

Unit 1

Biology and Disease

The Heart

Practice Exam Questions

1 (a) (i) What is atheroma?

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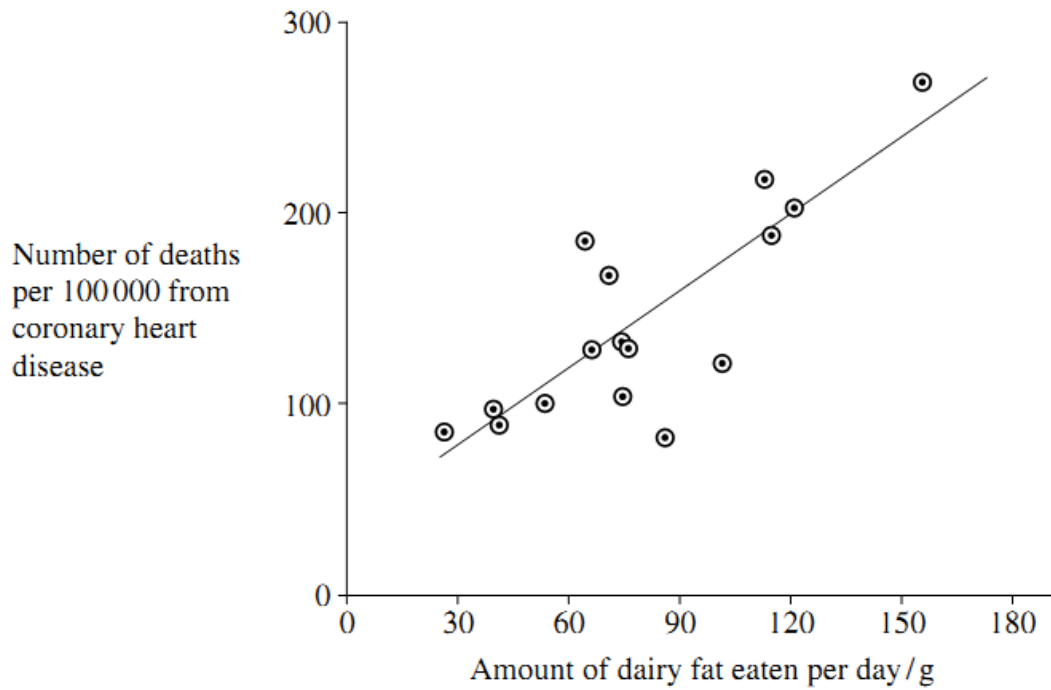
(2 marks)

(ii) Atheroma makes it more likely that a blood clot will form. Describe how a blood clot may lead to a myocardial infarction.

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(3 marks)

- (b) The graph shows the relationship between the amount of dairy fat eaten and the deaths from coronary heart disease (CHD) in different countries.



- (i) The number of deaths is given per 100 000 people. Explain why.

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(2 marks)

- (ii) Does the evidence from the graph show that eating dairy fat causes coronary heart disease? Explain your answer.

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(2 marks)

2.

- (a) The cardiac cycle is controlled by the sinoatrial node (SAN) and the atrioventricular node (AVN). Describe how.

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(5 marks)

- (b) What is atheroma and how may it cause myocardial infarction?

