Control of Heart Rate

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Control of Heart Rate

1 concentration.

1. _____

_____

_____

2. _____

_____

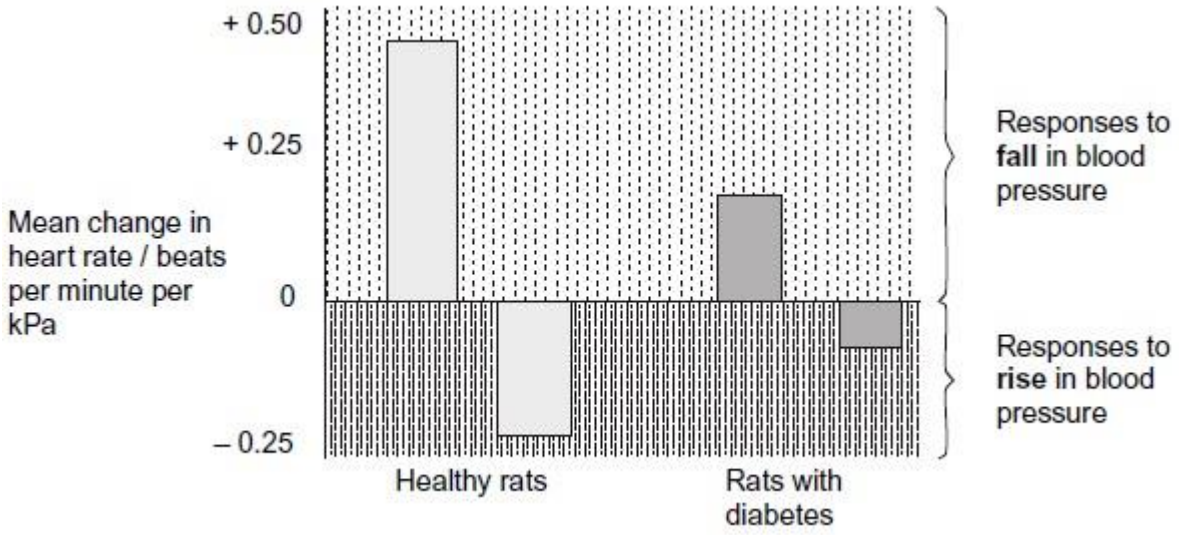
_____

(2)

(b) Scientists investigated the effect of diabetes on the control of heart rate in response to changes in blood pressure in rats.

The scientists found the mean changes in heart rates of healthy rats and rats with diabetes in response to rises or falls in blood pressure.

The diagram shows their results in the form they were presented.



Diabetes can damage the nervous system. The response of the rats with diabetes is different from the response of the healthy rats. Use your knowledge of the control of heart rate by the nervous system to suggest an explanation for these results.

(4)
(Total 6 marks)

2

Body position	Pulse rate / beats per minute			
	Reading 1	Reading 2	Reading 3	Mean
Sitting	80	76	76	77
Standing	84	88	92	88
Lying down	68	72	68	69

(a) Using the results in the table above, calculate the percentage decrease in mean pulse ratewhen lying down compared with when standing.

Answer = _____ %

(2)

(b) When the heart beats, both ventricles contract at the same time.
Explain how this is coordinated in the heart after initiation of the heartbeat by the SAN.

_____

_____

_____

_____

_____

(2)

(Total 4 marks)

3

(a) Describe how a Pacinian corpuscle produces a generator potential when stimulated.

[Extra space]

(3)

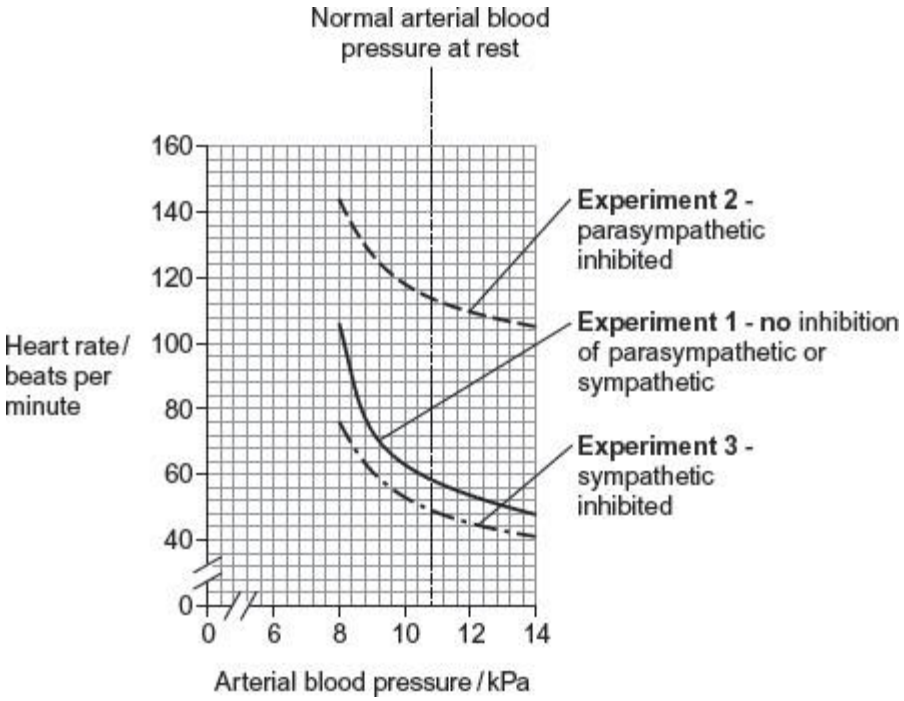
Doctors investigated the relationship between heart rate and arterial blood pressure. They recruited healthy volunteers. For each volunteer, they recorded their normal arterial blood pressure at rest. With each volunteer, they then carried out the following experiments.

Experiment 1 They recorded heart rate at different blood pressures.

