OXFORD
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AQA EXAMINATIONS

Please write clearly in block capitals.

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I declare this is my own work.

INTERNATIONAL AS

BIOLOGY (9610)

Unit 1 The Diversity of Living Organisms

Monday 8 May 2023 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	

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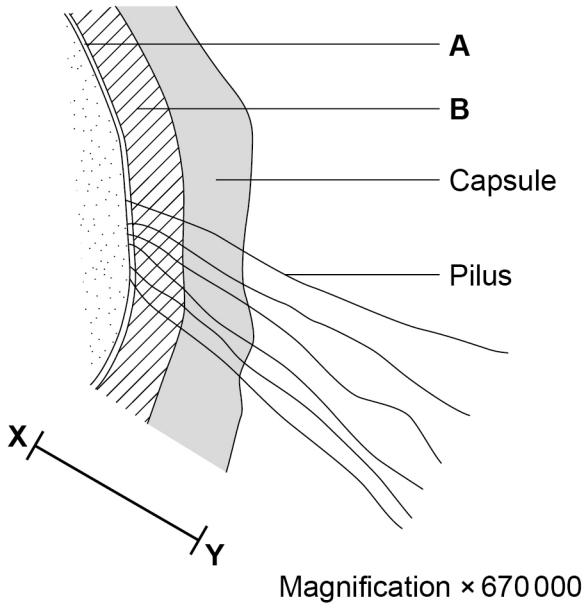
Answer **all** questions in the spaces provided.

0 1 . 1 **Figure 1** shows part of a bacterium.

Figure 1



Structures **A** and **B** contain different molecules.

Name the main molecule found in:

[2 marks]

Structure **A** _____

Structure **B** _____

0 1 . 2 State **one** function of the capsule and **one** function of the pilus.

[2 marks]

Capsule _____

_____

Pilus _____

_____

Do not write outside the box

0 1 . 3 Calculate the actual length of **X–Y** in **Figure 1**.

Give your answer in nm, to the nearest whole number.

[2 marks]

Actual length of **X–Y** = _____ nm

A scientist estimates the number of bacterial cells in 10 cm^3 of a suspension of bacteria.

The scientist:

1. transfers 0.1 cm^3 of the suspension into a beaker
2. adds 99.9 cm^3 of a dilute salt solution to the beaker
3. transfers 0.1 cm^3 of the diluted suspension to a microscope slide
4. adds a stain to the diluted suspension on the microscope slide
5. counts the number of bacterial cells on the microscope slide.

0 1 . 4 The scientist counts 36 cells on the slide.

Calculate the number of bacterial cells in 10 cm^3 of the original suspension.

Give your answer in standard form.

[2 marks]

Answer = _____

0 1 . 5 Suggest **one** reason why the calculated number of cells in the suspension may **not** be accurate.

[1 mark]

_____

_____

_____

Question 1 continues on the next page

Do not write outside the box

0 1 . 6 Eukaryotic cells and prokaryotic cells have differences in their cell walls.

Give **three** other differences between eukaryotic cells and prokaryotic cells.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

