8. Transport in Mammals

8.3 The Heart

Paper 2

Question Paper

1 Some people who are infected with HIV have HIV/AIDS.

(c) Studies suggest that people who are infected with HIV may be at a higher risk of heart disease. One cause of heart disease is the narrowing of the lumen of one or both of the main coronary arteries.

A coronary artery bypass graft (bypass graft) is a surgical operation that uses healthy blood vessels to divert blood around diseased sections of coronary arteries. The main choice of blood vessel to use for a bypass graft is known as the internal thoracic artery.

Fig. 6.1 is a diagram of an external view of the heart to show a **double** bypass graft.

The blood vessels used in the bypass graft shown in Fig. 6.1 are the great saphenous vein from the leg and the internal thoracic artery.

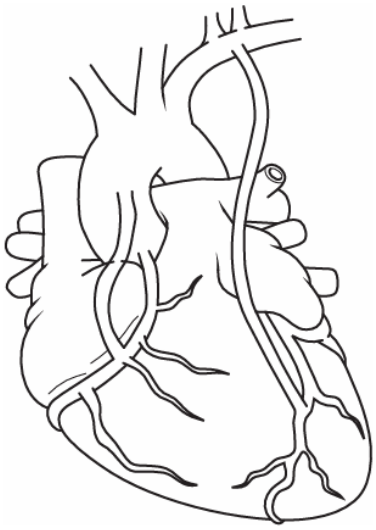


Fig. 6.1

(i) Draw a cross (**X**) on Fig. 6.1 to show an area of the **right** coronary artery that has been bypassed. [1]

2 **(d)** The heart rate of a penguin decreases while it is swimming underwater.

Heart rate is regulated by a group of specialised cells in the wall of the right atrium. The activity of these cells is modified by nerve impulses.

Name the group of specialised cells in the wall of the right atrium that regulates heart rate.

..... [1]

3 The sinoatrial node (SAN) and the atrioventricular node (AVN) have an important role in the control of the cardiac cycle. The timing of atrial and ventricular systole and diastole must be controlled so that blood passes through the heart efficiently.

(a) Fig. 1.1 is a summary of blood flow through the **right** side of the heart during one cardiac cycle. Three boxes in Fig. 1.1 are **not** complete.

Complete boxes **3**, **5** and **7** in Fig. 1.1 using **only** the terms **systole** and **diastole**.

