



# **A-Level Biology**

## **Control of Heart Rate**

### **Question Paper**

**Time available: 56 minutes**

**Marks available: 46 marks**

**[www.accesstuition.com](http://www.accesstuition.com)**

1.

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

---

---

---

---

---

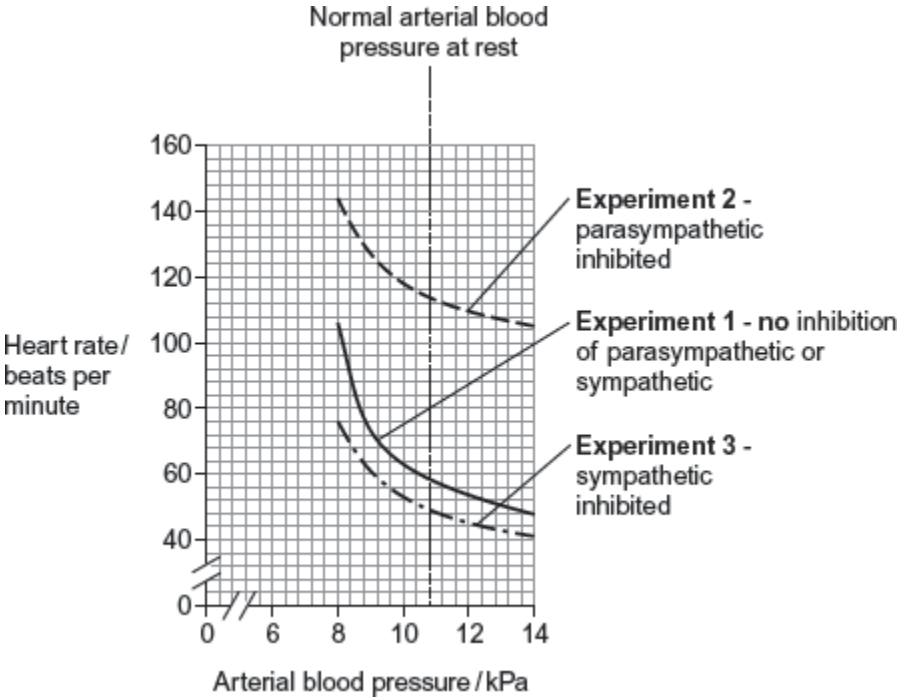
---

(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 and sympathetic nervous systems in response to changes in arterial blood pressure?

---

---

---

---

---

---

---

**(3)**

**(Total 8 marks)**

**2.**

(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 from the left atrium to the aorta.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

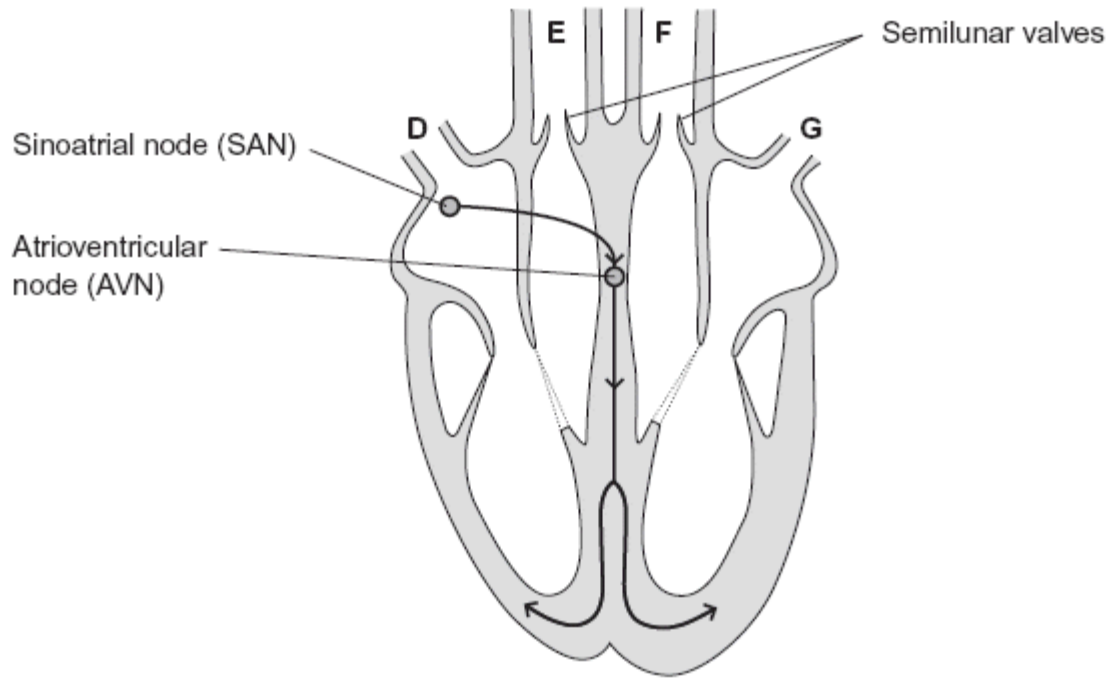
---

---

**(5)**

**(Total 10 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**

(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 new wave 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 after completing a training programme.