Experiment 2 They repeated **experiment 1** after injecting a drug that inhibited the parasympathetic nervous system.

Experiment 3 They repeated **experiment 1** after injecting a drug that inhibited the sympathetic nervous system.

The graph shows the results for one volunteer.



(b) Calculate the ratio of heart rate in **experiment 2** to heart rate in **experiment 3** at an arterial blood pressure of 10 kPa. Show your working.

Answer = _____

(2)

(c) What do these data suggest about the control of heart rate by the parasympathetic andsympathetic nervous systems in response to changes in arterial blood pressure?

_____

_____

_____

_____

_____

_____

[Extra space] _____

_____

_____

(3)

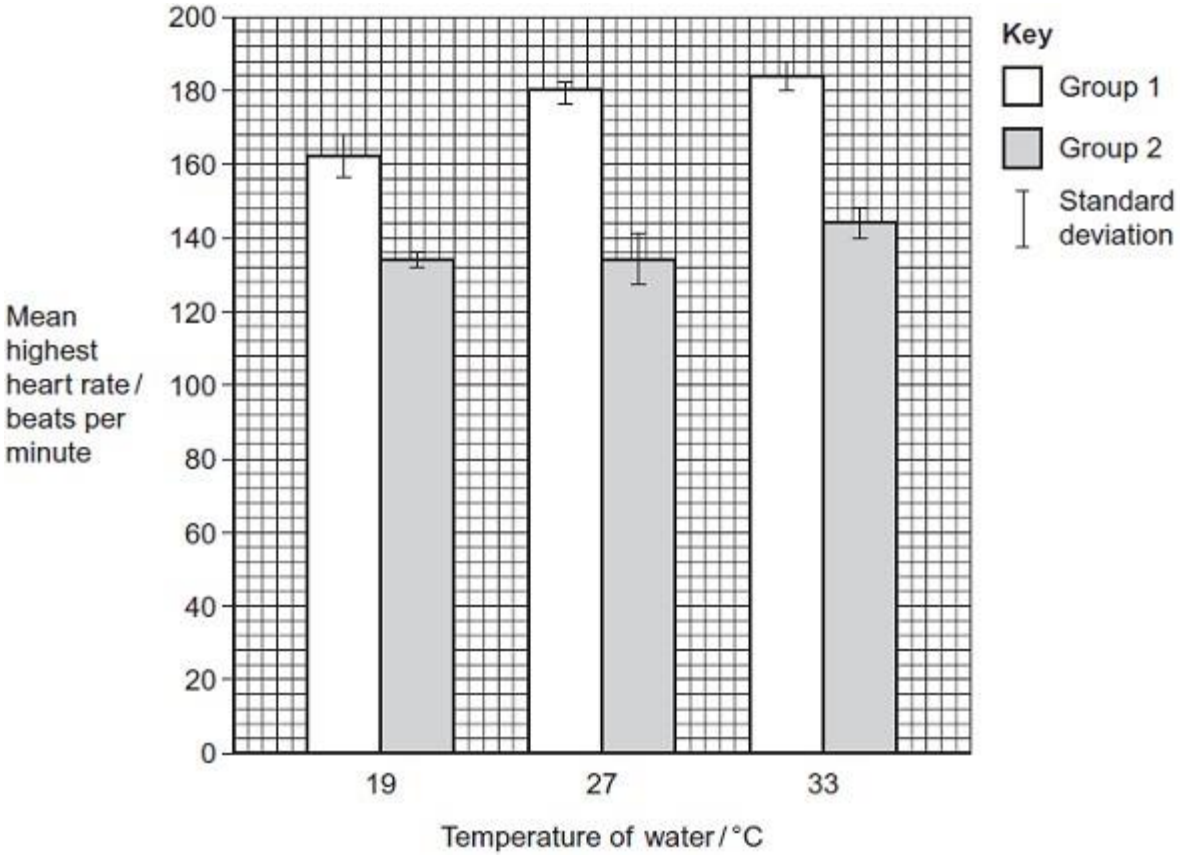
(Total 8 marks)

4 Scientists investigated the effects of water temperature on the heart rate of swimmers.

Two groups of volunteers were asked to repeat the same swim at three different temperatures.

- **Group 1** volunteers were asked to swim 100 m as quickly as they could.
- **Group 2** volunteers were asked to swim continuously for 30 minutes.

The scientists recorded the highest heart rate for each swimmer during each swim.
Their mean results are shown in the following figure.



(a) Give **one** conclusion that can be made from the scientists' investigation.

_____

_____

_____

(1)

(b) After reading the scientists' report, a member of a swimming club stated that "the reportshows that swimming flat out is better for you than swimming for a length of time." Evaluate this statement.