11

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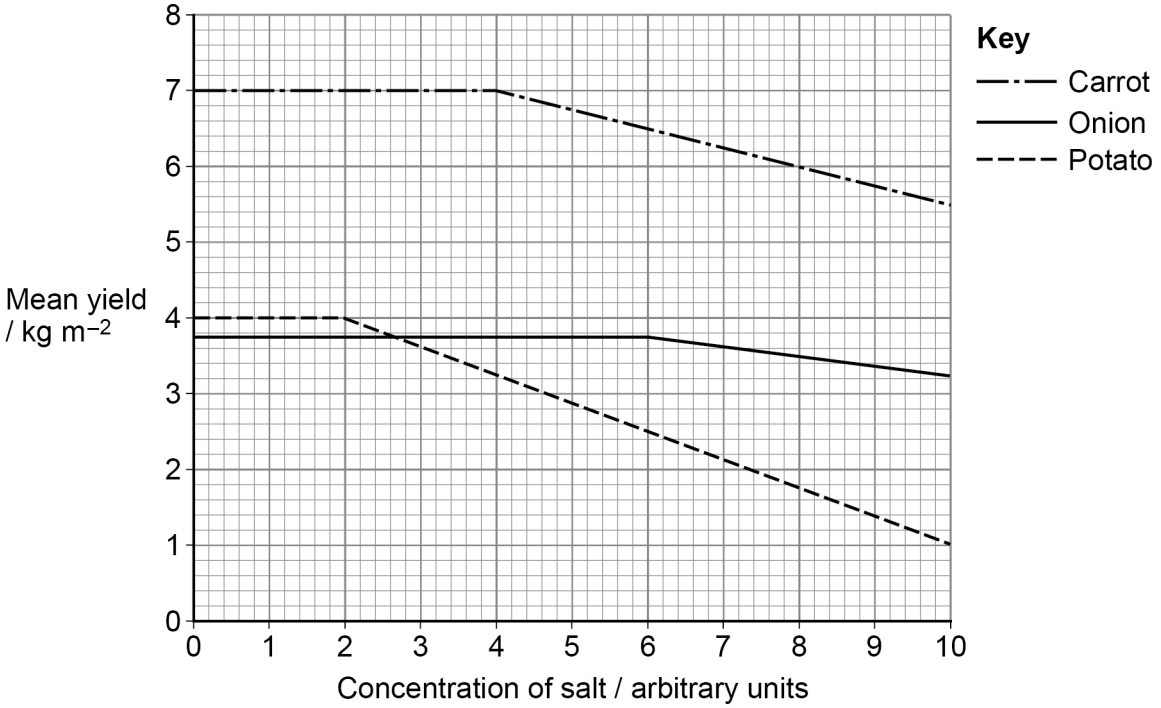
0 2 Seed producers are developing varieties of seeds that can grow in salt water.

Figure 2 shows the mean yield of three different plant species grown in different concentrations of salt.

Figure 2



0 2 . 1 The tolerance point of a plant is the highest concentration of salt that does **not** cause a decrease in mean yield.

Give **two** conclusions you can make from the information in **Figure 2**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 2 continues on the next page

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0 2 . 2 Each plant species has several varieties.

For each species, the seed producers use plants of only **one** variety in the investigation.

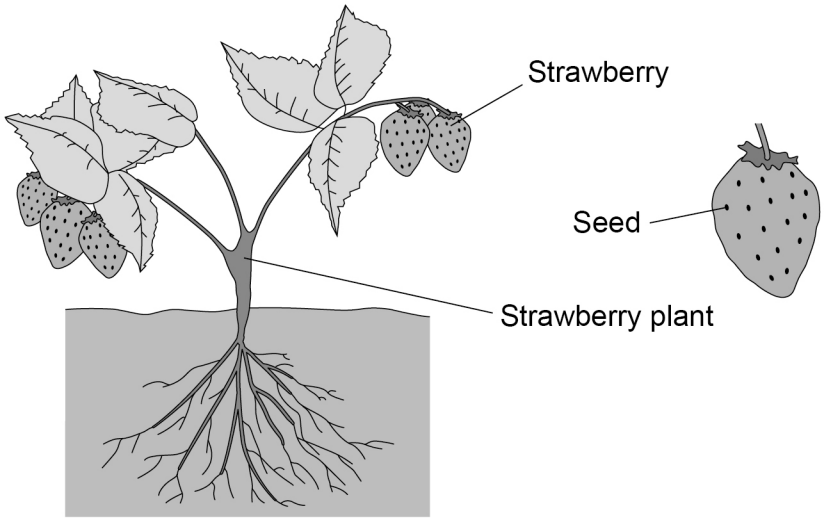
Suggest why.

[1 mark]

Some students investigate the effect of the concentration of salt on the growth of strawberries.

Figure 3 shows a strawberry plant.

Figure 3



The students:

- plant 50 strawberry seeds into individual containers
- choose 20 plants 21 days after planting the seeds
- grow 10 plants in soil with distilled water for 70 days
- grow the other 10 plants in soil with 0.4% salt solution for 70 days
- measure the mass of the strawberries from each plant and calculate the mean mass
- dry the strawberries in an oven
- measure the mass of the strawberries again and calculate the mean dry mass.

Do not write outside the box

0 2 . 3 The students grow the strawberry plants at a constant temperature of 20°C

State **two** other factors that should be controlled.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 4 Suggest **two** reasons why 50 strawberry seeds are planted but the students choose only 20 plants for the investigation.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 2 continues on the next page

Do not write outside the box

0 2 . 5 **Table 1** shows the results of the students' investigation.

