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INTERNATIONAL AS
BIOLOGY (9610)

Unit 2 Biological systems and disease

Wednesday 16 January 2019 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	
8	
TOTAL	

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

0 1 Microorganisms include bacteria and viruses. Pathogens are microorganisms that cause disease.

0 1 . 1 Give **two** ways that pathogens cause disease.

[2 marks]

1 _____

_____

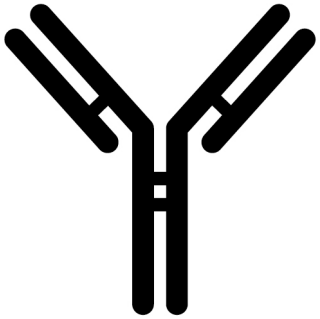
2 _____

_____

0 1 . 2 Antibodies are produced to resist infection by pathogens. The antibodies bind to antigens on the surface of the pathogen.

Figure 1 shows a diagram of an antibody.

Figure 1



Draw a circle on **Figure 1** to show a binding site on the antibody.

[1 mark]

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0 1 . 3 Typhoid is a disease caused by the bacterium *Salmonella typhi*.

A person is infected with *Salmonella typhi*. This person suffers the symptoms of typhoid and recovers.

If the person is infected with *Salmonella typhi* again they may not show the symptoms of typhoid.

Explain why.

[3 marks]

Question 1 continues on the next page

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0 1 . 4 Dysentery is a different disease caused by bacteria from the genus *Salmonella*.

Dysentery is caused by *Salmonella enteritidis*.

A person who has recovered from typhoid caused by *Salmonella typhi* can become ill with dysentery caused by *Salmonella enteritidis*.

Explain why.

[2 marks]

0 1 . 5 Recovery from an infection is one way a person can develop **active** immunity.

Tick (✓) **one** box to indicate another way to develop active immunity.

[1 mark]

Across the placenta (mother to fetus) ☐

Antibiotics ☐

Injection of antibodies ☐

Vaccination ☐

9

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0 2 Cauliflower mosaic virus (CaMV) infects plants in the *Brassica* family including cauliflower and oilseed rape.

One classification system puts viruses into groups depending on:
- the type of genetic material in the virus
- how the virus replicates.

Table 1 shows this classification system together with example viruses from each group.

Table 1

Group	Genetic material	Example
I	Double-stranded DNA	Smallpox virus
II	Single-stranded DNA	Canine parvovirus
III	Double-stranded RNA	Rotavirus
IV	Single-stranded (+) RNA	Tobacco mosaic virus
V	Single-stranded (–) RNA	Ebola
VI	Single-stranded RNA–RT	HIV
VII	Double-stranded DNA–RT	Cauliflower mosaic virus

0 2 . 1 Viruses in groups VI and VII replicate in a similar way. They use an enzyme not found in viruses from other groups.

Suggest the name of this enzyme. Use information from the table and your knowledge of HIV replication.

[1 mark]

_____

_____

Question 2 continues on the next page

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0 2 . 2 Complete **Table 2** to compare the structure of HIV with the structure of cauliflower mosaic virus (CaMV).

Table 2

	CaMV	**HIV**
Genetic material	DNA	
Protein capsid	Present	
Envelope	Absent	

[1 mark]

0 2 . 3 Cauliflower mosaic virus (CaMV) is transmitted to oilseed rape plants by aphids.

Aphids do not suffer symptoms of CaMV.

Name this type of transmission.

[1 mark]

