The Heart (8.3): Cambridge (CIE) A Level Biology 9700 Exam Questions by Topic

22 questions · 54 marks · about 65 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · Paper 2 · October/November 2022 (22) · Q1(c) · 2 marks

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

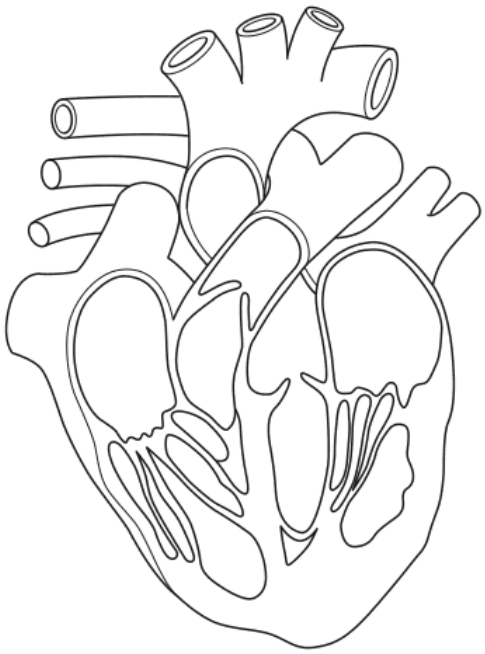


Fig. 1.1

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]

Question 2 · Paper 2 · February/March 2022 (22) · Q5(a)(i) · 1 mark

5 Control of heartbeat is myogenic. This means the electrical activity controlling the rhythm of a regular heartbeat begins in the heart muscle itself.

Atrial fibrillation (AF) is an abnormal heart rhythm that causes rapid and irregular contractions of the atria. Untreated cases of AF can lead to a stroke.

(a) A stroke is caused when a small blood clot, often forming in the left atrium, is carried by the blood to the brain where it blocks a small artery and leads to brain damage.

(i) List all of the structures through which a blood clot in the left atrium must travel to reach the blood vessels supplying the brain.

The structures must be listed in the correct sequence.

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Question 3 · Paper 2 · October/November 2017 (22) · Q6(a)(i) · 1 mark

6 Fig. 6.1 is a diagram of a vertical section through the mammalian heart. The labels **Q** to **X** represent valves and blood vessels of the heart.

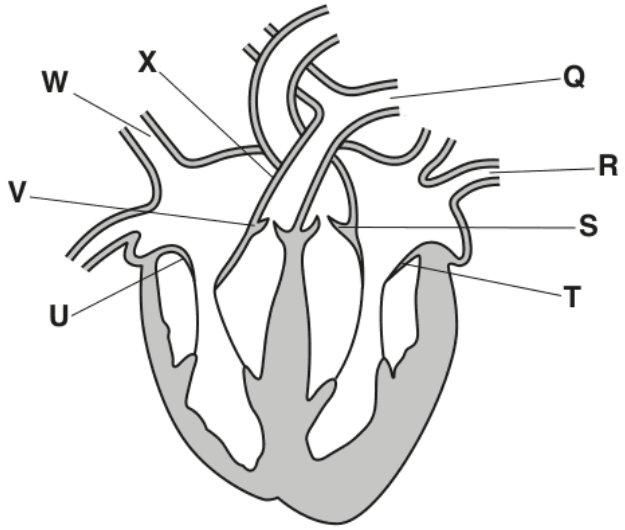


Fig. 6.1

(a) (i) State which label represents the valve that prevents the backflow of blood from the aorta into the ventricle.

Question 4 · Paper 2 · October/November 2017 (22) · Q6(a)(ii) · 2 marks

(ii) Name the blood vessel that carries oxygenated blood from the lungs to the heart **and** state which label represents this blood vessel.

name .....

label .....[2]

Question 5 · Paper 2 · February/March 2025 (22) · Q3(a)(i) · 1 mark

3 Fig. 3.1 and Fig. 3.2 are diagrams of transverse sections of the human heart during different stages of the cardiac cycle. The sections pass through the heart at a level that is just above the valves.

