AQA GCSE Biology | 8461

SPECIFICATION POINT 4.2.2.2

The heart and blood vessels

Past-paper questions

Tier	**Higher**
Question groups	**16**
Available paper years	**2008–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

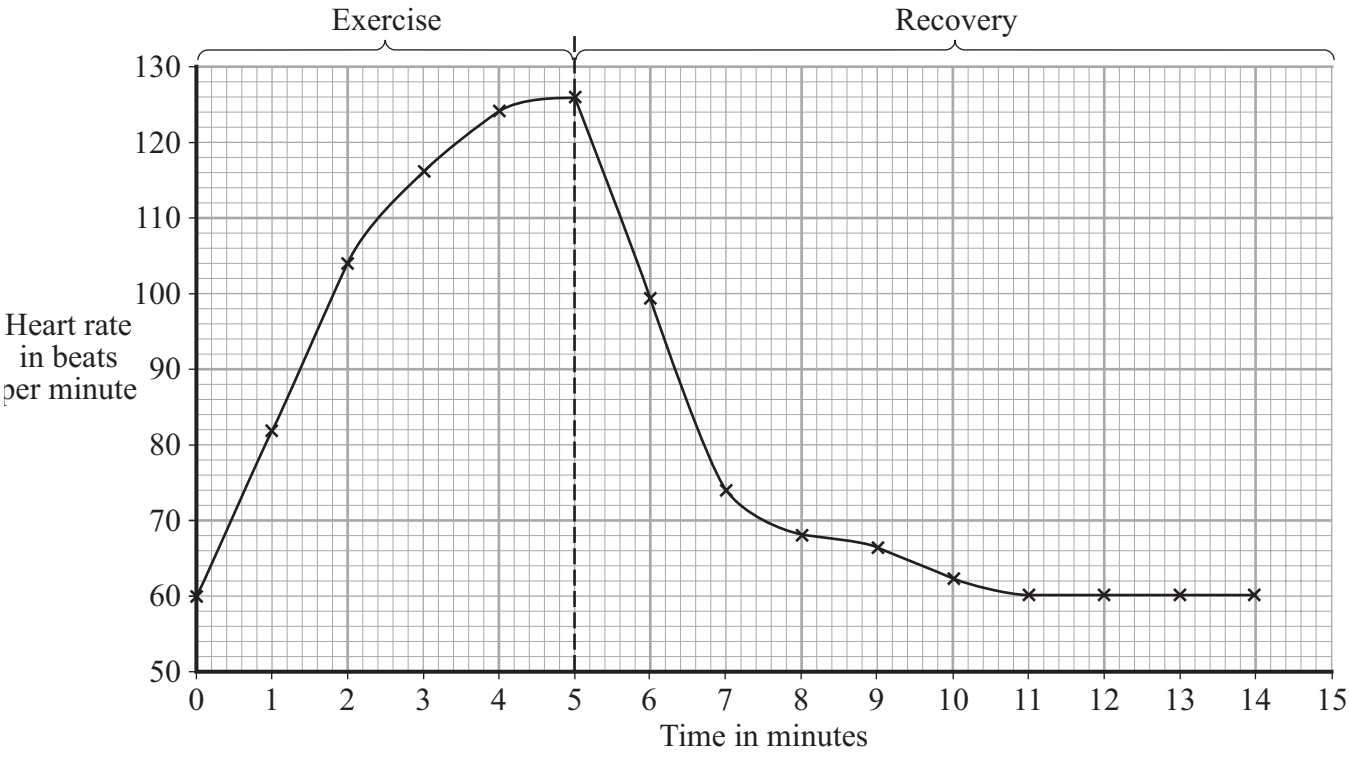
4.2.2.2 The heart and blood vessels

Question 01

January 2008 | BLY3H | Original Q4 | Legacy

4 A student pedalled an exercise cycle at constant speed for 5 minutes. The student's heart rate was recorded at one-minute intervals during the exercise and also during recovery.

The results are shown in the graph.



(a) Describe, in as much detail as you can, the changes in heart rate between 0 and 14 minutes.

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(3 marks)

4.2.2.2 The heart and blood vessels

Question 01 · continued

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(b) How do arteries supplying the leg muscles alter the rate of blood flow through them during exercise?

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(1 mark)

(c) Explain how an increase in heart rate helped the student during exercise.

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(4 marks)

8

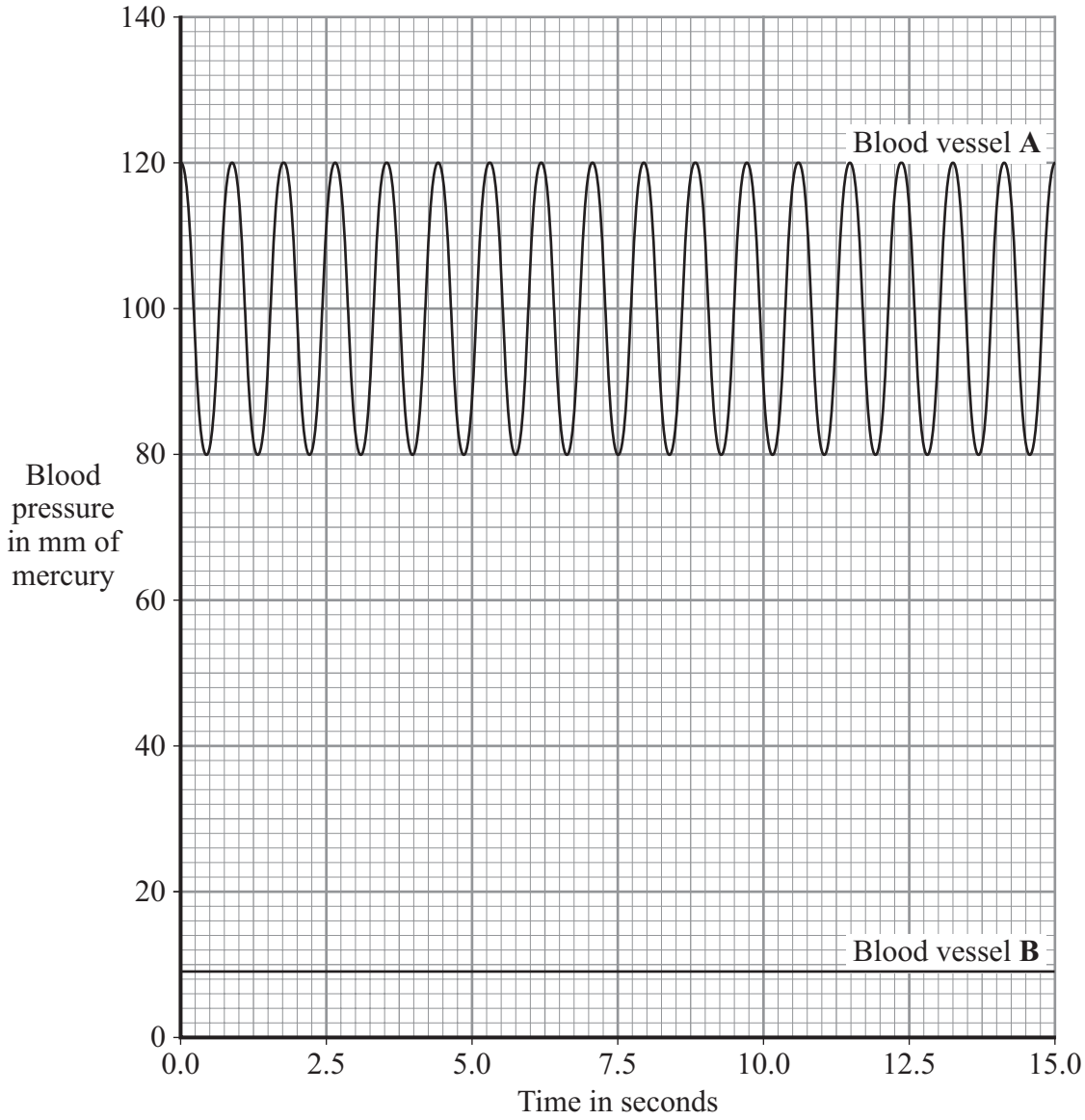
4.2.2.2 The heart and blood vessels

Question 02

June 2009 | BLY3H | Original Q1 | Legacy

1 The heart pumps blood around the body. This causes blood to leave the heart at high pressure.

The graph shows blood pressure measurements for a person at rest.
The blood pressure was measured in an artery and in a vein.



