GCSE Biology

The Heart and Heart Disease

Question Paper

Time available: 90 minutes
Marks available: 81 marks

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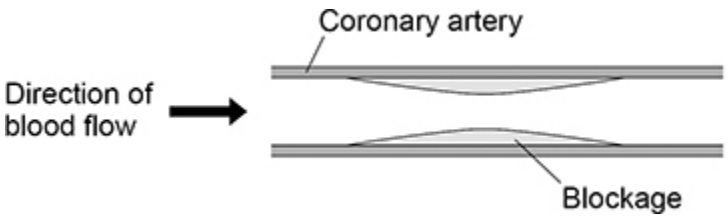
1. A high cholesterol concentration in the blood can lead to blockages inside arteries.

The coronary arteries supply blood to the heart muscle.

Figure 1 shows a coronary artery with a blockage.

Figure 1



(a) Why could the blockage in **Figure 1** cause cells in the heart to die?

_____

_____

_____

_____

(2)

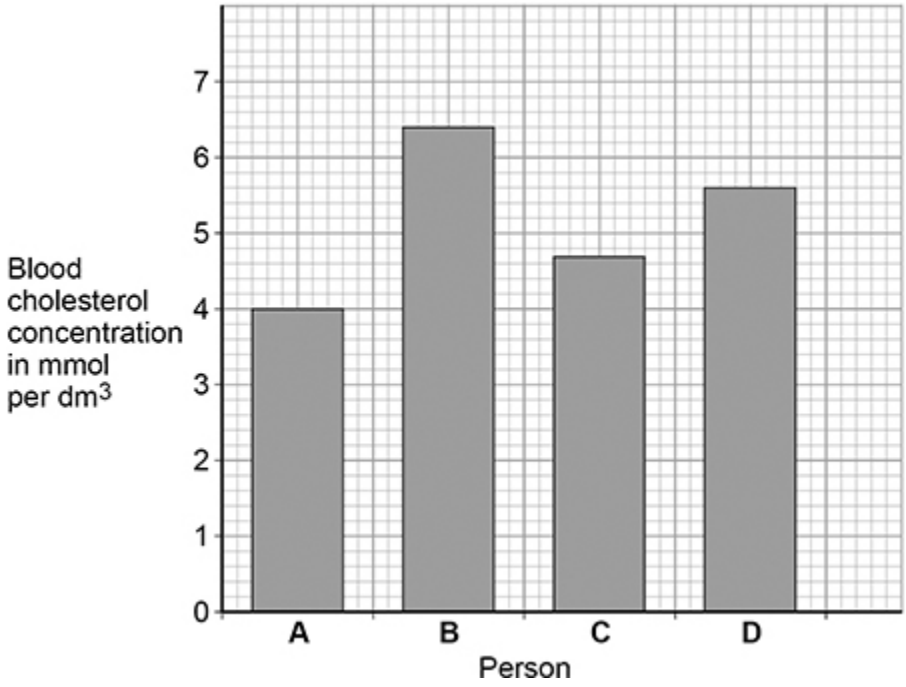
Doctors can measure the concentration of cholesterol in the blood.

The table below shows four different blood cholesterol categories.

Blood cholesterol concentration in mmol per dm^3	**Cholesterol category**
<4.6	Low
4.6–5.0	Normal
5.1–6.1	Medium
6.2 and above	High

Figure 2 shows the blood cholesterol concentration of four people.

Figure 2



(b) Which person is in the medium cholesterol category?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) Which person is most at risk of having a heart attack?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(d) Give a reason for your answer to part (c).

_____

_____

(1)

(e) The blood cholesterol concentration of person **D** is greater than the blood cholesterol concentration of person **A**.

Calculate how many times greater.

Use **Figure 2**.

