

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

2.2.1 THE HEART AND MONITORING HEART FUNCTION

SCORE

/83

PERCENTAGE

%

STEMUP

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1(a) The coronary artery supplies blood to the heart. If the coronary artery is blocked or damaged a heart attack may occur.

When a person is suspected of having a heart attack it is a medical emergency and the first step of the emergency procedure is to call for an ambulance.

State **two** other steps in the emergency procedure for a person who is suspected of having a heart attack.

1 _____

2 _____

[2]

- (b) Alcohol is a drug known to reduce the heart rate in humans. A group of students wanted to find out if alcohol had the same effect on the heart rate of the water flea, *Daphnia magna*.

One of the students made the following notes about the investigation.

1. We put a sample of *Daphnia* on a depression slide containing deionised water (control).
2. We put the slide under a light microscope and recorded a live video of the *Daphnia* sample.
3. We replayed the video in slow motion and counted the number of heart beats in 20s for 12 different *Daphnia*.
4. We then calculated the heart rate and recorded our data as the number of beats per minute (bpm).
5. We put a sample of *Daphnia* on a slide containing 2.5% alcohol and waited two minutes.
6. After two minutes we measured the heart rate using the same method as before.
7. We also repeated the investigation with 5% alcohol but decided that we could not repeat our investigation using this concentration, so we chose to use 2.5% alcohol.
8. We concluded that alcohol lowers the heart rate of *Daphnia* but the difference is not significant.

- (i) Give **one** reason why note 5, but **not** note 1, mentions that the students 'waited for two minutes'.

----- [1]

- (ii) Suggest **one** reason why the students decided that they could not repeat the investigation using 5% alcohol concentration.

----- [1]

(c) The results of the students' investigation are shown in Table 33.1.

<i>D. magna</i> individual	Heart rate in water (bpm)	Heart rate in 2.5% alcohol (bpm)	Difference (<i>d</i>)	Difference from the mean (<i>d</i> − <i>d̄</i>)	(<i>d</i> − <i>d̄</i>) ²
1	280	180	100	−7.3	53.29
2	295	185	110	2.7	7.29
3	283	181	102	−5.3	28.09
4	290	185	105	−2.3	5.29
5	289	180	109	1.7	2.89
6	291	183	108	0.7	0.49
7	293	185	108	0.7	0.49
8	289	182	107	−0.3	0.09
9	291	183	108	0.7	0.49
10	295	186	109	1.7	2.89
11	292	180	112	4.7	22.09
12	290	180	110	2.7	7.29
Mean (<i>d̄</i>) =			107.3	Sum =	130.36

Table 33.1

(i) Use the results in Table 33.1 to carry out a Student's paired *t*-test for these data.

Use the equations:

Standard deviation $s_d = \sqrt{\frac{\sum(d - \bar{d})^2}{n - 1}}$

$t = \frac{\bar{d}\sqrt{n}}{s_d}$

t = ... [3]

(ii) The table of critical values for 5% significance level is shown in Table 33.2.

Degrees of freedom	Critical value
4	2.78
5	2.57
6	2.48
7	2.37
8	2.31
9	2.26
10	2.23
11	2.20
12	2.18
13	2.16
14	2.15

Table 33.2

Using Table 33.2 and your answer to (i), comment on the conclusion made by the students in note 8: 'We concluded that alcohol lowers the heart rate of Daphnia but the difference is not significant'.

[2]

- 2 Which of the options, **A** to **D**, is the site of initiation of action potentials that lead to the contraction of heart muscle?

- A** accelerator nerve
- B** Purkyne fibres
- C** sinoatrial node
- D** vagus nerve

Your answer

[1]

3 Mammals have mass transport systems to move substances around the body.

Which feature of mammals, **A** to **D**, explains why they need mass transport systems?

- A low metabolic rates
- B large surface area to volume ratios
- C short diffusion distances
- D small surface area to volume ratios

Your answer

[1]

4(a) A student used the following method to investigate the effect of increasing duration of exercise on pulse rate.

1. Two sample groups of ten people were selected.
 2. The resting pulse rate was recorded for each person, using the radial artery on the wrist.
 3. Each person ran on a treadmill for 1 min.
 4. The pulse rate was taken immediately after exercise.
 5. The measurements were repeated for exercise durations of 2–10 min.
 6. All measurements were repeated.

(i) State **two** variables that the student would need to control when planning this investigation. For each variable give one reason why that variable must be controlled.

Variable -----

Reason -----

Variable -----

Reason -----

[4]

(ii) The student also used secondary data in this investigation.
Explain **two** advantages of using secondary data in investigations.

[2]

(b) Fig. 1.1 shows the heart rate of an athlete before and during a race.

- Stage 1 is at rest.
- Stage 2 is immediately before the starting pistol is fired.
- Stage 3 is immediately after the race has finished.

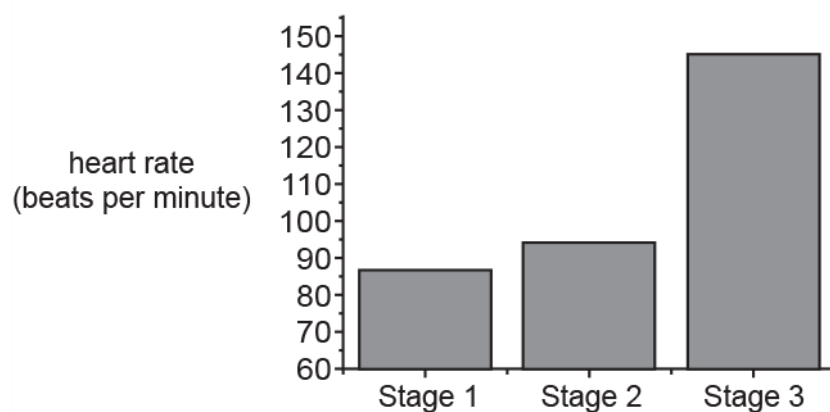


Fig. 1.1

(i) Describe and explain the effect of Stage 2 on heart rate.

[2]

(ii) The following measurements were made of the athlete during the race:

Stroke volume = 165 cm^3

Heart rate = 145 bpm

Calculate the cardiac output for this athlete.

cardiac output = ... units [1]

(iii) Explain why cardiac output decreases at very high heart rates.

----- [1]

(c) Fig. 1.2 shows an electrocardiogram (ECG) trace for a normal heartbeat. Fig. 1.3 shows an ECG trace of a patient suffering a heart attack.