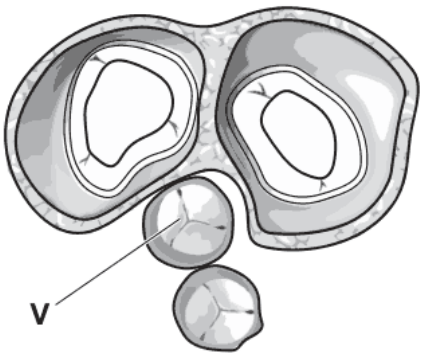


Fig. 3.1

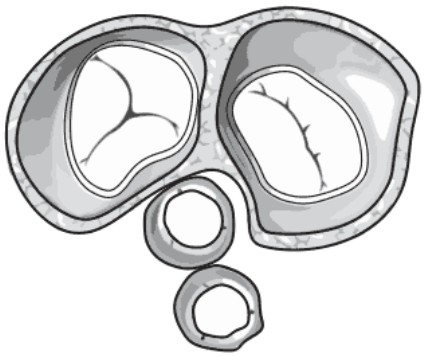


Fig. 3.2

(a) (i) Name the valve labelled **V** on Fig. 3.1.

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4 In a double circulatory system, blood passes through the heart twice in one complete circuit of the body. The complete circuit consists of the pulmonary circulation and the systemic circulation.

(a) Fig. 4.1 is a diagram of a vertical section through the mammalian heart. The differences in the thickness of cardiac muscle in the walls of the four chambers of the heart are shown.

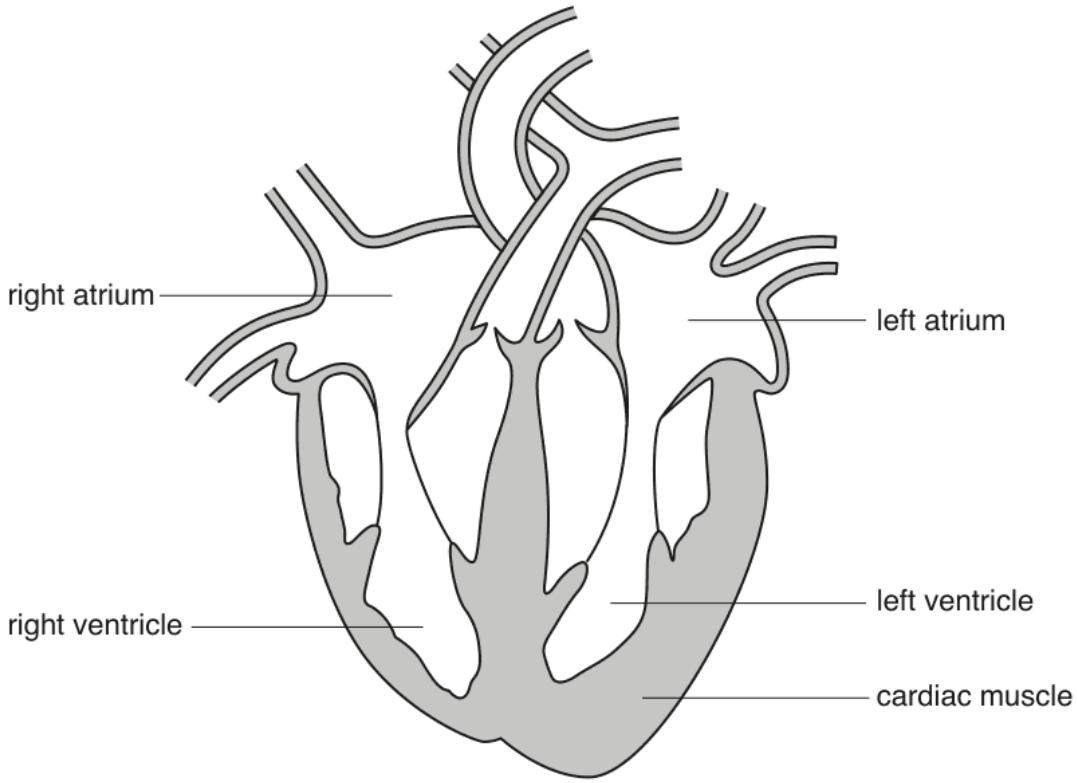


Fig. 4.1

Explain, with reference to their functions, the difference in the thickness of the walls of the left ventricle and right ventricle of the heart.

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Question 7 · Paper 2 · October/November 2023 (23) · Q6(a) · 2 marks

6 The mammalian heart consists of four chambers.

(a) Explain why the ventricles have thicker walls than the atria.

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Question 8 · information from earlier in the question

3 Fig. 3.1 and Fig. 3.2 are diagrams of transverse sections of the human heart during different stages of the cardiac cycle. The sections pass through the heart at a level that is just above the valves.