_____

_____

_____

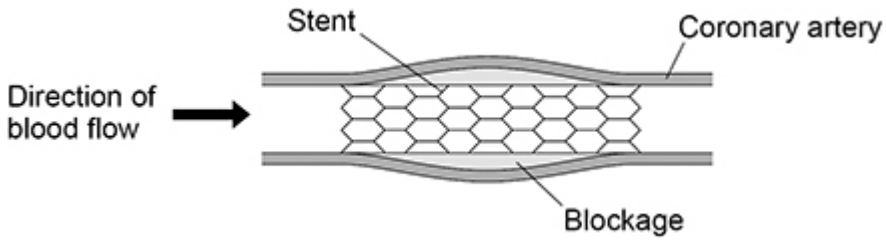
_____

Number of times greater = _____

(2)

Figure 3 shows how a stent can be used to treat a person with a blockage in a coronary artery.

Figure 3



(f) Explain how a stent works as a treatment for a person with a blockage in a coronary artery.

_____

_____

_____

_____

(2)

Patients are given anti-clotting drugs after they have a stent fitted.

The drugs help to prevent clots forming in the blood.

(g) Which part of the blood starts the blood clotting process?

Tick (✓) **one** box.

Antibodies ☐

Plasma ☐

Platelets ☐

Red blood cells ☐

(1)

(h) When a stent is fitted the doctor gives the patient an injection of anti-clotting drugs.

The patient then takes one anti-clotting tablet every day.

Anti-clotting drugs:

- are very effective
- can take a week to begin working fully
- have been used for over 60 years
- cost very little to make
- do **not** work effectively if the patient eats certain types of food.

The patient must have their blood tested every few weeks to check that the anti-clotting drugs are working.

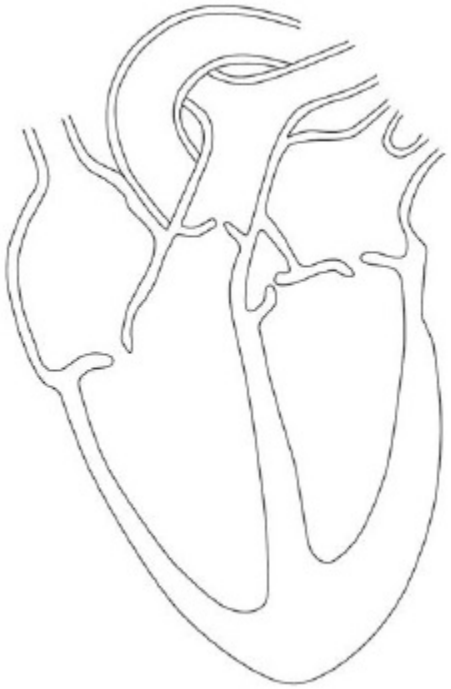
Evaluate the use of anti-clotting drugs in patients who have had a stent fitted.

(4)

(Total 14 marks)

2. **Figure 1** shows the internal structure of the human heart.

Figure 1



(a) Which organ system is the heart a part of?

_____

(1)

(b) Draw a ring around **one** valve on **Figure 1**.

(1)

(c) What is the function of the valves in the heart?

_____

_____

(1)

(d) Valves are also found inside some blood vessels.

Which type of blood vessel contains valves?

_____

(1)

Sometimes a valve in the heart can begin to leak.

A leaking heart valve may be replaced with either:

- a mechanical valve
- a biological valve from a pig.

Table 1 shows information about the replacement valves.

Table 1

Mechanical valve	Biological valve from a pig
Made of plastic or metal	Made from living tissue
Can cause the blood to clot around the valve	No risk of blood clotting around the valve
No need for another replacement valve after 5 years	Sometimes another replacement valve is needed after 5 years

(e) Suggest **two** reasons why a patient may choose a mechanical valve and **not** a biological valve from a pig.

1 _____

_____

2 _____

_____

(2)

(f) Suggest **one** reason why a patient may choose a biological valve from a pig and not a mechanical valve.

_____

_____

(1)

(g) A person may develop other medical conditions.

Draw **one** line from each medical condition to the correct treatment.

