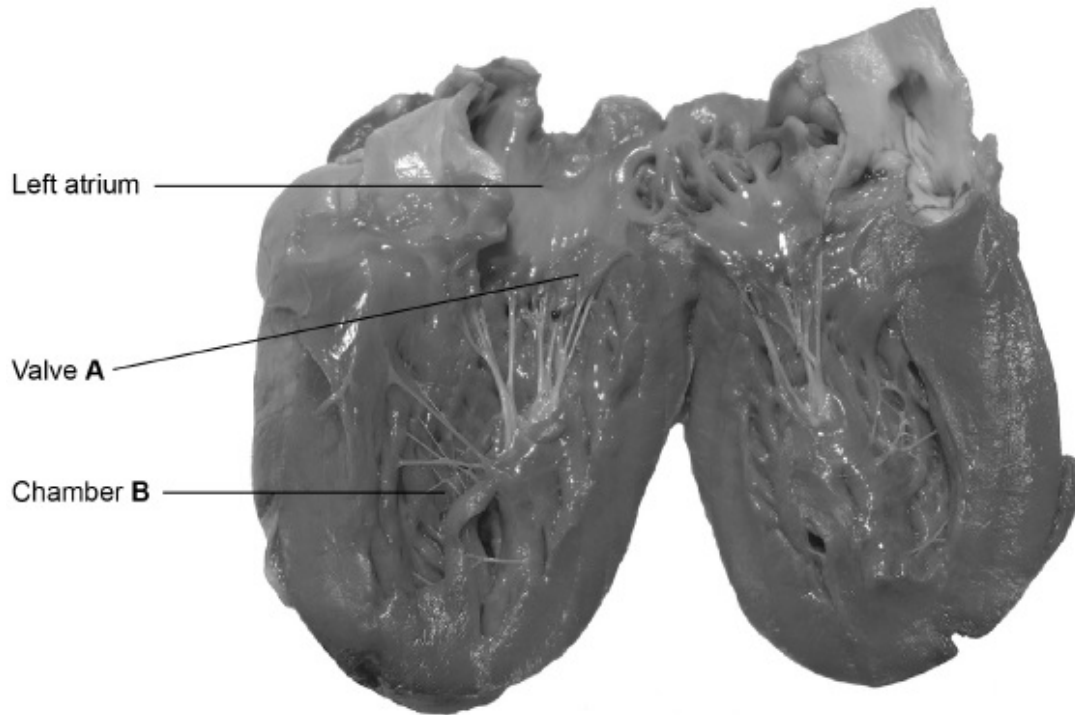


**Q1.**

**Figure 1** shows a photograph of a dissected heart.

**Figure 1**



(a) Name valve **A** and chamber **B**.

Valve **A** \_\_\_\_\_

Chamber **B** \_\_\_\_\_

(1)

(b) Give **two** safety precautions that should be followed when dissecting a heart.

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(1)

(c) Explain how valve **A** in **Figure 1** maintains a unidirectional flow of blood.

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(2)

A research scientist investigated the effect of caffeine on heart rate in human volunteers.

