OXFORD AQA
INTERNATIONAL QUALIFICATIONS

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INTERNATIONAL AS
BIOLOGY (9610)

Unit 2 Biological Systems and Disease

Monday 19 May 2025 07:00 GMT Time allowed: 1 hours 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 Plants absorb water from the soil using root hair cells.

0 1 . 1 Explain how **two** features of a root hair cell make it adapted to absorb water.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 1 . 2 Water moves through the roots using both the symplastic and apoplastic pathways until it reaches the endodermis.

Explain how water is prevented from using the apoplastic pathway to cross the endodermis.

[2 marks]

_____

_____

_____

_____

_____

_____

0 1 . 3 Water is lost from a plant by transpiration.

Name the type of cell that can reduce the volume of water lost by transpiration.

[1 mark]

_____

Do not write outside the box

0 1 . 4 Low light intensity reduces the rate of transpiration.

Give **one other** environmental factor that reduces the rate of transpiration.

[1 mark]

_____

Three students investigate the effect of light intensity on the rate of transpiration.

Each student uses a potometer to estimate the rate of transpiration from a plant shoot at a different light intensity.

The students:

- use identical potometers
- build their potometers under water and seal all joints
- cut shoots at an angle from a plant under water
- put a shoot into each of the potometers under water.

0 1 . 5 The students set up their potometers correctly to remove some of the possible sources of error.

However, the shoots could still be sources of error in the investigation.

Identify **two** of these sources of error **and** describe how to reduce each error.

[2 marks]

Error 1 _____

How to reduce error 1 _____

_____

Error 2 _____

How to reduce error 2 _____

_____

Question 1 continues on the next page

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0 1 . 6 Each student collects data from one potometer for one light intensity.

Describe how the students can collect and process data to make a valid comparison of the effect of light intensity on the **rate** of transpiration.

Do **not** refer to control variables in your answer.

[3 marks]

11

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 2 The BRAF gene codes for a protein that controls cell growth.

A mutation in the BRAF gene is common in the cancer cells of men with prostate cancer. The prostate gland is part of the reproductive system in men.

Scientists:

- use cells from the prostate glands of two men, one without prostate cancer and one with prostate cancer
- compare the base sequence of the same section of the BRAF gene in the cells of both men.

Table 1 shows the base sequences.

Table 1

	Triplet number									
	1	2	3	4	5	6	7	8	9	10
Man without prostate cancer	TTT	GGT	CTA	GCT	ACA	GTG	AAA	TCT	CGA	TGG
Man with prostate cancer	TTT	GGT	CTA	GCT	ACA	GAG	AAA	TCT	CGA	TGG

Do not write outside the box

Table 2 shows DNA triplets and the amino acids they code for.

Table 2

First base	Second base				Third base
	T	C	A	G	
T	Phe	Ser	Tyr	Cys	T
					C
	Leu		Stop	Stop	A
				Trp	G
C	Leu	Pro	His	Arg	T
					C
			Gln		A
					G
A	Ile	Thr	Asn	Ser	T
					C
			Lys	Arg	A
	Met				G
G	Val	Ala	Asp	Gly	T
					C
			Glu		A
					G

0 2 . 1 Complete the amino acid sequence coded for by the section of the BRAF gene from a man **without** prostate cancer. The first four amino acids are given.

Use **Table 1** and **Table 2**.

[1 mark]

Phe – Gly – Leu – Ala _____

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Name the type of mutation seen in the man with prostate cancer **and** identify the effect it would have on the amino acid sequence.

Use **Table 1** and **Table 2**.

[2 marks]

Type of mutation _____

Effect on amino acid sequence _____

_____

Scientists use animals as genetic models to study human diseases. The scientists consider if dogs are a suitable genetic model for human prostate cancer.

The scientists:

- use cells from the prostate glands of two dogs, one without prostate cancer and one with prostate cancer
- compare the base sequence of the same section of the BRAF gene in the cells of both dogs
- compare the base sequence of the dogs to the same section of the BRAF gene in men.

Table 3 shows the base sequence for the dogs.

