1.3 Cardiovascular System: The Heart and Blood Vessels: 30-minute Pack

AQA 8582 · Calculators not allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A swimmer takes part in a 12-week endurance training block. Their coach explains that this will increase the number of capillaries surrounding the muscles used in swimming.

(a) State the term used to describe this increase in the number of capillaries. **(1)**

(b) Explain how this adaptation benefits the swimmer's performance during a long-distance race. **(2)**

(Total for Question 1 is 3 marks)

2 A marathon runner's training programme is designed to improve the efficiency of their cardiovascular system.

Explain how long-term aerobic training adapts the heart and blood vessels, and evaluate how these adaptations help a named endurance performer, such as a marathon runner, sustain a fast pace for over two hours.

(Total for Question 2 is 6 marks)

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3 Explain why the coronary arteries, which supply the heart muscle itself with oxygenated blood, are particularly important during intense exercise.

(Total for Question 3 is 2 marks)

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4 Cardiac output is the term used to describe how much blood the heart pumps out in one minute.

(a) State what is meant by the term 'cardiac output'. **(1)**

(b) State the two factors, multiplied together, that determine cardiac output. **(1)**

(Total for Question 4 is 2 marks)

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5 Cardiac output (in ml per minute) can be calculated using the formula: cardiac output = stroke volume x heart rate.

A swimmer has a stroke volume of 120 ml and a heart rate of 150 beats per minute during a race.

(Total for Question 5 is 2 marks)

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6 Explain why cardiac output increases during exercise compared with at rest.

(Total for Question 6 is 2 marks)

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7 State the name of the blood vessel that carries deoxygenated blood from the body into the right atrium.

(Total for Question 7 is 1 mark)

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8 The coronary arteries branch off the aorta and supply the heart muscle itself with oxygenated blood. Suggest what would happen to part of the heart muscle if one of the coronary arteries became blocked, for example by a blood clot.

(Total for Question 8 is 2 marks)

9 A pulse can be felt at several points on the body, such as the wrist or the neck.

(a) Name one point on the body where a pulse can be measured. **(1)**

(b) Explain what causes the pulse felt at this point. **(2)**

(Total for Question 9 is 3 marks)

10 Describe the complete pathway of blood through the heart, starting from the right atrium and ending at the aorta, naming each chamber and each valve the blood passes through in the correct order.

(Total for Question 10 is 6 marks)

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11 The heart contains four valves, each preventing the backflow of blood.

(a) Name the valve found between the right atrium and the right ventricle. **(1)**

(b) Name the valve found between the left atrium and the left ventricle. **(1)**

(c) State the general function of the heart's valves. **(1)**

(Total for Question 11 is 3 marks)

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12 Which blood vessel carries deoxygenated blood from the right ventricle to the lungs?

- ☐ A) Pulmonary vein
- ☐ B) Pulmonary artery
- ☐ C) Aorta
- ☐ D) Vena cava

(Total for Question 12 is 1 mark)

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Mark scheme · 1.3 Cardiovascular System: The Heart and Blood Vessels: 30-minute Pack

Question 1

(a) capillarisation **B1**

(a) Answer: Capillarisation

(b) more capillaries around the working muscles increases the surface area available for the exchange of oxygen, nutrients and waste products between the blood and the muscle, oe **B1**

(b) this allows more oxygen to reach the muscles and more carbon dioxide/lactic acid to be removed, delaying fatigue and improving endurance performance, oe **B1**

(b) Answer: More capillaries around the working muscles increases the surface area for exchanging oxygen, nutrients and waste with the blood, so more oxygen reaches the muscles and waste products are removed more efficiently, delaying fatigue and improving endurance performance.

Question 2

Level 3 A detailed and coherent answer that explains at least three distinct cardiovascular adaptations (e.g. cardiac hypertrophy, increased stroke volume, decreased resting heart rate, capillarisation) and clearly evaluates how each one helps a named endurance performer sustain performance, using accurate terminology throughout. **5-6**

Level 2 At least two cardiovascular adaptations are explained with reasonable accuracy, with some link made to sustained endurance performance, but the evaluation may be underdeveloped. **3-4**

Level 1 One or two relevant points about cardiovascular adaptations are made, with little explanation or clear link to endurance performance. **1-2**

Level 0 No relevant content. **0**

Indicative content:

- Cardiac hypertrophy: the heart muscle, particularly the wall of the left ventricle, enlarges and thickens with regular aerobic training.
- Increased stroke volume: a stronger, larger heart can pump more blood out with each beat, both at rest and during exercise.
- Increased maximal cardiac output: because stroke volume increases, the maximum amount of blood the heart can pump per minute during hard exercise also increases, delivering more oxygen to the muscles.
- Decreased resting heart rate (bradycardia): with a greater stroke volume, fewer beats are needed to circulate the same amount of blood at rest, allowing the heart more recovery time between beats.
- Capillarisation: an increase in the number of capillaries around the muscles and alveoli, improving the exchange of oxygen, carbon dioxide and nutrients.
- For a named marathon runner: a larger stroke volume and higher maximal cardiac output mean more oxygenated blood reaches the leg muscles per minute, delaying the point at which the muscles must rely on anaerobic energy production, helping the runner maintain a fast, mostly aerobic pace for over two hours without a rapid build-up of fatigue.
- A lower resting and submaximal heart rate also means the heart works more efficiently at a given pace, leaving greater cardiovascular reserve for later stages of the race, such as a final surge.