_____

_____

_____

_____

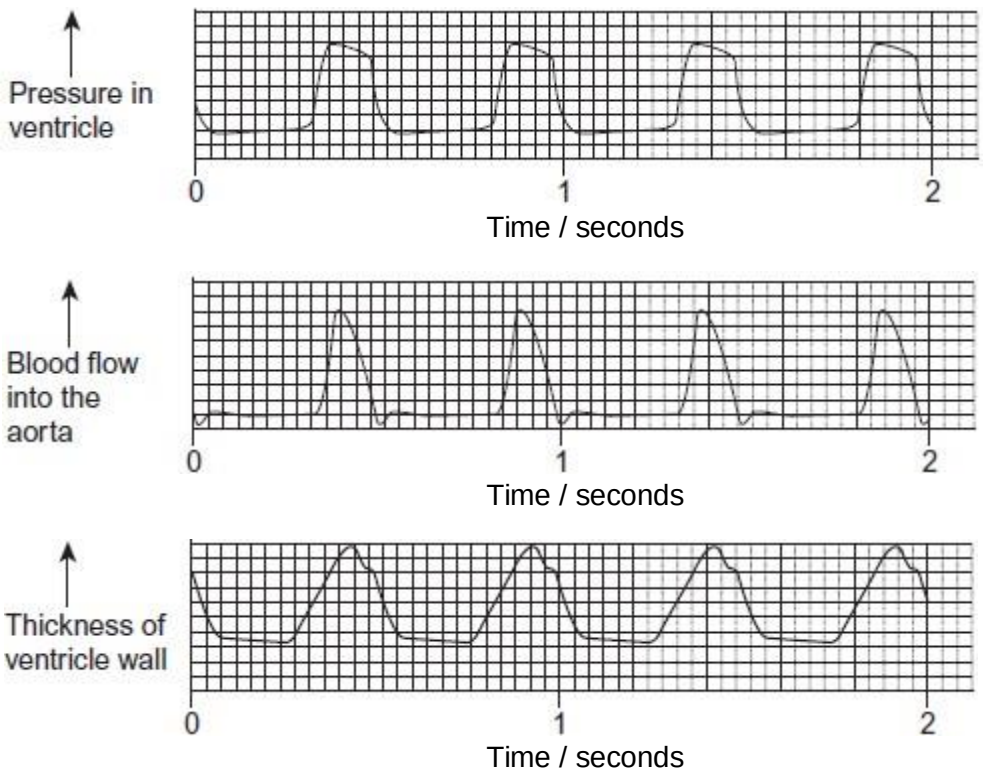
_____

(Extra space) _____

(4)

(Total 5 marks)

5 The figure below shows recordings made from the heart of a dog.



(a) Use information from the figure to explain how the pressure in the dog's ventricle is relatedto blood flow into the aorta.

_____

_____

*(Extra space)*_____

_____

(2)

(b) Use information from the figure to explain how the pressure in the dog's ventricle is relatedto the thickness of the ventricle wall.

_____

_____

_____

_____

*(Extra space)*_____

_____

(2)

(c) Use the figure to calculate the heart rate of the dog in beats per minute.Show your working.

Heart rate _____ beats per minute

(2)

(Total 6 marks)

6 (a) Describe how a heartbeat is initiated and coordinated.

(5)

(b) Explain how the heart muscle and the heart valves maintain a one-way flow of blood fromthe left atrium to the aorta.

(5)
(Total 10 marks)

7 Some people have a condition called *white-coat hypertension*. People with this condition develop a higher than normal heart rate and blood pressure when they are in a doctor's surgery. High heart rate is correlated with high blood pressure.

Doctors investigated differences in heart rate between men *with white-coat hypertension* and those without the condition. They measured the men's mean heart rates:

- in the doctor's surgery, by recording the pulse in the wrist for 1 minute, when the men werelying down
- at home, using a portable heart rate monitor when the men were walking around
- at home, using a portable heart rate monitor when the men were sleeping.

(a) The groups of men selected for this investigation were matched.

Other than being men, suggest **one** factor for which they should have been matched.

_____

(1)

(b) Explain why the pulse recordings in the doctor's surgery were taken when the menwere lying down.

_____

_____

_____

(1)

(c) The pulse felt in the artery in the wrist can be recorded and used to measure heartrate.

Suggest why the pulse felt can be used to measure heart rate.

_____

_____

_____

_____

_____

(2)

(d) The portable heart rate monitor recorded the men's heart rates continuously. Thisgave more reliable mean heart rates than those obtained by recording the pulse in the wrist for 1 minute.

Suggest why it is more reliable.

_____

_____

_____

_____

_____

(2)

(e) The table shows the doctors' results.

Where and how heart rate was measured	Mean heart rate / beats per minute	
	Men with white-coat hypertension	Men without white-coat hypertension
Doctor's surgery, recording pulse when lying down	67	63
At home, walking around, using heart monitor	76	73
At home, sleeping, using heart monitor	63	60

A journalist, who saw these results, stated that they showed there is no such thing as *white-coat hypertension*.

Do these data support this statement? Give reasons for your answer.

(2)

(Total 8 marks)

8 The heart controls and coordinates the regular contraction of the atria and ventricles.

Describe how.

(Extra space)

(Total 5 marks)

9 (a) Increased intensity of exercise leads to an increased heart rate. Explain how.

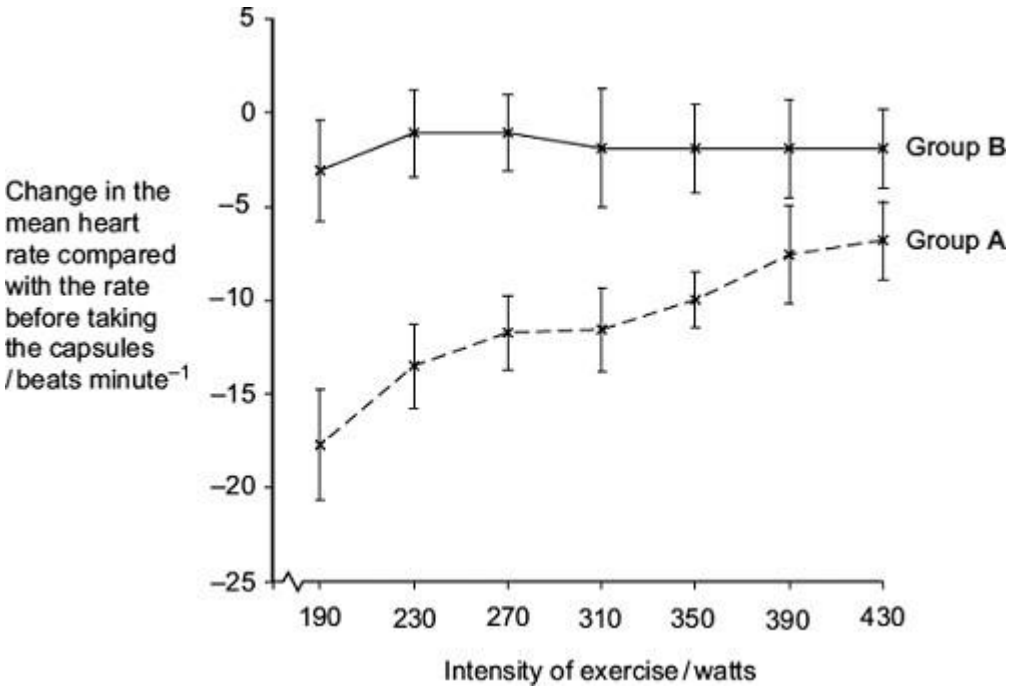
(Extra space)