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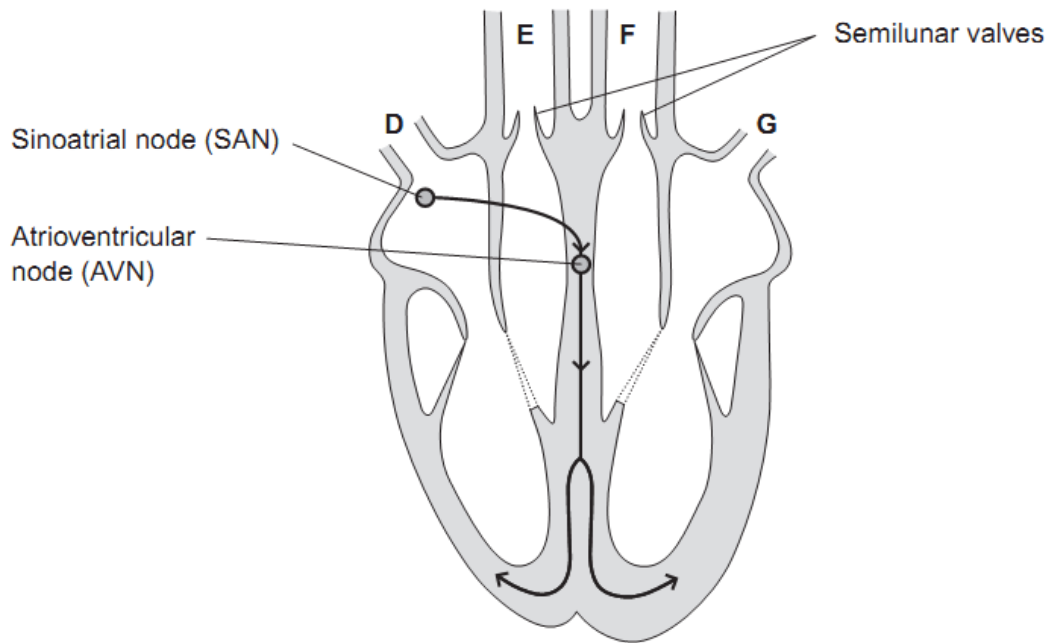
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(5 marks)

- 3 The diagram shows a human heart as seen from the front. The main blood vessels are labelled **D** to **G**. The arrows show the pathways taken by the electrical activity involved in coordinating the heartbeat in the cardiac cycle.



- (a) Which of the blood vessels, **D** to **G**
- (a) (i) carries oxygenated blood to the heart

(1 mark)

- (a) (ii) carries deoxygenated blood to the lungs?

(1 mark)

- (b) Explain, in terms of pressure, why the semilunar valves open.

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(1 mark)

- (c) When a wave of electrical activity reaches the AVN, there is a short delay before a new wave leaves the AVN. Explain the importance of this short delay.

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(2 marks)

- (d) The table shows the cardiac output and resting heart rate of an athlete before and after completing a training programme.

	Before training	After training
Cardiac output/cm ³	5000	5000
Resting heart rate/beats per minute	70	55

- (d) (i) Calculate the athlete's stroke volume after training. Show your working.

.....cm³
(2 marks)

- (d) (ii) Use information from the table to explain how training has caused the resting heart rate of this athlete to be lower.

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(2 marks)

4.

- (a) The sinoatrial node (SAN) is in the right atrium of the heart. Describe the role of the sinoatrial node.