Table 3

	Triplet number									
	1	2	3	4	5	6	7	8	9	10
Dog without prostate cancer	TTT	GGT	CTA	GCC	ACA	GTG	AAA	TCT	CGA	TGG
Dog with prostate cancer	TTT	GGT	CTA	GCC	ACA	GAG	AAA	TCT	CGA	TGG

Do not write outside the box

0 2 . 3 The scientists conclude that the dog is a suitable genetic model for human prostate cancer.

Explain why.

Use **Table 1** and **Table 3**.

[2 marks]

Prostate cancer causes tumours to develop in the prostate gland.

Another condition called prostatic hyperplasia also causes tumours to develop in the prostate gland.

The tumours in prostate cancer are **malignant** but the tumours in prostatic hyperplasia are **benign**.

0 2 . 4 Give **three** ways **malignant** tumours are different from **benign** tumours.

[3 marks]

1

2

3

8

Turn over for the next question

Do not write outside the box

0 3 A student plans to observe mitosis in plant root cells using a light microscope.

The student compares information about three plant species before deciding to use one species as the source of root cells.

Table 4 shows information about the three plant species the student could use.

Table 4

Plant species	**Number of chromosomes per cell**	**Time for roots to grow / days**
Allium cepa	16	5
Hyacinthus orientalis	16	14
Tulipa gesneriana	24	21

0 3 . 1 The student decides to use root cells from *Allium cepa*.

Explain why.

Use information from **Table 4**.

[2 marks]

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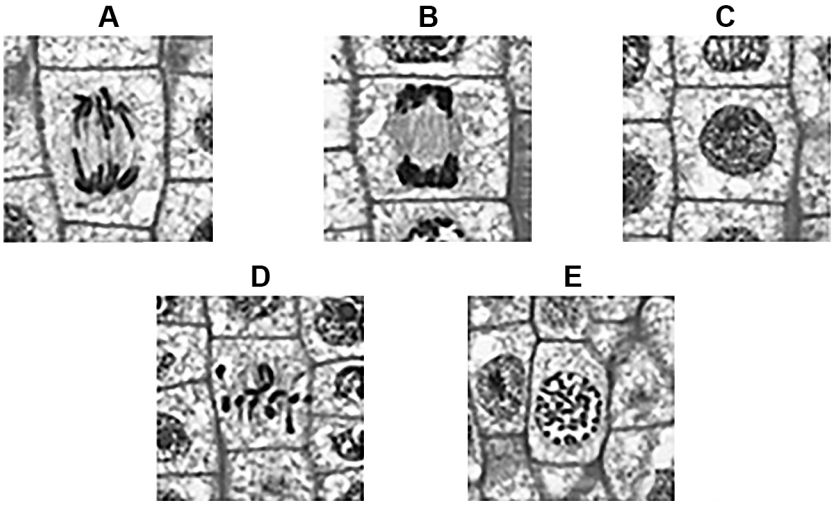
Figure 1 shows cells in different stages of mitosis.

Figure 1



0 3 . 2 Give the letter from **Figure 1** that represents:

[2 marks]

Anaphase ☐

Metaphase ☐

Prophase ☐

Telophase ☐

Question 3 continues on the next page

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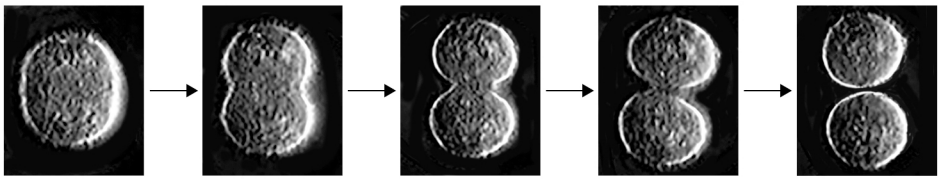
When nuclear division is complete, a process called cytokinesis occurs.

Figure 2 shows cytokinesis in an animal cell.

The sequence of images shows how the cell changes over time.

Figure 2



0 3 . 3 Describe how cytokinesis completes cell division in the animal cell.