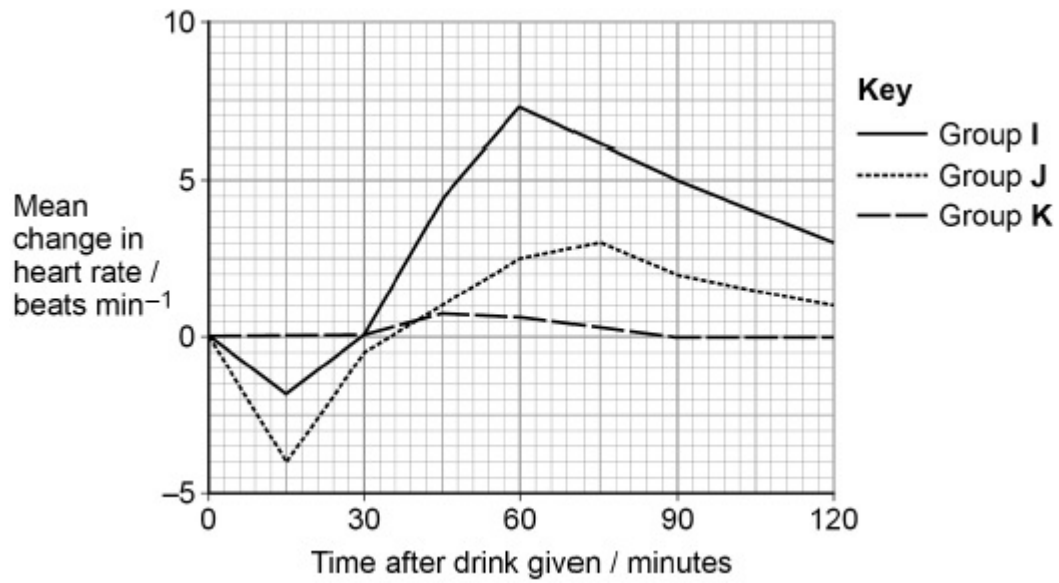
The scientist divided volunteers into three groups. Each group was given the same volume of fluid.

- Each member of Group **I** was given a sports drink containing caffeine and sugar.
- Each member of Group **J** was given a sports drink containing caffeine and no sugar.
- Each member of Group **K** was given water.

The scientist recorded the volunteers' heart rate before the drink was given and for 120 minutes after the drink was given.

Her results can be seen in **Figure 2**.

Figure 2



(d) Caffeine affects the autonomic nervous system.

Suggest how caffeine could account for the results of Group I in **Figure 2** at 60 minutes.

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(2)

(e) Before taking the drink, the mean heart rate of Group J was 68 beats per minute.

Fifteen minutes after taking the drink, the mean volume of blood leaving the hearts of Group J was 4700 cm<sup>3</sup> per minute.

Calculate the mean volume of blood leaving the heart at each beat fifteen minutes after taking the drink.

Answer = \_\_\_\_\_ cm<sup>3</sup> (1)

- (f) The increase seen in Group I could be due to the combination of caffeine and sugar.

Suggest **one** drink to be given to an **additional** group that should be investigated to find out if this is true.

Give a reason for your answer.

Group to be given \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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(2)  
(Total 9 marks)

**Q2.**

- (a) Exercise causes an increase in heart rate.

Describe the role of receptors and of the nervous system in this process.

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(4)

**Q3.**

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 rate when 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.

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(2)  
(Total 4 marks)

**Q4.**

Guillain–Barré syndrome is a rare disease in which the immune system damages the myelin sheath of neurones. Myelin sheath damage can cause a range of symptoms, for example numbness, muscular weakness and muscular paralysis. Sometimes, neurones of the autonomic nervous system are affected, causing heart rate irregularities. 5

Huntington’s disease is a disorder caused when a protein called huntingtin damages the brain. Huntingtin is produced because of a dominant, mutant allele.

The first successful drug trial to reduce concentrations of huntingtin in the human brain involved 46 patients. The patients received the drug for 4 months. The concentration of huntingtin was reduced in all the patients. The drug was injected at the base of the spine into the cerebrospinal fluid bathing the brain and spinal cord. The drug contains single-stranded DNA molecules. These single-stranded molecules inhibit the mRNA needed to produce huntingtin. 10

Symptoms of Huntington’s disease can start at any time, but usually develop between 30 and 50 years of age. The likelihood and age when symptoms start are linked to the number of CAG base sequence repeats in the gene for Huntington’s disease. However, recent studies have suggested that epigenetics may also affect the age when symptoms first start. 15

- (a) Damage to the myelin sheath of neurones can cause muscular paralysis (lines 2–4).

Explain how.

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(3)

- (b) Sometimes Guillain–Barré syndrome causes heart rate irregularities (lines 4–5).

Suggest and explain why.

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(3)