4.2.2.2 The heart and blood vessels

Question 02 · continued June 2009 | BLY3H | Original Q1 | Legacy

for mark

1 (a) Which blood vessel, **A** or **B**, is the artery?

Blood vessel .....

Give **two** reasons for your answer.

Reason 1 .....

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Reason 2 .....

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(2 marks)

1 (b) Use information from the graph to answer these questions.

1 (b) (i) How many times did the heart beat in 15 seconds? .....

(1 mark)

1 (b) (ii) Use your answer from part (b)(i) to calculate the person's heart rate per minute.

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Heart rate = ... beats per minute

(1 mark)

1 (c) During exercise, the heart rate increases. This supplies useful substances to the muscles and removes waste materials from the muscles at a faster rate.

1 (c) (i) Name **two** useful substances that must be supplied to the muscles at a faster rate during exercise.

1 .....

2 .....

(2 marks)

1 (c) (ii) Name **one** waste substance that must be removed from the muscles at a faster rate during exercise.

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(1 mark)

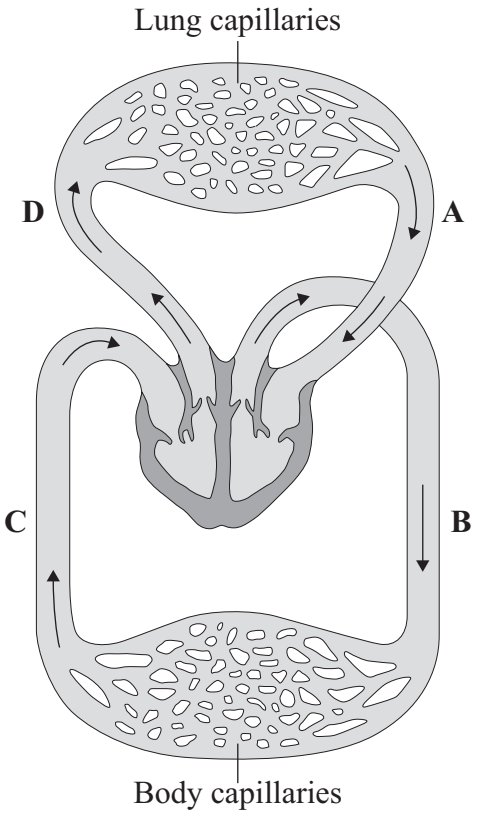
7

4.2.2.2 The heart and blood vessels

Question 03

January 2010 | BLY3H | Original Q1 | Legacy

1 The diagram shows the human circulation system.



1 (a) (i) Give the letter of **one** blood vessel that is an artery. ☐

(1 mark)

1 (a) (ii) Give the letter of **one** blood vessel that carries oxygenated blood. ☐

(1 mark)

4.2.2.2 The heart and blood vessels

Question 03 · continued

for mark

1 (b) During exercise, the heart rate increases.

Explain, as fully as you can, why this increase is necessary.

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(4 marks)

6

4.2.2.2 The heart and blood vessels

Question 04

January 2013 | BL1HP | Original Q4 | Legacy

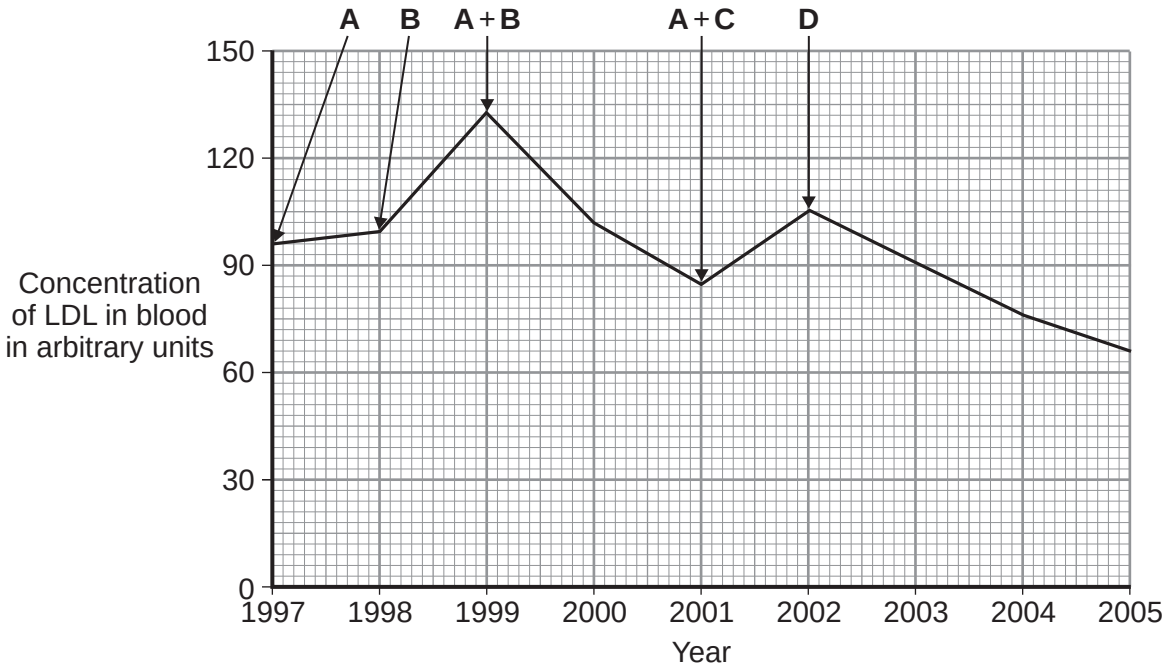
4 LDL is one form of cholesterol found in the blood.

People with a high concentration of LDL in their blood may be treated with drugs called statins.

A high concentration of LDL cholesterol in the blood may result in an increased risk of heart and circulatory diseases.

The graph shows the effects of the treatment of one person with four different statins, **A**, **B**, **C** and **D**, over a period of 8 years. The arrows show when each new treatment was started.

Each treatment was continued until the next treatment was started.



4.2.2.2 The heart and blood vessels

Question 04 · continued

Compare the effectiveness of the five treatments in reducing the risk of heart and circulatory diseases for this person.