_____

_____

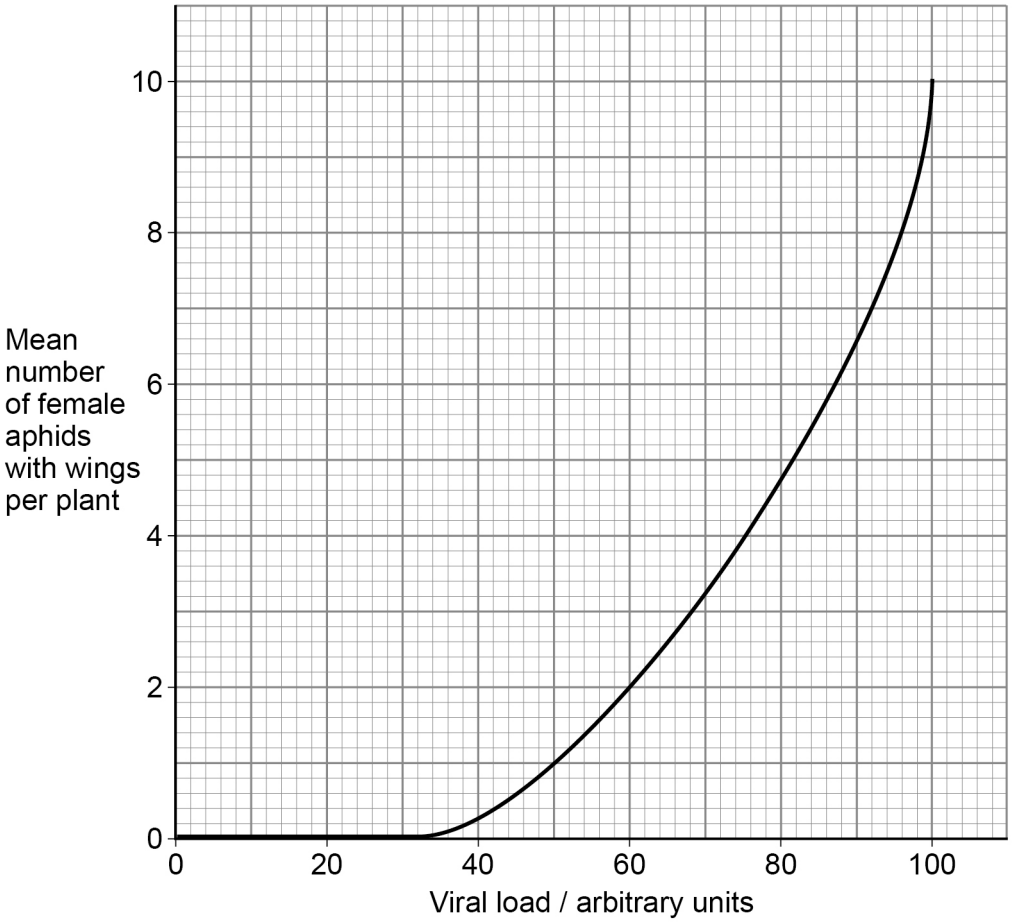
Do not write outside the box

The leaves of oilseed rape plants infected with CaMV turn yellow. This kills the plant.

Most aphids do not have wings and remain on the same plant. Sometimes females with wings are produced.

Figure 2 shows the relationship between the mean number of female aphids with wings and the viral load per plant.

Figure 2



0 2 . 4 What does **Figure 2** show about the number of aphids with wings?

[1mark]

0 2 . 5 Suggest how the relationship shown in **Figure 2** benefits the aphids.

[1 mark]

5

Turn over ►

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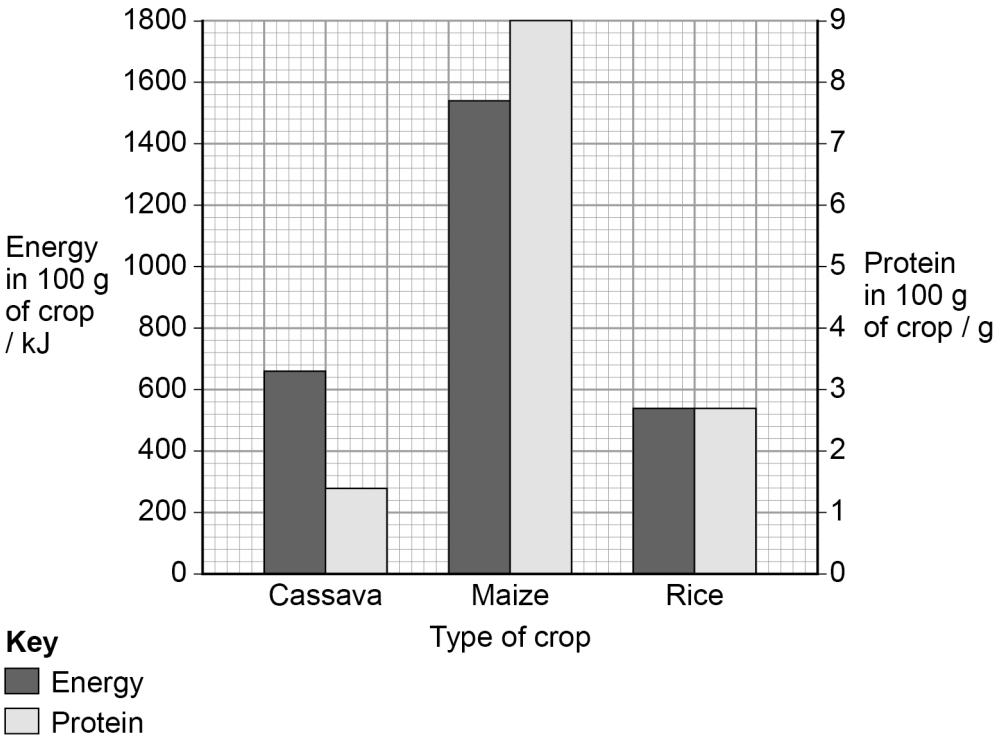
0 3 Kwashiorkor is a disease caused by malnutrition. In developing countries, children may develop kwashiorkor if their diet is not varied.

