

6.2 The Blood System

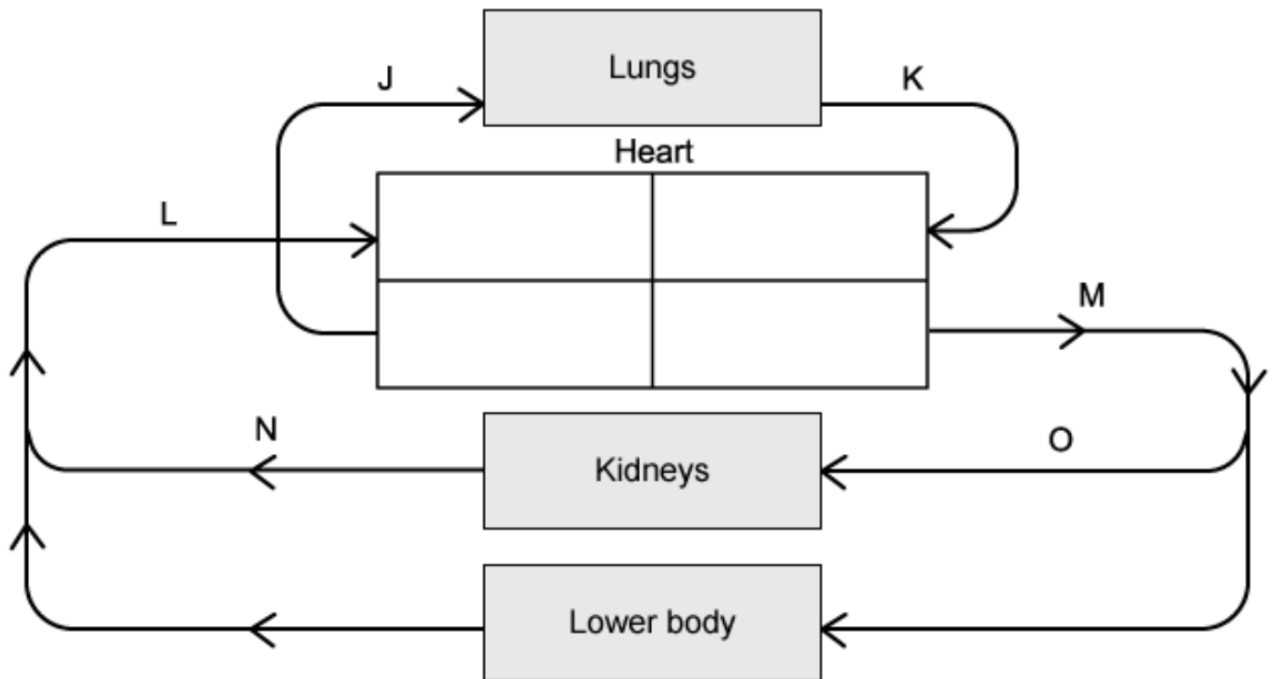
Question Paper

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|------------|----------------------|
| Course | DP IB Biology |
| Section | 6. Human Physiology |
| Topic | 6.2 The Blood System |
| Difficulty | Medium |

Time allowed: 60
Score: /47
Percentage: /100

Question 1a

a) The diagram below shows part of the blood circulation in a mammal.



Identify the letter that represents each of the following blood vessels

Pulmonary vein

Pulmonary artery

[2 marks]

Question 1b

- b) Explain the function of the coronary arteries.

[2 marks]

Question 1c

- c) The human circulatory system is a closed, double circulatory system.

Explain what is meant by this.

[2 marks]