(3)

(b) Scientists investigated the effect of taking omega- fatty acids in fish oil on heart rate during exercise. They recruited two large groups of volunteers, **A** and **B**. For each group, they measured the mean heart rates at different intensities of exercise. The volunteers were then given capsules to take for 8 weeks.

- Group **A** was given capsules containing omega-3 fatty acids in fish oil.
- Group **B** was given capsules containing olive oil.

After 8 weeks, they repeated the measurements of mean heart rates at different intensities of exercise. The graph shows their results. The bars represent the standard deviations.



(i) Group **B** was given capsules containing olive oil. Explain why.

_____

_____

_____

(1)

(ii) The scientists concluded that omega-3 fatty acids lower the heart rate duringexercise.
Explain how the information in the graph supports this conclusion.

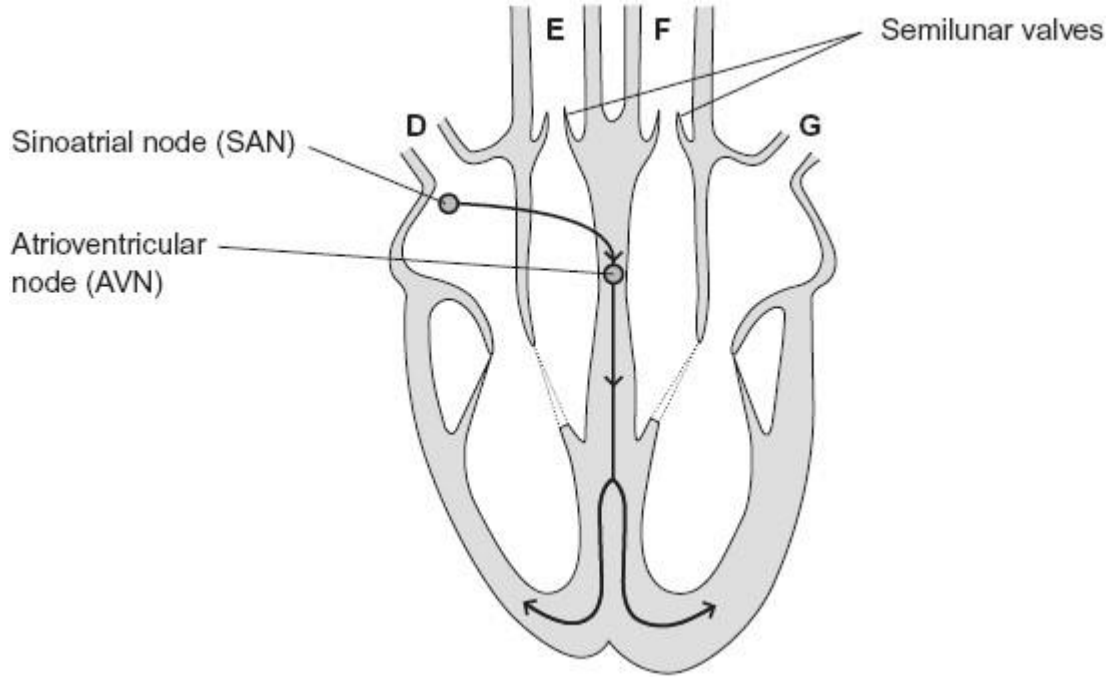
_____

(Extra space)

(3)

(Total 7 marks)

10 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**

(i) carries oxygenated blood to the heart

☐

(1)

(ii) carries deoxygenated blood to the lungs?

☐

(1)

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

_____

_____

_____

(1)

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

_____

_____

_____

_____

_____

(2)

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

	Before training	**After training**
Cardiac out/cm^3	5000	5000

Resisting heart rate/beats per minute	70	55

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

_____ cm^3

(2)

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

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

11 The cardiac cycle is controlled by the sinoatrial node (SAN) and the atrioventricular node (AVN).

Describe how.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 5 marks)