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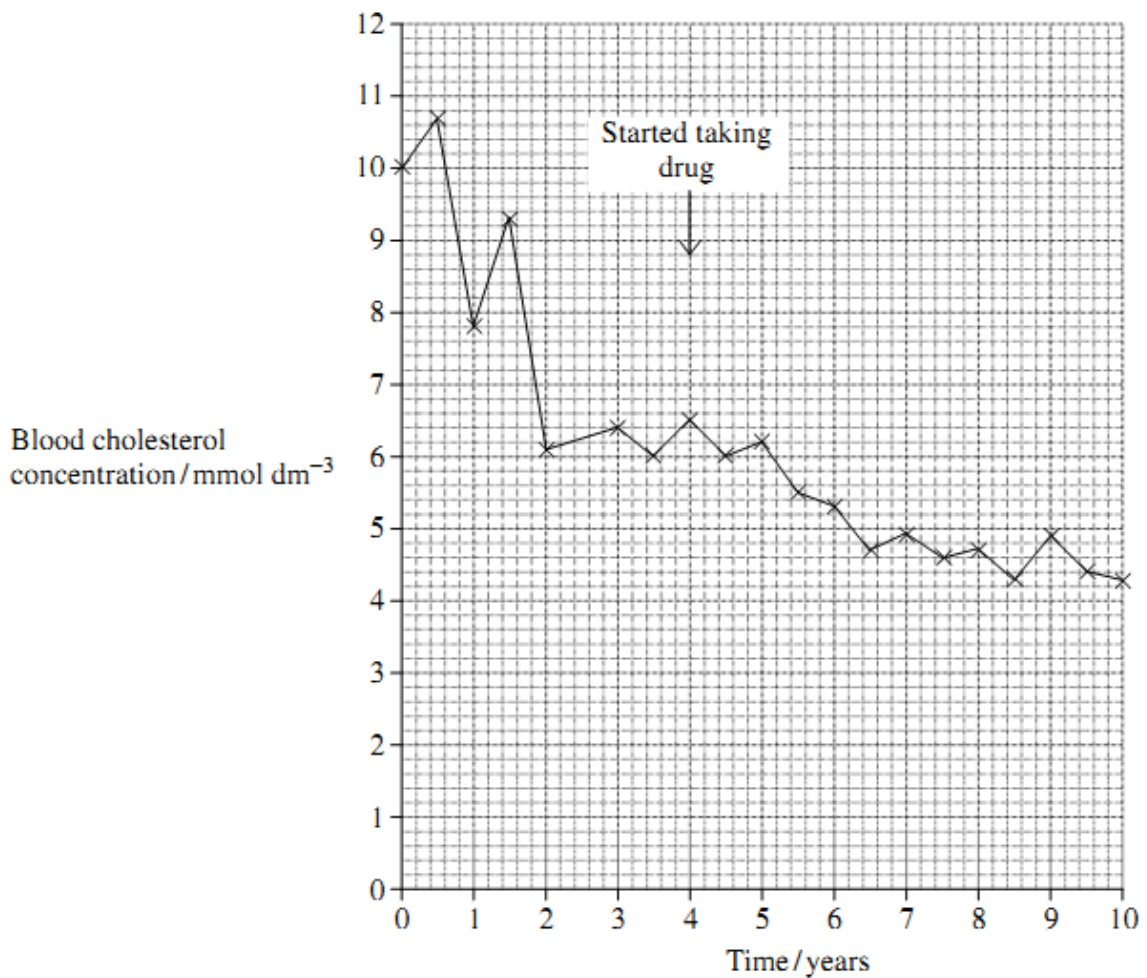
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(2 marks)

Ten years ago, a woman was found to have a high concentration of cholesterol in her blood. As a result, she was put on a special diet. She has been on this diet ever since. Four years after starting the diet, she started taking a drug to lower her blood cholesterol. The graph shows the concentration of cholesterol in her blood over the ten-year period.



- (b) Describe how the concentration of cholesterol in her blood changed over the ten-year period.

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(2 marks)

- (c) Explain the overall change in cholesterol concentration in the blood in the first two years.

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(2 marks)

- (d) Use the graph to evaluate the success of the special diet and of the drug in reducing the risk of coronary heart disease.

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(2 marks)

5.

Read the following passage.

Some foods contain substances called flavenoids. Flavenoids lower blood cholesterol concentration and reduce the risk of developing coronary heart disease.

Some types of dark chocolate have a high concentration of flavenoids. One group of scientists investigated the effect of eating dark chocolate on the risk of developing coronary heart disease. 5

The scientists randomly divided healthy volunteers into two groups. Every day one group was given dark chocolate containing flavenoids to eat. The other group acted as a control.

The scientists measured the diameter of the lumen of the main artery in the arms of the volunteers every week. At the end of a month, the diameter of the lumen of the main artery in the arm of the volunteers who had eaten dark chocolate containing flavenoids had increased. 10

Use information from the passage and your own knowledge to answer the questions.

(a) High blood cholesterol concentration is a risk factor associated with coronary heart disease.

Give **two** other risk factors associated with coronary heart disease.