Question 1d

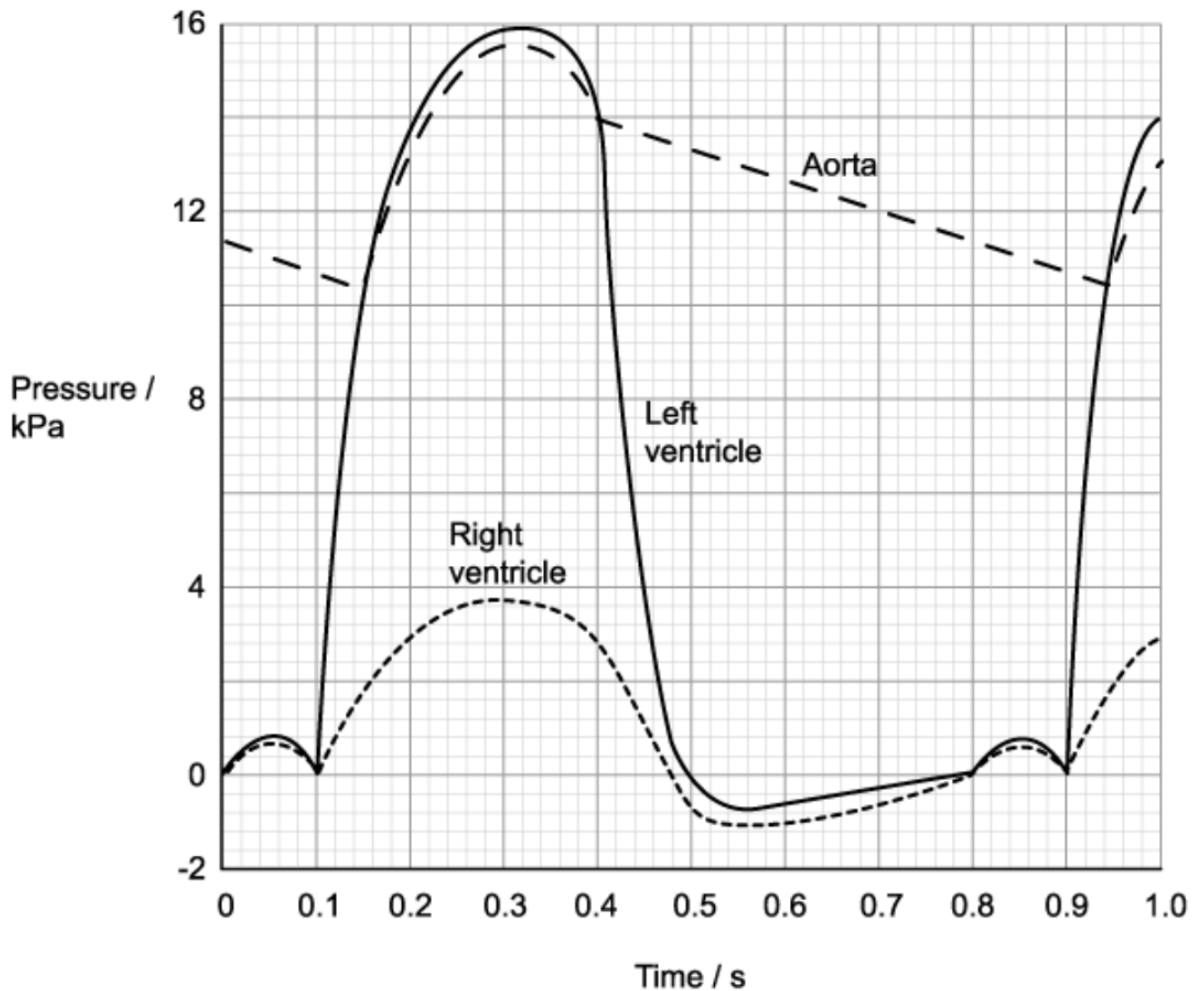
- d) Babies can sometimes be born with a small hole between the right and left ventricles of their heart.

Suggest why these babies often have problems supplying their tissues with enough oxygen.

[2 marks]

Question 2a

- a) The graph below shows changes in pressure in parts of a human heart during one second.



Identify the time at which the semilunar valves open.

[1 mark]

Question 2b

- b) Use the graph from part (a) to calculate the heart rate in beats per minute (bpm)

[1 mark]

Question 2c

- c) Valves are important structures found in the heart and veins.

Explain how valves work.

[2 marks]