Fig. 1.2



Fig. 1.3

(i) Which **one** of the following patterns, visible in Fig. 1.3, would indicate that the patient may be having a heart attack.

Place a tick (✓) in the appropriate box.

Elevation of the ST section	
Abnormally shaped P-wave	
Deep S wave	

[1]

(ii) The ECG trace in Fig. 1.4 was recorded using a smartphone app.

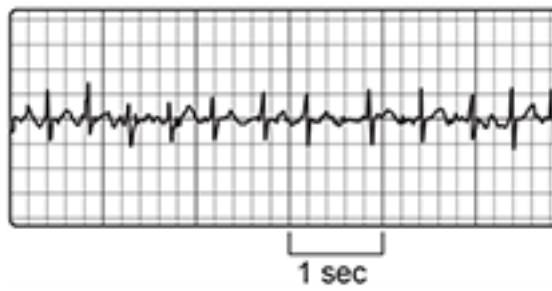


Fig. 1.4

Using Fig. 1.4 and your knowledge suggest why atrial fibrillation could lead to a cardiac arrest.

.....

.....

.....

[1]

(d) * An investigation was carried out into the effectiveness of smartphone apps for early diagnosis of heart conditions.

Two statements that were provided in this investigation.

Statement 1:

- Patients with compatible smartphones were issued with a smartphone app.
- The sample was composed of 148 patients 53 male, 95 female; average age 41 years, range 7 to 78, with two patients over 75.
- Patients were asked to record an ECG when they experienced symptoms of palpitations.
- Patients were linked to doctors via a secure website and could upload ECGs.
- Median time from symptoms to diagnosis was 9 days.
- In most cases no significant cardiac rhythm disturbance was found.

Statement 2:

- My patient was a 68 year old man with atrial fibrillation. He had previously been using cardiac event monitors to check his heart rhythm and started to use a smartphone app instead.
- Cardiac event monitors require the patient to wear electrodes attached to the chest, continuously for 30 days and to avoid the use of anything that may disrupt the signal, such as electric toothbrushes, metal detectors or mobile phones.
- With the smartphone app, I provide feedback so that the patient knows what his cardiac rhythm is doing and whether he is having symptoms.

Statement 1 was made by the scientists who carried out the investigation.

Statement 2 was made by a GP who was interviewed during the investigation.

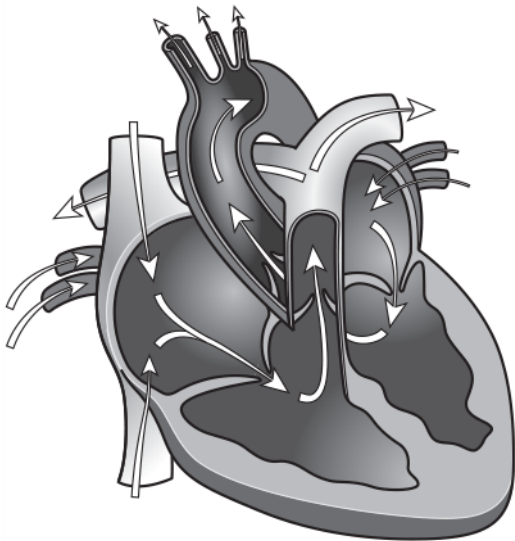
Using the information given in Statements 1 and 2, evaluate the use of the smartphone app in the monitoring of heart conditions.

Blank lined paper for writing.

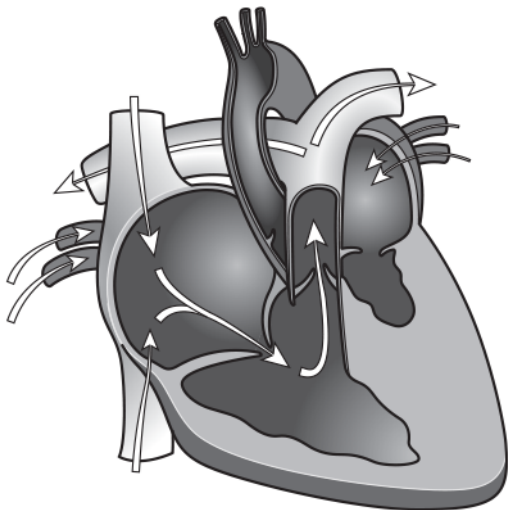
5(a) Hypoplastic Heart Syndrome (HHS) is a rare condition seen in newborn babies. HHS affects the internal structure of the heart.

The diagrams show a normal heart and the heart of a baby with HHS.

Normal Heart



Hypoplastic Heart Syndrome



Using your knowledge and the diagrams, describe how the structure of the heart has been affected by HHS.

[2]

(b) In babies with HHS, blood flow through the coronary artery is reduced.

- (i) Suggest **one** effect on heart function that could be caused by reduced blood flow in the coronary artery. Give a reason for your suggestion.

suggestion

.....

reason

.....

[2]

- (ii) The heart is the 'pumping' mechanism of the mass flow transport system in mammals.

Describe the advantages of a mass flow transport system.

.....

.....

.....

.....

.....

[2]

6 Which of the options, **A** to **D**, causes an increase in stroke volume following regular exercise?

- A** atrial hypertrophy
- B** decrease in blood pressure
- C** increase in heart rate
- D** ventricular hypertrophy

Your answer

☐

[1]

- 7 A student was learning about the heart and circulatory system. The student dissected a heart and made a drawing of their dissection as shown in Fig. 1.1.

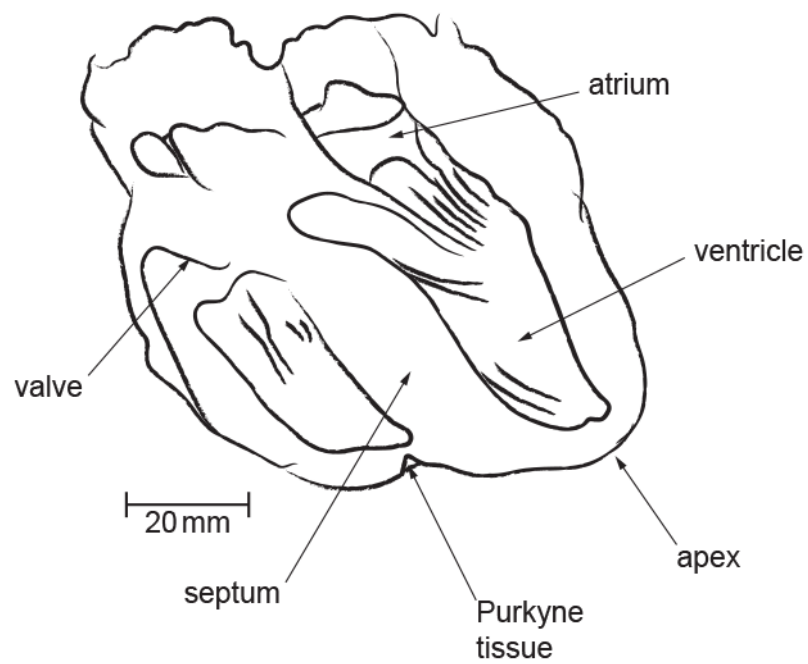


Fig. 1.1

Suggest **two** improvements that could be made to the drawing in Fig. 1.1.