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2

(2 marks)

(b) (i) The scientists used healthy volunteers in this investigation (line 7). Why was it important that the volunteers were healthy?

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(1 mark)

(b) (ii) The scientists randomly divided the volunteers into two groups (line 7). Explain why they divided them randomly.

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(1 mark)

(c) (i) Describe how the control group should have been treated.

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(2 marks)

(c) (ii) Why was it important to have a control group in this investigation?

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(1 mark)

(d) Suggest why an increase in the diameter of the lumen of the main artery in the arm (lines 11-12) is associated with a reduced risk of coronary heart disease.

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(3 marks)

- 6 The table shows pressure changes in the left side of the heart during one cardiac cycle.

Time / s	Blood pressure / kPa	
	Left atrium	Left ventricle
0.0	0.7	0.3
0.1	1.0	2.0
0.2	0.1	12.5
0.3	0.2	15.3
0.4	1.0	4.5
0.5	0.5	1.0
0.6	0.6	0.3
0.7	0.7	0.3

- (a) Between which times is the valve between the atrium and the ventricle closed?
Explain your answer.

Times s and s

Explanation

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(2 marks)

- (b) The maximum pressure in the ventricle is much higher than that in the atrium.
Explain what causes this.

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(2 marks)

- (c) Use the information in the table to calculate the heart rate in beats per minute.

Answer beats per minute
(1 mark)

7.

The heart of a mammal contains four main chambers. The action of these chambers is coordinated by electrical activity in specialised tissues.

Fig. 5.1 shows where these tissues are found in the heart.

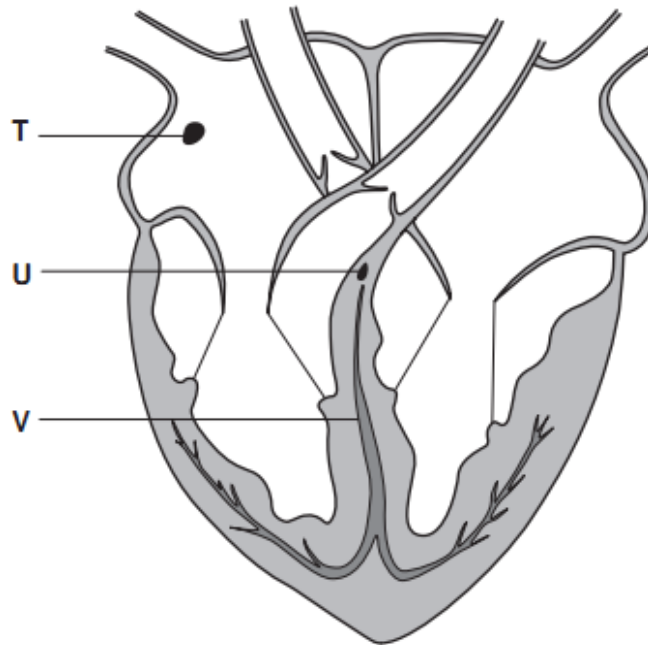


Fig. 5.1

(i) Name the tissues labelled **T**, **U** and **V**.

T

U

V

[3]

8.

(a) (i) Name the type of muscle found in the walls of the heart chambers.

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(ii) Name the process that creates pressure inside the heart chambers.

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(b) Fig. 6.1 shows the changes in pressure inside the heart chambers during one heart beat.

