Questions

Q1.

As levels of activity increase, the heart can respond to the changing demand for oxygen.

Which term describes the ability of heart muscle to contract without external stimulation?

(1)

- ☒ **A** autonomic
- ☒ **B** cardiac
- ☒ **C** myogenic
- ☒ **D** systolic

(Total for question = 1 mark)

Q2.

Anabolic steroids stimulate muscle development.

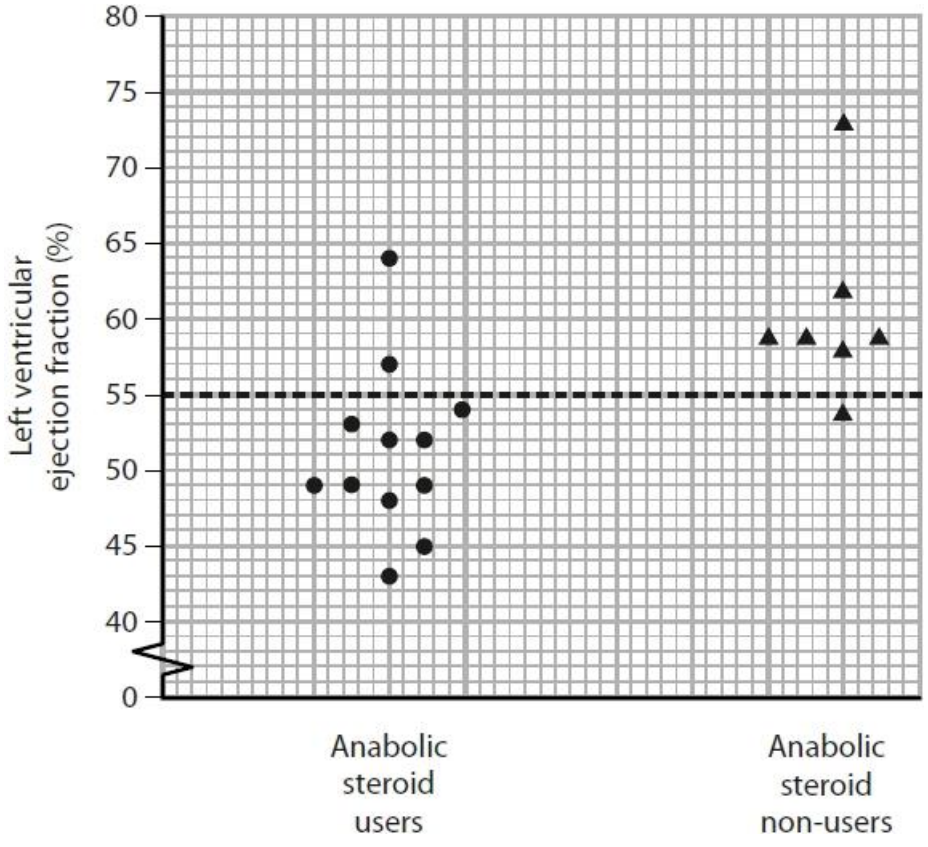
Some athletes use anabolic steroids in an attempt to improve their performance.

The effect of long-term anabolic steroid use on heart function has been investigated.

The left ventricular ejection fraction is the percentage of blood that leaves the left ventricle when it contracts.

The left ventricular ejection fraction for a healthy heart should be greater than 55%.

The results of a small study are shown in the graph.



(i) Analyse the data to determine the effect of anabolic steroid use on heart function.

(2)

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(ii) Some drugs used to treat cancer have also been shown to reduce the ventricular ejection fraction.
Describe how the safe dose of a cancer drug could be determined.

(3)

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(Total for question = 5 marks)

Q3.

Many animals possess a heart and a circulatory system.

Changes in the cardiac cycle can be observed by recording an electrocardiogram (ECG).

The ECG for a resting person is shown in the diagram.

Calculate the heart rate for this person.

(1)

Answer .....

(Total for question = 1 mark)

Q4.