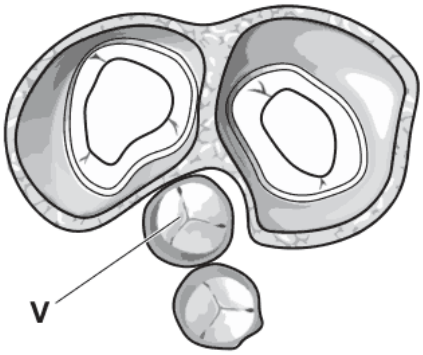


Fig. 3.1

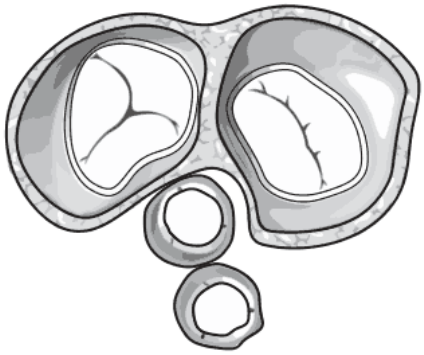


Fig. 3.2

Question 8 · Paper 2 · February/March 2025 (22) · Q3(a)(ii) · 2 marks

(ii) With reference to the chambers of the heart and the main blood vessels, describe the flow of blood through the heart that occurs when the transverse section of the heart appears as shown in Fig. 3.1.

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Question 9 · Paper 2 · February/March 2025 (22) · Q3(b) · 2 marks

(b) Identify the stage of the cardiac cycle shown in Fig. 3.2.

Give a reason for your answer.

stage of cardiac cycle .....

reason .....

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[2]

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1 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**.

