lipids.

Describe the role of the pancreas in the digestion of lipids.

[3 marks]

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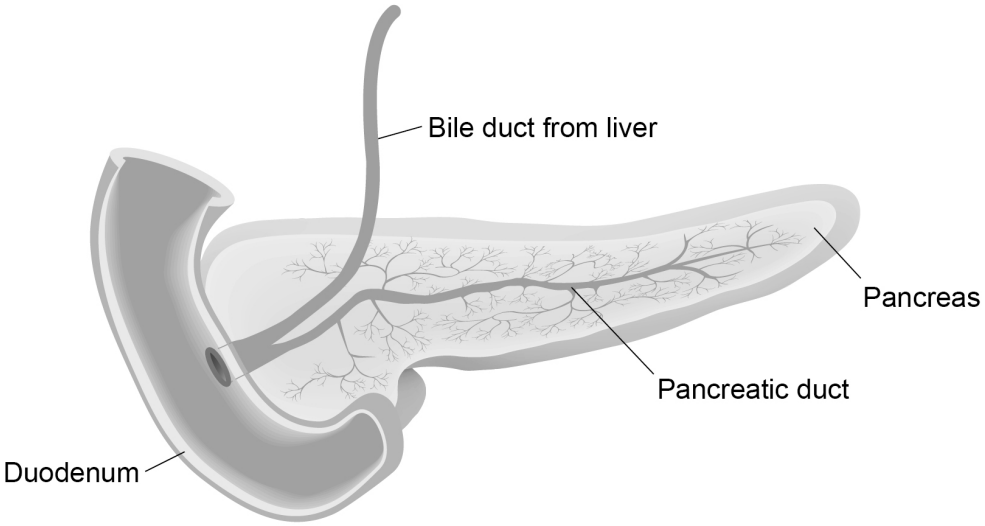
Figure 1 shows the position of the pancreas in the digestive system.

Figure 1



The early stages of pancreatic cancer are difficult to detect because there are few symptoms. Doctors can diagnose pancreatic cancer by observing other conditions that the patient has.

For example, some people with pancreatic cancer also develop jaundice. One symptom of jaundice is that the whites of the eyes turn yellow.

This is caused by the build-up of a substance in the body. This substance is produced by the liver and is usually excreted by the digestive system.

0 1 . 4 Suggest why pancreatic cancer may cause the whites of the eyes to turn yellow.

Use information from **Figure 1**.

[3 marks]

Do not write outside the box

0 1 . 5 Pancreatic cancer can be treated by removing the pancreas. After surgery, the enzymes normally secreted by the pancreas are taken as tablets.

These tablets have a special coating. This coating is only removed at certain pH values.

Suggest why this special coating is used.

[2 marks]

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11

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0 2 Severe diarrhoea causes dehydration that can result in death. The dehydration is caused when ions and glucose, as well as a large volume of water, travel out of the body.

0 2 . 1 Oral rehydration solution (ORS) is used to treat dehydration. ORS contains ions and glucose. Glucose is co-transported back into the blood with an ion.

Which ion is needed for the co-transport of glucose?

Tick (✓) **one** box.

[1 mark]

Chloride ☐

Citrate ☐

Potassium ☐

Sodium ☐

Question 2 continues on the next page

Do not write outside the box

Children deficient in zinc ions have the most severe diarrhoea and dehydration. Doctors investigate the effect of adding a supplement of zinc ions to standard ORS on:

- the duration of the diarrhoea
- the mass of the diarrhoea.

The doctors have 288 patients in the investigation.

All the patients:

- are male
- are aged 3–36 months
- have severe diarrhoea
- are given standard ORS
- are given a syrup containing vitamins.

Half of the patients receive a 20 mg dose of zinc sulfate in the syrup and the other half receive syrup with no zinc sulfate.

The doctors and the patients do not know who receives the zinc sulfate and who does not.

0 2 . 2 Give **one** advantage and **one** disadvantage of the design of the investigation.

[2 marks]

Advantage _____

_____

Disadvantage _____

_____

Do not write outside the box

The doctors measure the duration of diarrhoea and the total mass of diarrhoea produced. These data are shown in **Figure 2** and **Figure 3**.