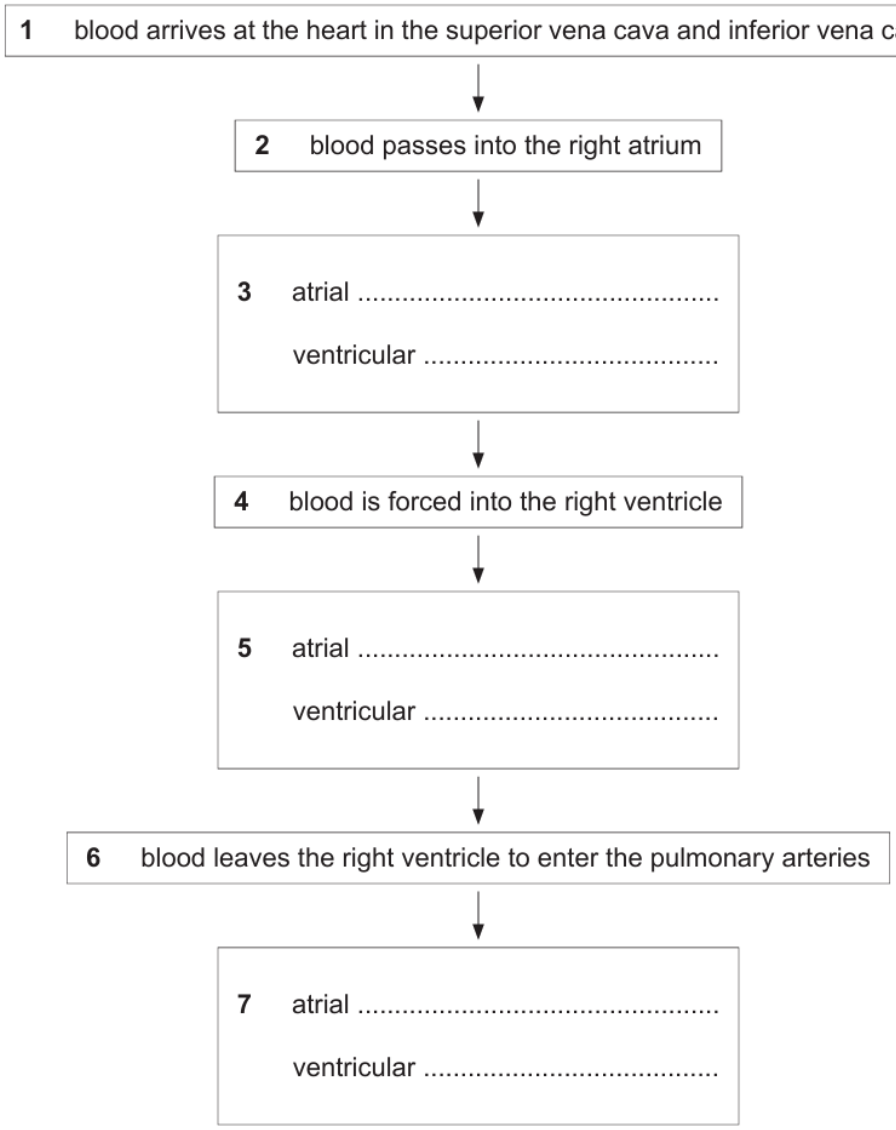


Fig. 1.1

[2]

(b) Impulses sent out by the SAN pass to the AVN, where there is a short delay.

With reference to Fig. 1.1, explain why it is important for the control of the cardiac cycle that there is a short delay at the AVN after impulses have been sent out by the SAN.

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(c) Changes in blood pressure occur in the heart during the cardiac cycle. These changes cause the opening and closing of the bicuspid and tricuspid (atrioventricular) valves and the aortic and pulmonary (semilunar) valves.

Explain how blood pressure changes:

- cause the **opening** of the **tricuspid** valve
- cause the **opening** of the **pulmonary** valve
- help the flow of blood through the heart.

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..... [3]

4 Some people who are infected with HIV develop HIV/AIDS.

(c) A person infected with HIV may develop a heart condition called cardiac tamponade.

The pericardium is a thin sac surrounding the heart, as shown in the healthy heart in Fig. 4.2. When a person develops cardiac tamponade, the pericardium starts to fill with blood. This prevents the ventricles functioning efficiently.