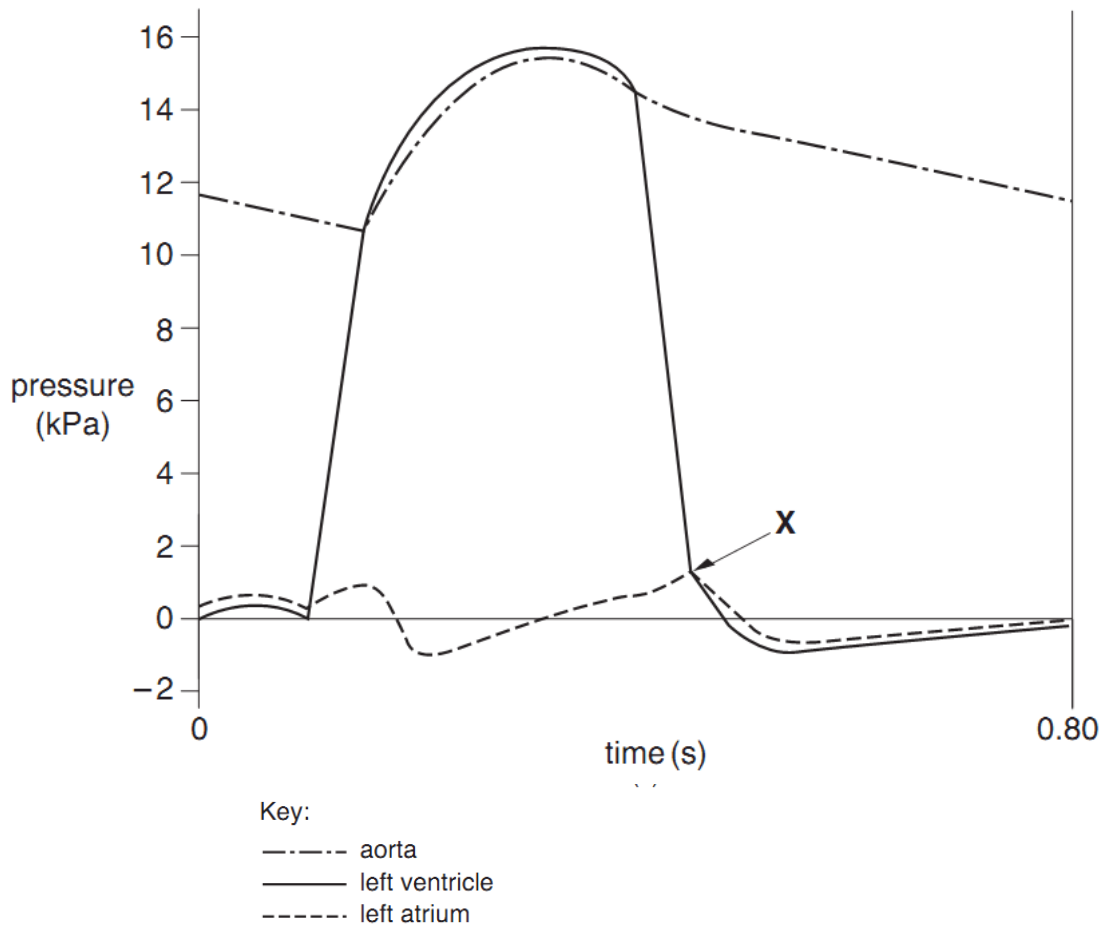


Fig. 6.1

(i) Calculate the heart rate from the information in Fig. 6.1.

Show your working and give your answer **to the nearest whole number**.

Answer = beats min⁻¹ [2]

(ii) Describe and explain what happens **immediately after X** on Fig. 6.1.



In your answer, you should use appropriate technical terms, spelt correctly.

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..... [4]

(iii) Explain how pressure changes in the heart bring about the closure of the atrioventricular (bicuspid) valve.

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..... [2]

(b) The mammalian transport system is a double circulatory system.

An efficient circulatory system consists of a pump, a means of maintaining pressure, a transport medium and exchange surfaces.

State the component of the **mammalian circulatory system** that fulfils each of these roles.