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(4 marks)

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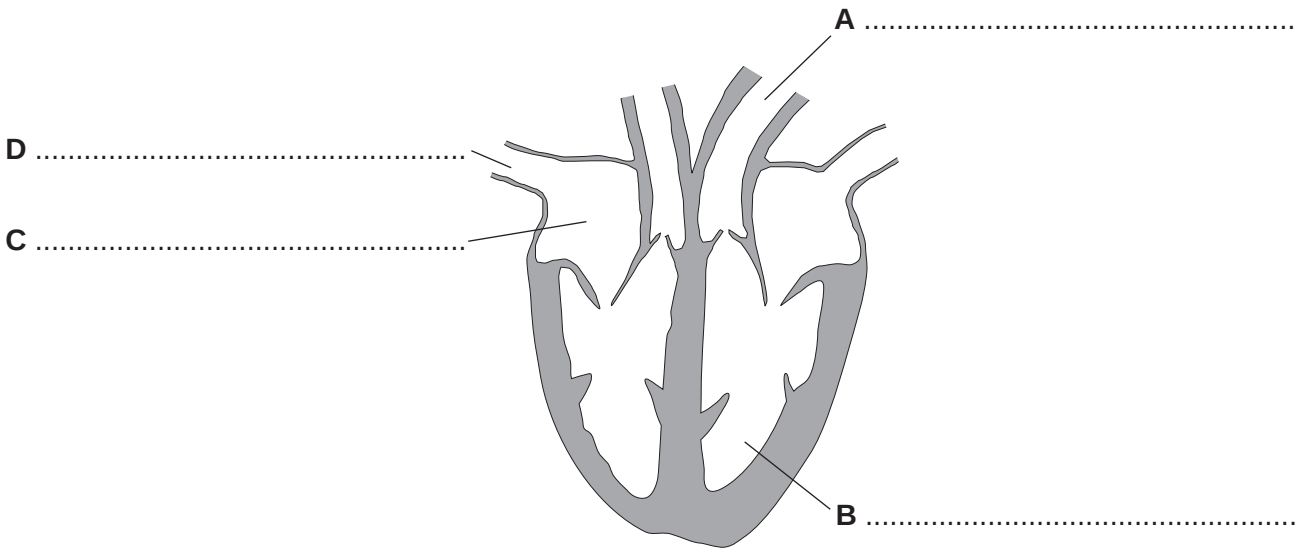
4.2.2.2 The heart and blood vessels

Question 05

June 2013 | BL3HP | Original Q1 | Legacy

1 **Diagram 1** shows a section through the heart.

Diagram 1



1 (a) On the diagram, name the parts labelled **A**, **B**, **C** and **D**.

(4 marks)

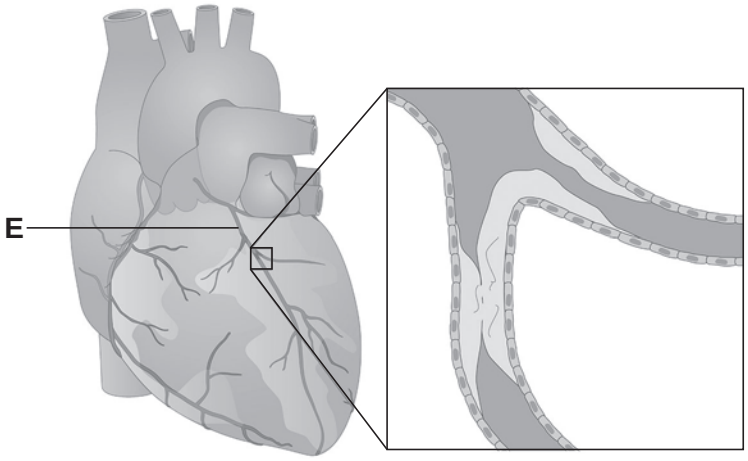
4.2.2.2 The heart and blood vessels

Question 05 · continued

1 (b) **Diagram 2** shows the blood vessels that supply the heart muscle.

Part of one of the blood vessels has become narrower.

Diagram 2



Enlarged view of narrowed area of blood vessel **E**

1 (b) (i) Name blood vessel **E**.

.....

(1 mark)

1 (b) (ii) Give **one** method of treating the narrowed part of blood vessel **E**.

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(1 mark)

1 (b) (iii) Explain how the method of treatment works.

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(2 marks)

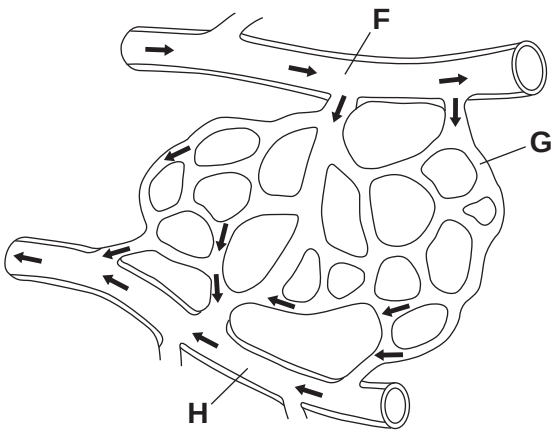
Question 1 continues on the next page

4.2.2.2 The heart and blood vessels

Question 05 · continued

1 (c) **Diagram 3** shows part of the blood supply in the lungs.

Diagram 3



1 (c) (i) Name the types of blood vessel labelled **F**, **G** and **H**.

F .....

G .....

H .....

(3 marks)

1 (c) (ii) Give **one** way in which the composition of the blood in vessel **F** is different from the composition of the blood in vessel **H**.

.....

.....

(1 mark)

12

4.2.2.2 The heart and blood vessels

Question 06

June 2014 | BL3HP | Original Q4 | Legacy

4 Blood is part of the circulatory system.

4 (a) (i) Give **one** function of white blood cells.

[1 mark]

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4 (a) (ii) Which of the following is a feature of platelets?

Tick (✓) **one** box.

[1 mark]

They have a nucleus. ☐

They contain haemoglobin. ☐

They are small fragments of cells. ☐

4 (b) Urea is transported by the blood plasma from where it is made to where the urea is excreted.

Complete the following sentence.

[2 marks]

Blood plasma carries urea from where it is made in the .....

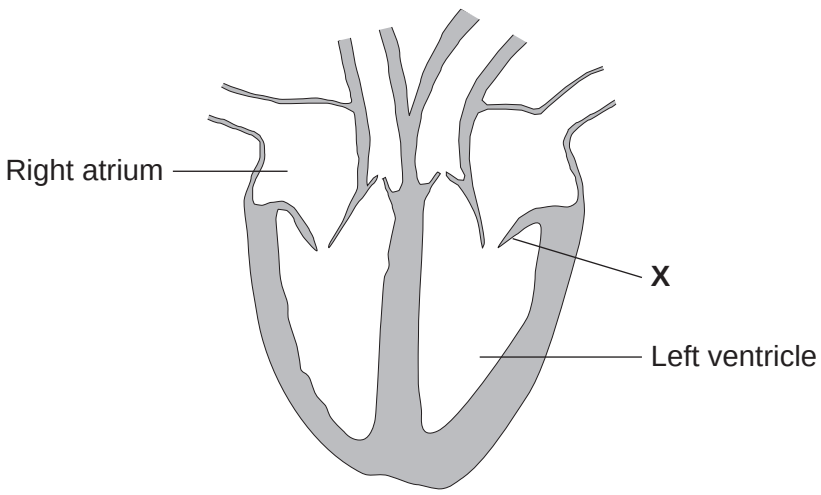
to the ..... where the urea is removed from the blood.

Question 4 continues on the next page

Question 06 · continued

4 (c) **Figure 4** shows a section through the human heart.

Figure 4



Structure **X** is a valve. If valve **X** stops working, it may need to be replaced.

A scientist is designing a new heart valve. The scientist knows that the valve must be the correct size to fit in the heart.

Suggest **two** other factors the scientist needs to consider so that the newly designed valve works effectively in the heart.

[2 marks]

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6

4.2.2.2 The heart and blood vessels

Question 07

June 2015 | BL1HP | Original Q9 | Legacy

9 (a) A healthy diet should be balanced.

What is meant by a balanced diet?

[2 marks]

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9 (b) Cholesterol has important functions in the body.
Some cholesterol is produced by the liver.

Cholesterol is needed in the body to make the hormone oestrogen.

9 (b) (i) Name the organ in the body which produces oestrogen.

[1 mark]

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9 (b) (ii) What effect does oestrogen have on the female reproductive cycle?