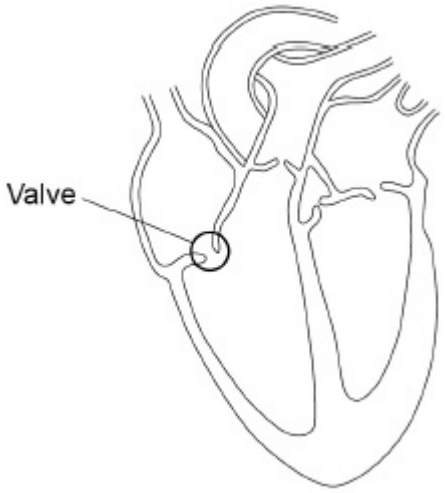
Medical condition	Treatment
High blood cholesterol	Antibiotics
	Artificial pacemaker
Irregular heart rate	Insulin
	Statins

(2)

(Total 9 marks)

3. The figure below shows the internal structure of the human heart.

One of the heart valves is labelled.



Sometimes a valve in the heart can start to leak.

(a) Explain why a person with a leaking heart valve has difficulty exercising.

(4)

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.

The following table shows the data.

	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

(b) Give **one** conclusion about the death of patients from heart-related problems after a valve replacement.

Include calculations to support your answer.

(3)

(c) 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)

(d) Evaluate the use of mechanical replacement heart valves and biological replacement heart valves.

Use information from the table above and your own knowledge.

(6)

(Total 14 marks)

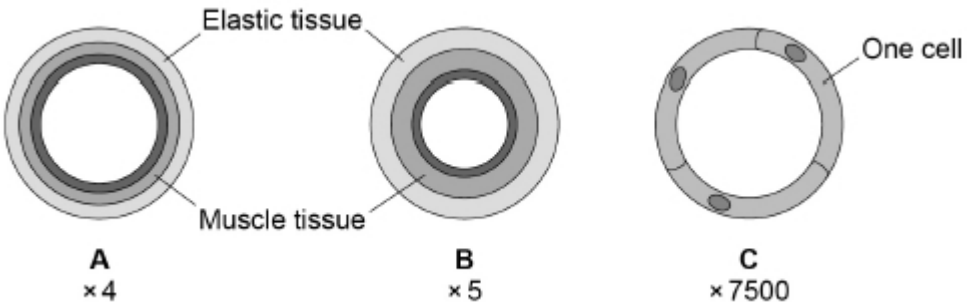
4. This question is about the circulatory system.

(a) Draw **one** line from each blood component to its function.

Blood Component	Function
	Destroys microorganisms
Platelet	Helps the blood to clot
Red blood cell	Transports glucose around the body
White blood cell	Transports oxygen around the body
	Transports urea

(3)

(b) The diagram below shows cross sections of the three main types of blood vessel found in the human body. Each blood vessel is drawn to the scale shown.



Which blood vessel has the smallest diameter?

Tick **one** box.

A		B		C	

(1)

(c) Which blood vessel in the figure above is an artery?

Give **one** reason for your answer.

Blood vessel: _____

Reason: _____

_____

(2)

Table 1 gives information about the blood flow in two people.

Table 1

Person	**Blood flow through the coronary arteries in cm^3 / minute**
A – does **not** have coronary heart disease	250
B – has coronary heart disease	155

(d) Calculate the difference in blood flow between person **A** and person **B**.

_____

_____

Difference = _____ cm^3 / minute

(1)

(e) Suggest why blood flow through the coronary arteries is lower in people with coronary heart disease.

_____

_____

(1)

(f) Calculate the volume of blood flowing through the coronary arteries of person **A** in 1 hour.

Give your answer in dm^3.

_____

_____

_____

_____

_____

Volume of blood in 1 hour = _____ dm^3

(2)

Coronary heart disease can be treated by:

- inserting a stent
- using a Coronary Artery Bypass Graft (CABG).

Table 2 gives information about each method.

Table 2

	Stent	CABG
Procedure	The patient is awake during the procedure. A small cut is made in the skin. A wire mesh is inserted into the coronary artery via a blood vessel in the arm or leg.	The patient is not awake during the procedure. The chest is cut open. A section of blood vessel from the arm or leg is removed. It is used to create a new channel for blood to bypass the blockage in the coronary artery.
When procedure is recommended	When only one blockage is present	When multiple blockages are present
Time spent in hospital after procedure	2-3 hours	at least 7 days
Recovery time after procedure	7 days	12 weeks
Risk of heart attack during procedure	1%	2%
Chance of failure within one year	40%	5%

(g) Give **two** advantages of using a stent instead of CABG.