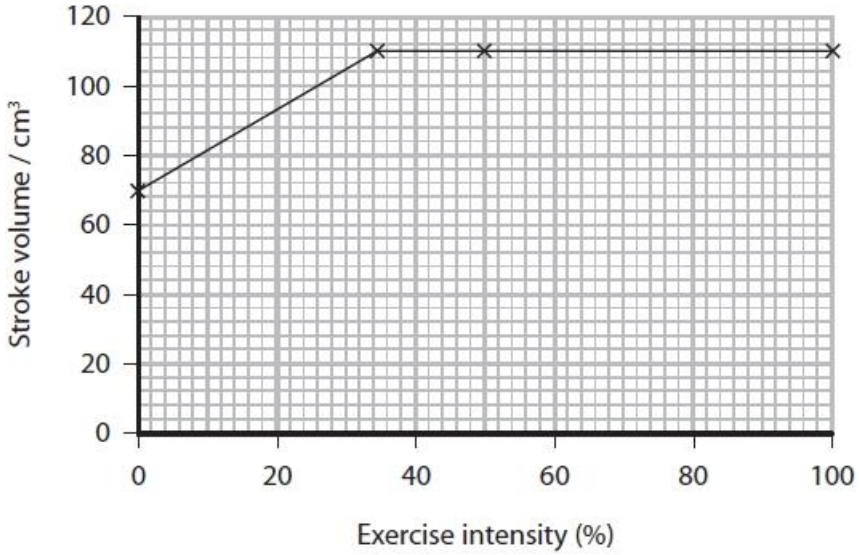
Athletic competitions often take place during the summer months when ambient temperatures are high.

High ambient temperatures affect marathon runners.

Heat stress occurs when the core body temperature rises above 40 °C.

When running a marathon, both heart rate and stroke volume increase.

The graph shows the effect of exercise intensity on stroke volume for marathon runners.



(i) Cardiac output is the product of stroke volume and heart rate.

During a race, a marathon runner's exercise intensity increased from 0 to 100%. The table shows the effect on the runner's heart rate.

Exercise intensity (%)	Heart rate / bpm
0	55
100	160

Calculate the increase in cardiac output for a marathon runner during a race.
Give your answer in $dm^3\ min^{-1}$.

(2)

..... $dm^3\ min^{-1}$

(ii) Explain why it is necessary for the cardiac output of marathon runners to increase during a race.

(2)

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(Total for question = 4 marks)

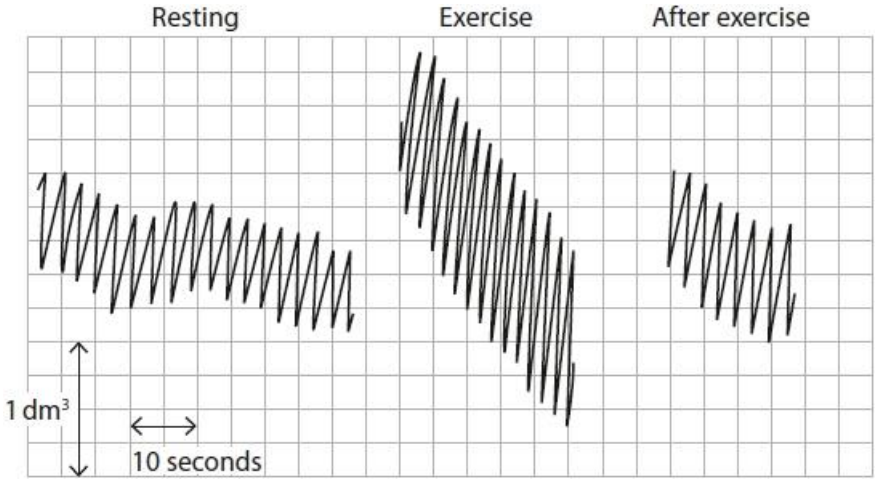
Q5.

The demand for oxygen changes during exercise.

The change in demand affects the breathing rate.

Changes in breathing can be investigated using a spirometer.

Spirometer traces taken from the same individual before, during and two minutes after exercise are shown.



Calculate the rate of oxygen consumption during exercise.

(2)

..... dm^3s^{-1}

(Total for question = 2 marks)

Q6.

Doctors sometimes prescribe beta-blockers for their patients.

Beta-blockers are a type of drug with antihypertensive properties.

Beta-blockers work by blocking the effects of a hormone called adrenaline.

Adrenaline is produced by the adrenal glands located on top of each kidney.

Adrenaline acts on the heart to cause changes in heart rate.

Deduce how adrenaline can cause a change in heart rate.

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(Total for question = 4 marks)

Q7.

Doctors sometimes prescribe beta-blockers for their patients.

Beta-blockers are a type of drug with antihypertensive properties.

In one study, the effect of beta-blockers on the heart rate during exercise was investigated.