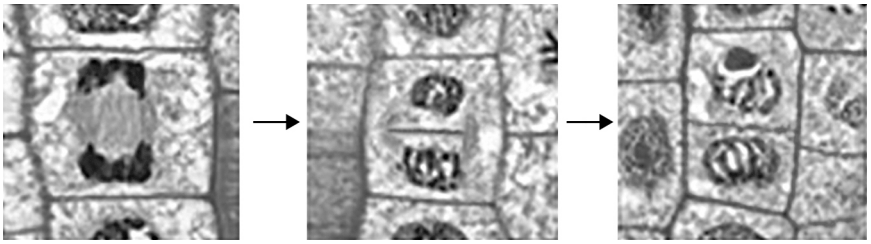
Use **Figure 2**.

[2 marks]

Do not write outside the box

Figure 3 shows cytokinesis in a plant cell.

Figure 3



0 3 . 4 Cytokinesis is different in plant and animal cells.

Give **one** difference in cytokinesis you can see in **Figure 3** compared with **Figure 2**.

[1 mark]

_____

_____

_____

0 3 . 5 Suggest **one** reason why cytokinesis in a plant cell is different from cytokinesis in an animal cell.

[1 mark]

_____

_____

_____

8

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0 4 In plants, the movement of sucrose in phloem sap is called translocation.

0 4 . 1 The mechanism of translocation can be explained by the mass flow hypothesis.

Describe what causes mass flow in the phloem.

[3 marks]

Aphids are insects that feed on plants by inserting their stylets into the phloem. The phloem sap flows through the stylet into the aphid's gut.

0 4 . 2 Aphid feeding can be described as a **passive** process.

Explain why.

[2 marks]

Question 4 continues on the next page

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Aphids live on plants where they feed and produce offspring. Sometimes these plants can be infected with the cucumber-mosaic virus (CMV).

Students investigate if CMV infection affects the number of offspring produced by the aphids living on a plant.

The students:

- use two plants of the same species, one infected with CMV and one **not** infected with CMV
- put 20 aphids onto each plant
- cover each plant with a glass container
- count the number of aphids on each plant every 3 days
- calculate the increase in the number of aphids for each 3-day period.

Table 5 shows the students' results.

Table 5

	Plant infected with CMV		Plant **not** infected with CMV	
Day	**Total number of aphids**	**Increase in the number of aphids**	**Total number of aphids**	**Increase in the number of aphids**
0	20	0	20	0
3	69	49	65	45
6	231	162	154	89
9	326	95	283	129
12	369	43	400	117
15	411	42	480	80

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0 4 . 3 Give **one** similarity and **one** difference between aphid reproduction on plants infected with CMV and plants **not** infected with CMV.

Use information from **Table 5**.

[2 marks]

Similarity _____

_____

_____

Difference _____

_____

_____

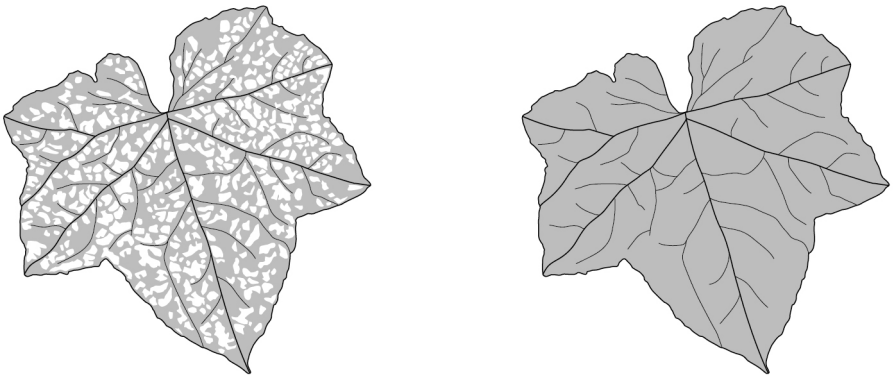
Question 4 continues on the next page

Do not write outside the box

One student suggests that the appearance of the leaves might affect the number of aphids on the plant.

Figure 4 shows a typical leaf from a plant infected with CMV and a typical leaf from a plant **not** infected with CMV.