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

_____

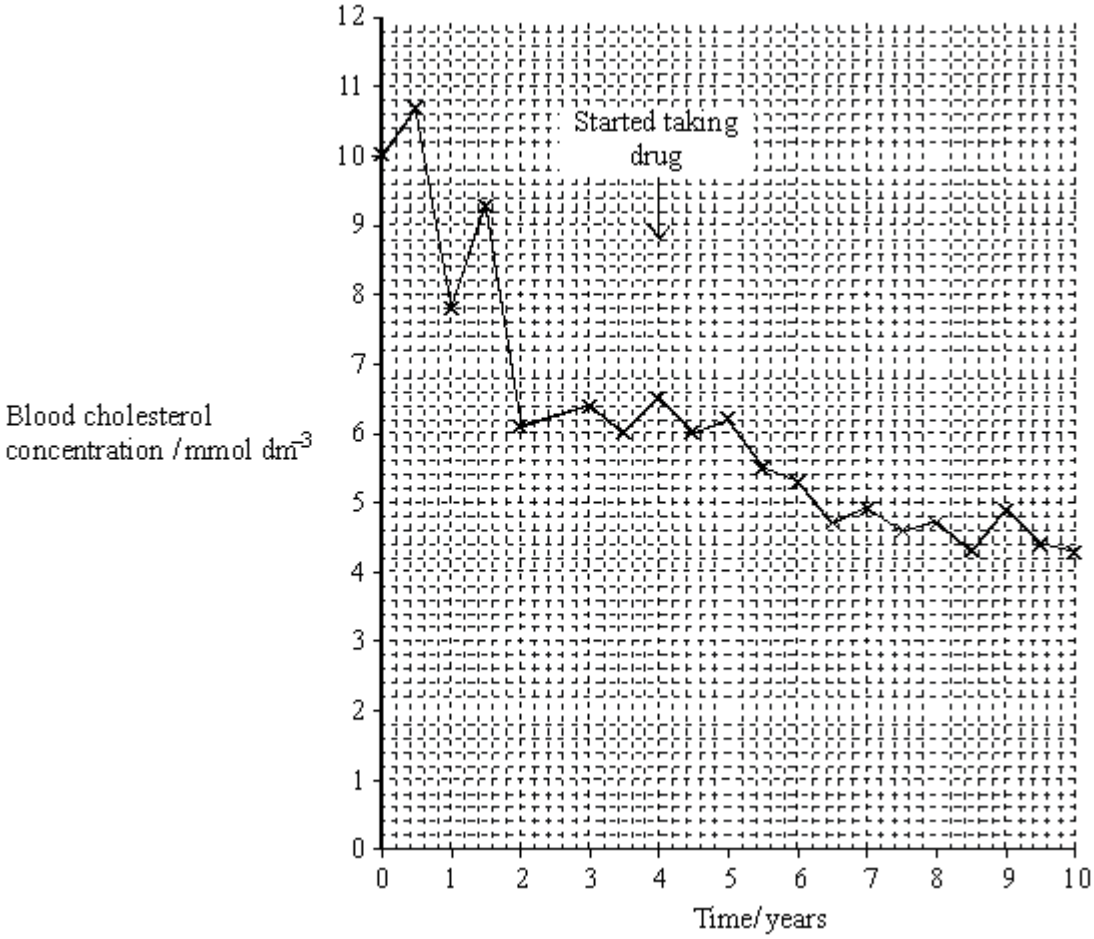
_____

_____

_____

(2)

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-yearperiod.

_____

_____

_____

_____

_____

(2)

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

_____

_____

_____

_____

_____

(2)

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

_____

_____

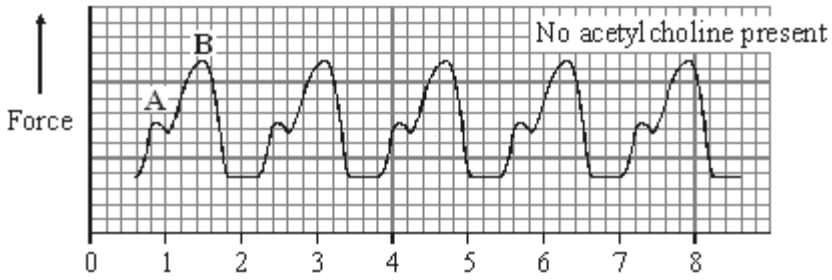
_____

_____

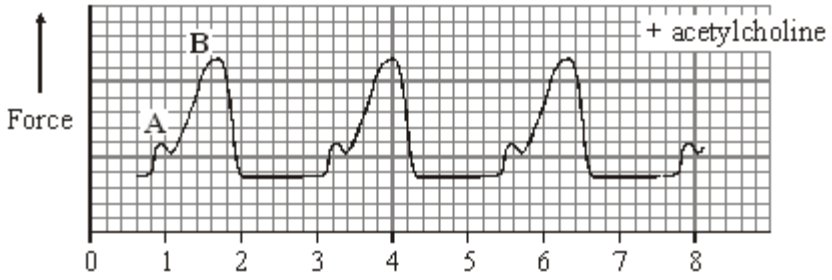
(2)

(Total 8 marks)

13 A frog's heart was attached to an instrument which measured the force produced as the heart contracted. **Graph 1** shows the changes in force when the heart was bathed in a solution of salts at 20 °C. **Graph 2** shows the results when the heart was bathed in the same solution at the same temperature, but including acetylcholine.



Graph 1



Graph 2

(a) Points **A** and **B** show when the atria and ventricle were contracting. Which point, **A** or **B**, shows contraction of the ventricle? Give **two** reasons for your answer.

Point _____

Reason 1 _____

_____

Reason 2 _____

_____

(2)

(b) Calculate the frog's heart rate when acetylcholine was **not** present. Show your working.

Heart rate = _____ beats per minute.

(2)

(c) (i) From the graphs, what can you conclude about the effect of acetylcholine on

heart rate;

_____

stroke volume?

_____

(2)

(ii) Use your answer to part (i) to explain the effect of acetylcholine on cardiac output.

_____

_____

(1)

(iii) Addition of acetylcholine in the experiment mimics the effect of one branch of theautonomic nervous system. Which branch is this?

_____

(1)

(d) (i) Explain how nervous control in a human can cause increased cardiac output duringexercise.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(ii) Explain why increased cardiac output is an advantage during exercise.

(3)
(Total 15 marks)

14 (a) Explain how a rise in blood pressure results in a decrease in the rate of heartbeat.

(6)

(b) Some drugs inhibit the transmission of nerve impulses to the heart. Explain how these drugs reduce high blood pressure.