[1 mark]

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9 (b) (iii) Oestrogen is a naturally occurring steroid hormone.

Give **one** artificial use of a steroid hormone in the body.

[1 mark]

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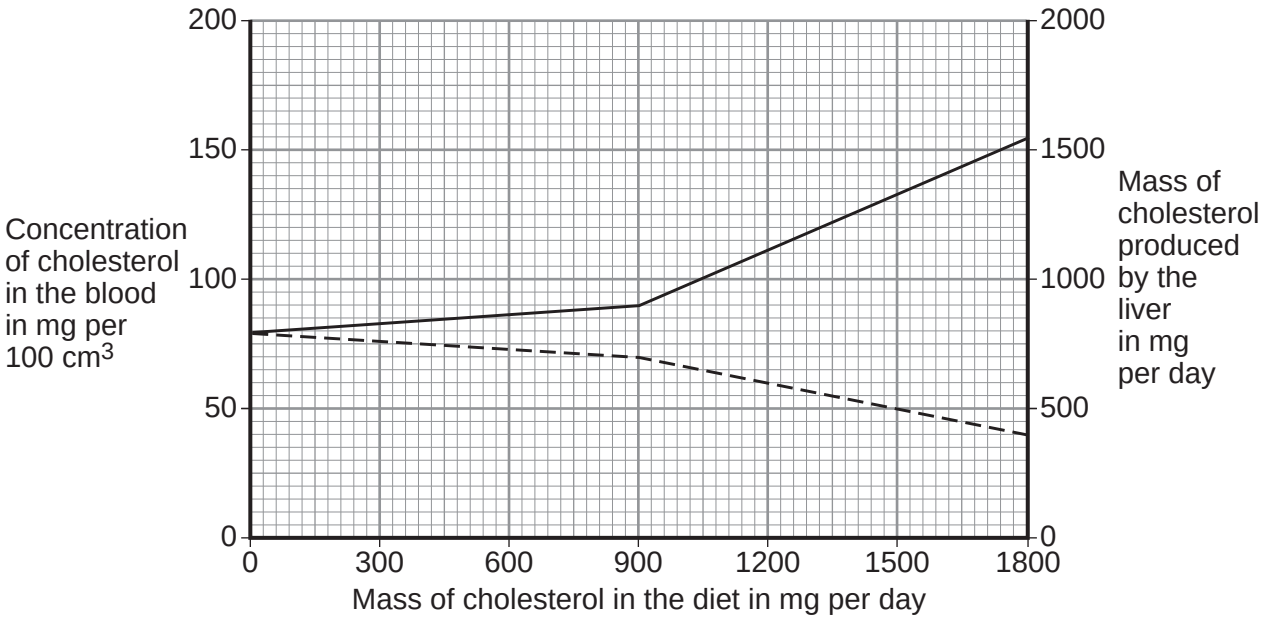
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Question 07 · continued

9 (c) **Figure 6** shows the effect of the mass of cholesterol in the diet on:

- the concentration of cholesterol in the blood
- the mass of cholesterol produced by the liver.

Figure 6



Key

——— Blood cholesterol concentration

– – – – Production by the liver

Describe the effect of increasing the mass of cholesterol in the diet on the mass of cholesterol produced by the liver.

To gain full marks you should include data from **Figure 6** in your answer.

[2 marks]

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Question 9 continues on the next page

4.2.2.2 The heart and blood vessels

Question 07 · continued

9 (d) Large amounts of cholesterol in the diet switch off the production of an enzyme called reductase, in the liver.

An increase of the enzyme reductase increases the production of cholesterol by the liver.

9 (d) (i) Which part of a liver cell is responsible for controlling the production of reductase?

[1 mark]

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9 (d) (ii) High blood cholesterol concentrations increase the likelihood of heart and circulatory diseases.

Doctors can prescribe statins to control the concentration of cholesterol in the blood.

Suggest how statins work.

[1 mark]

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4.2.2.2 The heart and blood vessels

Question 08

June 2015 | BL2HP | Original Q5 | Legacy

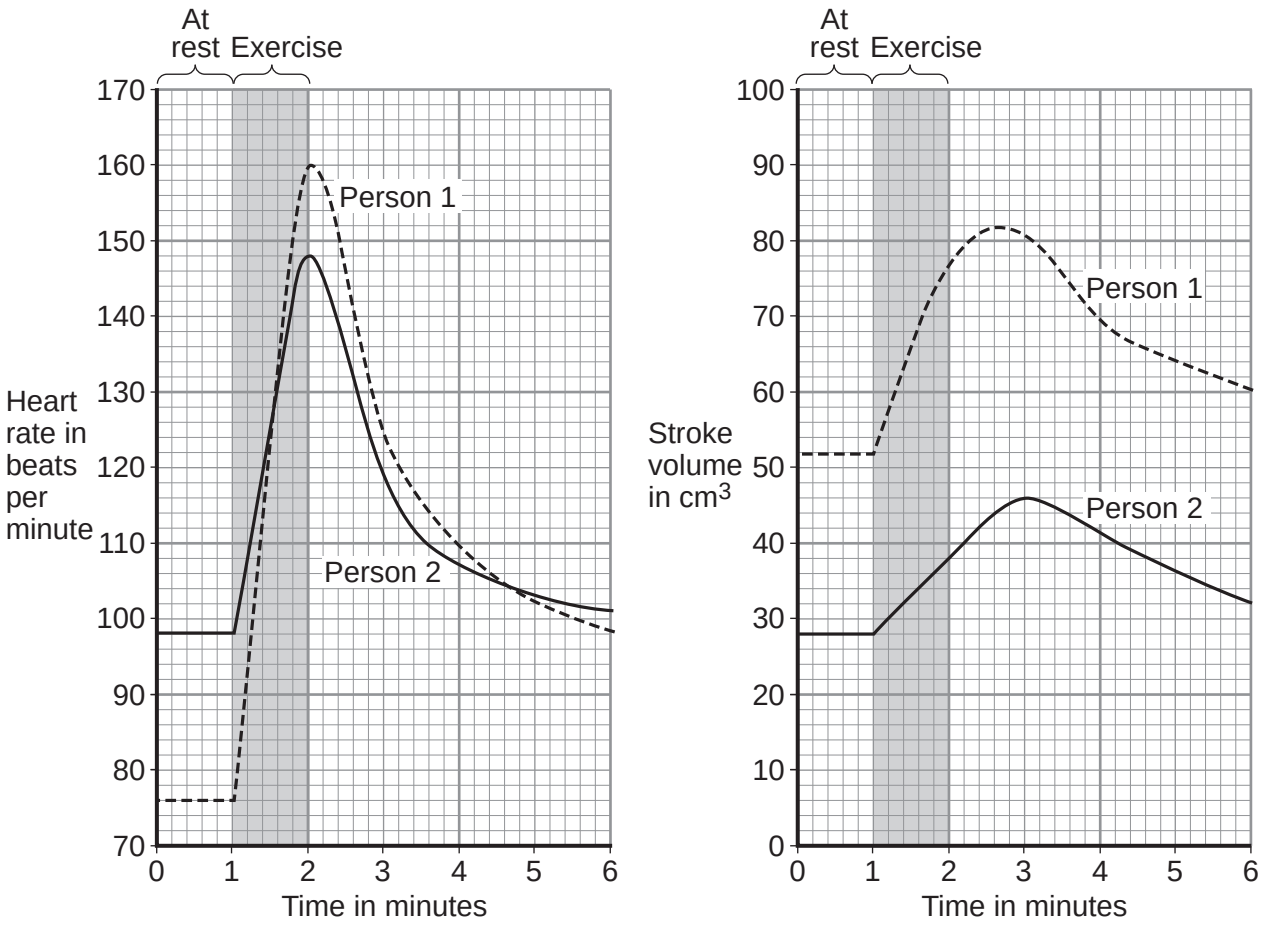
5 During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute.
The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

Figure 7 shows the scientists' results.