Question 2d

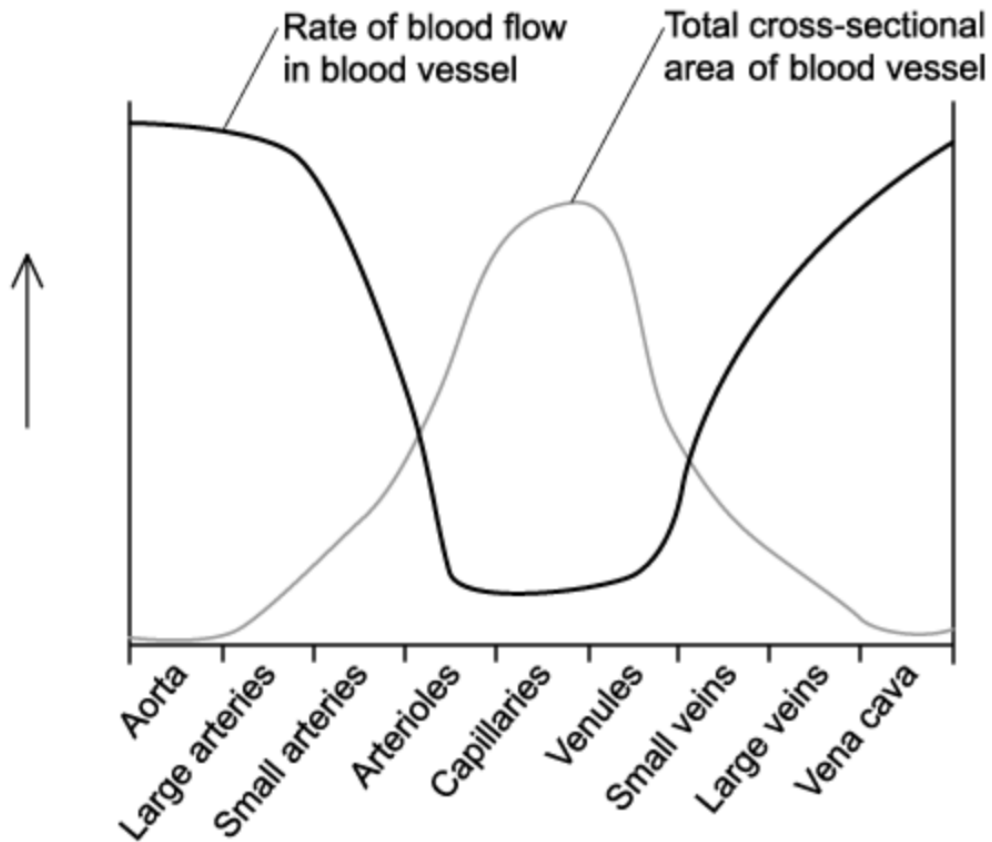
- d) Ventricular systole causes an increase in pressure in the aorta shown at around 0.16 seconds in part (a)

Explain why this increase in aortic pressure is important for the organism.

[3 marks]

Question 3a

- a) The graph below shows the rate of blood flow in various blood vessels in the body. It also shows the total cross-sectional area of the vessels.



Suggest why the rate of blood flow increases from the venules to the vena cava despite a large decrease in the total cross-sectional area.

[1 mark]

Question 3b

- b) The relative thickness of layers in the wall of an artery and a vein are shown in the table below.

| Layer in wall | Thickness / μm | |
|-------------------|---------------------------|------|
| | Artery | Vein |
| Endothelium | 25 | 25 |
| Smooth muscle | 495 | 245 |
| Elastic tissue | 375 | 245 |
| Connective tissue | 125 | 125 |

Explain the difference in the thickness of elastic tissue for the artery versus the vein.

[2 marks]

Question 3c

- c) The external diameter of a vein was measured at 1.5 mm.

Calculate the diameter of the lumen of the vein.

[2 marks]

Question 3d

- d) Explain how the structure of capillaries enable them to function efficiently as exchange surfaces.

[3 marks]

Question 4a

- a) Plant sterols and plant stanols are found in a range of food, including vegetables, cereals, seeds and nuts. Plant sterols and stanols have a similar structure to cholesterol and reduce the absorption of cholesterol in the small intestine, so more cholesterol is lost in the faeces. This helps to lower the levels of cholesterol in the blood and in turn, reduce the risk of coronary heart disease (CHD).

A group of scientists wanted to investigate the effects of eating plant sterols and stanols on the risk of CHD. The scientists randomly divided healthy volunteers into two groups. Every day for eight weeks, one group was given plant sterols and stanols to eat. The other group acted as a control.

Each week, the scientists measured the diameter of the lumen of the main artery in the arm of the volunteers.

State how the control group should have been treated.