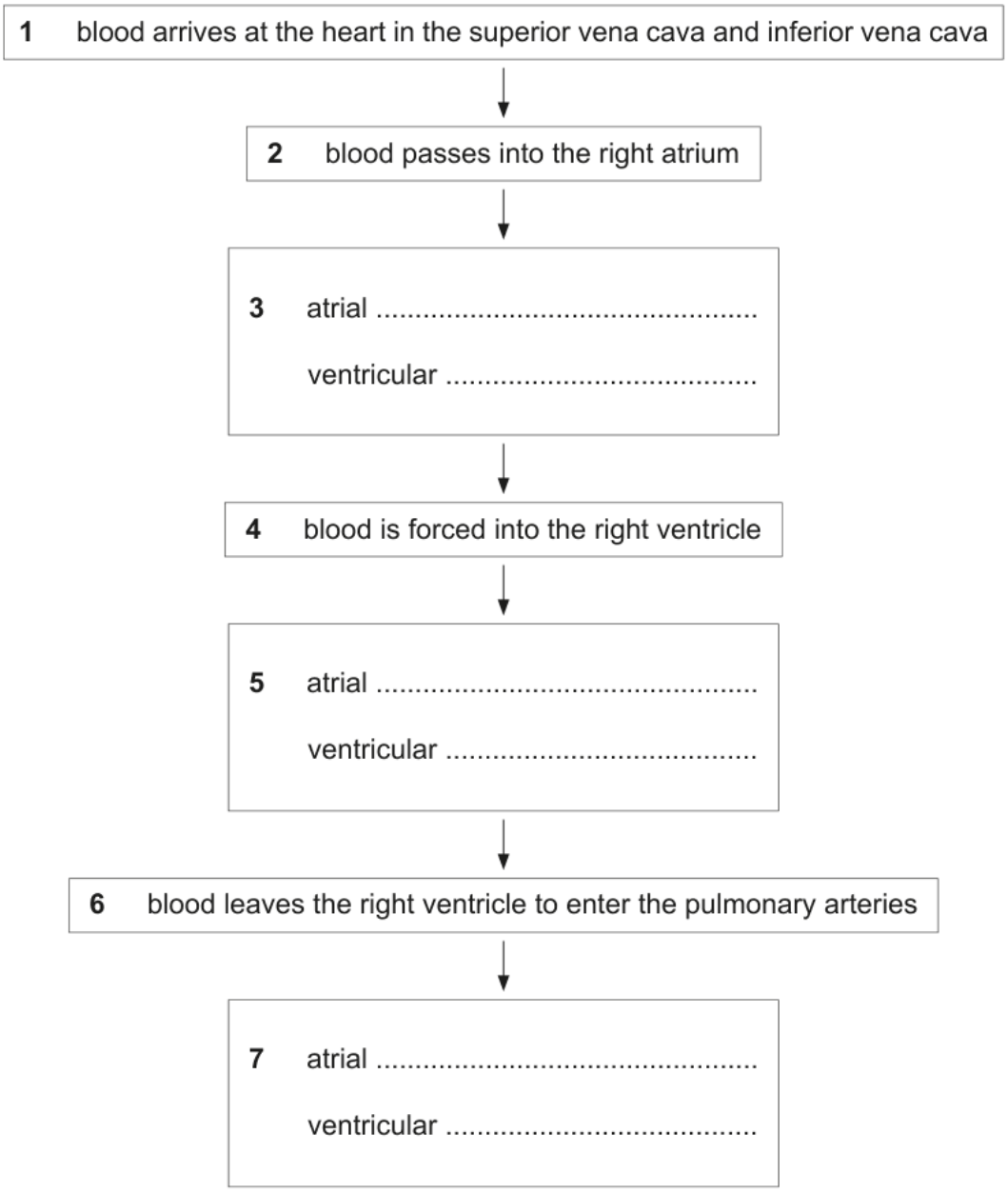


Fig. 1.1

[2]

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Question 11 · Paper 2 · May/June 2023 (22) · Q1(c) · 3 marks

(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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Question 12 · information from earlier in the question

3 During one cardiac cycle:

- blood enters the heart from the lungs and from the rest of the body
- blood leaves the heart to be transported to the lungs and to the rest of the body.

Questions, mark schemes and examiners' report extracts © Cambridge University Press & Assessment.

Question 12 · Paper 2 · February/March 2020 (22) · Q3(b) · 4 marks

(b) One phase of the cardiac cycle is ventricular diastole (ventricular relaxation). A number of events occur in the heart during this phase.

Outline **and** explain the events that occur in the heart during ventricular diastole.

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(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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Question 14 · Paper 2 · October/November 2025 (22) · Q6(a) · 5 marks

6 In the pulmonary circulation of a mammal, deoxygenated blood becomes oxygenated when red blood cells pass through alveolar capillaries and haemoglobin within the cells combines with oxygen.

The blood returns to the heart to be pumped around the systemic circulation.

(a) Describe the sequence of events occurring in the heart that allows blood returning in the pulmonary circulation to then enter the systemic circulation.

You should include in your description:

- the names of the relevant blood vessels of the pulmonary circulation and systemic circulation that are connected to the heart
- reference to blood pressure changes that cause the opening and closing of valves.

You **do not** need to include details of control of the cardiac cycle.

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Question 15 · information from earlier in the question

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

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Question 15 · Paper 2 · May/June 2020 (22) · Q2(c)(i) · 3 marks

(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.

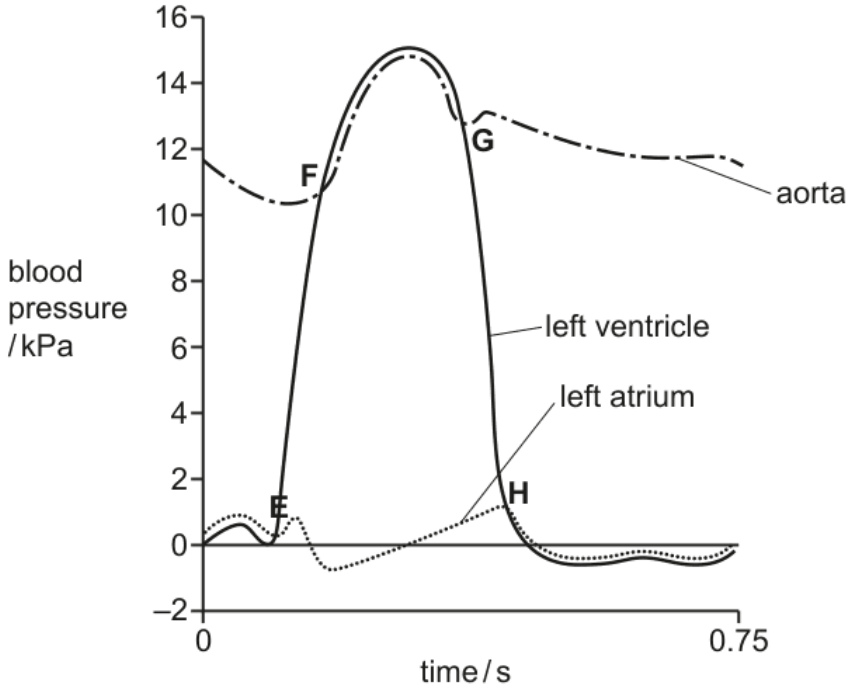


Fig. 2.1

(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]

Question 16 · Paper 2 · May/June 2020 (22) · Q2(c)(ii) · 2 marks

(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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Question 17 · Paper 2 · February/March 2025 (22) · Q3(c) · 3 marks

(c) The rate and rhythm of the heartbeat are controlled by an area of specialised muscle tissue in the wall of the right atrium, called the sinoatrial node.