Table 1

Solution added to the soil	Mean mass of strawberries per plant / g	Mean dry mass of strawberries per plant / g
Distilled water	214	19
0.4% salt solution	120	18

Describe the effect of 0.4% salt solution on the strawberries.

Use information from **Table 1**.

[2 marks]

Do not write outside the box

0 2 . 6 Name a statistical test the students could use to analyse the data in **Table 1**.

Give a reason for your answer.

[1 mark]

Statistical test _____

_____

Reason _____

_____

0 2 . 7 The students place a strawberry into a beaker containing concentrated salt solution and wait for 24 hours.

Explain what effect the concentrated salt solution has on the cells inside the strawberry.

Use your knowledge of water potential.

[3 marks]

_____

_____

_____

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_____

_____

13

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ANSWER IN THE SPACES PROVIDED

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0 3 A scientist researches the effect of a herbicide on the abundance of different species of plant. The scientist collects data from two fields. One field is treated with herbicide and the other is not treated with herbicide.

0 3 . 1 Describe a method to sample the fields randomly.

[3 marks]

0 3 . 2 The scientist collects a large number of random samples from each field.

Explain why the scientist collects:

[2 marks]

a large number of samples

random samples

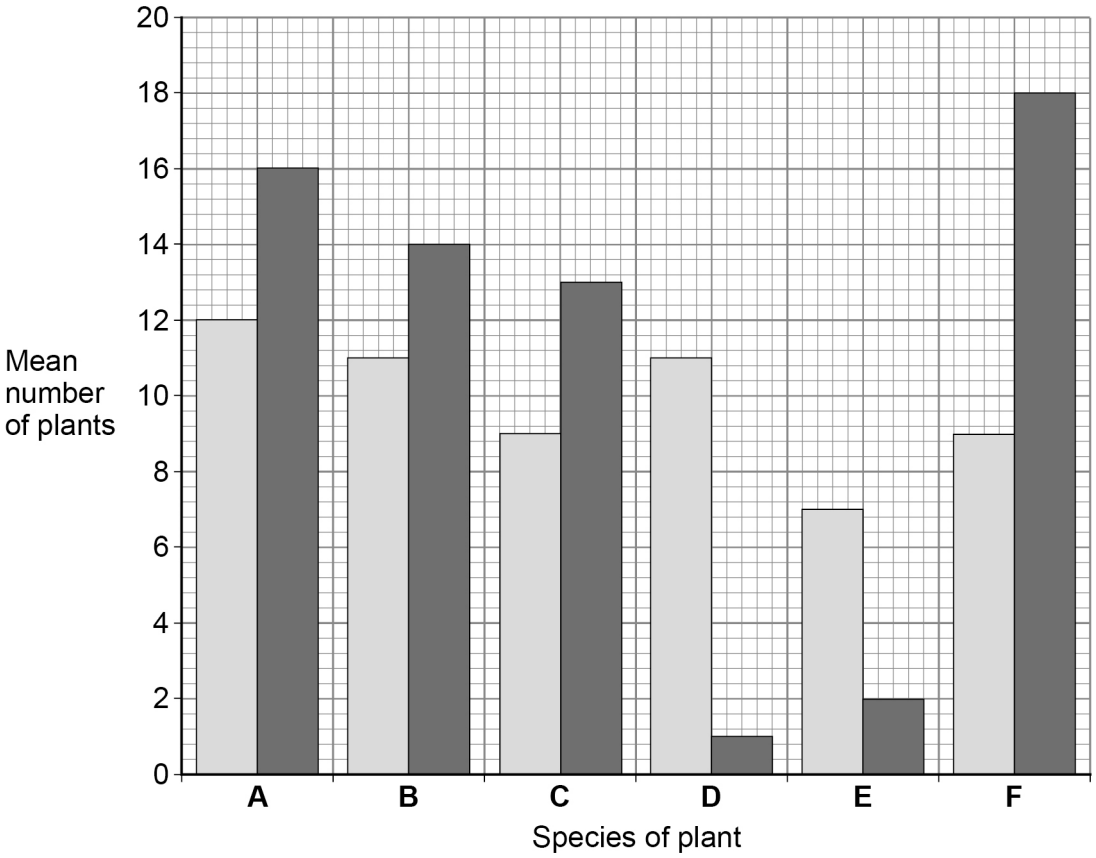
Question 3 continues on the next page

Do not write outside the box

The scientist finds the abundance of each species of plant by calculating the **mean** number of plants of each species from each of the samples.