- 1 _____
- _____
- 2 _____
- _____

[2]

8 Which of the options, **A** to **D**, is the heart chamber in which electrical activity is initiated?

A left atrium

B left ventricle

C right atrium

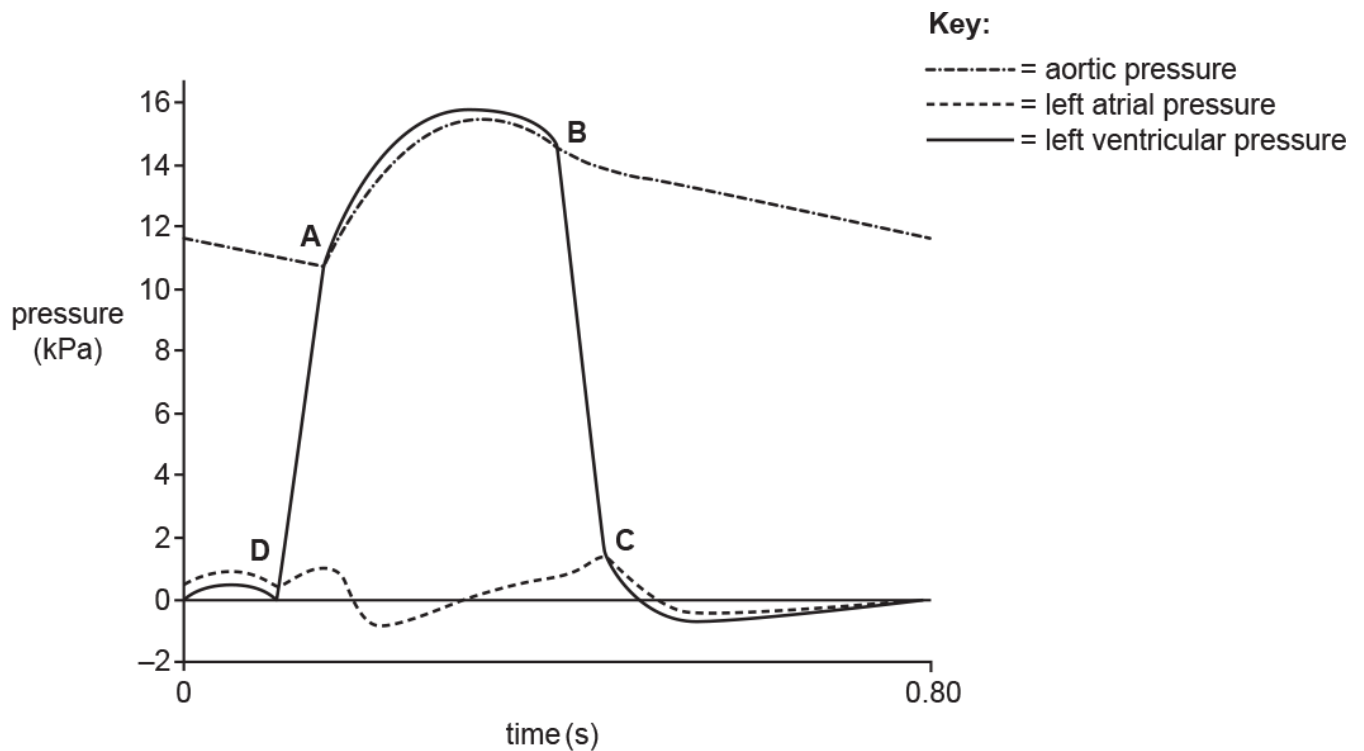
D right ventricle

Your answer

[1]

9 The graph below shows pressure changes in the left side of the heart during the cardiac cycle.

Four points on the graph are labelled **A** to **D**.



Which of the points, **A** to **D**, corresponds to closing of the semilunar valve?

Your answer

[1]

10(a) Cardiac output can be calculated using ultrasound.

The ultrasound probe is directed at a region of the ascending aorta and three measurements are made:

- aortic diameter (**D**)
- distance travelled by blood in the aorta during one cardiac cycle (**B**)
- heart rate (**HR**)

(i) The ultrasound measurements for a patient were as follows:

$$D = 3.2 \text{ cm}$$

$$B = 10.7 \text{ cm}$$

$$HR = 75 \text{ beats min}^{-1}$$

The aorta can be modelled as a cylinder using measurements **D** and **B**.

Calculate the cardiac output for this patient.

Answer $\text{cm}^3 \text{ min}^{-1}$ [3]

(ii) The cardiac output calculated in (i) makes an assumption about a property of the ascending aorta.

State this assumption.

.....
..... [1]

- (b) An experiment was conducted to study the effect of caffeine on heart rate in the water flea, *Daphnia*.

Daphnia is relatively transparent and its heart can be seen under a light microscope with low power.

The method was as follows:

1. Prepare five caffeine solutions, at concentrations of 0.1%, 0.2%, 0.3%, 0.4% and 0.5%
2. Place a water flea into a petri dish containing tap water
3. Observe the water flea under a light microscope with low power
4. Count the number of heart beats over a period of 10 seconds
5. Remove the tap water and repeat steps 2 to 4 with each caffeine solution
6. Repeat the entire procedure for two more water fleas.

The data were expressed as beats min^{-1} . Table 36 shows the results of the experiment.

Caffeine (%)	Heart rate (beats min^{-1})			
	Water flea 1	Water flea 2	Water flea 3	Mean
0.0	161	125	148	145
0.1	177	138	169	161
0.2	187	146	179	171
0.3	193	152	188	178
0.4	197	156	194	182
0.5	196	155	194	182

Table 36

- (i) Suggest why the study used *Daphnia* rather than human volunteers.

 ----- [1]

- (ii) Explain why *Daphnia* needs a circulatory system.