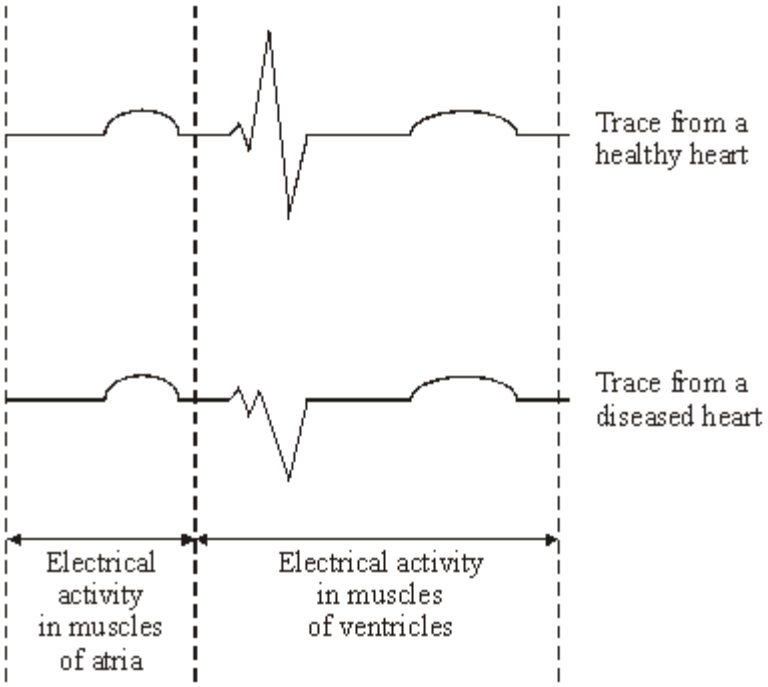
(2)

(Total 8 marks)

15 (a) A woman takes moderate exercise. Explain what causes her heart rate to increase while she exercises.

(6)

(b) An electrocardiogram (ECG) measures the electrical changes occurring in cardiac muscle as a heart is beating. An ECG trace for a healthy person and an ECG trace for a person suffering from heart disease are shown.



(i) Describe the route taken when electrical impulses are transmitted from the sinoatrialnode to the muscles of the ventricles in a healthy heart.

_____

_____

_____

_____

(2)

(ii) Explain how information from these ECG traces suggests that the damage caused tothe diseased heart is unlikely to have affected the sinoatrial node.

_____

_____

_____

_____

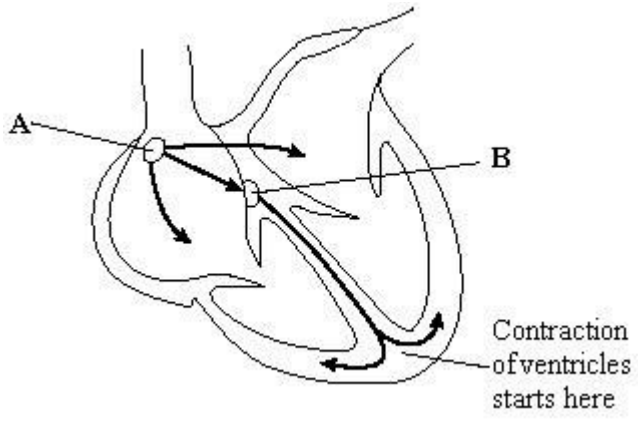
(2)

(Total 10 marks)

The diagram shows the pathways in the heart for the conduction of electrical impulses during the

16

cardiac cycle.



(a) The table shows the blood pressure in the left atrium, the left ventricle and the aorta atdifferent times during part of a cardiac cycle.

	Blood pressure / kPa		
Time / s	**Left atrium**	**Left ventricle**	**Aorta**
0.0	0.5	0.4	10.6
0.1	1.2	0.7	10.6
0.2	0.3	6.7	10.6
0.3	0.4	17.3	16.0
0.4	0.8	8.0	12.0

(i) At which time is blood flowing into the aorta?

_____

(1)

(ii) Between which times are the atrioventricular valves closed?

_____

(1)

(b) The maximum pressure in the left ventricle is higher than the maximum pressure in theright ventricle. What causes this difference in pressure?

_____

(1)

(c) The information below compares some features of different blood vessels.

		Blood vessel		
		Artery	**Capillary**	**Vain**
Property	Mean diameter of vessel	4.0 mm	8.0 µm	5.0 mm
	Mean thickness of wall	1.0 mm	0.5 µm	0.5 mm
		Relative thic ness (shown by length of bar)		
Tissues present in wall	Endothelium			
	Elastic tissue			
	Muscle			

Use the information to explain how the structures of the walls of arteries, veins and capillaries are related to their functions.

_____

_____

_____

_____

(6)

(Total 9 marks)

Mark schemes

(a) 1. Treat with insulin (injection/infusion);

1

2. (Control) diet/control sugar intake;

2. Accept '(regular) exercise'

2

(b) 1. Damage to <u>autonomic</u> (nervous) system in diabetic rats;
2. (Could be) pressure receptors/baroreceptors (in arteries/aorta /carotid body) don't work as well;
3. Damage to medulla

OR

Change in (number of) impulses to/from medulla;

4. (When pressure drops damage to) sympathetic system, sodoesn't speed up (enough);
5. (When pressure rises damage to) parasympathetic system, sodoesn't slow down (enough);

*Accept answers in terms of what happens in healthy rats **only** if then qualified by statement these things don't happen/happen less in rats with diabetes*

1. Accept damage to ANS

2. Ignore reference to chemoreceptors

4 and 5. Appropriate system and effect on heart rate both needed

4 max

[6] (a) 21.59 / 21.6;

2

19/88 × 100 = 1 mark

Accept for 1 mark - 19/69 × 100 = 27.5%;

(only award if rounding correct)

Max 1 for incorrect rounding

Accept any number of significant figures

as long as the rounding is correct

2

(b) 1. Electrical activity only through Bundle of His / AVN;

2. Wave of electrical activity passes over / through both ventricles at the same time;

For 'electrical activity' accept impulses / depolarisation / action potential

Reject messages/signals/information once only

2. Accept 'wave of electrical activity passes through the Purkinje / Purkyne fibres / tissue'

2

[4]

3

(a) 1. (Increased pressure) deforms / changes stretch-mediated sodium (ion) channel;

2. (Sodium channels open and) sodium ions flow in; *Accept Na^+*

3. Depolarisation (leading to generator potential). *Accept correct description of depolarisation*

3

(b) Value between 2.17:1 and 2.29:1;

Accept rounding up to 2.2 or 2.3

Accept: number without : 1

Correct working showing answer but incorrect rounding in answer line = 1

Values between 117 to 119 and between 52 to 54 found but ratio wrong way round = 1 mark.