Figure 4 shows the abundance of six species of plant (**A**–**F**) in the two fields.

Figure 4



Key

Untreated field

Field treated with herbicide

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0 3 . 3 Calculate the index of diversity for the **untreated** field using the equation below:

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

N = the total number of plants of all species
n = the total number of plants of each species

Give your answer to 2 significant figures.

[3 marks]

Index of diversity = _____

0 3 . 4 The scientist investigates the effect of the herbicide by comparing the treated and untreated fields.

The scientist uses the index of diversity rather than using species richness.

Explain why.

[2 marks]

_____

_____

_____

_____

_____

_____

Question 3 continues on the next page

Do not write outside the box

0 3 . 5 Scientists can classify a plant by collecting and analysing its DNA.

Name **two** other molecules that can be used to classify a species.

[2 marks]

1 _____

2 _____

0 3 . 6 A second scientist samples the fields and finds that the untreated field has a higher biodiversity of animals.

Suggest why.

[2 marks]

_____

_____

_____

_____

_____

_____

14

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Turn over for the next question

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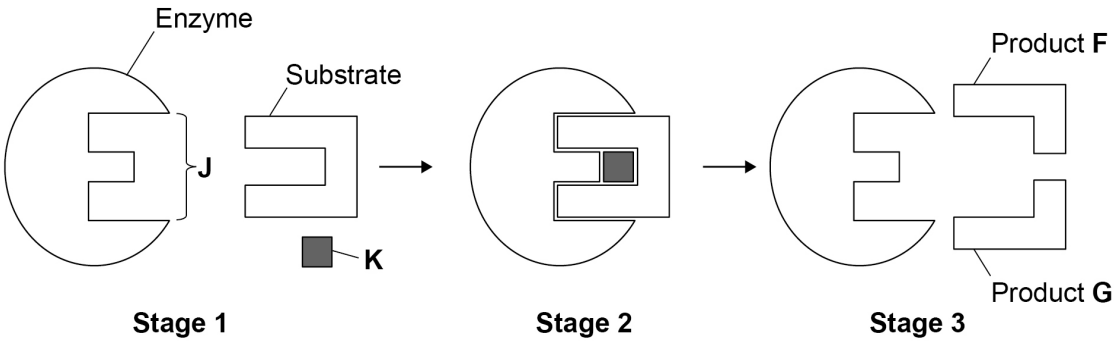
0 4 **Figure 5** shows a hydrolysis reaction catalysed by an enzyme.

Figure 5



Use **Figure 5** to answer Questions **04.1**, **04.2** and **04.3**.

0 4 . 1 Name region **J**.

[1 mark]

_____

0 4 . 2 Name reactant **K**.

[1 mark]

_____

0 4 . 3 Name the structure shown in stage **2**.

[1 mark]

_____

0 4 . 4 Explain the importance of the tertiary structure of an enzyme.

[2 marks]

_____

_____

_____

_____

_____

_____

Do not write outside the box

0 4 . 5 Protein kinase CK2 is an enzyme that can act on 100 different substrates.
This fact supports a model of enzyme action.

Name the model.

Give the reason for your answer.

[2 marks]

Model _____

Reason _____

_____

_____

7

Turn over for the next question

Do not write outside the box

0 5 Gametes are formed by meiosis.

0 5 . 1 Complete **Table 2**.

Tick (✓) **one** box that shows the total number of cell divisions and the type of cells produced by meiosis.

[1 mark]

Table 2

Type of cells produced	**Number of cell divisions**	
	1	**2**
Haploid		
Diploid		

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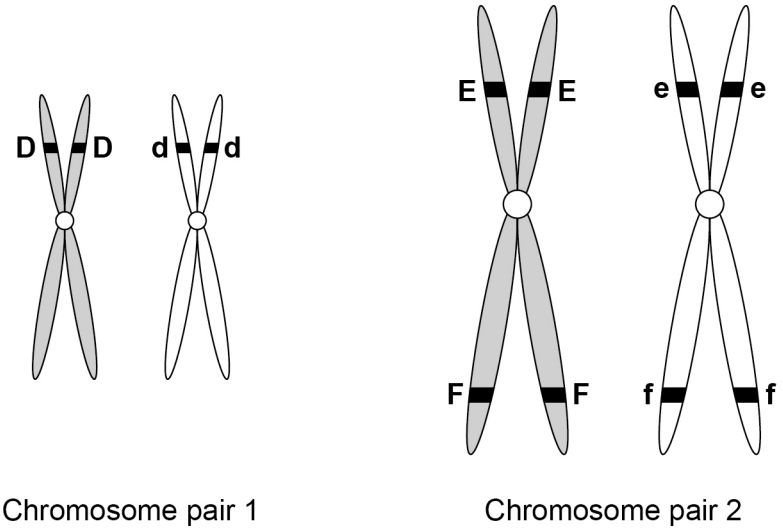
0 5 . 2 **Figure 6** shows the positions of the dominant and recessive alleles of three genes on two pairs of homologous chromosomes.