0 3 . 1 **Figure 3** shows the energy and protein provided by three common crops.

Figure 3



Kwashiorkor is caused by not having enough protein in the diet.
An average 3-year-old child needs 4200 kJ of energy and at least 13 g of protein per day.

A child:
- eats only one type of food
- eats just enough food to supply the total daily energy requirement.

Use this information, and information from **Figure 3**, to complete **Table 3**.

Do not write outside the box

Table 3

Crop	Mass of crop needed for 4200 kJ / g	Mass of protein in 4200 kJ of crop / g	At risk of kwashiorkor? Yes/No
Cassava	636	8.9	
Maize	273		
Rice			

[4 marks]

Question 3 continues on the next page

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0 3 . 2 A child with kwashiorkor may have a swollen abdomen.

Suggest why a lack of protein in the diet causes swelling.

Use your knowledge of tissue fluid.

[3 marks]

0 3 . 3 Another disease caused by malnutrition is obesity. Obese people take in more energy in their food than they use.

A study of over 250 000 children suggests that there may be a link between being obese as a child and having coronary heart disease (CHD) as an adult.

Hazard ratio is the probability of CHD in the obese group divided by the probability of CHD in the group with normal weight. A hazard ratio of 1.00 indicates that there is no difference between the two groups.

Table 4 shows the hazard ratio for the risk of coronary heart disease in adults who were obese as children.

Table 4

Age when obese / years	Hazard ratio
7	1.05
8	1.06
9	1.07
10	1.10
11	1.12
12	1.14
13	1.15

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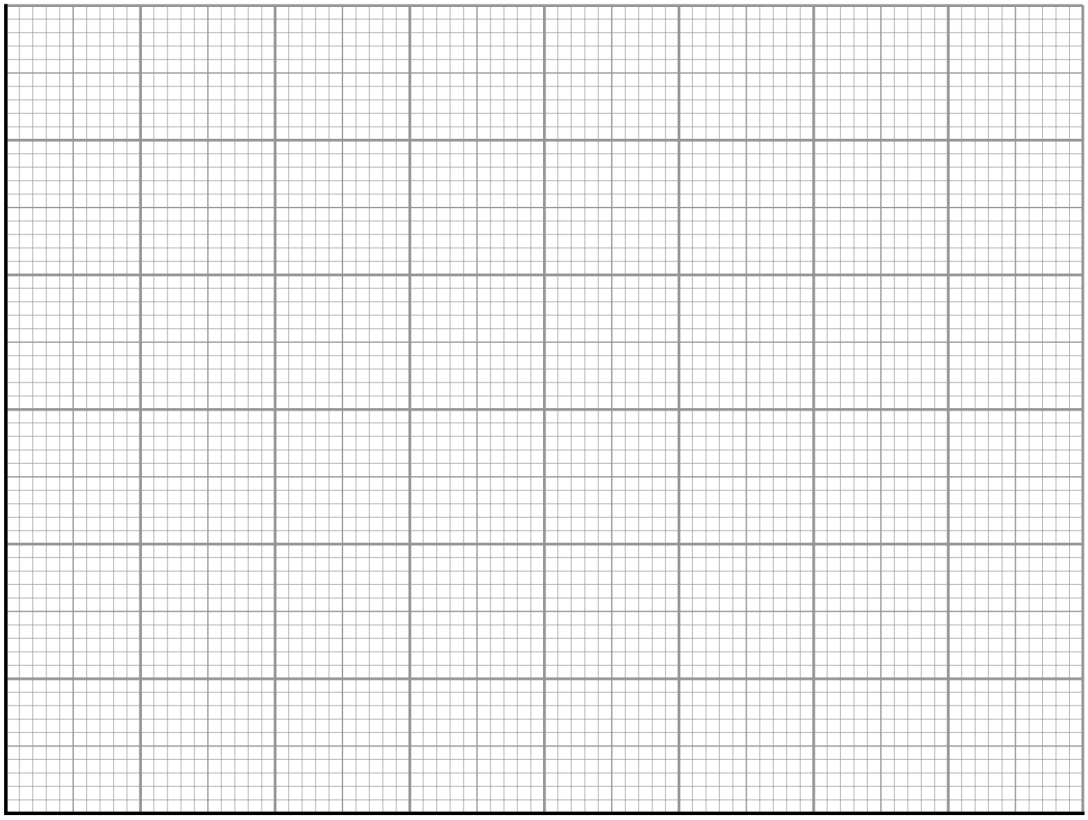
Plot a scatter diagram of these data on the graph paper.