The first one has been done for you.

pump heart
means of maintaining pressure
transport medium
exchange surface

[3]

Heart; Answers & Markscheme

1	(a)	(i)	Cholesterol/ lipoprotein/ fatty material/cells; In the artery wall/under lining/endothelium of artery/blood vessel;	2	Reject fatty acid Q Do not accept references to veins or capillaries as equivalent to blood vessels
1	(a)	(ii)	(Trapped in) coronary artery/artery supplying heart muscle/ tissue/cells; Prevents oxygen; Reaching (heart muscle/tissue); (Heart muscle) dies/stops respiring;	3 max	i.e. material of heart wall
1	(b)	(i)	Allows comparison; Different number of people in each country;	2	
1	(b)	(ii)	Correlation does not show causation / graph only shows correlation Something else/another named factor may be involved such as lack of fibre/smoking/stress;; Related to both CHD and dairy fat;	2 max	

2.

(a)		<ol style="list-style-type: none"> 1. SAN initiates heartbeat / acts as a pacemaker / myogenic; 2. (SAN) sends wave of electrical activity / impulses (across atria) causing atrial contraction; 3. AVN delays (electrical activity / impulses); 4. (Allowing) atria to empty before ventricles contract / ventricles to fill before they contract; 5. (AVN) sends wave of electrical activity / impulses down Bundle of His / Purkyne fibres; 6. (Causing) ventricles to contract (from base up) / ventricular systole; 	5 max	<p>Q Must be in context</p> <p>Reject: signals / electronic / messages / <u>nerve</u> impulses once only</p> <p>Neutral: reference to non-conducting tissue delaying impulses instead of the AVN</p>
(b)		<ol style="list-style-type: none"> 1. Cholesterol / plaque / lipoprotein / LDL / fatty material / cells; 2. In artery wall / under lining / endothelium of artery / blood vessel; 3. Atheroma linked to blood clot / thrombosis; 4. (Blocks) coronary artery / artery supplying heart muscle / tissue / cells; 5. Reduces oxygen / glucose supply (to heart muscle / tissues / cells); 6. (Heart muscle / tissue / cells) unable to respire / dies; 	5 max	<p>Accept: LDL / triglyceride / cell debris; Reject: fatty acids / HDL;</p> <p>Q Do not accept references to veins or capillaries as equivalent to blood vessels</p> <p>Q Must be in the correct context</p> <p>If coronary artery is not mentioned or described, reference to heart muscle / tissue / cells is needed for 5.</p>

3(a)(i)	G ;	1	Neutral: name of blood vessel
3(a)(ii)	E ;	1	Neutral: name of blood vessel
3(b)	Pressure is <u>greater</u> below valve / in ventricle than (artery);	1	Must be comparative Reject: pressure is greater in ventricle than atrium Neutral: pressure in ventricle increases Accept: E / F / named artery Accept: converse argument
3(c)	Allow atria to empty / contract / ventricles to fill; Before ventricles contract; OR Delays contraction of ventricles; Until after atria have contracted / ventricles have filled;	2	Neutral: 'to pump blood'
3(d)(i)	Two marks for correct answer of 91 / 90.9;; One mark for incorrect answers which clearly show understanding of the relationship between $SV = CO/HR$;	2	Correct answer = 2 marks outright 5000 divided by 70, 55 or 15 = 1 mark for principle
3(d)(ii)	Increase in size or volume of heart / ventricles / increased heart muscle / increased strength of contraction / hypertrophy; Cardiac output is the same (before and after training); Increase in stroke volume / more blood leaves heart in each beat;	2 max	Accept: increased strength of heart muscle Neutral: heart muscle contracts more Q Do not allow 'heart is stronger' Neutral: more blood leaves the heart If the term 'stroke volume' is not used, it must be defined

4.

(a)		Sends out electrical activity/ impulses; Initiates the heartbeat / acts as a pacemaker / (stimulates) contraction of atria;	2	Q Ignore reference to ventricles.
(b)		Fluctuation and overall decrease; Steep decrease first/after two years and then gradual decrease;	2	
(c)		Diet low in cholesterol/LDLs; Less absorbed into blood/ from intestines;	2	
(d)		Diet has greater effect in decreasing blood cholesterol concentration; Difficult to judge effect of drug as it is used at same time as diet / drug is not used on its own; Decrease in blood cholesterol concentration linked to reduced risk of heart disease;	2 max	Q Allow converse for third marking point.