1. _____

_____

2. _____

_____

(2)

(h) Give **two** advantages of using CABG instead of a stent.

1. _____

_____

2. _____

_____

(2)

(Total 14 marks)

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

(a) Urea is transported in the blood plasma.

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

1. _____

2. _____

(2)

(b) 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)

(c) Which **two** blood vessels carry deoxygenated blood?

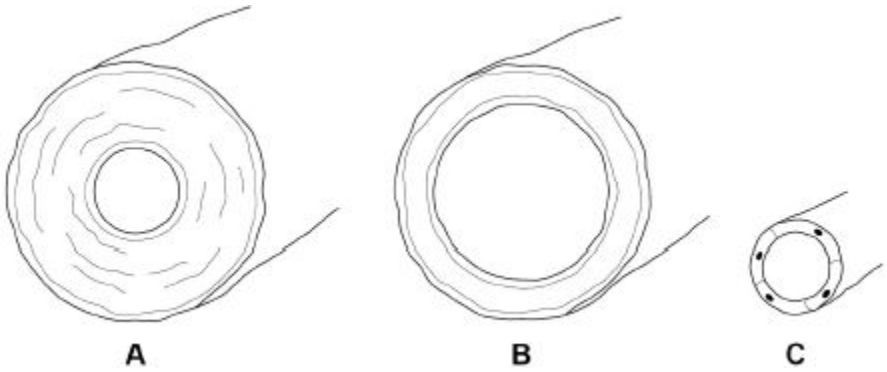
Tick **two** boxes.

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

(2)

Figure 1 shows the three types of blood vessel.

Figure 1



(d) Which type of blood vessel carries blood into the right atrium?

Tick **one** box.

A		B		C	

(1)

(e) Compare the structure of an artery with the structure of a vein.

_____

_____

_____

_____

_____

_____

_____

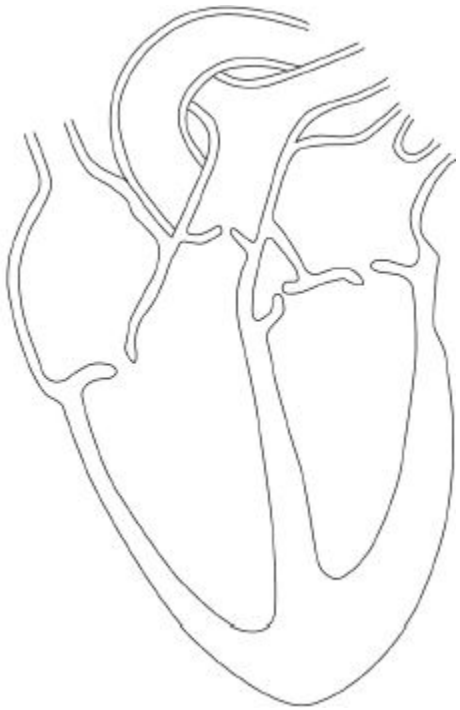
(3)

(f) Heart rate is controlled by a group of cells. This group of cells act as a pacemaker.

Figure 2 shows a section through the heart.

Draw an **X** on **Figure 2** to show the position of the pacemaker.

Figure 2



(1)

(g) A patient may be fitted with an artificial pacemaker.

What condition may be treated using an artificial pacemaker?