Figure 2

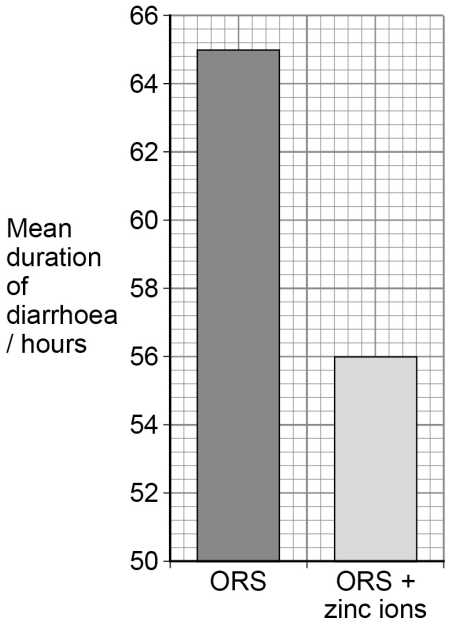
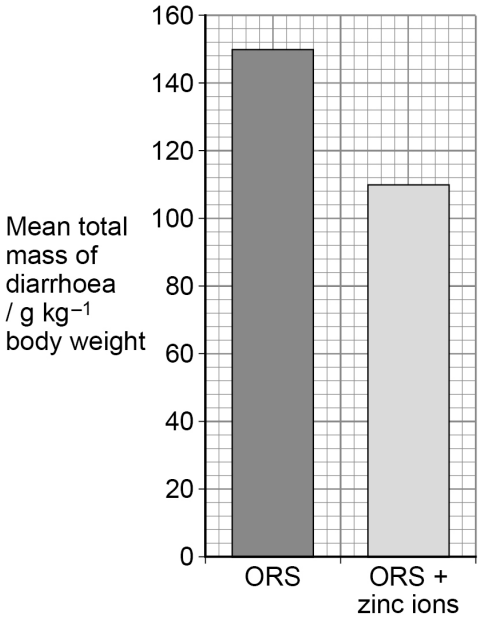


Figure 3



0 2 . 3 Describe the effect of the zinc ion supplement on diarrhoea.

Use data from **Figure 2** and **Figure 3**.

[2 marks]

_____

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Question 2 continues on the next page

Do not write outside the box

Cholera is a bacterial disease that results in severe diarrhoea leading to dehydration. The diarrhoea is caused by a toxin secreted by the bacteria.

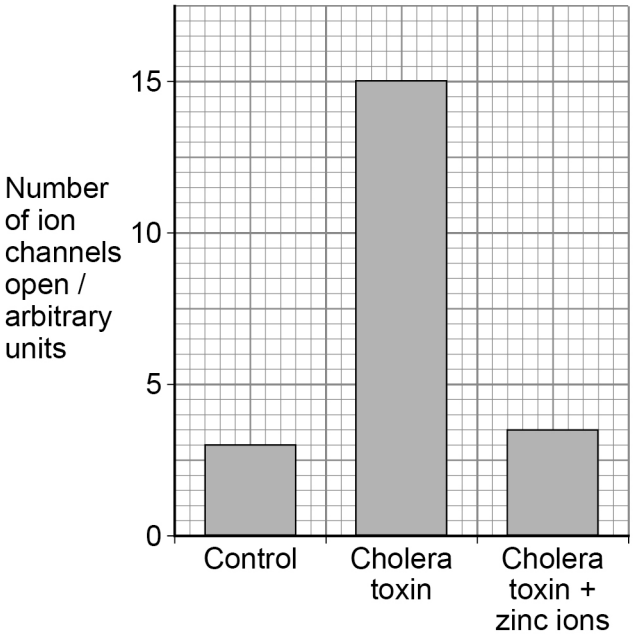
The doctors want to know if the zinc ion supplement could be useful in treating cholera.

They grow large numbers of human gut epithelial cells in culture.

The doctors:

- leave a third of the cells untreated (control)
- treat a third of the cells with cholera toxin
- treat a third of the cells with cholera toxin and zinc ions
- measure the number of ion channels open in the cell surface membranes in each of these groups of cells.

Figure 4



0 2 . 4 Calculate the percentage change in the number of ion channels open caused by the addition of zinc ions to cells treated with cholera toxin.

Use **Figure 4**.

[2 marks]

Answer = _____ %

Do not write outside the box

0 2 . 5 Zinc ions reduce the number of open ion channels in epithelial cell surface membranes.