Describe the sequence of events that control contraction of the ventricles during the cardiac cycle.

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Question 18 · information from earlier in the question

1 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**.

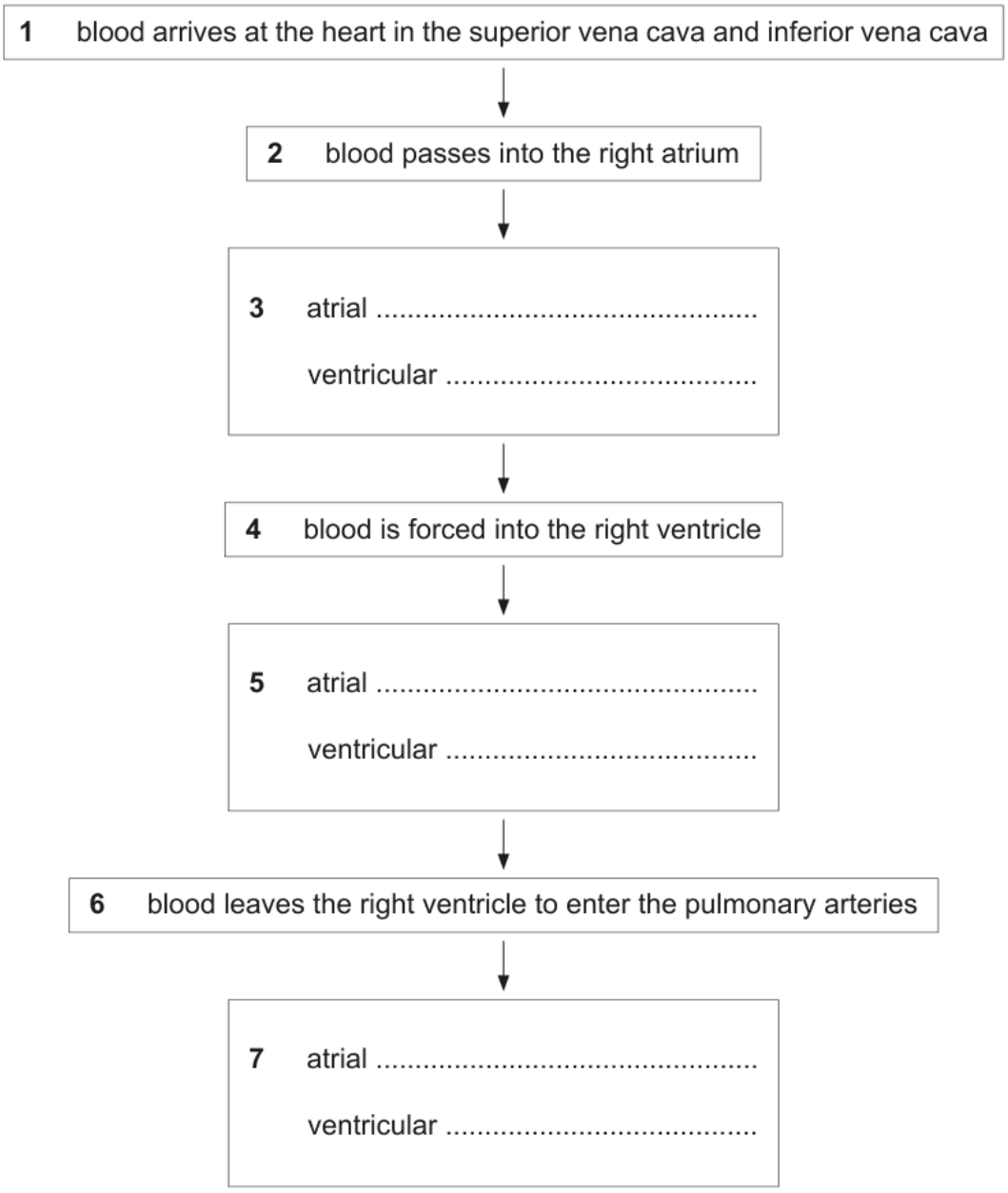


Fig. 1.1

[2]

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Question 18 · Paper 2 · May/June 2023 (22) · Q1(b) · 2 marks

(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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Question 19 · information from earlier in the question

5 Control of heartbeat is myogenic. This means the electrical activity controlling the rhythm of a regular heartbeat begins in the heart muscle itself.