Wrong way round gives answer between 0.35:1 and 0.46:1

2

(c) 1. Parasympathetic greater effect than sympathetic;*Ignore: descriptions of graph*

2. Parasympathetic keeps heart rate down / lower / decreases heart rate (as bloodpressure increases);

3. Sympathetic keeps heart rate up / higher / increases heart rate (as bloodpressure increases);

2. and 3. Accept converse for blood pressure decreases

4. Parasympathetic greatest / greater effect at high blood pressure / sympatheticgreatest effect at low blood pressure.

3 max

[8] (a) 1. People swimming 100 m / group1 had higher heart rates than

4 people swimming for 30 minutes / group 2;

2. (Trend is) as temperature increases heart rate increases for swimming 100 m /group 1;

3. No trend for swimming for 30 minutes / group 2;

4. (SD values show that) each set of results has little variation;

Four approaches but only 1 mark available

1 max

(b) 1. Assumes that an increased HR is beneficial (whatever the temperature of the water);

2. (But) haven't measured the 'benefits' to health / increased heart rate may not be 'better';

3. No definition of better / flat out / better / flat out is subjective / based on opinion;

4. Only know the highest heart rate / time at highest heart rate not known;

5. Swimmers only tested once / only a short-term effect (on heart rate) / long-termeffects are not known;

6. Distance covered in 30 minutes not known / might vary / time to complete 100 m not known / might vary / swimming ability might vary (among volunteers / between groups);

7. Groups may not be representative (of population);

4 max

[5]

(a) 1. Ventricle pressure rises **then** blood starts to flow into aorta because pressure causes

5

(aortic / semilunar) valve to open;

Accept times, eg ventricle pressure rises at 0.3 (25) seconds,followed by blood flow into aorta at 0.35 / 0.4 seconds

Idea of sequence is essential

Accept times

2. Ventricle pressure starts to fall **so** blood flow falls;

Idea of sequence is essential

2

(b) 1. Thickness of wall increases **because** ventricle (wall) contracts;

Must be idea that increase in thickness is linked to contraction

Accept muscle for ventricle and systole for muscle contraction

2. Contraction **causes** the increase in pressure;

Accept thickening of wall

2

(c) *2 marks for correct answer*

1. Between 120 ± 5;;

Length of cycles varies slightly

2. Length of cardiac cycle correct but final answer wrong;

Length of cardiac cycle = 0.45 - 0.52

2

[6]

6 (a) 1. SAN sends wave of electrical activity / impulses (across atria) causing atrial contraction;

Accept excitation

2. Non-conducting tissue prevents immediate contraction of ventricles / preventsimpulses reaching the ventricles;

3. AVN delays (impulse) whilst blood leaves atria / ventricles fill;

4. (AVN) sends wave of electrical activity / impulses down Bundle of His;

4. Allow Purkyne fibres / tissue

5. Causing ventricles to contract from base up;

5

(b) 1. Atrium has higher pressure than ventricle (due to filling / contraction) causing atrioventricular valves to open;

Start anywhere in sequence, but events must be in the correct order.

1. Accept bicuspid, reject tricuspid

1. *Allow: blood passes through the valve = valve open / bloodstopped from passing through the valve = valve closed*

2. Ventricle has higher pressure than atrium (due to filling / contraction) causingatrioventricular valves to close;

3. Ventricle has higher pressure than aorta causing semilunar valve to open;

Points 1, 2 and 3 must be comparative: eg higher 3. Allow aortic valve

4. Higher pressure in aorta than ventricle (as heart relaxes) causing semilunarvalve to close;

4. Allow aortic valve

5. (Muscle / atrial / ventricular) contraction causes increase in pressure;

5

[10] (a) One suitable factor;

7

Not health or lifestyle

E.g. Age / no heart condition / not on medication;

Accept BMI / smokers / diet / fitness / race etc. – has to affect heart rate or blood pressure

1 max

(b) Patients were at rest / not moving / not using muscles / in standardised position /controlled conditions;

Accept same position as sleeping

Ignore relaxed

1

(c) 1. Caused by pressure / surge of blood;

Ignore pulse rate equals heart rate

2. From (one) contraction / beat of (left) ventricle / heart;

Reject right ventricle

Ignore pumps / pumping

2

(d) 1. Monitor records heart rate over long period of time / all the time / more datacollected;

Ignore reference to continuously as in stem

Ignore anomalies can be discarded

2. Anomalies in recording have less effect;
   Ignore more accurate / reliable mean

3. Recording pulse rate for <u>one minute only</u> may give an anomalous / atypical result;

4. Errors when trying to count pulse for one minute / human error;

5. Monitor records HR over a range of activities during the day / pulse rate onlyrecords for a single set of conditions;

2 max

(e) 1. Men with condition always have higher heart rates;
   Accept blood pressure references for heart rate

2. But no direct measurements of blood pressure;
   Accept – no stats analysis to show significance

3. Only one investigation / test / need more studies;*Ignore references to 'yes' and 'no' throughout*

4. Using different recording methods / conditions (in each case so cannot compareresults);

5. Men without condition also have increased / higher heart rate in doctor'ssurgery;

2 max

[8]

8

1. SAN → AVN → bundle of His / Purkyne fibres;

   1. *Mark for correct sequence*

   2. Impulses / electrical activity (over atria);

   3. Atria contract;

   4. Non-conducting tissue (between atria and ventricles);

   5. Delay (at AVN) ensures atria empty / ventricles fill before ventricles contract;

   6. Ventricles contract from apex upwards;

5 max

9

[5] (a) 1. (Oxygen / carbon dioxide) detected by chemoreceptors / (pressure) detected by baroreceptors;