Explain how the zinc ion supplement reduces the dehydration caused by cholera.

[4 marks]

11

Turn over for the next question

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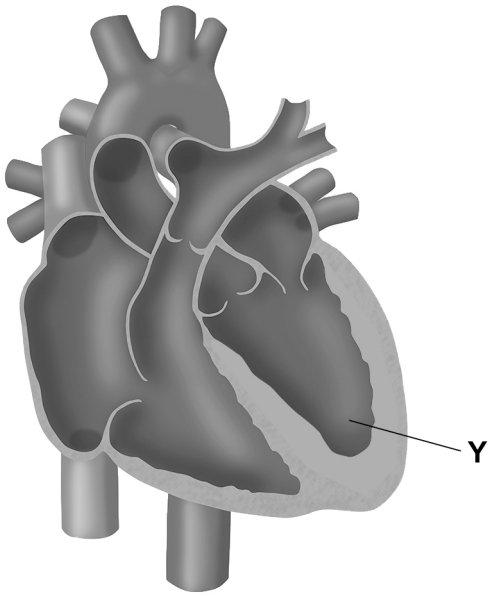
0 3 The human heart has four chambers, as shown in **Figure 5**.

Figure 5



0 3 . 1 Name chamber **Y** in **Figure 5**.

[1 mark]

_____

0 3 . 2 Atrial fibrillation is a heart condition that causes a very fast, irregular heart rate. This means that the atria do not relax fully between contractions. People with atrial fibrillation can feel dizzy and may faint.

Suggest why a person with atrial fibrillation may feel dizzy or may faint.

[3 marks]

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0 3 . 3 Pulse rate is a measure of heart rate.

A doctor can check for suspected atrial fibrillation by measuring a patient's pulse rate.

Describe how to measure pulse rate.

[2 marks]

Question 3 continues on the next page

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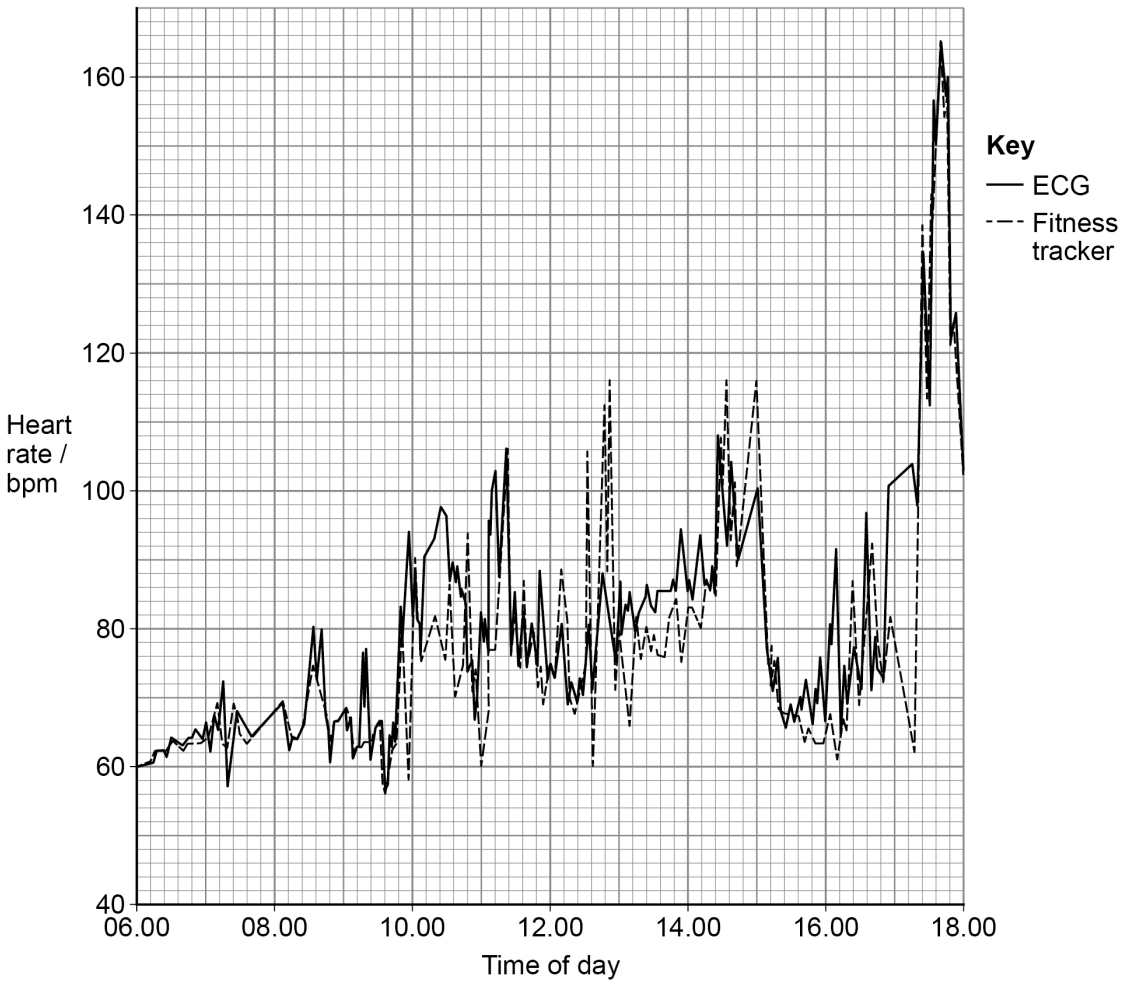
Atrial fibrillation can be difficult to detect using only pulse rate because it occurs very briefly and at random intervals.