Atrial fibrillation (AF) is an abnormal heart rhythm that causes rapid and irregular contractions of the atria. Untreated cases of AF can lead to a stroke.

Question 19 · Paper 2 · February/March 2022 (22) · Q5(b) · 3 marks

(b) A common cause of AF is when a small group of muscle cells in the wall of the left atrium starts to send out electrical impulses to the surrounding heart muscle cells.

Explain how the control of heartbeat by the sinoatrial node can be disrupted by AF, resulting in rapid and irregular atrial contractions.

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Question 20 · Paper 2 · October/November 2023 (23) · Q6(b) · 4 marks

(b) Complete Table 6.1 to identify the structure in the heart responsible for each function listed.

Table 6.1

function	structure in the heart
initiates the heartbeat	
delays the wave of depolarisation between the atria and the ventricles	
transmits the wave of depolarisation through muscles of the ventricle	
closes when the left ventricle contracts	

[4]

Question 21 · Paper 2 · October/November 2017 (22) · Q6(b) · 1 mark

(b) State **precisely** where the sinoatrial node is located.

Question 22 · information from earlier in the question

6 The sinoatrial node, atrioventricular node and the Purkyne tissue have important roles in the cardiac cycle.

Question 22 · Paper 2 · May/June 2022 (23) · Q6(c) · 2 marks

(c) Part of the control of the cardiac cycle involves the contraction of the ventricle walls after the walls of the atria have finished contracting.

Outline how this control is achieved.

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Mark schemes

Question 1 · Paper 2 · October/November 2022 (22) · Q1(c) · 2 marks

1(c)	label line pointing to, left atrioventricular / tricuspid, valve and labelled **R** ; **R** if pointing to one of the chordae tendinae label line pointing to, pulmonary artery and labelled **L** ; **A** pointing to left or right pulmonary artery	**2**

Question 2 · Paper 2 · February/March 2022 (22) · Q5(a)(i) · 1 mark

5(a)(i)	mitral / bicuspid / atrioventricular, valve **and** left ventricle **and** semilunar / aortic, valve **and** aorta ;	**1**

Question 3 · Paper 2 · October/November 2017 (22) · Q6(a)(i) · 1 mark

6(a)(i)	**S ;** **1**

Question 4 · Paper 2 · October/November 2017 (22) · Q6(a)(ii) · 2 marks

(a)(ii)	pulmonary vein ; **R ;**	**2**

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Question 5 · Paper 2 · February/March 2025 (22) · Q3(a)(i) · 1 mark

3(a)(i)	semi-lunar valve ; **accept** aortic valve / pulmonary valve	**1**

Question 6 · Paper 2 · February/March 2019 (22) · Q4(a) · 3 marks

4(a)	*any **three** from:* right ventricle pumps blood to lungs (and back to heart) and left ventricle pumps blood to (rest of) body (and back to heart) / AW ; (so) short(er) / less, distance (for blood to travel) / ora ; less resistance (to, flow / overcome) / ora ; less force / lower pressure, required / ora ;	**3**

Question 7 · Paper 2 · October/November 2023 (23) · Q6(a) · 2 marks

6(a)	*any **two** from:* (ventricles) pump / AW, blood a greater distance / into the pulmonary and systemic circulations ; **A** to the lungs and to the body **R** left into lungs and right to body ventricles have more (cardiac) muscle to, pump / AW, blood, at high(er) pressure / with more force (than atria) ; **R** if smooth or striated/skeletal muscle **I** 'pump harder' (ventricles) pump / AW, blood to overcome a high(er) resistance ; **I** answers that only explain why the atria have thinner walls	**2**

Question 8 · Paper 2 · February/March 2025 (22) · Q3(a)(ii) · 2 marks

3(a)(ii)	1 from the atria to the ventricles ; 2 into the (left and right) atria from the pulmonary vein and vena cava ; **A** venae cavae for vena cava **A** superior vena cava and inferior vena cava	**2**