Figure 4



Infected with CMV **Not infected with CMV**

0 4 . 4 Explain the trend seen in the data for the infected plants after **day 6**.

Use information from **Table 5** and **Figure 4**.

[3 marks]

Do not write outside the box

Some of the aphids grow wings. The students count the number of aphids with wings on each type of plant every 3 days.

Table 6 shows the students' data.

Table 6

	Number of aphids with wings on each day				
Plant	3	6	9	12	15
Infected with CMV			𝍸 𝍸 𝍸 𝍸 𝍸 II	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 III	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
Not infected with CMV				𝍸 IIII	𝍸 𝍸 𝍸 𝍸 𝍸 II

Key:
I = 1 aphid
II = 2 aphids
III = 3 aphids
IIII = 4 aphids
𝍸 = 5 aphids

0 4 . 5 On the last day of the investigation, the students compare the number of aphids with wings on the infected and **not** infected plants. The students do this using a ratio.

Calculate the ratio and give it to one decimal place.

Use data from **Table 6**.

[2 marks]

Ratio of aphids on infected plants to aphids on **not** infected plants = _____ :1

Question 4 continues on the next page

Do not write outside the box

0 4 . 6 In the natural environment, an aphid having wings could be an advantage to:

- the aphid
- the virus.

Suggest **one** reason for each.

[2 marks]

Advantage to aphid _____

_____

_____

Advantage to virus _____

_____

_____

14

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0 5 The kidney is an organ that removes waste products from the blood and produces urine.

A patient with kidney disease can receive a new kidney in a transplant operation. This operation involves removing the kidney from one person, known as the donor, and transferring the kidney to the patient.

However, the patient's body might reject the transplant. This is when the patient's immune system attacks the transplant causing damage to it.

0 5 . 1 Explain why the patient's immune system might reject the new kidney transplant.

[2 marks]

To prevent the patient rejecting the transplant, the patient takes drugs to reduce their immune response. These drugs are called **immunosuppressants** and must be taken for the rest of the patient's life.

0 5 . 2 Taking immunosuppressants is a risk factor for becoming very overweight.

What is meant by a 'risk factor'?

[1 mark]

Question 5 continues on the next page

Do not write outside the box

Scientists investigate body mass in a large number of patients who have had a kidney transplant.

Body mass index (BMI) is a way of assessing if a person is a healthy weight for their height.

The scientists:

- calculate the BMI for each patient
- use BMI to group the patients as underweight, healthy weight, overweight or very overweight
- calculate the size of the sectors needed to plot the data as a pie chart.

Table 7 shows the number of patients in each group and the size of the sector needed to represent each group on a pie chart.

Table 7

BMI group	**BMI**	**Number of patients**	**Size of sector on pie chart / degrees**
Underweight	<18.5	7	9.9
Healthy weight	18.5–24.9	154	
Overweight	25–29.9	69	
Very overweight	≥30	25	35.3

0 5 . 3 Calculate the size of the sectors to represent healthy weight and overweight.

Complete **Table 7**.

[1 mark]

Do not write outside the box

Many of the patients report weight gain following their kidney transplant. Patients who gain too much weight could develop coronary heart disease.

Consuming less fat could help patients avoid too much weight gain.

The scientists use the Spearman rank test to see if there is a relationship between the amount of fat in a patient's diet and the patient's BMI.

0 5 . 4 The Spearman rank test gave an r value of 0.45 with a P value of <0.025

What do each of these two values generated by this statistical test indicate?

[2 marks]