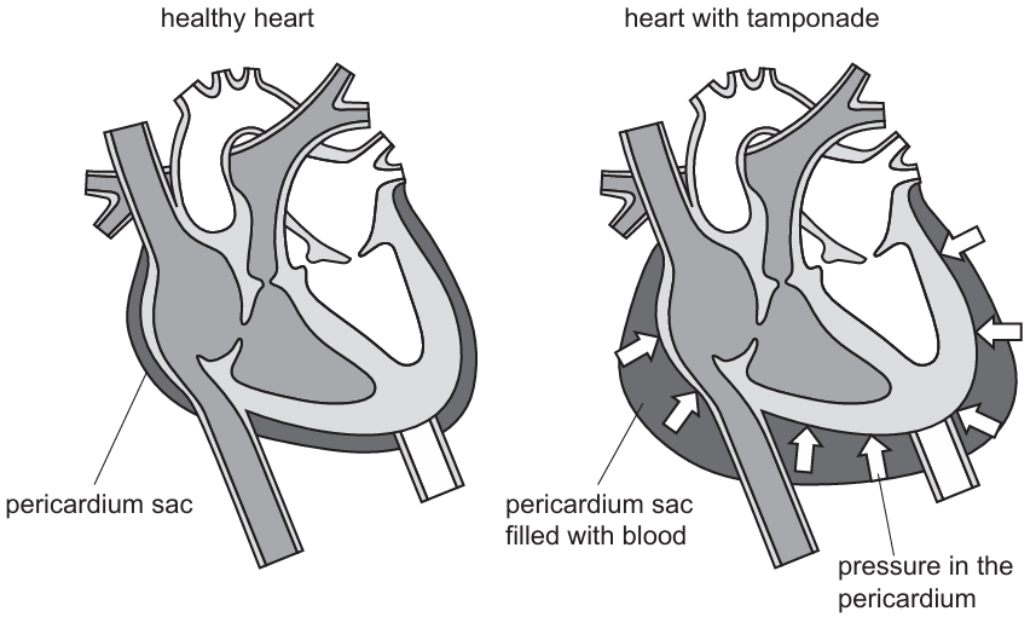


Fig. 4.2

People with cardiac tamponade experience a variety of symptoms including low blood pressure and an increased breathing rate.

Suggest why a person with cardiac tamponade would experience symptoms of low blood pressure and an increased breathing rate.

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5 Hummingbirds are the smallest of birds and are found in the Americas. Some species migrate hundreds of kilometres between warmer overwintering areas and summer breeding grounds. Like mammals, birds maintain a constant body temperature.

Hummingbirds have a high requirement for sugars because they have a very high metabolic rate. Fig. 3.1 shows a hummingbird feeding on nectar, one of their main food sources.



Fig. 3.1

(d) The heart of birds has the same structure as the heart of mammals. Compared with the heart of mammals, the heart of birds is larger in proportion to their body size.

Suggest why the heart of birds is larger in proportion to their body size.

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..... [2]

6 The mammalian circulatory system is adapted for the long-distance transport of the respiratory gases, oxygen and carbon dioxide.

The system is described as a closed double circulation.

(c) Fig. 1.1 is a diagram of a section through the heart.

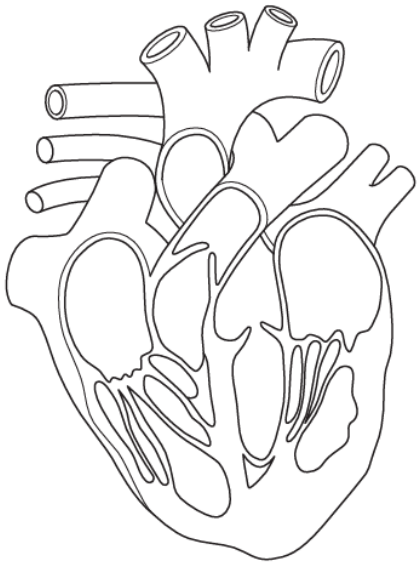


Fig. 1.1

On Fig. 1.1:

- add a label line and the letter **L** to show the artery that takes blood from the heart to the lungs
- add a label line and the letter **R** to show the valve that closes when the right ventricle is in systole. [2]

7 Fig. 6.1 is a diagram of sections through the heart showing two stages of the cardiac cycle, **A** and **B**.

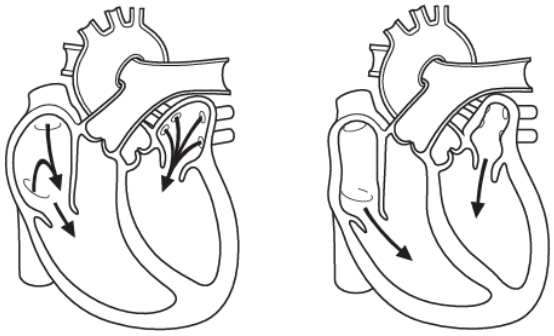


Fig. 6.1

(a) Name stage **B** in Fig. 6.1 **and** state one piece of evidence from the diagram that supports your answer.

stage **B** .....

evidence .....

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..... [2]

(b) **(i)** Draw a label line on Fig. 6.1 to identify **one** semilunar valve. Label the valve **S**. [1]

(ii) Describe the role of the semilunar valves in the cardiac cycle.