Figure 7



4.2.2.2 The heart and blood vessels

Question 08 · continued

5 (a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

Cardiac output = Heart rate × Stroke volume

At the end of the exercise, **Person 1**'s cardiac output = 160 × 77 = 12 320 cm^3 per minute.

Use information from **Figure 7** to complete the following calculation of **Person 2**'s cardiac output at the end of the exercise.

[3 marks]

At the end of the exercise:

Person 2's heart rate = ... beats per minute

Person 2's stroke volume = ... cm^3

Person 2's cardiac output = ... cm^3 per minute

5 (b) **Person 2** had a much lower cardiac output than **Person 1**.

5 (b) (i) Use information from **Figure 7** to suggest the **main** reason for the lower cardiac output of **Person 2**.

[1 mark]

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5 (b) (ii) **Person 1** was able to run much faster than **Person 2**.

Use information from **Figure 7** and your own knowledge to explain why.

[5 marks]

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4.2.2.2 The heart and blood vessels

Question 09

June 2015 | BL3HP | Original Q2 | Legacy

2 The circulatory system transports substances such as glucose and oxygen around the body.

2 (a) Name **two** other substances that the circulatory system transports around the body.

[2 marks]

1 .....

2 .....

2 (b) (i) Blood is a tissue. Blood contains red blood cells and white blood cells.

Name **two** other components of blood.

[2 marks]

1 .....

2 .....

2 (b) (ii) The heart is part of the circulatory system.

What type of tissue is the wall of the heart made of?

[1 mark]

.....

Question 2 continues on the next page

4.2.2.2 The heart and blood vessels

Question 09 · continued

2 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Every year, many patients need to have heart valve replacements.

Figure 2 gives information about two types of heart valve.

Figure 2

Living human heart valve	Cow tissue heart valve
• It has been used for transplants for more than 12 years. • It can take many years to find a suitable human donor. • It is transplanted during an operation after a donor has been found. • During the operation, the patient's chest is opened and the old valve is removed before the new valve is transplanted.	• It has been used since 2011. • It is made from the artery tissue of a cow. • It is attached to a stent and inserted inside the existing faulty valve. • A doctor inserts the stent into a blood vessel in the leg and pushes it through the blood vessel to the heart.

A patient needs a heart valve replacement. A doctor recommends the use of a cow tissue heart valve.

Give the advantages and disadvantages of using a cow tissue heart valve compared with using a living human heart valve.

Use information from **Figure 2** and your own knowledge in your answer.

[6 marks]

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4.2.2.2 The heart and blood vessels

Question 10

June 2016 | BL3HP | Original Q6 | Legacy

6 The circulatory system contains arteries and veins.

6 (a) (i) Describe how the structure of an artery is different from the structure of a vein.

[2 marks]

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6 (a) (ii) A comparison is made between blood taken from an artery in the leg and blood taken from a vein in the leg.

Give **two** differences in the composition of the blood.

[2 marks]

1 _____

_____

2 _____

_____

4.2.2.2 The heart and blood vessels

Question 10 · continued

6 (b) During operations patients can lose a lot of blood. Patients often need blood transfusions to keep them alive.

Figure 6 shows information about a new artificial blood product.

Figure 6

Sea worms give hope for people in need of blood transfusions

Scientists have carried out a five-year trial using a new artificial blood product. The scientists have used a protein from sea worms to create the new artificial blood and the results from the trial are very positive. Thousands of sea worms can be grown and collected.

During the trial, mice were given blood transfusions of the artificial blood. The bodies of the mice tolerated the artificial blood and the artificial blood did not cause any side effects.

Suggest **two** possible advantages of using the new artificial blood, instead of using human blood for a transfusion in humans.

[2 marks]

1 _____

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2 _____

_____

6

4.2.2.2 The heart and blood vessels

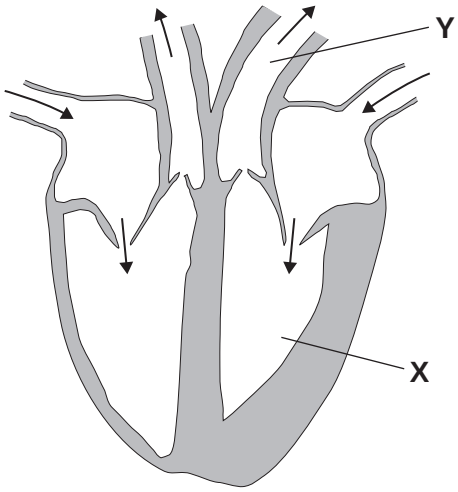
Question 11

June 2017 | BL3HP | Original Q2 | Legacy

2 Each year people need to have treatment for heart problems.

Figure 2 shows a human heart.

Figure 2



2 (a) (i) Name part **X** in **Figure 2**.

[1 mark]

_____

2 (a) (ii) Name part **Y** in **Figure 2**.

[1 mark]

_____

2 (a) (iii) There are valves inside the heart.

What is the function of these valves?

[1 mark]

_____

_____

Question 2 continues on the next page

Question 11 · continued

2 (b) Some patients need to have their heart valves replaced.

Table 1 shows the percentage of patients who died from different causes after having heart valve replacements.

Two types of heart valve were used:

- mechanical – made of metal and plastic
- pig tissue – made from pig heart tissue on a metal frame.

The data was collected over 15 years and 400 patients were involved.

Table 1

Cause of death	Percentage of patients who died	
	Mechanical valve	Pig tissue valve
Blood clots blocking coronary arteries	9	9
Bleeding	26	15
Second operation	5	15
Bacterial heart infection	4	8
Heart valves stopped working	0	12

Use information from **Table 1** and your own knowledge to answer the following question.

A patient decides to have a mechanical valve replacement rather than a pig tissue valve replacement.

Suggest reasons for **and** against choosing a mechanical valve.

[4 marks]

4.2.2.2 The heart and blood vessels

Question 11 · continued

2 (c) Some people have narrowed arteries.

Describe how stents can be used to prevent a heart attack in a person with narrowed arteries.

[2 marks]

9

4.2.2.2 The heart and blood vessels

Question 12

June 2018 | 8461/1H | Original Q3

0 3 The circulatory system is composed of the blood, blood vessels and the heart.

0 3 . 1 Urea is transported in the blood plasma.

Name **two** other substances transported in the blood plasma.

[2 marks]

1 _____

2 _____

0 3 . 2 Some athletes train at high altitude.

Training at high altitude increases the number of red blood cells per cm^3 of blood.

Explain why having more red blood cells per cm^3 of blood is an advantage to an athlete.

[3 marks]

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0 3 . 3 Which **two** blood vessels carry deoxygenated blood?

[2 marks]

Tick **two** boxes.

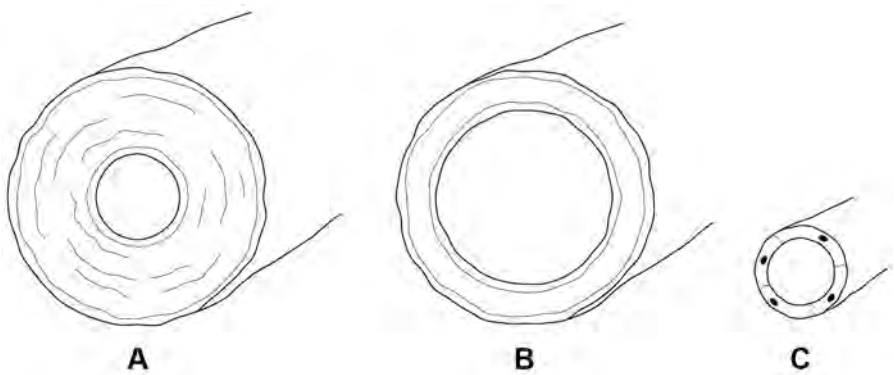
- Aorta ☐
- Coronary artery ☐
- Pulmonary artery ☐
- Pulmonary vein ☐
- Vena cava ☐

4.2.2.2 The heart and blood vessels

Question 12 · continued

Figure 4 shows the three types of blood vessel.