[2 marks]

Question 4b

- b) The results of the experiment in part (a) are shown in the table below.

| | Mean maximum diameter of lumen of main artery in the arm (mm) | |
|--------------------------|---|--|
| | Experimental group (\pm standard deviation) | Control group (\pm standard deviation) |
| Before experiment | 0.69 (\pm 0.02) | 0.71 (\pm 0.02) |
| After 8 weeks | 0.74 (\pm 0.03) | 0.72 (\pm 0.05) |

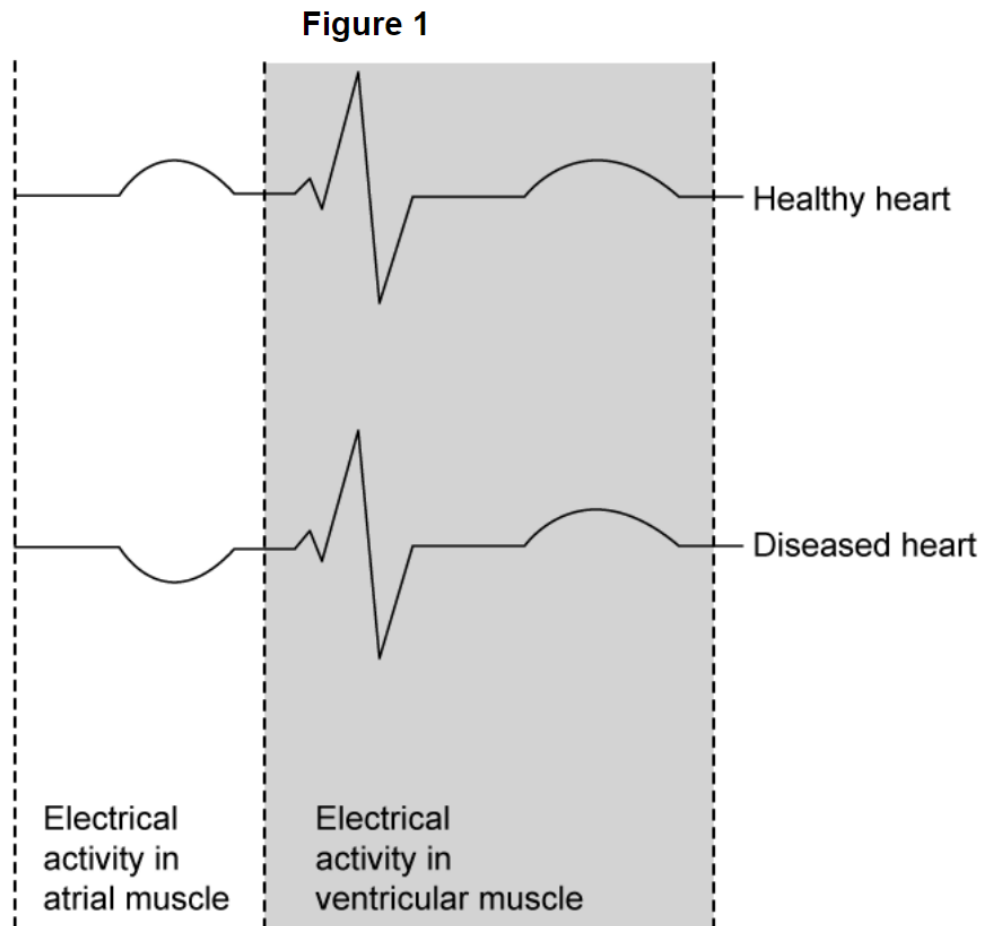
A student reading the results concluded that there was sufficient evidence to assume a causal relationship between plant sterols and stanols, and a reduced risk of CHD.

Evaluate the student's conclusion.

[3 marks]

Question 4c

- c) An electrocardiogram (ECG) measures the electrical fluctuation within a cardiac muscle as a heart is beating. The diagram below shows an ECG trace for a normal, healthy person and an ECG trace for a person suffering from heart disease.



Describe the path that electrical impulses follow when they are transmitted from the sinoatrial node to cause contraction in the ventricular muscle in a healthy heart.

[2 marks]

Question 4d

- d) Suggest how the information from part (c) shows that the damage caused to the diseased heart is likely to have affected the sinoatrial node (SAN).

[2 marks]

Question 5a

One mark is available for clarity of communication throughout this question.

- a) Explain what causes heart rate to increase during exercise.

[6 marks]

Question 5b

- b) Describe how blood returns to the heart from the legs.

[4 marks]

Question 5c

- c) Outline William Harvey's theories about circulation

[5 marks]