Question 3

the coronary arteries supply the heart's own muscle (the myocardium) with oxygenated blood, oe **B1**

during intense exercise the heart works much harder/faster and needs more oxygen itself to keep contracting powerfully, so an adequate supply through the coronary arteries is essential to prevent the heart muscle fatiguing, oe **B1**

Answer: The coronary arteries supply the heart's own muscle with oxygenated blood; during intense exercise the heart works much harder and needs more oxygen itself to keep contracting powerfully, so an adequate coronary blood supply is essential to prevent the heart muscle fatiguing.

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Question 4

(a) the volume of blood pumped out by the heart (by one ventricle) in one minute, oe **B1**

(a) Answer: The volume of blood pumped out by the heart in one minute.

(b) stroke volume and heart rate, oe **B1**

(b) Answer: Stroke volume and heart rate.

Question 5

120 x 150 seen/attempted **M1**

18000 ml/min (accept 18 litres/min), cao **A1**

Answer: 18000 ml per minute (18 litres per minute)

Question 6

both stroke volume and heart rate increase during exercise, oe **B1**

because cardiac output = stroke volume x heart rate, an increase in either (or both) increases cardiac output, delivering more oxygenated blood to the working muscles to meet their increased demand, oe **B1**

Answer: Both stroke volume and heart rate increase during exercise, and because cardiac output = stroke volume x heart rate, this increases cardiac output, delivering more oxygenated blood to the working muscles to meet their greater demand for oxygen.

Question 7

vena cava **B1**

Answer: Vena cava

Question 8

the area of heart muscle normally supplied by that artery would receive a reduced/no supply of oxygenated blood, oe **B1**

without enough oxygen this heart muscle tissue could be damaged or start to die, which can cause a heart attack (myocardial infarction), oe **B1**

Answer: The area of heart muscle normally supplied by that coronary artery would receive little or no oxygenated blood, so it could become damaged or start to die from lack of oxygen, which is what happens during a heart attack (myocardial infarction).

Question 9

(a) any one of: wrist (radial pulse) / neck (carotid pulse) **B1**

(a) Answer: For example, the wrist (radial pulse).

(b) each time the left ventricle contracts, it forces a surge of blood into the arteries, oe **B1**

(b) this surge of pressure can be felt as a pulse where an artery lies close to the skin, so the pulse rate is the same as the heart rate, oe **B1**

(b) Answer: Each time the left ventricle contracts, it forces a surge of blood into the arteries; this surge of pressure can be felt as a pulse where an artery runs close to the skin, so the pulse rate matches the heart rate.

Question 10

from the right atrium, blood passes through the tricuspid valve into the right ventricle **B1**

from the right ventricle, blood passes through the pulmonary valve into the pulmonary artery, to the lungs **B1**

at the lungs, blood becomes oxygenated (gas exchange), then returns via the pulmonary vein into the left atrium **B1**

from the left atrium, blood passes through the bicuspid (mitral) valve into the left ventricle **B1**

from the left ventricle, blood passes through the aortic valve into the aorta, to the body **B1**

correct overall order maintained throughout (right atrium -> tricuspid -> right ventricle -> pulmonary valve -> pulmonary artery -> lungs -> pulmonary vein -> left atrium -> bicuspid/mitral -> left ventricle -> aortic valve -> aorta), oe wording **B1**

Answer: Right atrium -> tricuspid valve -> right ventricle -> pulmonary valve -> pulmonary artery -> lungs (blood is oxygenated) -> pulmonary vein -> left atrium -> bicuspid (mitral) valve -> left ventricle -> aortic valve -> aorta.

Question 11

(a) tricuspid valve **B1**

(a) Answer: Tricuspid valve

(b) bicuspid valve (mitral valve) **B1**

(b) Answer: Bicuspid valve (mitral valve)

(c) to prevent the backflow of blood (keeping blood flowing in one direction through the heart), oe **B1**

(c) Answer: To prevent the backflow of blood, keeping it flowing in one direction through the heart.

Question 12

B (pulmonary artery) **B1**

Answer: B (pulmonary artery)

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