[3 marks]



0 3 . 4 A newspaper used this information and printed:

'Obese teenagers will die from a heart attack as adults.'

Evaluate this statement.

[3 marks]

13

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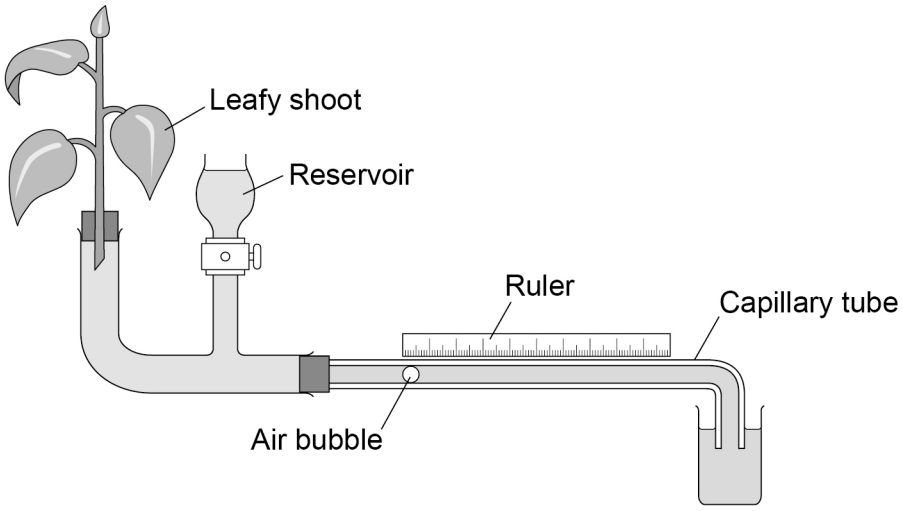
0 4 A class of students plan to use potometers to measure the rate of water uptake by a leafy shoot.

The potometers have been prepared for the students as shown in **Figure 4**.

Figure 4



0 4 . 1 When the leafy shoot was taken from the plant, the cut was made under water.

Explain why.

[2 marks]

Do not write outside the box

0 4 . 2 There is a problem with the potometer in **Figure 4**. The air bubble has reached the end of the ruler.

Describe how to correct the problem.

[1 mark]

0 4 . 3 The students investigate the effect of air movement on water uptake.

The students:
- use an electric fan to make air movements
- use the fan on a slow setting for 3 minutes
- measure how far the air bubble has moved
- repeat using the fan on a fast setting for 3 minutes
- include a control by measuring how far the air bubble moves in 3 minutes when the fan is switched off.

The students expect the air bubble to move the furthest when using the fan on the fast setting.

Explain why.

[3 marks]

Question 4 continues on the next page

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0 4 . 4 Three groups of students, A, B and C, carry out the investigation.