 ----- [2]

(iii) Analyse the data in Table 36.

What can be concluded about the effect of caffeine on heart rate in *Daphnia*?

[3]

(iv) Describe **two** limitations of the method that may influence the **reproducibility** of the results.

1

2

[2]

11 The action of valves is vital to the function of the heart.

Which of the options, **A** to **D**, is an event that occurs immediately before opening of the semilunar valves?

- A emptying of the atria
- B stimulation of the atrioventricular node
- C stimulation of the sinoatrial node
- D start of ventricular systole

Your answer

[1]

12(a) An electrocardiogram (ECG) trace represents the electrical changes that occur in heart muscle during the cardiac cycle. Electrical changes occur as a result of depolarisation and repolarisation of cardiac muscle cells.

Fig. 5.1 shows the electrical changes that occur in a normal cardiac cycle.

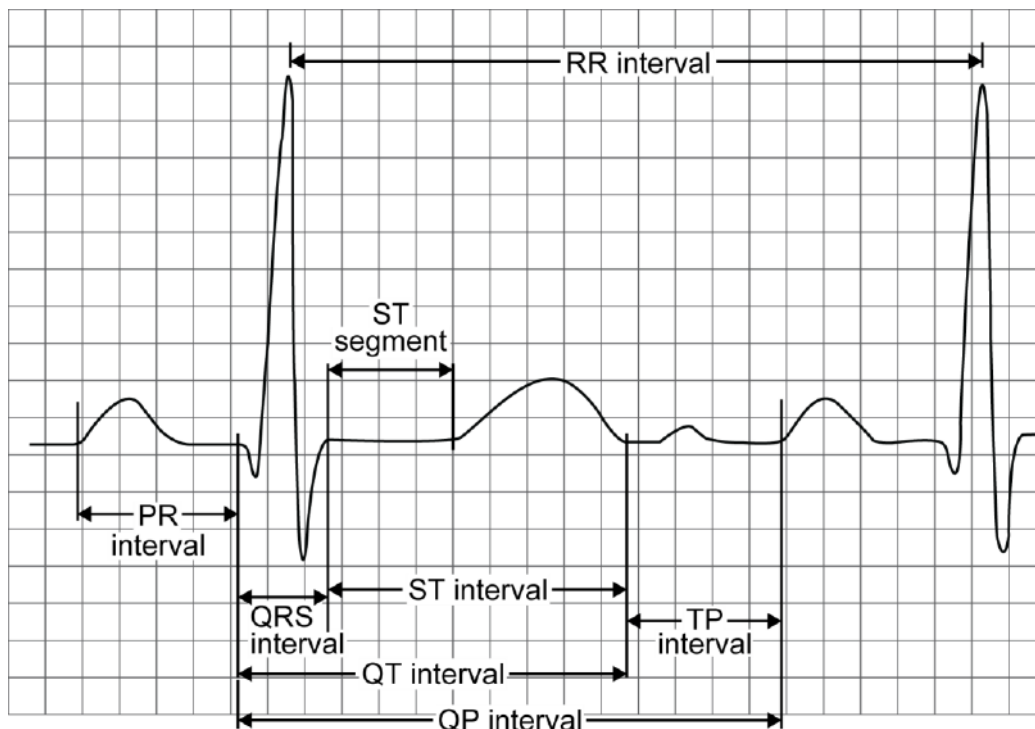


Fig. 5.1

The subject from whom the ECG trace in Fig. 5.1 was obtained had a resting heart rate of 65 bpm.

Calculate the duration of the **RR** interval. Give your answer to **three** significant figures.

Answer = _____ ms [2]

(b) Using the information in Fig. 5.1, identify which of the intervals or segments shown correspond to the following descriptions:

(i) The time taken to conduct the cardiac impulse through the AV node.

-----[1]

(ii) The time taken for ventricular depolarisation and repolarisation.

-----[1]

(iii) The time taken for ventricular diastole.

-----[2]

(iv) Two intervals which decrease during exercise.

-----[2]

(v) Will be elevated during or after a heart attack.

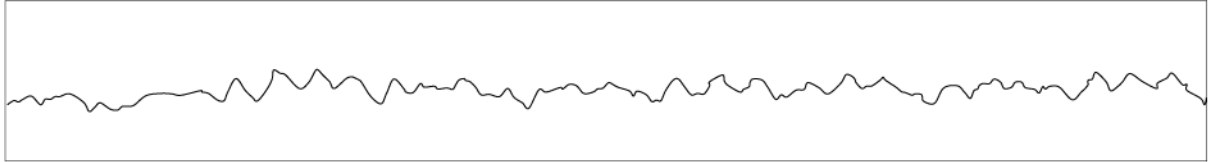
-----[1]

(c) The chances of surviving and recovering from a heart attack can be increased if first aid is provided quickly.

In addition to calling 999 and informing ambulance control that a heart attack is suspected, outline the procedure a first aider should perform to assist someone having a heart attack.

-----[3]

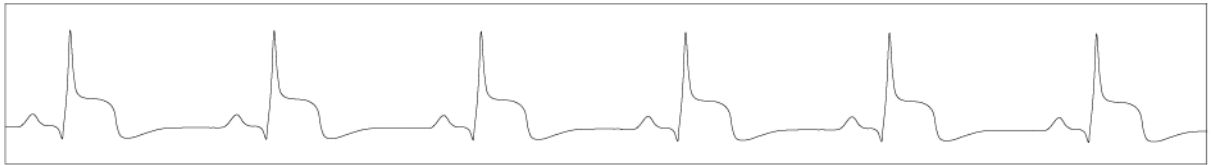
13 Four electrocardiogram (ECG) traces labelled A to D are shown below.



A



B



C



D

Which of the traces, A to D, shows evidence of S-T elevation?

Your answer

[1]

- 14 The total blood volume of a human adult is 4.8 dm^3 . The heart rate for this adult during intense exercise was 200 bpm.

At this heart rate, the blood completed **six** full circulations of the body in one minute.

Which of the options, **A** to **D**, is the correctly calculated stroke volume of the left ventricle for this adult?

- A 24 cm^3
- B 82 cm^3
- C 144 cm^3
- D 184 cm^3

Your answer

[1]

15(a) During the cardiac cycle, the pressure inside the heart varies. Fig. 37.1 shows the pressure changes on the right and left sides of the heart during one cardiac cycle.