Figure 4



0 3 . 4 Which type of blood vessel carries blood into the right atrium?

[1 mark]

Tick **one** box.

A		B		C	

0 3 . 5 Compare the structure of an artery with the structure of a vein.

[3 marks]

4.2.2.2 The heart and blood vessels

Question 12 · continued

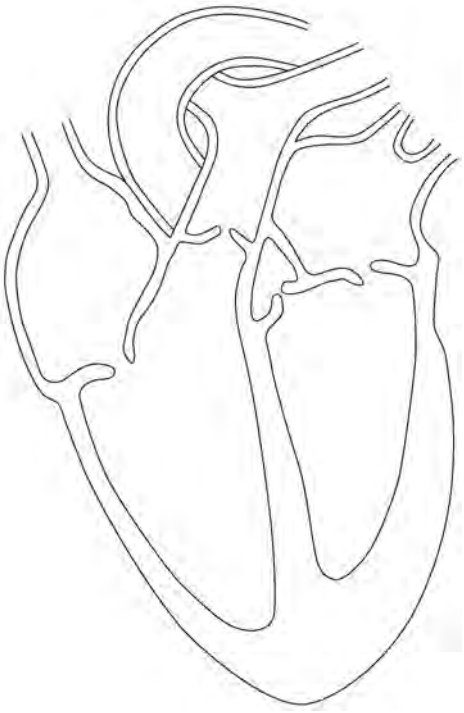
0 3 . 6 Heart rate is controlled by a group of cells. This group of cells act as a pacemaker.

Figure 5 shows a section through the heart.

Draw an **X** on **Figure 5** to show the position of the pacemaker.

[1 mark]

Figure 5



0 3 . 7 A patient may be fitted with an artificial pacemaker.

What condition may be treated using an artificial pacemaker?

[1 mark]

13

4.2.2.2 The heart and blood vessels

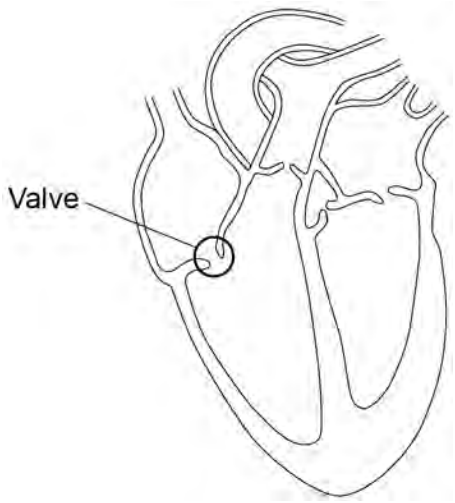
Question 13

June 2019 | 8461/1H | Original Q5

0 5 **Figure 6** shows the internal structure of the human heart.

One of the heart valves is labelled.

Figure 6



Sometimes a valve in the heart can start to leak.

0 5 . 1 Explain why a person with a leaking heart valve has difficulty exercising.

[4 marks]

Question 13 · continued

A patient with a leaking heart valve may have the valve replaced.

A study compared two different types of replacement heart valve:

- mechanical valves
- biological valves from pigs.

The data used in the study was collected from female patients aged 50–69.

Table 4 shows the data.

Table 4

	Type of replacement heart valve	
	Mechanical	**Biological**
Number of patients given the valve	2852	1754
Number of patients who died from heart-related problems after valve replacement	180	178
Percentage of patients alive after 5 years	91	89
Percentage of patients needing a second valve replacement within 6 years	2.2	5.2
Percentage of patients who had a blood clot on the brain after surgery	5.8	0.1

0 5 . 2 Give **one** conclusion about the death of patients from heart-related problems after a valve replacement.

Include calculations to support your answer.

[3 marks]

4.2.2.2 The heart and blood vessels

Question 13 · continued

0 5 . 3 One risk of mechanical valves is that blood clots can form on the surface of the valve.

Name the component of the blood that starts the process of blood clotting.

[1 mark]

0 5 . 4 Evaluate the use of mechanical replacement heart valves and biological replacement heart valves.

Use information from **Table 4** and your own knowledge.

[6 marks]

14

4.2.2.2 The heart and blood vessels

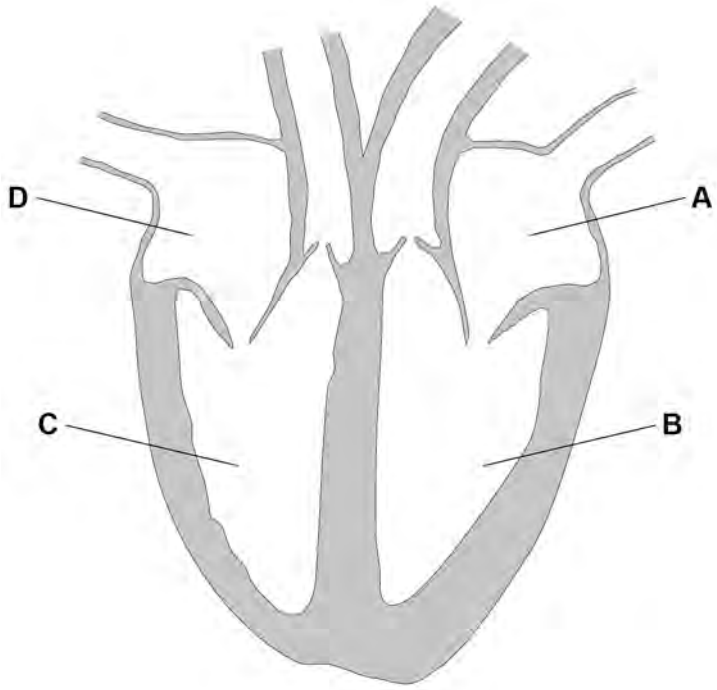
Question 14

June 2023 | 8461/1H | Original Q2

0 2 This question is about the circulatory system.

Figure 1 shows the human heart.

Figure 1



0 2 . 1 Which part of the heart receives oxygenated blood from the lungs?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 2 Which part of the heart pumps deoxygenated blood to the lungs?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

4.2.2.2 The heart and blood vessels

Question 14 · continued

0 2 . 3 A group of cells called the pacemaker controls the resting heart rate.

Where in the heart is the pacemaker found?

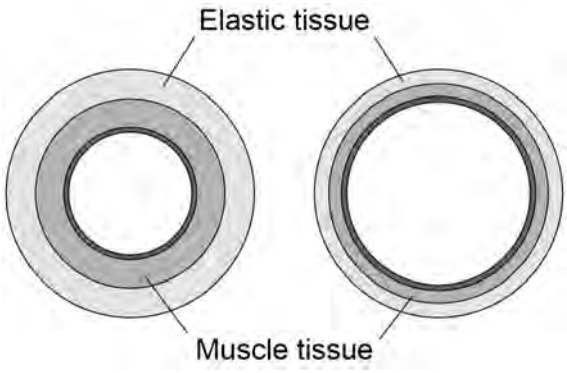
[1 mark]

Tick (✓) **one** box.

- Left atrium ☐
- Left ventricle ☐
- Right atrium ☐
- Right ventricle ☐

0 2 . 4 **Figure 2** shows a cross section of an artery and of a vein.

Figure 2



Describe **two** ways that the structure of an artery is different from the structure of a vein.