	Before training	After training
Cardiac out/cm <sup>3</sup>	5000	5000
Resting heart rate/beats per minute	70	55

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

\_\_\_\_\_ cm<sup>3</sup>

(2)

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

---

---

---

---

---

(2)

(Total 9 marks)

4.

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

---

---

---

---

---

---

---

---

---

---

---

---

---

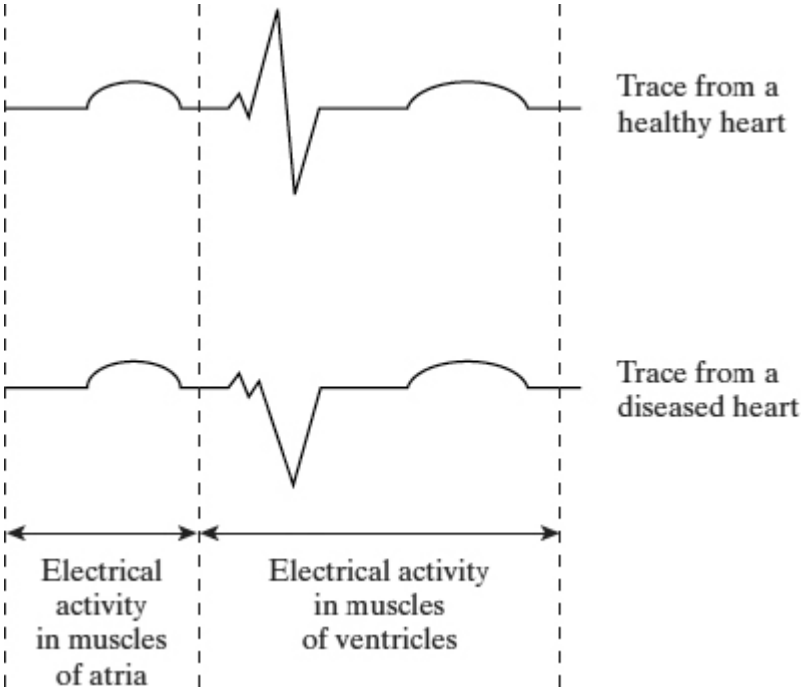
---

---

---

(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 sinoatrial node to the muscles of the ventricles in a healthy heart.

---

---

---

---

(2)

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

---

---

---

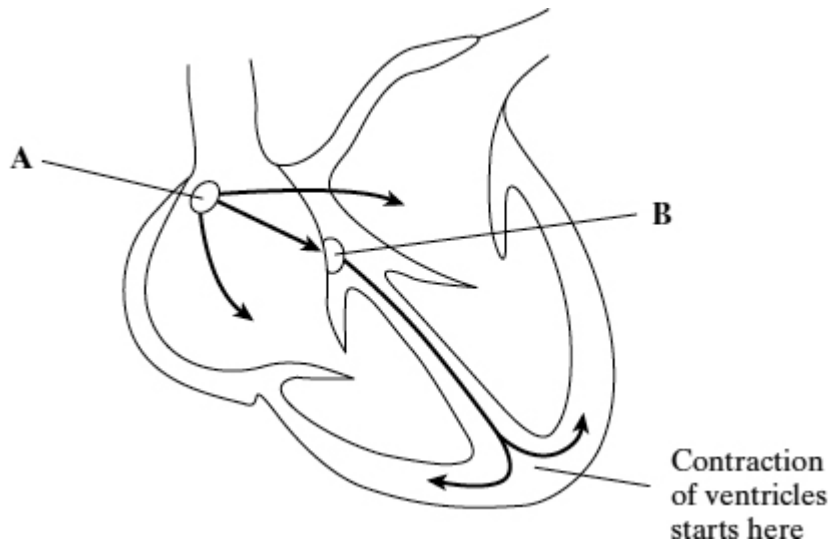
---

(2)

(Total 10 marks)

5.

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





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

Time / s	Blood pressure / kPa		
	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 the right 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 $\mu\text{m}$	5.0 mm
	Mean thickness of wall	1.0 mm	0.5 $\mu\text{m}$	0.5 mm
		<b>Relative thickness (shown by length of bar)</b>		
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)**