2. Medulla / cardiac centre involved;

Accept a valid equivalent e.g. cardioacceleratory centre

3. More impulses to SAN / along sympathetic nerve;

Neutral: signals / messages

Accept: acceleratory nerve

Need idea of 'more impulses' directly, not by implication

3

(b) (i) 1. To ensure results are due to omega-3 / fatty acids (only) / not due to something else in the oil;

Neutral: Idea of comparing groups / results

2. Placebo linked to mental / psychological effect;

Neutral: reference to a control group / placebo (unqualified)

1 max

(ii) 1. Lower / greater change of heart rate for Group **A**;

Ignore references to methodology

2. (Differences) are real / reliable / significant / not due to chance;

3. As bars do not overlap / values are not shared;

3

[7]

10 (a) (i) **G**;

Neutral: name of blood vessel

1

(ii) **E**;

Neutral: name of blood vessel

1

(b) Pressure is greater below valve / in ventricle than (artery);

Must be comparative

Reject: pressure is greater in ventricle than atrium

Neutral: pressure in ventricle increases

*Accept: **E** / **F** / named artery*

Accept: converse argument

1

(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;

Neutral: 'to pump blood'

2

(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;

Correct answer = 2 marks outright

5000 divided by 70, 55 or 15 = 1 mark for principle

2

(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) so must be increase in stroke volume / more blood leaves heart in each beat;

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

2

[9]

11

1. SAN initiates heartbeat / acts as a pacemaker / myogenic;

***Q** Must be in context*

2. (SAN) sends wave of electrical activity / impulses (across atria) causing atrialcontraction;

Reject: signals / electronic / messages / <u>nerve</u> impulses once only

3. AVN delays (electrical activity / impulses);

Neutral: reference to non-conducting tissue delaying impulses instead of the AVN

4. (Allowing) atria to empty before ventricles contract / ventricles to fill before theycontract;

5. (AVN) sends wave of electrical activity / impulses down Bundle of His / Purkynefibres;

6. (Causing) ventricles to contract (from base up) / ventricular systole;

5 max

[5] (a) Sends out electrical activity / impulses;

12

Initiates the heartbeat / acts as a pacemaker / (stimulates) contraction of atria;

Q *Ignore reference to ventricles.*

2

(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;

Q *Allow converse for third marking point.*

2 max

[8] (a) B – It is the 2nd contraction / occurs (immediately) after A / occurs after atrium;

13

Larger / more force / more pressure;

2

(b) $\frac{60}{\text{time for 1 cycle}}$

= 37 to 38

allow 1 mark if correct working shown

max 2

(c) (i) (Heart rate) reduced;
(Stroke volume) no effect;

2

(ii) Reduced because C.O. = H.R. x S.V. / connection argument based on reduced H.R;

1

(iii) Parasympathetic;

1

(d) (i)
1. Coordination via medulla (of brain) / cardiac centre;
2. (Increased) impulses along sympathetic (/ cardiac accelerator) nerve
3. To S.A. node / pacemaker;
4. More impulses sent from / increased rate of discharge of S.A. node /pacemaker;

Not "beats"; not "speeds up"

4

(ii) In exercise – More energy release / more respiration / actively respiring muscles / for aerobic respiration;
Higher cardiac output – Increases O_2 supply (to muscles);
Increases glucose supply (to muscles);
Increases CO_2 removal (from muscles) / lactate removal;
Increases heat removal (from muscles) / for cooling;

If no "increase" – max 2 marks

3

[15]

14 (a) 1. pressure receptors / baroreceptors / stretch receptors in aorta / carotid arteries / carotid sinus;
(*reject car*

otidbody)

2. send impulses to cardiovascular centre / medulla / cardio-inhibitory centre;
(reject signals / messages / electronic)
3. impulses via parasympathetic nerves / vagus; *(accept inhibitory nerve)*
4. to SAN;
5. release of ACh / inhibits SAN / decreases impulses from SAN;
6. decreases impulses to AVN / decreased stimulation of AVN / decreases impulses fromAVN;

(any reference to signals / messages / electronic disqualifies points 3 and 5 only)

6

(b) 1. inhibit impulses in sympathetic nerves / from cardio-acceleratory centre;
2. SAN not stimulated / noradrenaline not released so heart rate lowers / does not increase;
(accept inhibits / blocks synapses);

2

[8]

QWC 1

(a) 1. rate of respiration increases (in muscle cells);

15 2.

carbondio

xidecconcentrationincreases/pHfalls/H

+ increases / acidity increases;

3. chemoreceptors in aortic / carotid bodies / medulla *(accept reference to aorta / carotid arteries not sinus)*;
4. (impulses to) medulla / cardioaccelerator centre;
5. increased frequency of impulses (*award only once*);
6. along sympathetic pathway to sinoatrial node / SAN *(not pacemaker);*

6

(b) (i) through cardiac muscle;
to atrioventricular node;
along bundle of His / Purkyne fibres;

2 max

(ii) sinoatrial node in the (right) atrium; trace from healthy person is identical to the trace for the diseased heart in the region of the atria / only differences seen in trace for ventricles;

2

[10] (a) (i) 0.3 s;

16

1

(ii) 0.2 - 0.4 s;

1

(b) thicker / more muscle in the left ventricle;

1

(c) Artery

1. thickest wall, enabling it to carry blood at high pressure / withstand pressure surges;
2. most elastic tissue, which smoothes out flow / maintains pressure;
3. most muscle which maintains pressure;
4. muscle in wall to control blood flow;

Vein

5. thin wall does not have to withstand high pressure;

Capillary

6. thin wall, allowing diffusion / exchange;
7. only endothelium present, allowing short diffusion pathway;

All vessels

8. have endothelium that reduces friction;

6 max

[9]