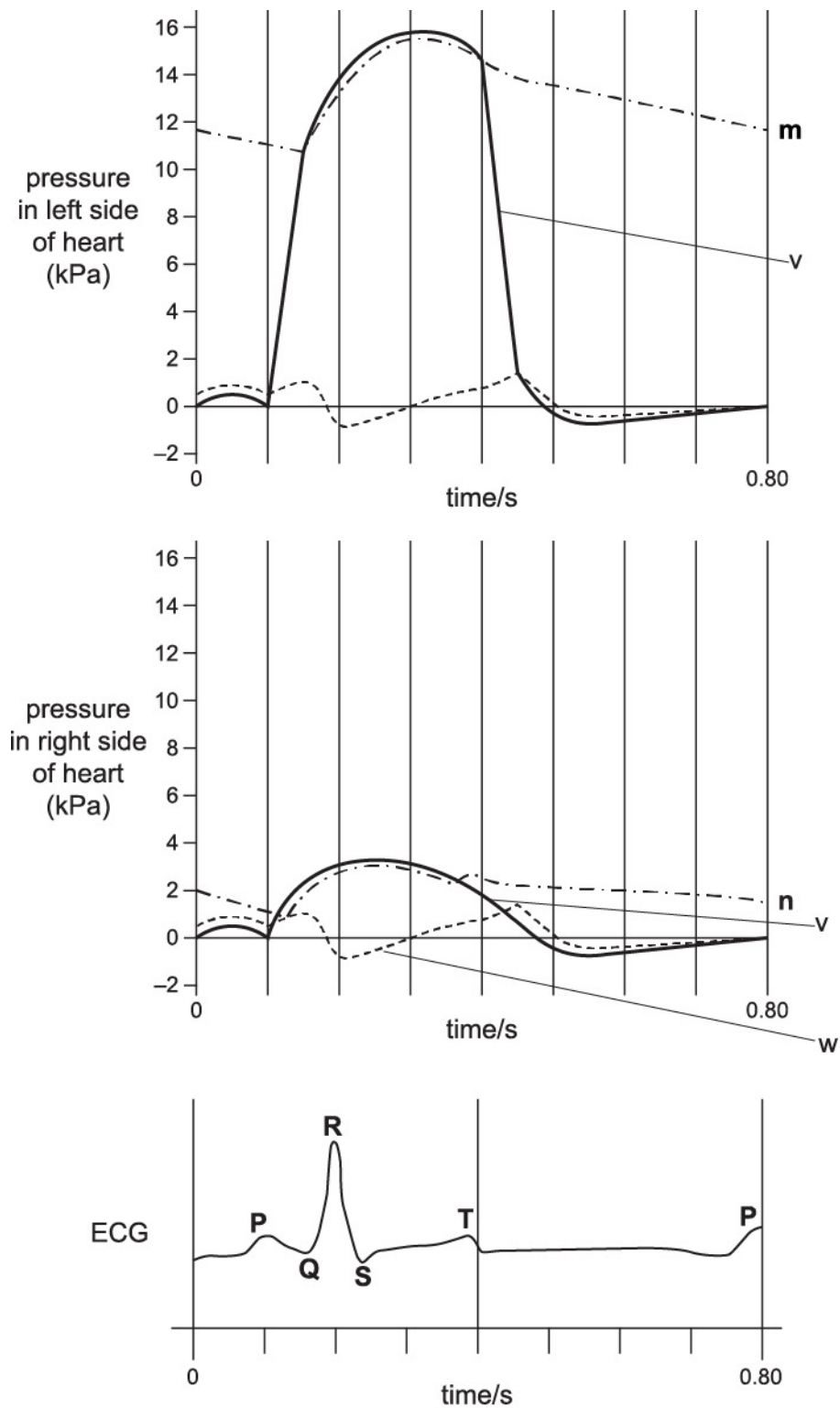


Fig. 37.1

Identify the vessels represented by the labels **m** and **n** in **Fig. 37.1**.

m

n [2]

- (b) The lines labelled **w** and **v** in **Fig. 37.1** show the pressure changes in the ventricles and atria during one cardiac cycle.