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..... [2]

8 In a healthy mammalian heart, contraction of the four chambers is coordinated by the action of the sinoatrial node (SAN) and atrioventricular node (AVN).

(a) After the atria fill with blood, atrial systole (contraction) occurs.

State the events that occur to initiate and cause atrial systole.

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(b) State **and** explain how the structure of the heart allows the atria to contract before the ventricles.

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(c) Fig. 2.1 shows blood pressure changes that occur in the left ventricle, left atrium and aorta during one cardiac cycle.

E, **F**, **G** and **H** are the points at which a valve opens or closes as a result of blood pressure changes.

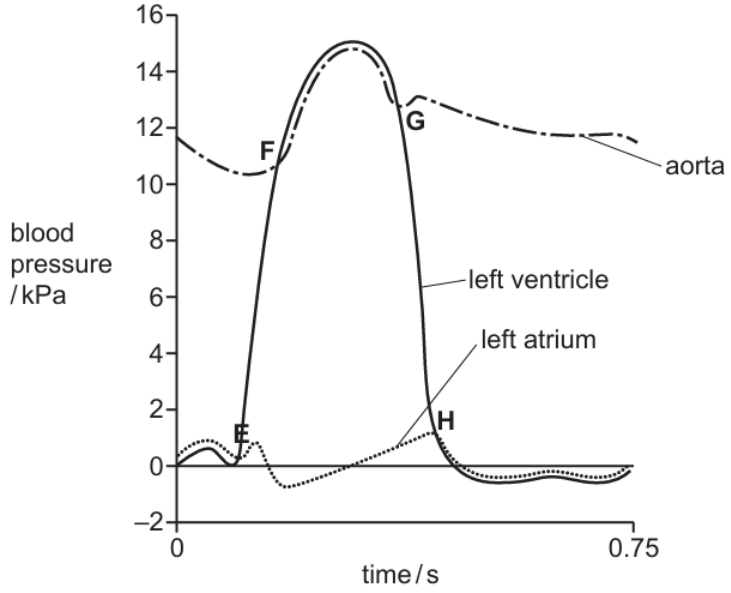


Fig. 2.1

(i) For each of the points **E**, **F**, **G** and **H** on Fig. 2.1, name the valve concerned **and** state whether the valve opens or closes.

E .....

F .....

G .....

H ..... [3]

(ii) Explain how Fig. 2.1 provides evidence that the wall of the left atrium has a different thickness to the wall of the left ventricle.

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9 **(a)** The circulatory system of mammals is a double circulation.

(ii) Fig. 3.1 is a photograph showing one valve in the mammalian heart.

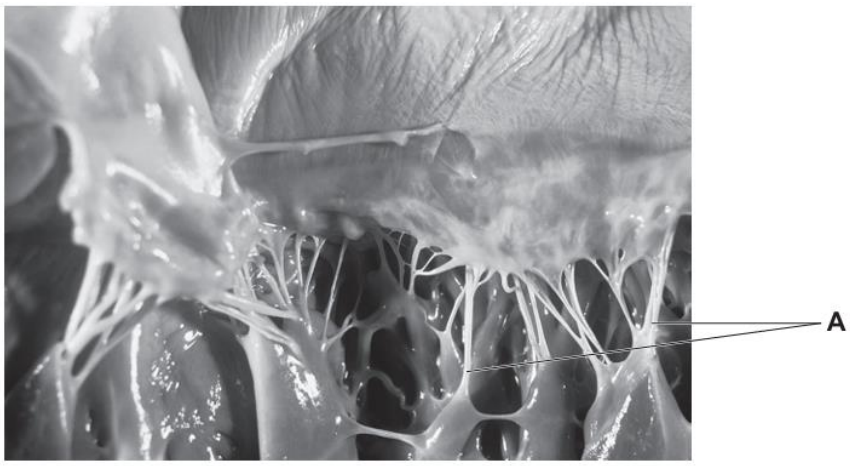


Fig. 3.1

Identify the structures labelled **A** in Fig. 3.1 **and** describe their role during the cardiac cycle.

structure **A** .....

role of structure **A**

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[3]

10 **(c)** Blood is circulated around the body by the heart.