_____

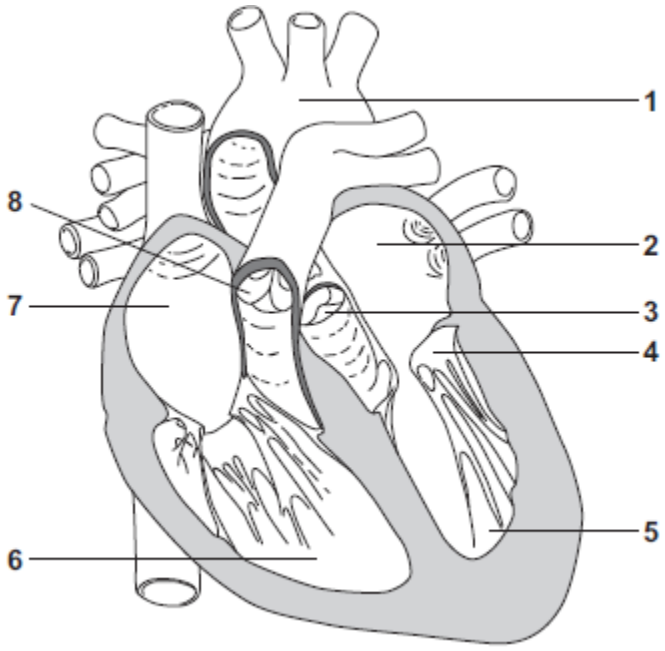
_____

(1)

(Total 13 marks)

6. The diagram in **Figure 1** shows a section through the human heart, seen from the front.

Figure 1



(a) Draw a ring around the correct answer to complete each sentence.

(i) The wall of the heart is made mostly of

epithelial
glandular
muscular

tissue.

(1)

(ii) The resting heart rate is controlled by the pacemaker.

The pacemaker is located at position

1.
6.
7.

(1)

(iii) If a person's heart rate is irregular, the person may be fitted with an artificial pacemaker.

The artificial pacemaker is

an electrical device.
a pump.
a valve.

(1)

(b) (i) Write a number, **2**, **5**, **6** or **7**, in **each** of the three boxes to answer this question.

Which chamber of the heart:

pumps oxygenated blood to the head and body ☐

receives deoxygenated blood from the head and body ☐

receives oxygenated blood from the lungs? ☐

(3)

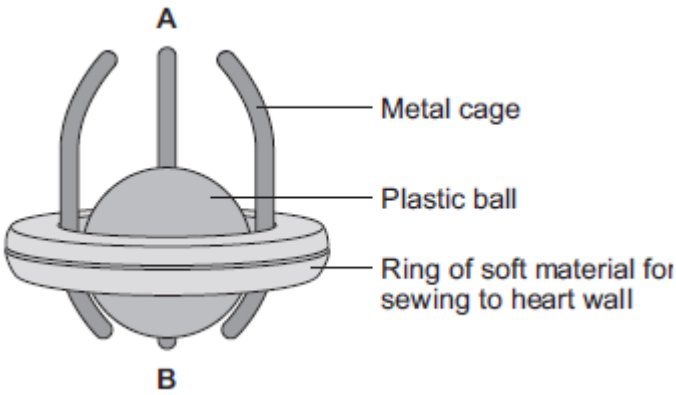
(ii) Give the number, **3**, 4 or **8**, of the valve that closes when the blood pressure in the aorta is greater than the blood pressure in the left ventricle.

Write the correct answer in the box. ☐

(1)

(c) The diagram in **Figure 2** shows one type of artificial heart valve. The plastic ball is in the closed position.

Figure 2



This type of artificial valve could be used to replace a faulty valve in the heart.

(i) What is the function of valves in the heart?

_____

_____

(1)

(ii) The artificial valve could be used to replace valve **4** shown in **Figure 1**.

The artificial valve opens to let blood through when the ball is moved towards **A**.

Which end of the valve, **A** or **B**, should point towards chamber **5**?

Explain your answer.

_____

_____

_____

_____

_____

_____

_____

(3)

(d) (i) The artificial heart valve may cause blood clots to form on its surface.

Describe what happens during blood clotting.

_____

_____

_____

_____

(2)

(ii) Read the information in the passage.

> Replacing a damaged heart valve can dramatically improve the blood circulation and the supply of oxygen to the body's tissues. The operation to replace a heart valve is a long one during which the patient's blood goes through a bypass machine. Sometimes the artificial valve can fail to work. If the surface of the valve becomes rough, small blood clots can form on its surface then break away and be carried around the body by the blood.

Evaluate the advantages and disadvantages of artificial heart valves.

(4)

(Total 17 marks)