Figure 6



Crossing over and independent segregation of homologous chromosomes cause genetic variation in the gametes.

Describe how.

Use information from **Figure 6** to give examples.

[4 marks]

Crossing over _____

_____

_____

_____

_____

_____

Independent segregation _____

_____

_____

_____

_____

_____

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 Each gamete has only one allele of each gene.

Describe how this occurs.

[3 marks]

8

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0 6 . 1 Haemoglobin is a protein with quaternary structure.

Define **quaternary structure**.

[1 mark]

Question 6 continues on the next page

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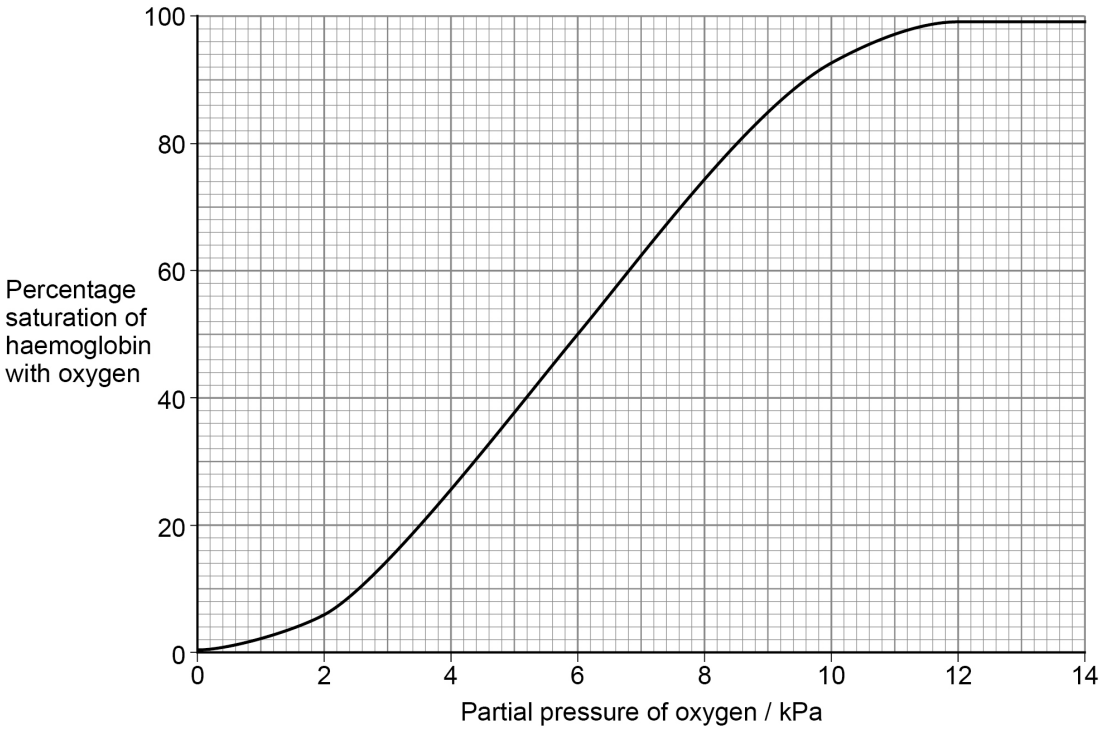
0 6 . 2 The function of haemoglobin is to transport oxygen. When fully saturated, each molecule of haemoglobin is attached to four molecules of oxygen.

Figure 7 shows the oxygen-haemoglobin dissociation curve for rat haemoglobin.

Figure 7



The first molecule of oxygen to attach causes a change in the shape of the haemoglobin molecule.

This change in shape of the haemoglobin molecule increases its affinity for oxygen and the next oxygen molecule attaches more readily.

Explain how **Figure 7** shows this.