r value _____

_____

_____

P value _____

_____

_____

Question 5 continues on the next page

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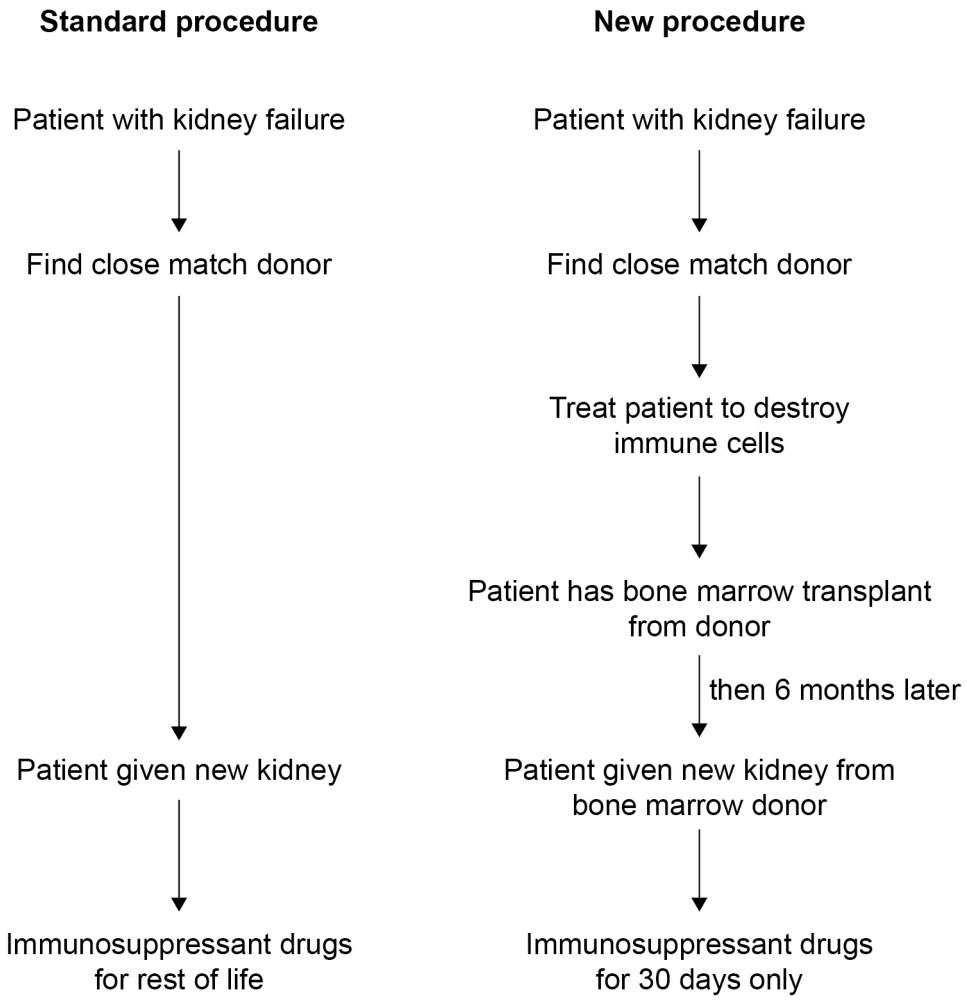
A girl receives a kidney from her mother using a new transplant procedure.

Figure 5 compares the standard kidney transplant procedure with the new procedure used for the girl.

Figure 5



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0 5 . 5 Evaluate the new kidney transplant procedure.

Use information from **Figure 5**.

[3 marks]

0 5 . 6 Several years before the kidney transplant, the girl had a measles vaccination. Measles is a viral disease that can cause death.

Her mother has **never** had measles and has **not** had the measles vaccination.

A doctor recommends that the girl has another measles vaccination after the kidney transplant.

Suggest why.

[3 marks]

12

Turn over for the next question

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0 6 Heart rate decreases when a person is asleep.

0 6 . 1 Suggest why heart rate decreases when a person is asleep.

[3 marks]

Sometimes people concentrate on the same task for so long that they feel tired or even fall asleep.

Driving a car is a task that requires concentration.

Scientists investigate if a person's heart rate changes while driving.

The scientists use a driving simulator in their investigation. A driving simulator is a virtual environment to represent driving on the road.

The scientists:

- select six drivers who are healthy males between the ages of 30 and 45
- ask the drivers **not** to consume any coffee for 3 days before the test
- tell the drivers to drive for 5 hours in the simulator without stopping.

0 6 . 2 Suggest why the drivers are asked **not** to consume any coffee.

[1 mark]

Do not write outside the box

0 6 . 3 A scientist observes each driver to assess when the driver becomes tired.

Suggest why this may **not** be an accurate method to assess becoming tired.