The students in group A record their raw data as follows:

Fan set to

Off = 3.3 cm Slow = 5.4 cm Fast = 7.5 cm

Table 5 shows the results for groups B and C.

Complete **Table 5** by adding the results from group A.

[1 mark]

Table 5

	Water uptake / mm min^{-1} when the setting on the fan is		
	Off	**Slow**	**Fast**
Group A			
Group B	19	27	38
Group C	9	18	27

Do not write outside the box

0 4 . 5 The data in **Table 5** are different for one of the groups compared with the other two groups.

The teacher suggests that transpiration rate measured in mm min^{-1} mm^{-2} of leaf surface would give a more valid comparison.

Describe a method the students could use to find the rate of water uptake in mm min^{-1} mm^{-2} of leaf surface.

Give **one** reason why this is a more valid comparison.

[3 marks]

Method _____

_____

_____

_____

_____

_____

Reason it is a more valid comparison _____

_____

_____

_____

_____

_____

10

Turn over for the next question

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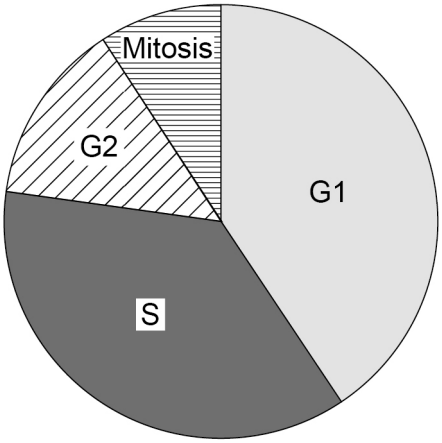
0 5 The cell cycle in a eukaryotic cell is divided into phases as shown in the pie chart in **Figure 5**.

Figure 5



0 5 . 1 The whole cell cycle for this cell is completed in 22 hours.

Calculate the time spent in each phase.

Give your answers to the nearest whole hour.

Write your answers in **Table 6**.

Table 6

	G1	**S**	**G2**	**Mitosis**
Sector size / degrees	147	131	49	33
Time / hours				

[2 marks]

0 5 . 2 Give **two** processes that occur during phase G1.

[2 marks]

1 _____

2 _____

Do not write outside the box

0 5 . 3 The stages of mitosis in plant cells can be seen with a light microscope by preparing a root tip squash.

To prepare the slide, the root tip is:
- stained with aceto-orcein or toluidine blue
- squashed between a microscope slide and coverslip.

State why the tissue is:

[2 marks]

stained _____

_____

_____

squashed _____

_____

_____

0 5 . 4 Root tip squashes can be used to calculate the mitotic index of the tissue.

Describe how to:
- collect the data needed
- calculate the mitotic index.

[2 marks]

_____

_____

_____

_____

_____

_____

0 5 . 5 In animal cells the mitotic index could be used to tell the difference between a cancerous tumour and a benign tumour.

Suggest how.

[1 mark]

_____

_____

9

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0 6 A student investigates the effect of bile on the digestion of lipids.

The student sets up four test tubes.

Table 7 shows the contents of each test tube.

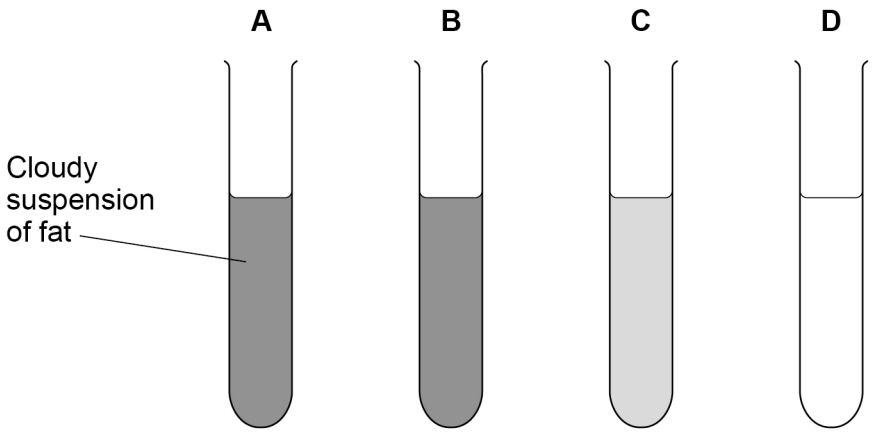
Table 7

	Volume / cm^3			
	Tube A	**Tube B**	**Tube C**	**Tube D**
Fat suspension	2	2	2	2
Lipase solution	–	–	1	1
Bile salts solution	–	1	–	1
Water	5	4	4	3

The test tubes are kept at 30 °C in a water bath.