Atrial fibrillation can be detected by wearing an electrocardiogram (ECG) machine for 24 hours. A scientist investigates if a fitness tracker could be used instead of an ECG machine.

A 24-year-old woman wears a fitness tracker and a standard ECG machine. She can move around as normal. The fitness tracker records her heart rate every 10 minutes, whereas the ECG records constantly.

The woman's heart rate record for the 12 hours between 6 am (06.00) and 6 pm (18.00) is shown in **Figure 6**.

Figure 6



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0 3 . 4 The woman has an exercise class between 14.00 and 15.00

Explain why the heart rate increases during exercise.

[3 marks]

During the investigation, the woman's stroke volume varies. The stroke volume increases by a maximum of 20% compared to when she is at rest at 6 am.

At 6 am, the woman's:

- heart rate is 60 bpm
- cardiac output is 5.25 $dm^3\ min^{-1}$

0 3 . 5 Calculate the woman's **maximum** cardiac output in the 12 hours shown.

Use data from **Figure 6**.

[3 marks]

Woman's maximum cardiac output _____ $dm^3\ min^{-1}$

Question 3 continues on the next page

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0 3 . 6 The manufacturer of the fitness tracker wants to release this press statement:

'Our fitness tracker is as accurate as an ECG in detecting atrial fibrillation.'

However, the scientist thinks there are some limitations in the method of the investigation so that the data do not support this statement.

State **two** limitations in the method.

[2 marks]

1 _____

_____

_____

2 _____

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14

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 4 The rate of water uptake by a leafy shoot can be measured and used for estimating transpiration rate.

0 4 . 1 Define **transpiration**.

[1 mark]

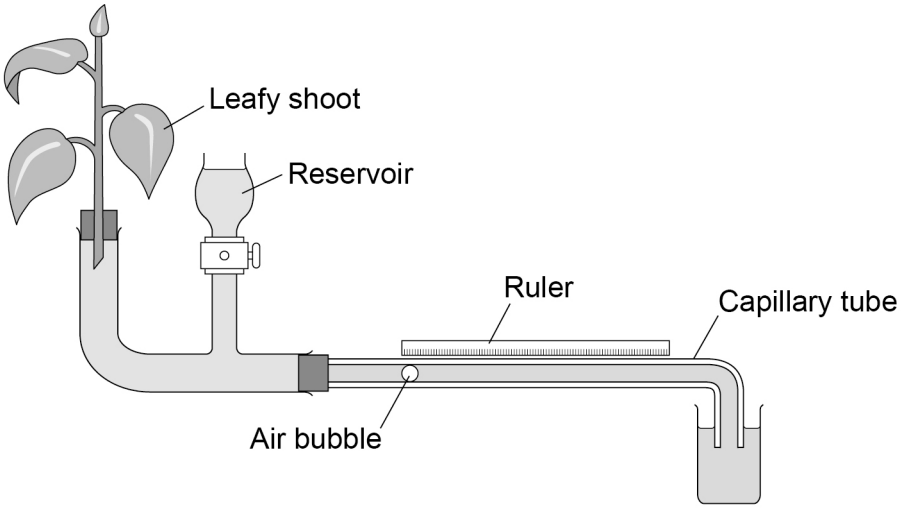
0 4 . 2 The rate of water uptake in a plant is only an estimate of transpiration rate.