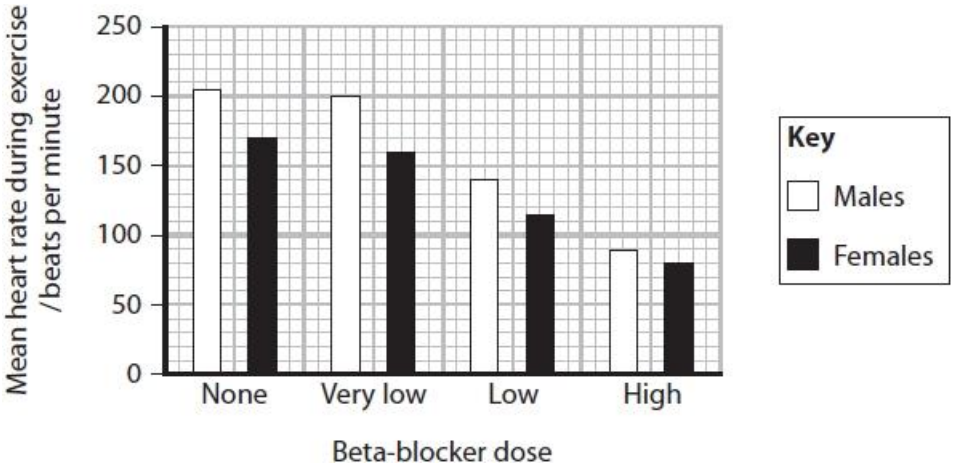
In this study, volunteers were placed randomly into one of four groups shown in the table.

Group	Dose of beta-blocker
A	none
B	very low
C	low
D	high

The heart rate of each volunteer was recorded during a period of exercise.

A mean value was calculated separately for the males and females in each group.

The graph shows the results of this study.



(i) Calculate the percentage change in male heart rate caused by increasing the dose of beta-blocker from very low to high.

(2)

Answer .....

(ii) Deduce the effect of beta-blockers on the supply of blood to muscle during exercise.

(4)

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(Total for question = 6 marks)

Q8.

A spirometer can be used to study the performance of an athlete.

snabbiology.wordpress.com

The trace produced by a spirometer can be used to determine the respiratory minute ventilation and the
oxygen consumption of an individual.

A student compared the spirometer trace for a pair of healthy, genetically identical twins.

State two variables that would have to be controlled to make this a valid comparison.

(2)

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(Total for question = 2 marks)

Q9.

The demand for oxygen changes during exercise.

The change in demand affects the breathing rate.

At the start of exercise, breathing rate increases.

Explain how starting to exercise causes an increase in breathing rate.

(3)

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(Total for question = 3 marks)

Q10.

The demand for oxygen changes during exercise.

The change in demand affects the breathing rate.

Explain the effect of exercise on the changes in oxygen consumption.

(4)

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(Total for question = 4 marks)

Q11.

A spirometer can be used to study the performance of an athlete.

snabbiology.wordpress.com

The trace produced by a spirometer can be used to determine the respiratory minute ventilation and the oxygen consumption of an individual.

Describe how a spirometer trace can be used to calculate the respiratory minute ventilation and the
oxygen consumption per minute.

(4)

respiratory minute ventilation

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oxygen consumption per minute

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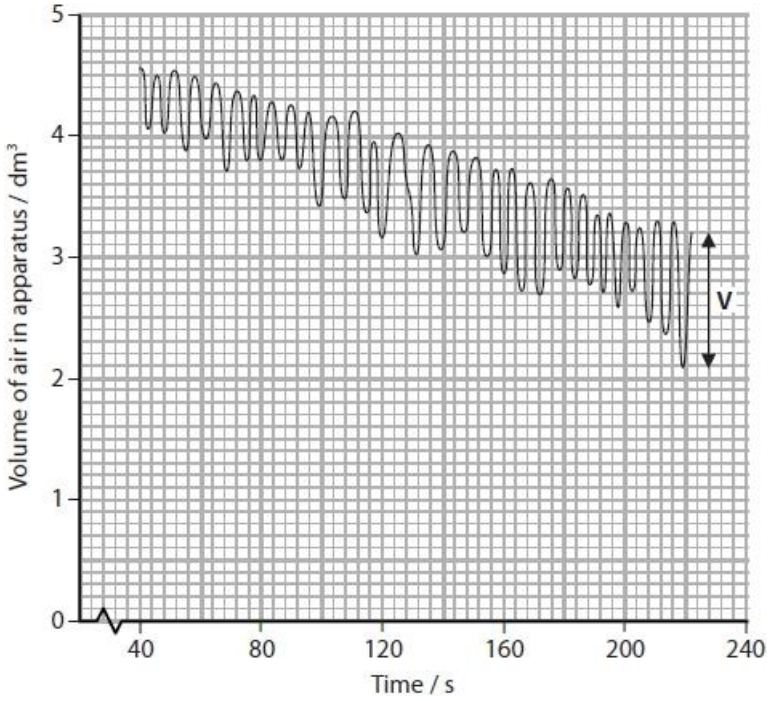
(Total for question = 4 marks)

Q12.