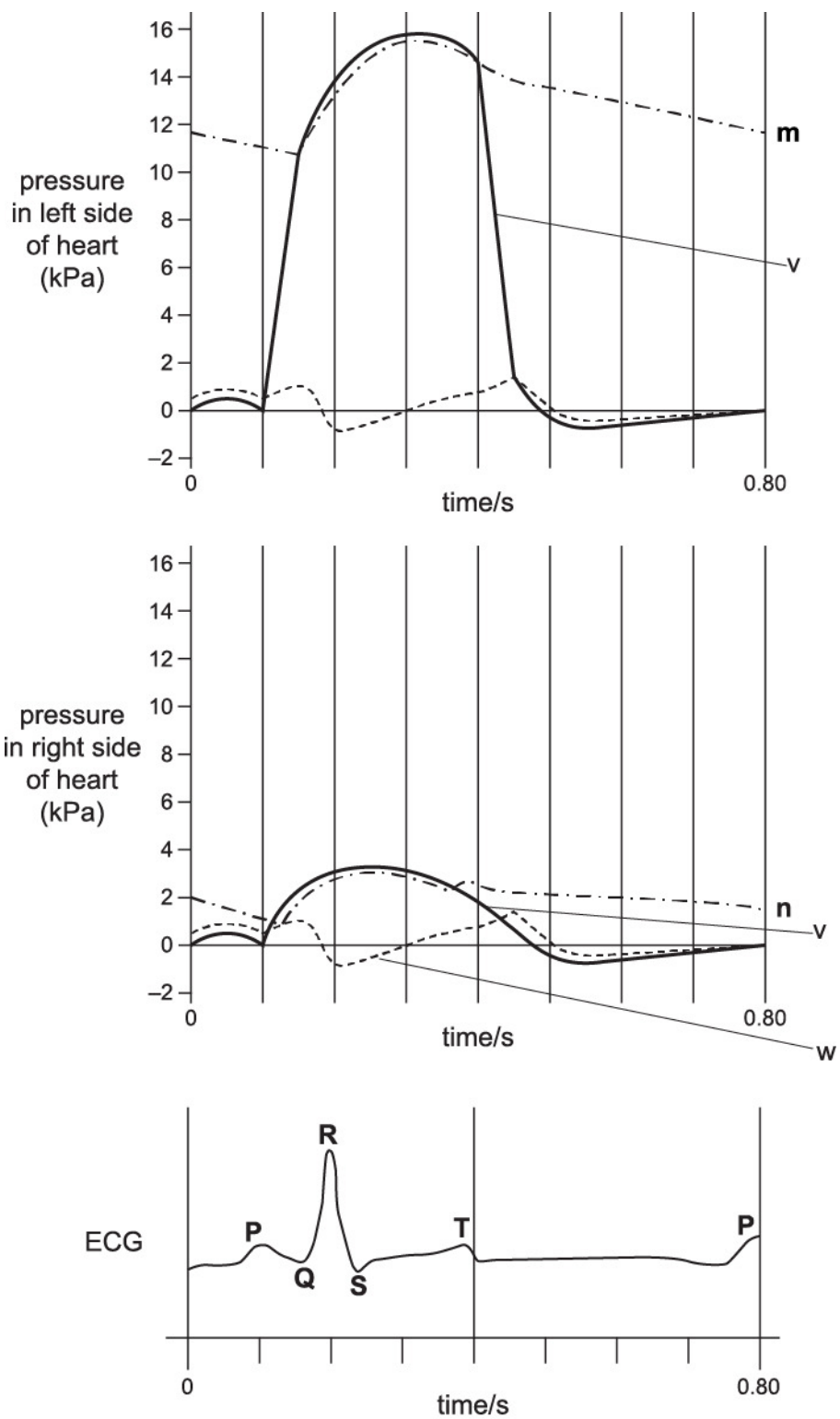


Fig. 37.1

- (i) The line labelled **w** shows the pressure changes in the right atrium.

What can be concluded about the structure of the right atrium?

You should use data to support your conclusion.

----- [2]

(ii) The lines labelled v show the pressure changes in the left and right ventricles.

Express the **maximum** pressures in the left and right ventricles as a simple ratio.

ratio ----- :1 [1]

(iii) Assuming the thickness of the left ventricle wall is 8 mm, use the ratio calculated in part (ii) to estimate the thickness of the right ventricle wall.

Give your answer to one decimal place.

right ventricle wall thickness ----- [2]

(c) In addition to changes in pressure, **Fig. 37.1** also shows an ECG trace.

The part of the trace labelled T represents the repolarisation of the ventricles. Until this has happened, it is not possible for another heartbeat to occur.

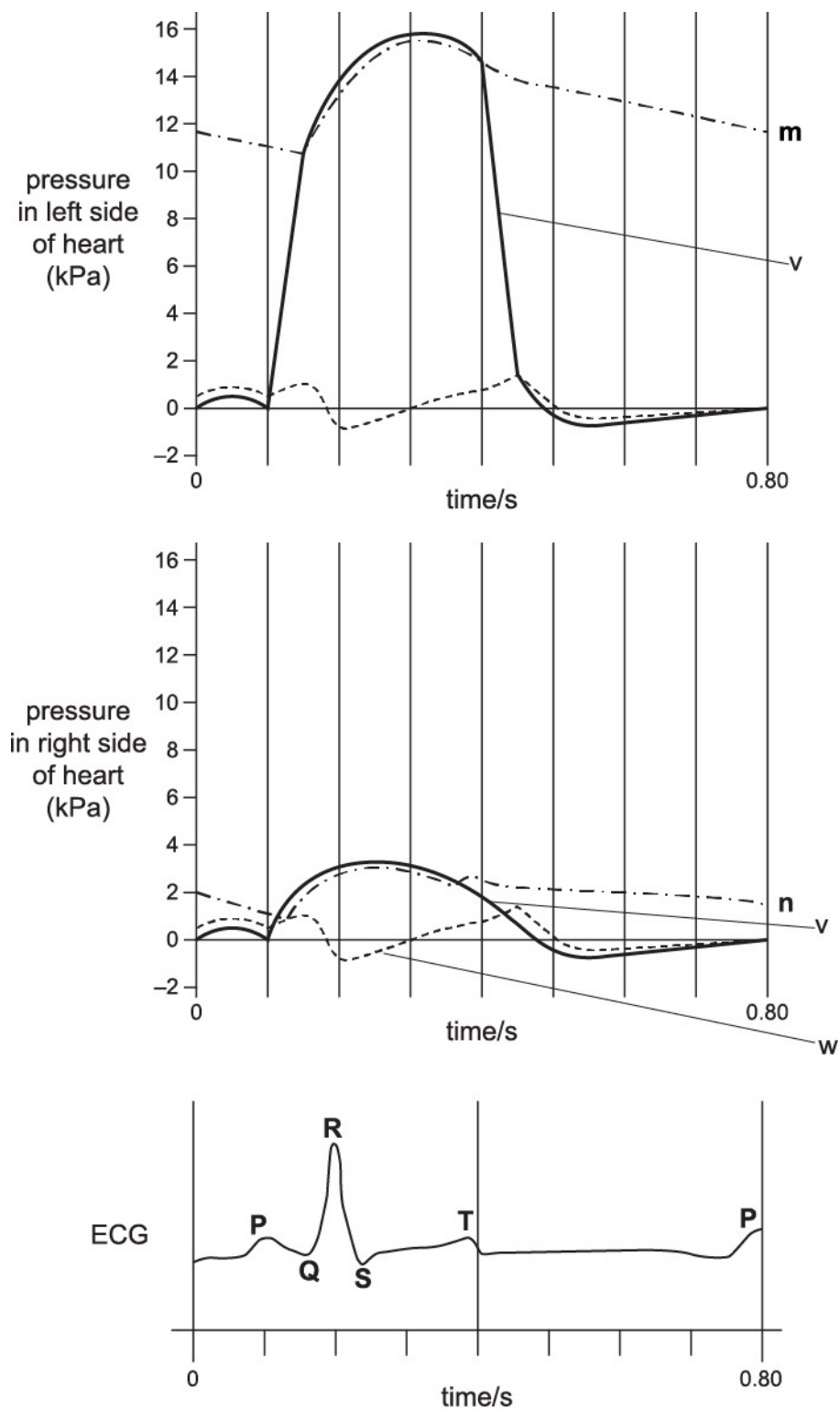


Fig. 37.1

- (i) As the heart rate increases, what happens to the time between the T wave and the P wave which signals the start of the next heartbeat?

----- [1]

- (ii) It can be dangerous in some circumstances to exercise at a level where the heart rate approaches its maximum possible.

Using the information in Fig. 37.1, calculate the maximum heart rate possible for the person from whom this trace was obtained.

Maximum heart rate ----- [2]

The concentration of other molecules within the plasma is now more commonly used. One of these molecules is cardiac troponin (troponin T).

- (i) Describe the role of troponin T in cardiac muscle cells during diastole.