Question 9 · Paper 2 · February/March 2025 (22) · Q3(b) · 2 marks

3(b)	*stage of cardiac cycle:* ventricular systole ; *reason:* bicuspid / mitral, valve and tricuspid valve closed **or** atrioventricular valves closed **or** semi-lunar valves / aortic and pulmonary valves, open ;	**2**

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Question 10 · Paper 2 · May/June 2023 (22) · Q1(a) · 2 marks

1(a)	**3** = (atrial) systole (ventricular) diastole **5** = (atrial) diastole (ventricular) systole ; **7** = (atrial) diastole (ventricular) diastole ;	**2**

Question 11 · Paper 2 · May/June 2023 (22) · Q1(c) · 3 marks

1(c)	*opening of tricuspid valve* pressure in (right) ventricle becomes lower than pressure in (right) atrium **or** pressure in (right) atrium becomes higher than pressure in (right) ventricle ; *opening of pulmonary (semilunar) valve* pressure in (right) ventricle becomes higher than pressure in pulmonary artery **or** pressure in pulmonary artery becomes lower than pressure in (right) ventricle ; *if mp1* ***and*** *2 have correct ideas but not referred to pressures on both 'sides' of the valve, allow one mark for idea of, increasing / high, pressure opening <u>each</u> of the valves* *help flow of blood through the heart* *any* ***two*** *from:* one-way flow of blood / prevents backflow of blood / directs blood in correct direction / blood flows in one direction / AW ; **A** blood flows from atrium to ventricle to, pulmonary artery / lungs blood flows from (area of) higher pressure to (area of) lower pressure ; *idea that* (blood) pressure changes aid coordination ; e.g. semilunar valve is open (about same time) when tricuspid valve is shut	**3**

Question 12 · Paper 2 · February/March 2020 (22) · Q3(b) · 4 marks

3(b)	*any* ***four*** *from:* 1 pressure in ventricles decreases (in context of relaxation) ; 2 semilunar valves close ; 3 atria filling with blood / blood entering atria 4 bicuspid and tricuspid / left and right atrioventricular, valves open ; **A** mitral *for bicuspid* 5 blood enters ventricles (passively) ; allow once only (either marking point 5 or 8) 6 atria contract / atrial systole ; 7 pressure in atria exceeds pressure in ventricles ; 8 (so) blood enters ventricles (from atria) ; allow once only (either marking point 5 or 8) 9 AVP ; e.g. ref. to heart sounds (from valve closure)	**4**

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Question 13 · Paper 2 · October/November 2018 (22) · Q2(d)(i) · 4 marks

2(d)(i)	*allow* *systole for contraction and diastole for relaxation* *bicuspid valve or mitral valve for (left) atrioventricular* *aortic valve for semi-lunar valves* *any four from (max 3 if whole response based on right side of heart)* *before atrial contraction / during relaxation of the left atrium and left ventricle* **1** atrioventricular valve, opens / is open **A** *following atrial contraction* **or** blood trickling into ventricle / some blood enters ventricle **;** **2** atrial contraction, blood flow to ventricles / ventricles fill (with blood) **or** atrial contraction then ventricular contraction **;** *ventricular contraction* **3** biscuspid valve closes <u>and</u> semi-lunar valve opens **;** **R** *if occurs before ventricular contraction* **4** blood flows into aorta **;** **R** if states 'from atrium' or 'then to lungs' **R** *if occurs before ventricular contraction* **5** *ref. to* atrium in relaxation during ventricular contraction **;** *pressure changes* **6** contraction of, atrium / ventricle, increases pressure (of that chamber) **or** *ref. to* (blood) pressure differences to cause opening or closing of valves **;** e.g. pressure in atrium greater than in ventricle so atrioventricular valve opens pressure in ventricle greater than aorta so semilunar valves open pressure in ventricle greater than atrium so bicuspid valve closes	**4**

Question 14 · Paper 2 · October/November 2025 (22) · Q6(a) · 5 marks

6(a)	• *consider <u>all</u> mps to award if response clearly addresses events in the left side* ○ *mps 1,2,6,7,8 must be in the context of the left side of the heart* • *otherwise allow mp 3, 4, and 5 to max 3 – these mark points are inset to the right* *any **five** from:* **1** blood enters (heart) via / in, pulmonary vein(s) **;** **2** blood exits heart to aorta **;** **R** arota **3** blood flows from atrium to ventricle **;** **4** atrial, systole / contraction, then, ventricular, systole / contraction **;** **A** atrium contracts then ventricle contracts **5** pressure in ventricle, increases / gets higher **;** **I** high pressure unclear attempts / mixed right and left sides **6** bicuspid / (left) atrioventricular valve closes **; A** mitral valve **R** *if in context of events in the atrium* **7** semilunar / aortic, valve opens **; ecf** *from arota in mp 2* **R** *if in context of events in the atrium* **8** bicuspid / (left) atrioventricular, valve closes when (blood) pressure in ventricle higher than atrium **or** semilunar / aortic, valve opens when (blood) pressure in ventricle higher than aorta **; A** aortic valve	**5**