Cystic fibrosis is a condition that affects breathing.

A person breathed air in and out of the air chamber of a piece of apparatus.

Measurements were made of changes in the volume of air in the chamber. The carbon dioxide produced was removed from the chamber. The changes in volume were recorded on the trace shown in the diagram.



(i) Which of the following is the name of this piece of apparatus?

(1)

- ☒ **A** colorimeter
- ☒ **B** potometer
- ☒ **C** respirometer
- ☒ **D** spirometer

(ii) Which of the following is shown by the label **V** on the trace?

(1)

- ☒ **A** alveolar volume
- ☒ **B** tidal volume
- ☒ **C** total lung volume
- ☒ **D** ventilation rate

(iii) Which of the following is the breathing rate in breaths per minute between 80 and 120 seconds?

(1)

- ☒ **A** 6 breaths min^{-1}
- ☒ **B** 9 breaths min^{-1}
- ☒ **C** 12 breaths min^{-1}
- ☒ **D** 16 breaths min^{-1}

(iv) Calculate the rate of oxygen uptake between 80 and 120 seconds.

(3)

Answer ..... cm^3 min^{-1}

(Total for question = 6 marks)

Q13.

As levels of activity increase, the heart can respond to the changing demand for oxygen.

Describe how the sinoatrial node (SAN) is involved in bringing about a change in heart rate as the level of activity increases.

(2)

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(Total for question = 2 marks)

Mark Scheme

Q1.

Question number	Answer	Mark
	The only correct answer is C - Myogenic ***A*** *is not correct because autonomic refers to the nervous system* ***B*** *is not correct because cardiac refers to the whole heart* ***D*** *is not correct because systolic describes a stage in the cardiac cycle*	(1)

Q2.

Question Number	Answer	Additional guidance	Mark
(i)	An answer the makes reference to the following: • (use of anabolic steroids) reduces {ventricular fraction / ejection fraction /stroke volume / cardiac output } (1) • {83 % / 10 out of 12} of users have ventricular fraction below {55% / the healthy value} (1)	ALLOW less blood leaving the ventricle when it contracts ALLOW more users of anabolic steroids have a ventricular fraction below 55% than non-users ALLOW other valid quantitative values e.g. comparing mean values for each group 51.25 and 60.6%	**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer the makes reference to the following: • test the drug on { healthy individuals / animals / cell cultures } (1) • (then) test on group of individuals with cancer (1) • (gradually increasing the dose) to determine dose that does not reduce ventricular ejection fraction (1)	ALLOW test on a group of patients ALLOW to determine the dose that does not cause side effects	**(3)**

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Q3.

Question Number	Answer	Additional guidance	Mark
	• correct calculation of heart rate as 60 bpm	Heart rate and units required for the mark ALLOW 1 beat per second / 1 bps	**(1)**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct calculation of both cardiac outputs • correct calculation of difference and converted to dm^3 (1)	<u>Example of calculation</u> 70 x 55 = 3850 (cm^3) / 3.85 (dm^3) 110 x 160 = 17600 (cm^3) /17.6 (dm^3) An increase of 13.75 ($dm^3\ min^{-1}$) Correct answer with no working gains full marks. If correct answer not given ALLOW 13750 for 1 mark Or 13.64 to 13.86 for 1 mark	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • increase supply of oxygenated blood (to muscles) (1) • to allow aerobic respiration • to provide more energy (to meet the increased demands)	ALLOW more oxygen (to the muscles)	**(2)**

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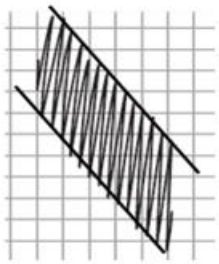
Q5.

Question Number	Answer	Additional guidance	Mark
	• correct slope drawn on the chart (1) • correct calculation (1)	 e.g. 1 ÷ 15 = 0.0667 ALLOW 0.06 to 0.075 Correct answer with no working gains full marks	**(2)**

Q6.