Give the reason why.

[1 mark]

Figure 7 shows a potometer.

Figure 7



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0 4 . 3 A student uses the potometer to investigate how changing environmental conditions affect the rate of water uptake by the leafy shoot.

The student takes some precautions when setting up the potometer to make sure that the measurements are as accurate as possible.

Complete **Table 1** to show why each precaution is taken.

[2 marks]

Table 1

Precaution	**Why this precaution is taken**
Cover any joints in the equipment with petroleum jelly or wax	
Cut the leafy shoot off the plant underwater	

0 4 . 4 The internal diameter of the capillary tube of the potometer is 1 mm

Describe how the potometer in **Figure 7** could be used to measure the rate of water uptake in cm^3 per minute.

[4 marks]

Do not write outside the box

The student uses the potometer to investigate how an increase in humidity affects the rate of water uptake by the leafy shoot.

0 4 . 5 Explain how an increase in humidity would change the rate of water uptake.

[3 marks]

0 4 . 6 State **two** environmental factors that the student needs to control when investigating the effect of increased humidity.

[2 marks]

1

2

13

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0 5 . 1 Describe how the immune system distinguishes between the body's own cells (self) and foreign cells (non-self).

[3 marks]

Question 5 continues on the next page

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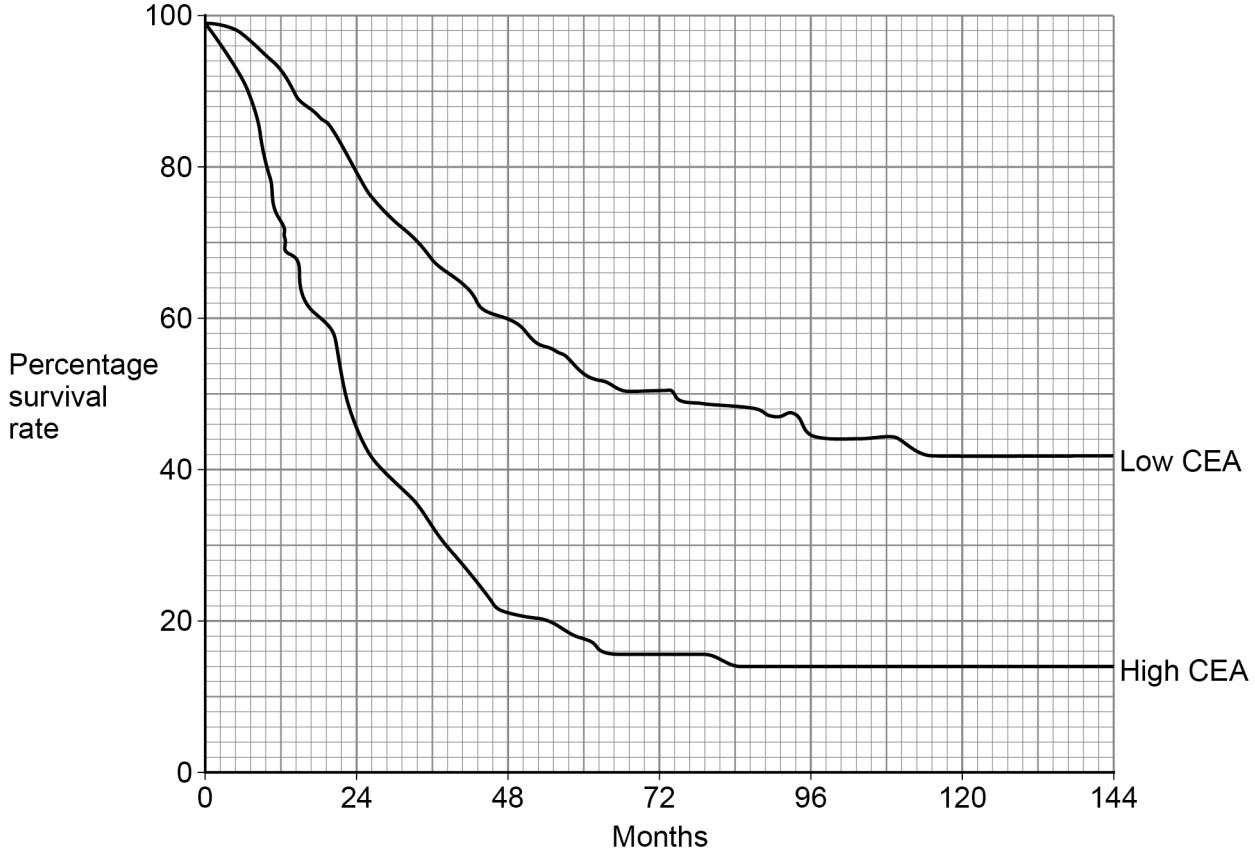
Cancerous tumours release chemicals, called marker molecules, into the blood. Marker molecules can be used for predicting how long a patient is likely to survive.