The action of the heart is coordinated and controlled by structures located in its walls, such as the sinoatrial node (SAN) and the atrioventricular node (AVN).

(i) Describe the role of the SAN.

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(ii) In a healthy heart, the AVN provides the only pathway for electrical impulses to travel from the atria to the ventricles.

The bundle of Kent is a structure found in the heart in a small number of people.

Some electrical impulses do not pass through the AVN but travel directly from the atria to the ventricles through the bundle of Kent.

Suggest **and** explain the effects that the presence of the bundle of Kent may have on heart rate.

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..... [3]

11 **(b)** Fig. 5.1 shows a drawing of an external view of a mammalian heart.

Two cross-sections were made of the heart:

- section 1 was made across the line **A**–**B**.
- section 2 was made across the line **C**–**D**.

Drawings of the two sections were viewed from above as shown by the arrow on Fig. 5.1. Fig. 5.2 is a drawing of section **A**–**B**. Fig. 5.3 is a drawing of section **C**–**D**.

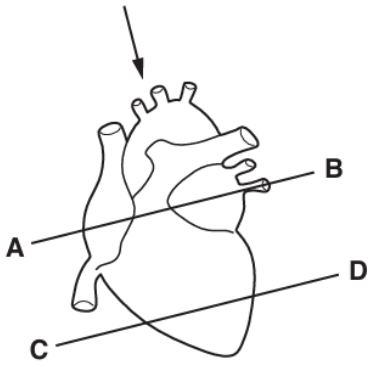


Fig. 5.1

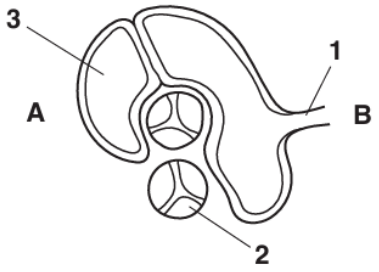


Fig. 5.2



Fig. 5.3

(i) Name structures **1**, **2** and **3**, as shown in Fig. 5.2.

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2 .....

3 .....
[3]

(ii) Explain why the wall of chamber **Y** is thicker than the wall of chamber **X**, as shown in Fig. 5.3.

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..... [3]

(c) Explain how the contractions of the chambers of the heart are coordinated during one cardiac cycle.

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..... [4]

12 When tobacco smoke is inhaled, chemicals such as nicotine and carbon monoxide enter the circulatory system through the gas exchange system. Tar builds up on the lining of the gas exchange system.

Many people decide to give up smoking tobacco in order to improve their health.

(b) Soon after a person stops smoking, the short term effects of nicotine are reversed.

State the **changes** that will occur in the cardiovascular system as a result of reduced nicotine levels.

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.....[2]

13 Woolly foxglove, *Digitalis lanata*, shown in Fig. 2.1**A**, and common oleander, *Nerium oleander*, shown in Fig. 2.1**B**, are plants grown for the attractive flowers that they produce.

Both plants are poisonous, as their leaves produce toxic organic compounds known as cardiac glycosides. Cardiac glycosides have a powerful effect on the action of cardiac muscle.



A B

Fig. 2.1

(d) Digoxin, a cardiac glycoside extracted from *D. lanata* leaves, can be purified and used as a drug to treat some heart disorders.

Examples of these heart disorders are:

- atrial fibrillation, where the normal rhythmic cardiac cycle is disrupted
- heart failure, where cardiac muscle is contracting weakly.

(i) Describe the **sequence** of events occurring in the left side of the heart during one **normal** cardiac cycle. Include reference to blood pressure changes.

The first event in the sequence is described for you.

The left atrium fills with blood during relaxation of the left atrium and left ventricle.

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(ii) Suggest how the health of a person with heart failure can be improved by treatment with the drug digoxin.

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