Question number	Answer	Additional guidance	Mark
	An answer that makes reference to four of the following: • adrenaline carried in the blood (1) • (acts on the) sinoatrial node (1) • increasing the frequency of impulses {produced by theSAN / that spread across the heart} (1) • increasing the rate at which the heart contracts	ALLOW increases the frequency of {actionpotentials / depolarisations} in the SAN ALLOW atria / ventricles ALLOW increasing heart rate	(4)

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Q7.

Question number	Answer	Additional guidance	Mark
(i)	• correct values taken from the graph (1) • correct percentage decrease (1)	200 and 90 ((200 – 90) ÷ 200) x 100 = 55%	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: • the larger the dose the greater the decrease in heart rate (1) • reducing the heart rate reduces the cardiac output (1) • therefore, reducing the supply of blood to the muscle (1) • increasing the dose has a greater effect on males than females (1)	ALLOW at very low dose there is little changein heart rate IGNORE oxygen / nutrients / body ALLOW comparison of decrease in males and females e.g. 56% decrease in males and 53% decrease in females	Choose an item. (4)

Q8.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to two of the following: • level of fitness / physical activity (1) • body mass (1) • exposure to the same environmental conditions (1)	ALLOW same level of exercise / duration of exercise ALLOW same weight	**(2)**

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Q9.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • exercise initiates impulses from the {motor cortex / stretch receptors in muscles / proprioceptors } (1) • (impulses sent to or from the) { ventilation centre / respiratory control centre / medulla oblongata } (1) • leading to increased impulses to { intercostal muscles / diaphragm } (1)	**IGNORE** reference to chemoreceptors and changes in carbon dioxide or temperature receptors	**(3)**

Q10.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to four of the following: • (exercise will) increase oxygen consumption (1) • (because there is) increased aerobic respiration (1) • because (more) {energy / ATP} is needed by muscles (1) • oxygen required to convert { lactate / lactic acid } into { glucose / pyruvate } (1) • oxygen consumption begins to decrease after exercise (1)	ALLOW more oxygen is needed with exercise ALLOW oxygen consumption after exercise is higher than at rest	**(4)**

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Q11.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to four of the following: Respiratory minute volume: • find the difference in peak to trough volume (to give the tidal volume) (1) • find ventilation rate (1) • multiply the tidal volume by ventilation rate (1) Oxygen consumption • difference in volume of one { peak / trough } compared to a subsequent one (1) • description of time calculation to produce a value per minute (1)	ALLOW reference to troughs instead of peaks e.g. count the number of peaks in a stated time and convert to per minute / count how many peaks in one minute ALLOW: breathing rate for ventilation rate e.g. divide by time between the two { peaks / troughs } and multiply by 60	**(4)**

Q12.

Question number	Answer	Mark
(i)	**The only correct answer is D – spirometer** ***A*** *is not correct because a colorimeter measures light* ***B*** *is not correct because a photometer measures evaporation* ***C*** *is not correct because a respirometer measures the rate of respiration*	(1)

Question number	Answer	Mark
(ii)	**The only correct answer is B – tidal volume** ***A*** *is not correct because alveolar volume is not shown on the trace* ***C*** *is not correct because total lung volume is not shown on the trace* ***D*** *is not correct because ventilation rate requires a calculation involving time*	(1)

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Question number	Answer	Mark
(iii)	**The only correct answer is B – 9 breaths min^{-1}** ***A*** *is not correct because 6 is the number of breaths in the 40 second time interval* ***C*** *is not correct because 12bpm is incorrect* ***D*** *is not correct because 16bpm is incorrect*	(1)

Question number	Answer	Additional guidance	Mark
(iv)	• volume divided by time to produce rate (1) • conversion of volume measured from graph from dm^3 to cm^3 (1) • calculation of rate per minute (1)	Example of calculation 0.65 ÷ 40 Multiplied by 1000 = 16.25 e.g. 16.25 x 60 Answer = **900- 975** 90.0-97.5 or 9000-9750 gains two marks as only one step incorrect Correct answer with no working gains full marks	(3)

Q13.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to two of the following points: • more { stimulation / depolarisation } of the SAN (from the sympathetic nervous system) / more impulses to the SAN (1) • (causing) more frequent waves of depolarisation from the SAN (to the atria) (1) • leading to more frequent { contraction of atria / stimulation of AVN } (1)		(2)