A marker molecule called CEA is used for patients with bowel cancer.

Doctors measure the levels of CEA in the blood and put patients into two groups, one group with high CEA and another with low CEA.

Figure 8 shows the percentage survival rate of patients with bowel cancer and either high or low CEA.

Figure 8



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0 5 . 2 Compare the survival rate at 6 years for patients with low levels of CEA with the survival rate at 6 years for patients with high levels of CEA.

Use data from **Figure 8**.

[2 marks]

0 5 . 3 Two patients have low CEA levels. After 2 years, only one patient has survived.

Suggest why.

[1 mark]

6

Turn over for the next question

Do not write outside the box

0 6 . 1 Insect vectors often spread plant viruses.

State why a vector is needed to transmit viruses from one plant to another plant.

[1 mark]

_____

_____

0 6 . 2 Thrips and aphids are insects that may spread viruses as they feed from plants. Thrips and aphids get food from plants in different ways.

Table 2 compares how the two types of insect feed.
Complete **Table 2**.

[2 marks]

Table 2

Insects	Part of the plant the insect eats	How the food is taken in
Thrips	Contents of leaf cells	Sucked in
Aphids		

Thrips could be vectors for tomato spotted wilt virus (TSWV).

The thrips show 2 types of feeding behaviour:

- probing – the thrips release saliva only
- ingestion – the thrips release saliva and suck in the cell contents.

Probing and ingestion damage the leaf. However, probing is more likely to spread TSWV from cell to cell.

Normal thrips do **not** carry TSWV.

Scientists investigate if carrying TSWV changes the thrips' feeding behaviour.

The scientists:

1. put 20 normal male thrips on tomato plants
2. watch the thrips' feeding behaviour for 1 hour
3. record the number of times the thrips show probing or ingestion
4. repeat steps 1–3 with 20 male thrips that are carriers of TSWV
5. repeat steps 1–3 with 20 normal female thrips
6. repeat steps 1–3 with 20 female thrips that are carriers of TSWV.

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Question 6 continues on the next page

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Table 3 shows the number of times each type of feeding behaviour is recorded over 1 hour.

Table 3

	Number of times each type of feeding behaviour is recorded over 1 hour			
Type of feeding	Normal males	Carrier males	Normal females	Carrier females
Probing	50	130	150	140
Ingestion	40	50	75	80

0 6 . 3 Draw a suitable graph to show the number of times each type of thrips was recorded **probing** the leaf.

[3 marks]

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0 6 . 4 The scientists suggest that becoming a carrier of TSWV makes thrips more likely to spread TSWV.

Give **one** way the data support this suggestion and **one** way the data do not support this suggestion.

Use information from **Table 3** and your graph.

[2 marks]

Support: _____

_____

_____

Do not support: _____

_____

_____

0 6 . 5 Symptoms of TSWV include small brown patches on the leaves and a reduced number of tomatoes produced.

Explain why fewer tomatoes are produced.

[2 marks]

_____

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10

Turn over for the next question

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0 7 . 1 Human skin cells are eukaryotic cells that have a cell cycle.

Mitosis is one stage of the cell cycle but other stages also occur.

Various processes take place during each stage of the cell cycle.

Describe how each of these processes helps in the production of new cells.

[6 marks]

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0 7 . 2 The cell cycle is usually regulated, but exposure to UV light can result in skin cancer. This is because UV light increases the likelihood of mutation.

Explain how exposure to UV light could result in skin cancer.

[4 marks]

10

END OF QUESTIONS

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