[2 marks]

1 _____

_____

2 _____

_____

Question 2 continues on the next page

0 2 . 5 In coronary heart disease, the coronary arteries become narrower.

A build-up of fatty material can cause a blockage in a coronary artery.

Table 2 shows how a blockage in a coronary artery affects blood flow.

Table 2

Percentage (%) of coronary artery that is blocked	Blood flow in cm^3/minute
0	100
10	64
20	42
50	8
80	2

Describe the trend shown in **Table 2**.

[1 mark]

Question 14 · continued

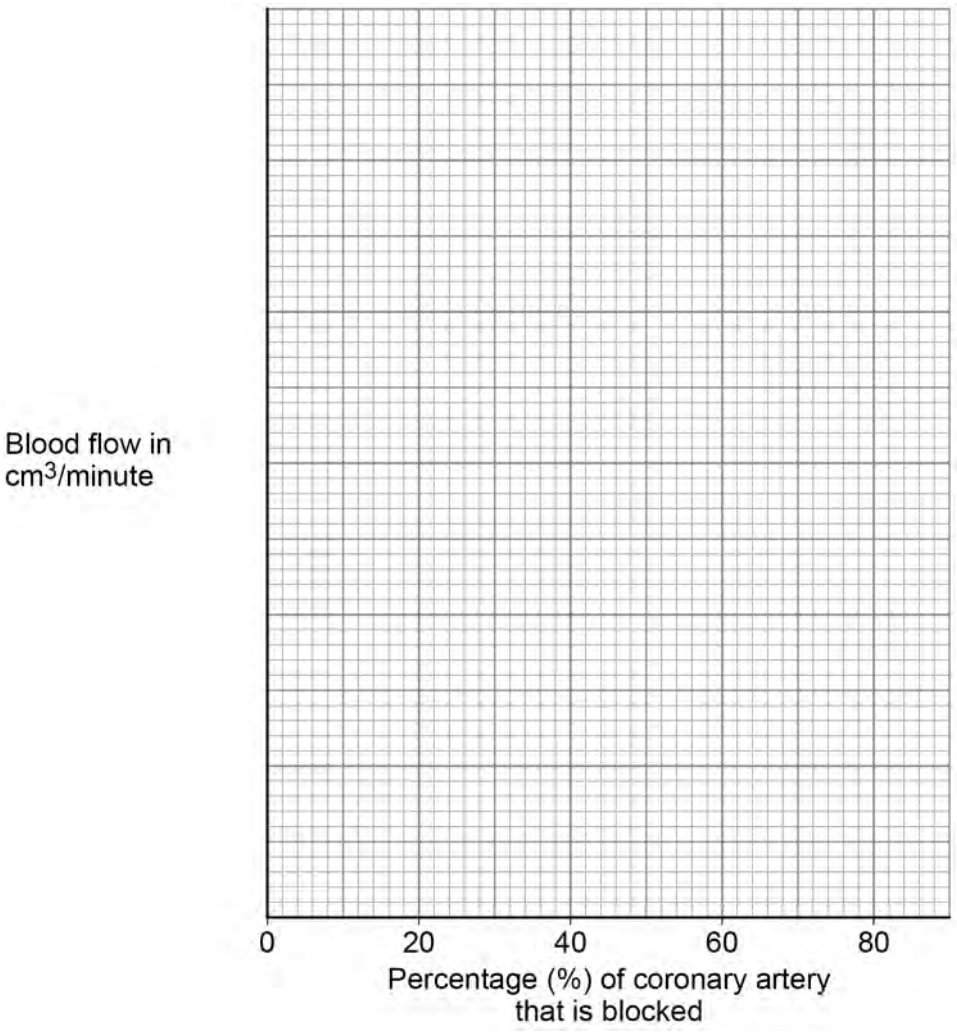
0 2 . 6 Complete **Figure 3**.

You should:

- use a suitable scale for the y-axis
- plot the data from **Table 2**
- draw a line of best fit.

[4 marks]

Figure 3



0 2 . 7 Predict the blood flow in a coronary artery with a 35% blockage.

Use **Figure 3**.

[1 mark]

Blood flow = _____ cm^3/minute

Question 2 continues on the next page

4.2.2.2 The heart and blood vessels

Question 14 · continued

0 2 . 8 Explain the effect of a partly blocked coronary artery on the human body.

[6 marks]

0 2 . 9 There are different treatments for a blockage in a coronary artery.

Explain how **one** treatment for a blockage in a coronary artery works.

[2 marks]

19

4.2.2.2 The heart and blood vessels

Question 15

June 2024 | 8461/1H | Original Q1

0 1 A person has coronary heart disease.

0 1 . 1 Which blood vessels are affected by coronary heart disease?

[1 mark]

Tick (✓) **one** box.

Arteries ☐

Capillaries ☐

Veins ☐

A person's heart stops beating.

The person stops breathing.

A first-aider pushes down on the person's chest.

Pushing down on the person's chest puts pressure on the heart.

0 1 . 2 Explain why putting pressure on the heart helps the person.

[2 marks]

4.2.2.2 The heart and blood vessels

Question 15 · continued

0 1 . 3 The first-aider also forces air into the person's lungs by blowing into their mouth.

Describe how forcing air into the person's lungs helps the person.

[1 mark]

0 1 . 4 The person's heart starts to beat again and the person starts breathing.

The person has a high level of cholesterol in their blood.

Name **one** type of drug that would decrease the level of cholesterol in the person's blood.

[1 mark]

0 1 . 5 A doctor decides that the person needs to have a stent fitted.

Explain how a stent works to treat coronary heart disease.

[2 marks]

Question 1 continues on the next page

Question 15 · continued

Table 1 shows the effect of smoking on the risk of developing different cardiovascular diseases.

Table 1

Cardiovascular disease	Percentage (%) increase in risk compared to people who have never smoked
E	14
F	20
G	29
H	70

0 1 . 6 Give **two** conclusions that can be made from the data in **Table 1**.

[2 marks]

1 _____

_____

2 _____

_____

0 1 . 7 Complete **Figure 1**.

You should:

- label the y-axis
- add the correct scale to the y-axis
- plot the data from **Table 1**
- label each bar.

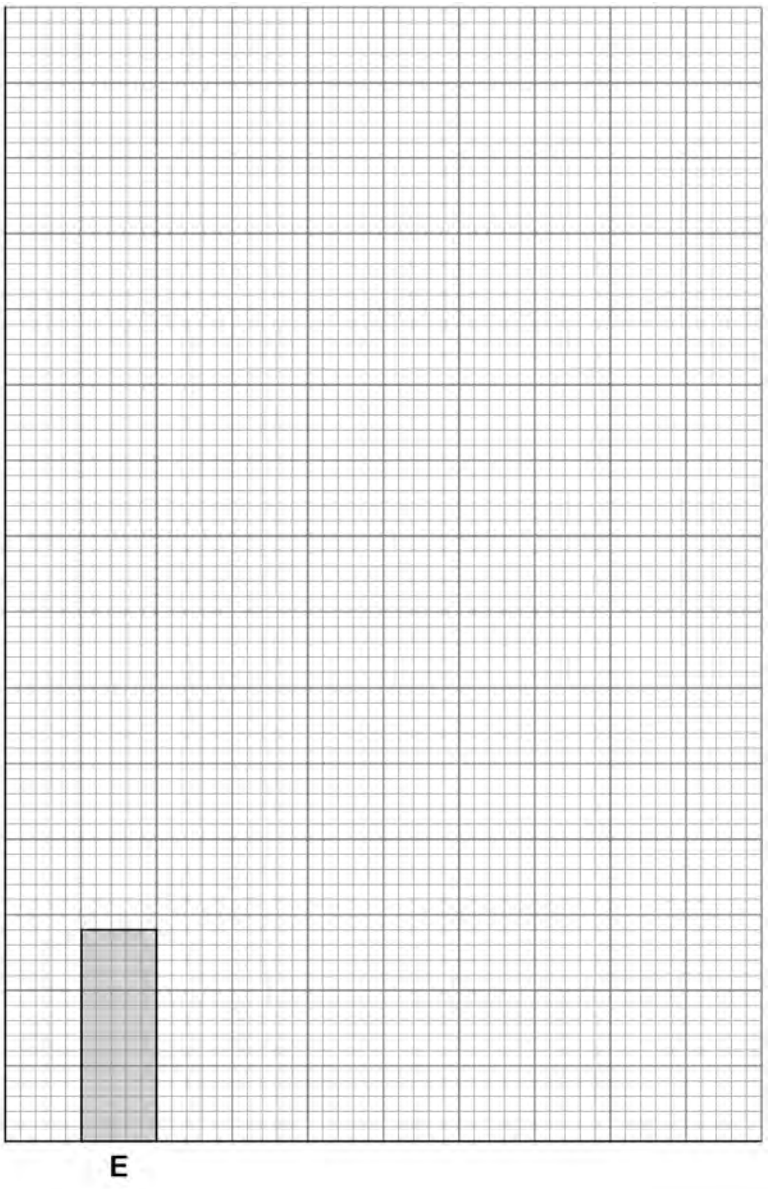
The bar for cardiovascular disease **E** has been plotted for you.