5.

(a)	Two suitable factors, e.g: <u>Named</u> dietary factor(s) / (cigarette) smoking / <u>high</u> blood pressure / gender / age / alcohol / genes / lack of exercise / obesity / stress;	2 max	<p><i>Neutral:</i> cholesterol</p> <p><i>Accept:</i> two different dietary factors for 2 marks e.g. LDL and salt</p> <p><i>Accept:</i> LDL <u>or</u> fatty material</p> <p><i>Accept:</i> ethnicity / race for 'genes'</p> <p><i>Accept:</i> overweight for 'obesity'</p>
(b)(i)	Healthy volunteers have 'normally' functioning vessels; OR Blood vessel / lumen / diameter not affected by other factors / is of normal size;	1	<p><i>Accept:</i> a valid ethical argument e.g. treatment does not harm healthy volunteers</p> <p><i>Reject:</i> ref. to change in artery thickness</p> <p><i>Accept:</i> converse arguments for unhealthy volunteers</p> <p>Must be related to <i>this</i> investigation</p> <p><i>Neutral:</i> to ensure that that the results are due to the independent variable</p>
(b)(ii)	Avoids bias / selection (by scientists);	1	<p><i>Neutral:</i> ref. to having the same number / gender / age of people in each group;</p>
(c)(i)	Same as experimental group; Chocolate with no flavenoids;	2	<p><i>Neutral:</i> no dark chocolate</p> <p><i>Neutral:</i> placebo</p> <p><i>Reject:</i> milk chocolate</p> <p><i>Neutral:</i> ref. to fair testing</p>

i(c)(ii)	(To ensure that results are) not due to some other substance in the chocolate / due to flavenoids (only);	1	<p>Must be related to <i>this</i> investigation</p> <p><i>Neutral:</i> to ensure that that the results are due to the independent variable</p> <p><i>Neutral:</i> to show results are not due to other factors</p> <p><i>Neutral:</i> to show results are only due to the chocolate</p> <p><i>Neutral:</i> to compare results for people who did and did not have flavenoids</p>
i(d)	<p>Coronary artery also likely to have a wide lumen;</p> <p>(Less chance of) high blood pressure;</p> <p>(Less chance of) a blood clot / thrombosis;</p> <p>(Less chance of) atheroma / description given;</p>	3 max	<p><i>Accept:</i> reduces blood pressure</p> <p><i>Neutral:</i> (less chance of) a blockage</p>

6.

6(a)	0.1 and 0.5; Pressure in ventricle greater (than pressure in atrium);	2	<p>Both figures must be correct.</p> <p>Comparison needed</p>
6(b)	<p>1. (Ventricle has) thick wall / more muscle;</p> <p>2. So <u>contractions</u> are stronger / harder;</p>	2	<p>2. <i>Neutral:</i> Contracts to produce more pressure</p> <p>2. <i>Neutral:</i> Pump harder.</p> <p>2. <i>Neutral:</i> Reference to a need to pump blood further/round the body.</p>
6(c)	85 / 86 / 85.7;	1	Ignore additional decimal places

7.

(i)	<p>T SAN / sinoatrial node ;</p> <p>U AVN / atrioventricular node ;</p> <p>V bundle of His / Purkyne tissue ;</p>	<p>3</p>	<p>ACCEPT pacemaker DO NOT ACCEPT sinoarterial / atrial node DO NOT ACCEPT arterioventricular node ACCEPT Purkinje</p>
(ii)	<p>T / SAN, creates / initiates / starts / originates, excitation ;</p> <p>wave (of excitation) spreads over atrial, wall / muscle ; ref to, AVN / U ; atria contract / atrial systole ; contraction is synchronised / AW ; delay at AVN ; (excitation spreads) down septum ;</p> <p>ref to, bundle of His / Purkyne fibres ; ventricles contract / ventricular systole, from, apex / bottom ;</p> <p>QWC – technical terms, spelled AND used in correct context</p>	<p>4 max</p> <p>1</p>	<p>ACCEPT acts as pacemaker ACCEPT impulse / action potential / depolarisation DO NOT ACCEPT electricity / signal / message DO NOT ACCEPT if response suggests that brain needed to trigger SAN</p> <p>ACCEPT EITHER in context of both atria OR both ventricles contracting together ACCEPT Purkinje</p> <p>any three from: pacemaker, sinoatrial node, atrioventricular node, excitation, atrial / atrium / atria, septum, Purkyne, bundle of His, ventricle(s) / ventricular, apex, systole.</p>