[1 mark]

Question 6 continues on the next page

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The scientists need to know the drivers' normal heart rates before the investigation starts. They measure the drivers' heart rates during:

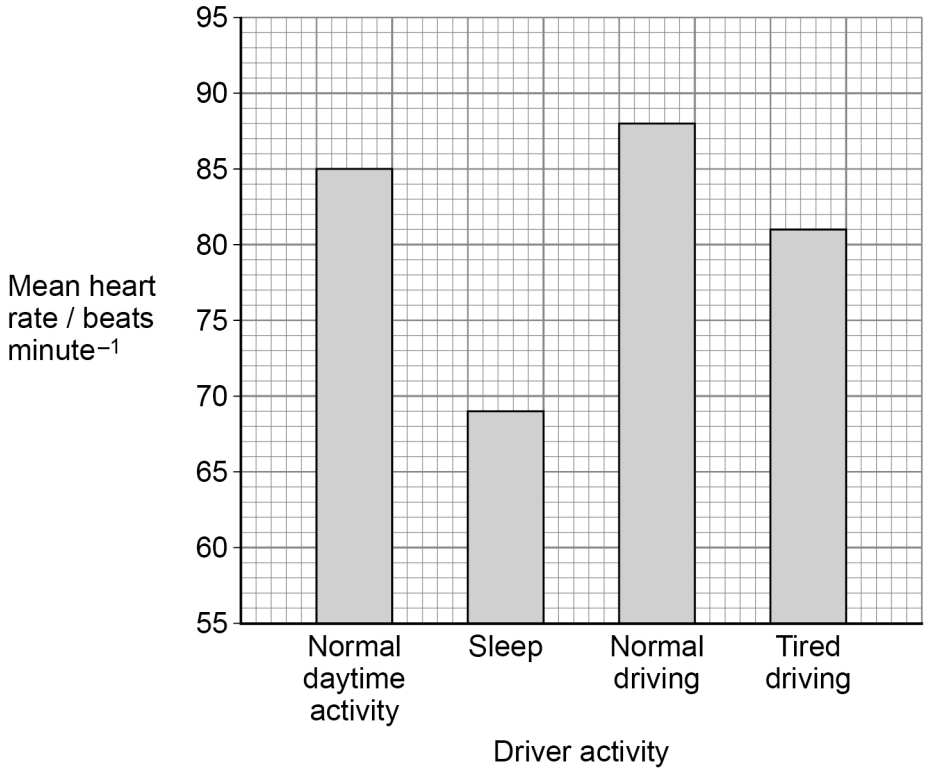
- normal daytime activity
- sleep.

Then the scientists measure the drivers' heart rates during the 5-hour drive in the simulator. Based on the scientists' observations, the drivers are graded as:

- normal driving
- tired driving.

Figure 6 shows the scientists' results.

Figure 6



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0 6 . 4 Describe the effect of normal driving and of tired driving on heart rate compared to normal daytime activity.

Use information from **Figure 6**.

[1 mark]

_____

_____

_____

0 6 . 5 Calculate the percentage change in heart rate from normal driving to tired driving.

Use data from **Figure 6** and give your answer to the nearest whole number.

[2 marks]

Percentage change = _____%

0 6 . 6 One of the drivers suggests that all cars should be fitted with an alarm that sounds when the driver's heart rate falls below 82 beats minute^{-1}

Evaluate this suggestion.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

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0 6 . 7 An investigation with drivers on real roads would produce a more valid result.

The scientists think that the investigation is **not** ethical.

Suggest why.

[1 mark]

_____

_____

_____

_____

12

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0 7 Some human diseases are caused by pathogens, including viruses or bacteria.

0 7 . 1 HIV is a virus that causes disease in humans.

Describe the replication cycle of HIV in the human body.

[5 marks]

Question 7 continues on the next page

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0 7 . 2 Cholera is a human disease caused by a bacterium. Patients with cholera are treated to reduce the symptoms of the disease.

Describe how the cholera bacterium causes the symptoms **and** how the treatment reduces the symptoms of cholera.

[5 marks]

10

END OF QUESTIONS

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