[2 marks]

Do not write outside the box

0 6 . 3 State **one** advantage of the increase in the affinity of haemoglobin for oxygen.

[1 mark]

_____

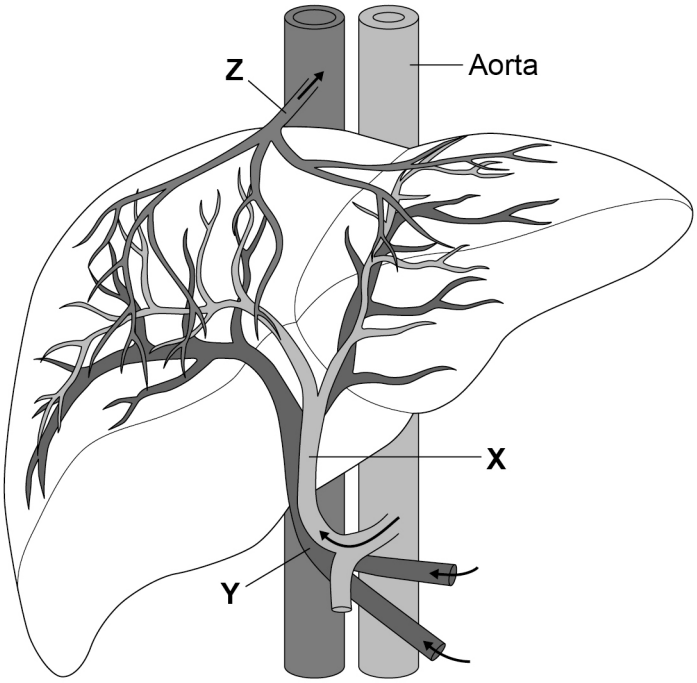
_____

_____

0 6 . 4 Scientists investigate the effect of tumours on the percentage saturation of haemoglobin in rats' livers.

Figure 8 shows some of the major blood vessels entering and leaving the liver. The arrows show the direction of blood flow.

Figure 8



Name blood vessels **X**, **Y** and **Z** in **Figure 8**.

[3 marks]