[2]

- (ii) Table 33.1 shows the results from an investigation comparing troponin T plasma concentrations in three different groups.

Group	Number of subjects	Concentration of plasma troponin T ($\mu\text{g dm}^{-3}$)	
		Median	Interquartile range
Normal subjects	100	0.20	0.16–0.30
Subjects where a heart attack was confirmed using an ECG	72	15.30	9.60–22.70
Subjects with other injuries but no heart attack occurred as confirmed using an ECG	13	0.29	0.23–0.43

Table 33.1

Evaluate the evidence that the use of troponin T concentration in plasma is a useful diagnostic test to confirm a heart attack.

You should use information from Table 33.1 to support your argument.

----- [3]

- 17 The average heart rate at rest is 72 beats per minute and the average stroke volume is 70 cm^3 .

Assuming a total blood volume of 5 dm^3 , what is the shortest time it would take for the heart to pump the total volume of blood in the body?

- A between 10 and 20 seconds
- B between 30 and 40 seconds
- C between 50 and 60 seconds
- D between 60 and 70 seconds

Your answer

[1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1	a		Any two from: sit person down in upright position with knees bent ✓ help them take their medicine for , heart problem / angina ✓ give an aspirin tablet / get them to chew aspirin tablet ✓ monitor breathing and pulse rates ✓	2 max(AO1.1)	ALLOW sit in 'W' position
	b	i	<i>idea that</i> in note 1 Daphnia would already have been in water so already acclimatised ✓ <i>idea that</i> in note 5 time is required for alcohol to be taken in by Daphnia ✓	1 max(AO3.4)	
		ii	Daphnia died so invalid results ✓ AVP ✓	1 max(AO3.4)	e.g. ethical reason
	c	i	$(t =) 108.1$ ✓✓✓	3(AO3.1)	ALLOW 107.96 to 109.32 ALLOW 1 mark for $Sd = \sqrt{11.85} = 3.44$ ALLOW 1 mark for $t = (107.3 \sqrt{12}) \div (\text{ANS})$
		ii	students are correct that alcohol lowers heart rate but incorrect because it is significantly lower ✓ (because) critical value for 11 degrees of freedom / 2.20, is much lower than value for t ✓	2(AO3.2)	ALLOW ECF ALLOW ORA e.g. t is much higher than 2.20
			Total	9	
2			C	1(AO1.1)	
			Total	1	
3			D	1(AO1.2)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4	a	i	<i>Explanation must be qualified <u>and</u> correspond to the variable</i> <i>Credit any two pairs</i> speed / gradient (of treadmill) ✓ <i>because</i> (higher speed/gradient) creates <u>higher</u> energy demands for body and <u>higher</u> heart rates ✓ health of participant / smoking ✓ <i>because</i> health conditions / smoking, (may) increases heart rate ✓ BMI / obesity ✓ <i>because</i> high(er) BMI / obesity, increases heart rate ✓ sex ✓ <i>because</i> males (tend to) have <u>higher</u> heart rate ✓ age of participants ✓ <i>because</i> older people have <u>lower</u> heart rates ✓ <u>initial</u> fitness of the subject ✓ <i>because</i> fitter people have <u>lower</u> (resting) heart rates ✓	max 4 AO 2.7	ALLOW 'pulse rate' as alternative wording for 'heart rate' IGNORE 'speed person ran' as unrelated to the treadmill
		ii	<i>Any two from</i> from a larger sample so, more (likely to be) reliable ✓ peer reviewed so, conclusions more valid ✓ different methods (may have been used) so, achieved reproducibility ✓ <i>idea that</i> procedure used to collect secondary data (may have) used a more, accurate / precise, methodology, so improved accuracy of data (obtained) ✓	max 2 AO 2.5	Must explain point for mark

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance						
	b	i	<i>Description</i> (slight) increase in heart rate ✓ <i>Explanation</i> anticipatory response/ increases delivery of oxygen to muscles in anticipation of exercise OR caused by release of, neurotransmitters / noradrenaline / adrenaline ✓	2 AO 2.3	ALLOW use of data to show increase of heart rate IGNORE 'HR <u>changes</u>' as this could be an increase or a decrease in the HR						
		ii	23925 AND <u>cm³ min⁻¹</u> ✓	1 AO 2.4	Correct answer only: 165 x 145 = 23925 Must include units for mark. ALLOW correct answer in other form, e.g. 23.925dm³ min⁻¹, 23925 ml min⁻¹						
		iii	less time for ventricles to fill so, stroke volume is lower ✓	1 AO 2.3	ALLOW ref to incomplete filling of ventricles <u>and</u> reduced SV						
	c	i	<table><tr><td>Elevation of the ST section</td><td>✓</td></tr><tr><td>Abnormally shaped P-wave</td><td></td></tr><tr><td>Deep S wave</td><td></td></tr></table>	Elevation of the ST section	✓	Abnormally shaped P-wave		Deep S wave		1 AO 1.2	
Elevation of the ST section	✓										
Abnormally shaped P-wave											
Deep S wave											
		ii	(cardiac) muscle in atrial wall contracts, arrhythmically / in an uncoordinated way AND inefficient filling of ventricles ✓	1 AO 2.5							
	d		<i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics): award the higher mark where the Communication Statement has been met.</i> <i>Award the lower mark where aspects of the Communication Statement has been missed.</i>	6 AO 3.2	Indicative marking points may include: <i>Benefits/ advantages :</i> • Unexplained symptoms may have an effect on quality of life and may lead to anxiety • Patients are reassured and further investigations can be avoided • Results are immediately available • Less disruption to lifestyle than other cardiac monitors • Less additional cost to NHS than cardiac monitors. • The knowledge allows doctors to make more informed treatment decisions e.g. such as medication dosage • Other indicators of (later onset) heart disease are painful and frightening –						