8.

(a)	(i)	cardiac ;	1	ACCEPT myogenic	
(a)	(ii)	(muscle) contraction / systole ;	1	ACCEPT atrial or ventricular systole DO NOT ACCEPT atrial or systolic pressure	
(b)	(i)	<i>correct answer = two marks</i> 75 ; ; <i>if answer incorrect ALLOW one mark for correct working</i> 60 / 0.8	2		
(b)	(ii)	pressure in ventricle is below (pressure in) atrium ; bicuspid / atrioventricular valve, open(s) ; blood flows into (atrium and) ventricle ; max 3 QWC - technical terms used appropriately and spelt correctly ; 1	4	ORA ACCEPT mitral DO NOT ACCEPT pushed or pumped DO NOT ACCEPT arterioventricular Use three terms in correct biological context from: ventricle / ventricular, atrium / atrial, bicuspid, mitral, atrioventricular, diastole	
Total			8		

9.

(a)	(i)	<p>X = <u>right</u> atrium ;</p> <p>Y = aorta ;</p> <p>Z = (left) pulmonary artery ;</p>	<p>3</p>	<p>Mark the first answer for each letter. If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT <u>right</u> atria IGNORE RA</p> <p>IGNORE PA</p>
(a)	(ii)	<p><i>left ventricle</i></p> <p>1 (more muscle to create) more force ;</p> <p>2 (needs to create) <u>high</u>er pressure ;</p> <p>3 push blood against greater , resistance / friction ;</p> <p>4 (left ventricle) pumps blood further / pumps blood to all parts of body / supplies systemic circulation ;</p>	<p>3 max</p>	<p>Assume answer refers to left ventricle unless otherwise stated. ACCEPT ORA for left atrium throughout</p> <p>1 IGNORE more powerful contraction ACCEPT stronger contraction</p> <p>2 IGNORE withstanding or maintaining pressure</p> <p>4 ACCEPT pumps blood , all round body / greater distance IGNORE pumps blood to the body DO NOT CREDIT references to , right ventricle / lungs</p>

(a)	(iii)	<p>1 ventricular systole or ventricle , wall / muscle , contracts ;</p> <p>2 (ventricular contraction) raises ventricular pressure ;</p> <p>3 (ventricular pressure) higher than atrial pressure ;</p> <p>4 <i>idea of</i> (pressure / movement of blood, generated by ventricular contraction) pushes valve shut ;</p> <p>5 chordae tendinae prevent inversion ;</p>	<p>max 2</p>	<p>DO NOT CREDIT statements that refer to right atrium or right ventricle</p> <p>1 IGNORE ref to atrial contraction</p> <p>4 DO NOT CREDIT 'valve shuts' alone DO NOT CREDIT in context of blood flowing from atrium to ventricle resulting in pressure increase to close valve</p> <p>5 ACCEPT valve tendons / tendinous cords</p>
(b)		<p>aorta / (named) artery / arteries / arteriole(s) ;</p> <p>blood / plasma ;</p> <p>capillary / capillaries / capillary wall / (capillary) endothelium ;</p>	<p>3</p>	<p>Mark the first answer for each role. If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT smooth muscle / elastic tissue / collagen / narrow lumen</p> <p>DO NOT CREDIT valves</p>
Total			[11]	