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Question 15 · Paper 2 · May/June 2020 (22) · Q2(c)(i) · 3 marks

2(c)(i)	one mark if **F** and **G** are semilunar and **E** and **H** are bicuspid ; one mark for **E** and **G** opens ; one mark for **F** and **H** closes ; ***E*** *bicuspid / (left) atrioventricular, valve, closes* ***F*** *semilunar / aortic, valve opens* ***G*** *semilunar / aortic, valve closes* ***H*** *bicuspid / (left) atrioventricular, valve opens*	**3**

Question 16 · Paper 2 · May/June 2020 (22) · Q2(c)(ii) · 2 marks

2(c)(ii)	(during contraction) left ventricle, generates / AW, higher pressure (than left atrium) ; **A** do not produce the same pressure when contracting *any one from* (because) wall of left ventricle thicker / more (cardiac) muscle, so reaches higher ; data from Fig. 2.1 to show difference in pressure ;	**2**

Question 17 · Paper 2 · February/March 2025 (22) · Q3(c) · 3 marks

3(c)	*any **three** from:* 1 impulses reach the atrioventricular node ; 2 short delay / after 0.1 s ; 3 (AVN) sends impulses through, Purkyne fibres / Bundles of His ; **A** Purkinje for Purkyne 4 impulses (travel down through the septum and) reach the, base / apex, of the ventricles / heart ; 5 atria complete contraction / atria and ventricles do not contract at the same time / ventricles fill with blood / atria empty ; 6 impulses travel upwards / AW, causing ventricles to contract from base upwards ; 7 ref. to (both) ventricles contract at same time ;	**3**

Question 18 · Paper 2 · May/June 2023 (22) · Q1(b) · 2 marks

1(b)	*allow responses in context of both sides or one side of heart* *any **two** from:* atria and ventricles, do not contract / are not in systole, at the same time ; AW ventricles, contract / are in systole, after atria ; AW ora *idea that* allows atria to empty (completely) / allows ventricles to fill ; **A** *idea that* (all) blood, pumped / AW, into ventricles (ready for systole)	**2**

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Question 19 · Paper 2 · February/March 2022 (22) · Q5(b) · 3 marks

5(b)	*any **three** from:* 1 normally only SAN in (wall of) right atrium sends out impulses ; 2 ref. to extra impulses (from wall of left atrium) ; 3 atrial systole might occur when it should be in diastole ; 4 impulses interfere with each other / AW ; 5 SAN no longer able to act as a pacemaker ; 6 rapid since extra contractions ;	**3**

Question 20 · Paper 2 · October/November 2023 (23) · Q6(b) · 4 marks

6(b) *if SAN and AVN given alone for rows 1 and 2 allow 1 mark* **4**

function	structure in the heart
initiates the heartbeat	sinoatrial node ;
delays the wave of depolarisation between the atria and the ventricles	atrioventricular node and non-conducting tissue / AW (between atria and ventricles) ; **I** atrioventricular septum
transmits the wave of depolarisation through muscles of the ventricles	Purkyne / Purkinje, fibres / tissue ;
closes when the left ventricle contracts	left atrioventricular / bicuspid / mitral, valve ; **R** right atrioventricular valve **I** AV valves

Question 21 · Paper 2 · October/November 2017 (22) · Q6(b) · 1 mark

6(a)(iii)	wall of right atrium ; **A** muscle of right atrium	**1**

Question 22 · Paper 2 · May/June 2022 (23) · Q6(c) · 2 marks

6(c)	AVN delays impulse (from sinoatrial node / atrial muscle) ; AW e.g. excitation wave / conduction *plus one from:* ring of non-conducting fibrous tissue prevents impulse from sinoatrial node directly passing to ventricles ; impulse must pass through, atrioventricular node / AVN ; (then) passes to Purkyne tissue (to ventricles for contraction) ;	**2**

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