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			• <i>The science content determines the level.</i> • <i>The Communication Statement determines the mark within a level.</i> <i>A level annotation should be used where all marks for a level have been achieved e.g. for 6 marks L3, 5 marks L3' etc. No marks (0) should have a cross</i> Level 3 (5-6 marks) Describes and <u>explains</u> both benefits and drawbacks, with conclusion drawn. Detailed evidence of using information from both statements 1 and 2. <i>There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.</i> Level 2 (3-4 marks) Describes some benefits and drawbacks and explains at least one benefit and at least one drawback in detail. Evidence of using information from either statements 1 or statements 2. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.</i> Level 1 (1-2 marks) Describes some benefits or drawbacks. Information from statement 1 and 2 may not be stated clearly. <i>There is an attempt at a logical structure with a line of reasoning. The information is mostly relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		e.g. pressure in chest, breathlessness, discomfort • Patient is involved in diagnosis of symptoms • Less need for training in emergency treatment of heart attacks e.g. defibrillator, CPR • Median time from symptoms to diagnosis relatively short • Less need for GP/ consultant appointment time • No need for specialist to fit device <i>Drawbacks/disadvantages:</i> • (Older) people, who are at greater risk of heart disease, may not possess compatible smartphones • Patients may not use the smartphone app correctly • No evidence of correlation between use of smartphone app and decreased GP consultation • New device not fully tested on trialled over many years • May create fear /worry from user as they can access data / trace in real time • Battery life of smartphone may affect the long-term use of the app • Quality of trace not as good as the CEM /standard hospital ECG with 12 electrodes • Older people, who are at greater risk of heart disease, may not have confidence in technology • Less data is collected as a result of lack of continual recording (as compared to CEM being worn continuously) • Patients may not use the app if they fail to recognise their own symptoms
			Total	18	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5	a		small / reduced volume of , <u>left</u> ventricle ✓ small / narrow , aorta ✓ small(er) valves on <u>left</u> side ✓	2 max AO2.1	ALLOW named valves
	b	i	<i>suggestion</i> reduced cardiac output OR increased heart rate / tachycardia OR heart attack ✓ <i>reason</i> lack of , oxygen / nutrients , to , heart / cardiac , muscle ✓	2 AO1.2	
		ii	shortens diffusion distance ✓ allows organisms to grow larger ✓ moves substances quickly ✓	2 max AO1.1	ALLOW named substances
			Total	6	
6			D	1 AO1.1	
			Total	1	
7			<i>any two of the following:</i> use a sharp pencil ✓ lines should be, (clear) continuous / non-overlapping /AW ✓ label lines could be, horizontal / justified / AW ✓ label lines should not have arrow (heads) ✓ has labelled structures which are not visible ✓ no shading should be included / AW ✓ add, (informative) title / annotation(s) ✓	2 (AO 3.4)	e.g. cannot label Purkyne tissue IGNORE 'add left/right' ALLOW correct example of an annotation <u>Examiner's Comments</u> Generally this question was answered well. In some cases answers were not clear and could not be credited e.g. "add more labels", "make lines solid". Candidates should be aware that the command word was to suggest two improvements, so only the first 2 improvements will be assessed by examiners. Candidates who provide additional suggestions are at risk of contradicting their initial answers.
			Total	0	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8			C	1	
			Total	1	
9			B ✓	1	Examiner's Comments Candidates should be very familiar with this graph showing pressure changes in the heart, yet the correct response was only achieved by just over 50% of the candidates.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10	a	i	6460 ✓ ✓ ✓	3	6454.9 ✓ ✓ $\pi(1.6)^2 \times 10.7 \times 75$ ✓ ✓
		ii	(cross-section of) aorta is circular ✓ same diameter over length ✓	max 1	
	b	i	ref to dangers of caffeine ✓ ref to caffeine tolerance in (some) humans ✓ fewer / no ethical considerations with Daphnia ✓	max 1	
		ii	small surface area : volume ratio ✓ diffusion distance too great ✓	2	ALLOW 'SA:V'
		iii	general increase in heart rate with caffeine concentration ✓ greater increase at lower (0.1% / 0.2%) concentrations / smaller increase at higher (0.3% / 0.4%) concentrations ✓ no difference between 0.4% and 0.5% / no increase after 0.4% ✓	3	
		iv	too few replicates / need more than 3 fleas ✓ oxygen concentration of solutions not controlled ✓ fleas not left to acclimatise to solutions ✓ temperature of each solution not considered ✓ 10 seconds too short for sampling ✓ fleas may be different, size / age ✓	max 2	
			Total	12	
11			D ✓	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12	a		923 (ms) (1)(1)	2	If answer is incorrect, look for $60 \div 65$ or 0.923 (s) = 1 mark
	b	i	PR interval (1)	1	Mark first answer only. If a second answer is given that is incorrect = no mark
		ii	QT interval (1)	1	Mark first answer only. If a second answer is given that is incorrect = no mark
		iii	TP (1) PR (1)	2	Answers in any order
		iv	RR (1) TP(1) QP (1)	2	Answers in any order
		v	ST (segment) (1)	1	
	c		sit person in W position (1) give aspirin to chew if appropriate (1) assist them to take any angina medication (1) monitor pulse and breathing (1)	3	ALLOW a description 'semi-recumbent with knees bent' DO NOT ALLOW 'give aspirin' without a further qualification e.g. no allergy, over 16
			Total	12	
13			C	1	
			Total	1	
14			C	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15	a		m – aorta n – pulmonary artery	2	
	b	i	wall must be thinner than right ventricle wall figures in support	2	ALLOW manipulated figures e.g. right ventricle pressure is 6 x higher, ratio is 3 : 0.5 or 6 : 1
		ii	ratio = 5 : 1	1	ALLOW 5.3 : 1
		iii	1.5 mm	2	Award 1 mark if units are incorrect or omitted. If an alternative answer is given with units and to one decimal place, ALLOW 2 marks for 1 divided by ratio obtained from (ii) multiplied by 8 as error carried forward
	c	i	Time between them gets less / AW	1	
		ii	Any 2 from: Minimum time for 1 beat = 0.3 seconds (distance from first P to T wave) 60 ÷ 0.3 Answer = 200 bpm / beats per minute	2	
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
16		i	troponin, binds to / AW, tropomyosin myosin binding site is blocked (by tropomyosin) / <i>idea that</i> myosin is prevented from binding to actin	2	
		ii	comparison of median values in support of a statement / comparison of interquartile range values in support of a statement <i>plus any two from the following marks up to a maximum of 3</i> <i>idea that</i> (very) high concentrations are only seen where a heart attack is confirmed / heart attack subject have significantly higher median values than other groups <i>idea that</i> bottom of interquartile range for confirmed heart attacks is significantly higher than other groups / top of interquartile range of other groups is significantly below bottom of range for group with heart attack <i>idea that</i> unlikely to get 'false positives' or 'false negatives' <i>idea that</i> sample sizes are very different in the three groups and could affect the validity of the data	3	DO NOT ALLOW a simple description of the concentrations for each group – look for a clear statement that the high levels are specific to a heart attack or that they are significantly higher for this group.
			Total	5	
17			C	1	
			Total	1	