[4 marks]

4.2.2.2 The heart and blood vessels

Question 15 · continued

Figure 1



0 1 . 8 Describe **one** lifestyle factor that can increase the risk of cardiovascular disease.

Do **not** refer to smoking in your answer.

[1 mark]

14

4.2.2.2 The heart and blood vessels

Question 16

June 2025 | 8461/1H | Original Q5

0 5 This question is about the human circulatory system.

0 5 . 1 Blood plasma transports blood cells around the body.

Give **one** other function of blood plasma.

Do **not** refer to oxygen in your answer.

[1 mark]

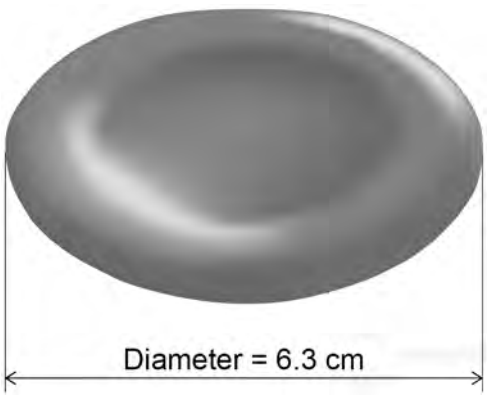
Question 5 continues on the next page

4.2.2.2 The heart and blood vessels

Question 16 · continued

0 5 . 2 **Figure 5** shows a red blood cell.

Figure 5



The image of the red blood cell in **Figure 5** is magnified 7200 times.

Calculate the real diameter of the red blood cell.

Give your answer in micrometres (µm).

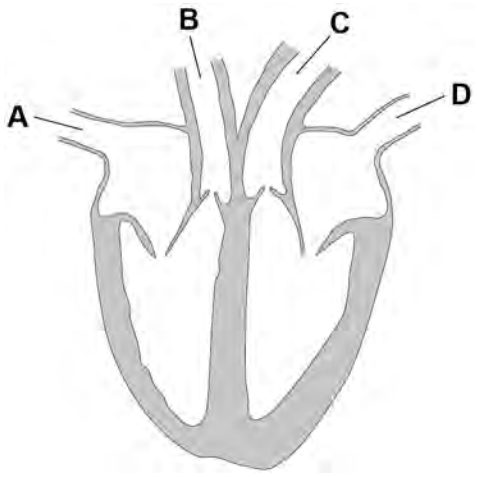
[5 marks]

Real diameter = _____ µm

Question 16 · continued

Figure 6 shows the heart.

Figure 6



0 5 . 3 Blood pressure is a measure of the force of the blood against the walls of the blood vessels.

Table 5 shows information about the different types of blood vessel shown in **Figure 6**.

[2 marks]

Table 5

Pressure of blood travelling through blood vessel in arbitrary units	Blood vessel in Figure 6
4	**D**
5	
18	
120	

Complete **Table 5** using the correct letters from **Figure 6**.

One row has been completed for you.

0 5 . 4 Name blood vessel **D** in **Figure 6**.

[1 mark]

Question 5 continues on the next page

4.2.2.2 The heart and blood vessels

Question 16 · continued

0 5 . 5 Describe the structure of the walls of an artery.

[1 mark]

An athlete ran on a running machine.

The athlete:

- reached their maximum intensity of exercise and then stopped exercising
- had their use of oxygen recorded
- had the lactic acid concentration in their blood recorded.

0 5 . 6 During the exercise the athlete respired aerobically **and** anaerobically.

Explain why anaerobic respiration is less efficient than aerobic respiration.

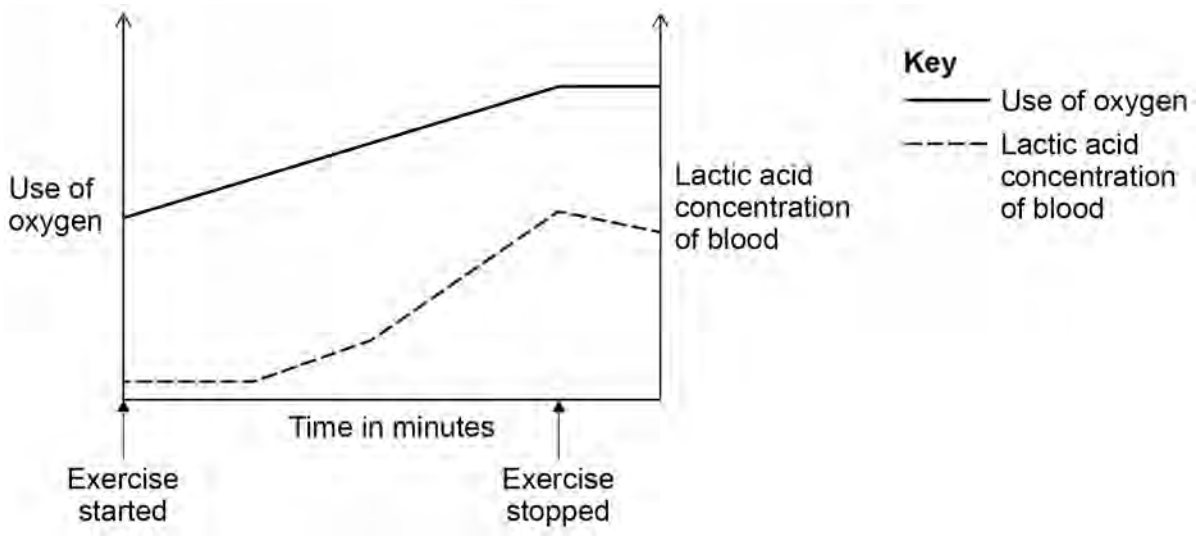
[2 marks]

4.2.2.2 The heart and blood vessels

Question 16 · continued

Figure 7 shows the athlete's use of oxygen and the lactic acid concentration of blood during exercise and after exercise.

Figure 7



0 5 . 7 Explain why the use of oxygen remained high **after** the athlete stopped exercising.

[2 marks]

Question 5 continues on the next page

4.2.2.2 The heart and blood vessels

Question 16 · continued

0 5 . 8 Some athletes regularly exercise in conditions that increase the number of red blood cells.

Explain why having an increased number of red blood cells is an advantage to an athlete.

[2 marks]

16