X _____

Y _____

Z _____

Question 6 continues on the next page

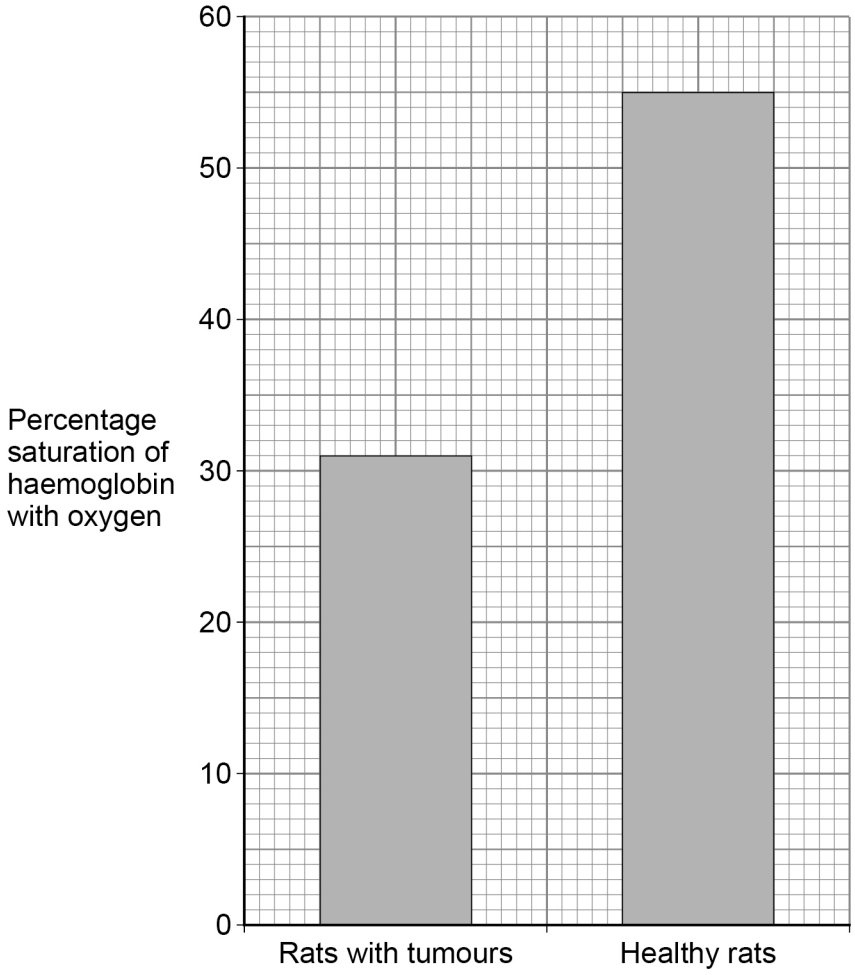
Do not write outside the box

0 6 . 5 Scientists investigate the percentage saturation of haemoglobin with oxygen in the blood in Vessel **Z**. They compare the percentage saturation in rats that have a tumour in the liver with the percentage saturation in healthy rats.

Tumours are made up of cancer cells with faster than normal rates of cell division.

Figure 9 shows their results.

Figure 9



The partial pressure of oxygen in the blood in Vessel **Z** is different between rats with tumours and healthy rats.

Calculate the difference.

Use data from **Figure 7** (on page 22) and **Figure 9**.

[2 marks]

Difference = _____ kPa

Do not write outside the box

0 6 . 6 The percentage saturation of haemoglobin with oxygen in the blood **entering** the liver is the same for rats with tumours and healthy rats.

The percentage saturation of haemoglobin with oxygen in Vessel **Z** is different in rats with tumours and healthy rats.

Suggest **one** reason for this difference.

[1 mark]

_____

_____

_____

0 6 . 7 Suggest **three** factors that the scientists should control in their investigation.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

13

Turn over for the next question

Do not write outside the box

0 7 Read the following passage:

The modern technique of genetic sequencing has allowed scientists to research the bacteria, archaea, fungi and viruses that live in our digestive systems.

A recent study found that 70% of the microbial populations (2000 species) had not been identified previously. As scientists identify more species, the importance of these organisms in mental health and disease prevention is becoming clear. 5

The majority of bacteria within the digestive system belong to four phyla. These are *Firmicutes, Bacteroidetes, Actinobacteria* and *Proteobacteria* and they contain within them the seven most common genera. Other species of bacteria, including *Escherichia coli*, *Campylobacter coli* and *Campylobacter jejuni,* belong to different genera. 10

The diversity of the organisms living in the human digestive system is affected by many environmental factors including diet. Diets with high proportions of meat and animal products promote the growth of bacteria linked to inflammation of the gut. Diets that include a high proportion of food from plant sources have been found to increase the variety of organisms in the digestive system. These diets result in a 15 greater number of bacteria of the genus *Prevotella.* These bacteria are responsible for improved digestion of fibre. Digestion of fibre by these bacteria forms short-chain fatty acids that are similar to some drugs prescribed to improve mental health. It is thought that improved mental health could be associated with these short-chain fatty acids. 20

Use information from the passage and your own knowledge to answer the questions.

0 7 . 1 "A recent study found that 70% of the microbial populations (2000 species) had not been identified previously" (lines 3–4).

If 70% of the microbial populations contained 2000 species, how many species might be expected to be found in 100% of the populations?

[1 mark]

Number of species = _____

0 7 . 2 Two bacteria from the digestive system have their genes sequenced. Their DNA is identical but the bacteria have different characteristics.

Suggest **one** reason.

[1 mark]

_____

_____

_____

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0 7 . 3 *Escherichia coli*, *Campylobacter coli* and *Campylobacter jejuni* are all mentioned in the article (line 9).

State which **two** of these bacteria are the most closely related.

Give the reason for your answer.

[2 marks]

Mostly closely related _____

and _____

Reason _____

_____

_____

0 7 . 4 *E. coli* and *C. jejuni* both share the same domain and phylum, but are in different classes.

Name another taxon that they share.

[1 mark]

_____

0 7 . 5 Many of the bacterial species in the digestive system have only recently been classified.

Suggest why it might be difficult to give a species name to a bacterium.

[1 mark]

_____

_____

_____

0 7 . 6 Give a potential health benefit of eating a plant-based diet.

Use the information from the passage.

[1 mark]

_____

_____

_____

Question 7 continues on the next page

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0 7 . 7 Scientists compare the effect of fibre intake on the diversity of organisms living in the human digestive system.

Other factors could affect this diversity.

Scientists would need to consider these other factors when analysing data from participants.

Suggest **two** other factors that could affect diversity.

[2 marks]

1 _____

_____

2 _____

_____

9

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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