Figure 6 shows the appearance of each test tube after 5 minutes.

Figure 6



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0 6 . 1 Explain the results shown in **Figure 6**.

[3 marks]

0 6 . 2 Describe how bile assists in the absorption of fats in the small intestine.

[2 marks]

0 6 . 3 The small intestine is lined with epithelial cells. Fatty acids enter the epithelial cells by diffusion.

Name **one** process by which amino acids enter the epithelial cells.

[1 mark]

Question 6 continues on the next page

Do not write outside the box

0 6 . 4 A scientist measures the effects of different diets on the concentration of biological molecules entering the bloodstream.

The scientist:
- collects blood samples from the vein leaving the small intestine
- measures the concentration of glucose, amino acids and fatty acids in the blood.

The concentration of fatty acids measured in the blood may be less than the total amount of fatty acids absorbed by the small intestine.

Suggest why.

[2 marks]

Do not write outside the box

0 6 . 5 Orlistat is a lipase inhibitor. Orlistat reduces the amount of fat that can be absorbed. Orlistat could be used to help people lose weight.

The manufacturers claim that people taking orlistat lose weight faster than people who follow the same diet without taking orlistat.

The manufacturers plan to do a clinical trial to prove their claim. They select 10 obese women for the trial.

For 4 weeks the women:
- follow the same diet
- take one 120 mg tablet of orlistat three times a day
- follow the same exercise plan.

The women are weighed at the start of the trial and then once a week until the end of the trial.

Is this trial is likely to produce valid evidence to support their claim?
Evaluate the methods.

[4 marks]

12

Turn over for the next question

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0 7 A student used the apparatus in **Figure 7** to investigate the elastic recoil of different types of blood vessels.

Figure 7

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The student:
1. cuts a ring approximately 20 mm wide from the vena cava of a mammal
2. attaches the ring of vena cava to the hook and measures its starting length
3. adds a 20 g weight and measures the length of the ring of vena cava
4. removes the weight and measures the length of the ring of vena cava
5. repeats with 40 g, 60 g and 80 g weights
6. repeats steps 1-5 with an approximately 20 mm wide ring from the aorta of the same mammal.

Table 8 shows how the lengths of the blood vessels change as the weights are added and removed.

Table 8

	Length of ring of vena cava / mm			**Length of ring of aorta / mm**		
Mass added / g	**Starting**	**With weight**	**After weight removed**	**Starting**	**With weight**	**After weight removed**
20	22	42	40	33	43	33
40	40	46	45	33	48	33
60	45	46	46	33	52	33
80	46	47	47	33	54	33

Do not write outside the box

0 7 . 1 Use the data in **Table 8** to explain how the structure of the aorta is related to its function.

[3 marks]

0 7 . 2 The aorta and the pulmonary artery both carry blood away from the heart.

The blood pressure in the aorta ranges from 10.7 to 16.0 kPa.
The blood pressure in the pulmonary artery ranges from 1.1 to 2.7 kPa.

Explain what causes the difference in blood pressure between these two arteries.

[2 marks]

Question 7 continues on the next page

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0 7 . 3 The blood pressure in veins is less than 1.0 kPa.

Describe how the structure of veins allows the blood to return to the heart even though the blood pressure is so low.

[2 marks]

_____

_____

_____

_____

_____

_____

7

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0 8 . 1 Eukaryotic cells divide by mitosis to produce genetically identical cells.

Describe how the nuclear membrane and spindle fibres make sure each new cell contains the correct number of chromosomes.

[5 marks]

Question 8 continues on the next page

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0 8 . 2 Uncontrolled cell division results in the formation of a tumour.

What might cause a normal body cell to divide uncontrollably?

[5 marks]

10

END OF QUESTIONS

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