1.7 Long-Term Effects of Exercise: Training Adaptations: 30-minute Pack

Total Marks

AQA 8582 · Calculators not allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A gymnast follows a long-term training programme involving repeated high-impact landings. Explain how this can lead to an increase in bone density over time.

(Total for Question 1 is 2 marks)

2 Explain how long-term training can increase the strength of tendons and ligaments, and how this benefits a performer.

(Total for Question 2 is 2 marks)

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3 Table 1 gives descriptions of long-term training adaptations, with the term missing.

Table 1

Part	Description of adaptation
(a)	The heart muscle, particularly the left ventricle wall, enlarges and thickens
(b)	Resting heart rate falls below the typical untrained range
(c)	The number of capillaries around the muscles and alveoli increases
(d)	Muscle fibres increase in size (cross-sectional area)
(e)	Bones become denser and stronger in response to repeated loading

(a) Name the adaptation described in row (a) of Table 1. **(1)**

(b) Name the adaptation described in row (b) of Table 1. **(1)**

(c) Name the adaptation described in row (c) of Table 1. **(1)**

(d) Name the adaptation described in row (d) of Table 1. **(1)**

(e) Name the adaptation described in row (e) of Table 1. **(1)**

(Total for Question 3 is 5 marks)

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4 Although a trained endurance athlete's resting heart rate is lower than an untrained person's, their maximal cardiac output during hard exercise is actually higher. Explain why this is the case.

(Total for Question 4 is 2 marks)

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5 Explain how muscle hypertrophy from a resistance training programme would help a weightlifter perform better in competition.

(Total for Question 5 is 2 marks)

6 Explain why a single, one-off exercise session does not cause long-term adaptations such as cardiac hypertrophy or muscle hypertrophy, but a structured training programme lasting several months does.

(Total for Question 6 is 2 marks)

7 Explain one way increased bone density specifically benefits a gymnast who repeatedly performs high-impact landings throughout their career.

(Total for Question 7 is 3 marks)

8 Long-term (many months of) aerobic and resistance training causes lasting adaptations across the body's systems.

(a) State one long-term adaptation of the cardiovascular system to training. **(1)**

(b) State one long-term adaptation of the respiratory system to training. **(1)**

(c) State one long-term adaptation of the muscular system to training. **(1)**

(d) State one long-term adaptation of the skeletal system to training. **(1)**

(Total for Question 8 is 4 marks)

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9 A marathon runner stops training completely for six months due to injury. Explain what is likely to happen to their long-term training adaptations, such as cardiac hypertrophy and increased stroke volume, during this time.

(Total for Question 9 is 2 marks)

10 Explain what cardiac hypertrophy is, and how it leads to an increase in stroke volume.

(Total for Question 10 is 2 marks)

11 A cyclist's resting heart rate falls from 72 bpm to 54 bpm over a two-year period of consistent training. Explain why this fall in resting heart rate occurs.

(Total for Question 11 is 2 marks)

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12 A bodybuilder follows a resistance training programme for a year, causing their muscles to noticeably increase in size.

(a) State the term used for this increase in muscle size. **(1)**

(b) Explain how repeated resistance training causes this increase in muscle size. **(2)**

(Total for Question 12 is 3 marks)

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13 Long-term aerobic training also increases the amount of myoglobin stored within muscle cells. State what myoglobin's function is, and explain how having more of it benefits a trained performer.

(Total for Question 13 is 2 marks)

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Mark scheme · 1.7 Long-Term Effects of Exercise: Training Adaptations: 30-minute Pack

Question 1

repeated impact/weight-bearing forces place mechanical stress on the bones, oe — **B1**

in response, the bones gradually lay down more bone tissue/mineral, becoming denser and stronger over time to better withstand this repeated stress, oe — **B1**

Answer: Repeated impact and weight-bearing forces place mechanical stress on the bones; in response, the bones gradually lay down more bone tissue and mineral, becoming denser and stronger over time to better withstand this repeated stress.

Question 2

repeated loading of the tendons and ligaments during training causes them to gradually adapt and become thicker/stronger over time, oe — **B1**

stronger tendons and ligaments can withstand greater forces and provide more joint stability, reducing the risk of injuries such as strains and sprains, oe — **B1**

Answer: Repeated loading of the tendons and ligaments during training causes them to gradually adapt and become thicker and stronger over time; stronger tendons and ligaments can withstand greater forces and provide more joint stability, reducing the risk of injuries such as strains and sprains.

Question 3

(a) cardiac hypertrophy — **B1**

(a) Answer: Cardiac hypertrophy

(b) bradycardia — **B1**

(b) Answer: Bradycardia

(c) capillarisation — **B1**

(c) Answer: Capillarisation

(d) (muscle) hypertrophy — **B1**

(d) Answer: Muscle hypertrophy

(e) increased bone density — **B1**

(e) Answer: Increased bone density

Question 4

long-term training has significantly increased the athlete's stroke volume, oe — **B1**

because cardiac output = stroke volume x heart rate, this much larger stroke volume means that even at a similar maximum heart rate to an untrained person, the trained athlete's maximal cardiac output is higher, oe — **B1**

Answer: Long-term training has significantly increased the athlete's stroke volume; because cardiac output = stroke volume x heart rate, this much larger stroke volume means that even at a similar maximum heart rate to an untrained person, the trained athlete's maximal cardiac output is higher.

Question 5

hypertrophy increases the cross-sectional area of the muscle fibres, oe — **B1**

a larger cross-sectional area allows the muscle to generate a greater maximal force, allowing the weightlifter to lift heavier loads, oe — **B1**

Answer: Hypertrophy increases the cross-sectional area of the muscle fibres, and a larger cross-sectional area allows the muscle to generate a greater maximal force, allowing the weightlifter to lift heavier loads.

Question 6

a single session only produces short-term effects (such as a temporary rise in heart rate), which reverse once the exercise stops, oe — **B1**

long-term adaptations require the body to be repeatedly stressed/overloaded over weeks and months, so it gradually adapts and rebuilds its tissues to cope with this repeated demand, which cannot happen from a single session, oe — **B1**

Answer: A single session only produces short-term effects, such as a temporary rise in heart rate, which reverse once the exercise stops; long-term adaptations require the body to be repeatedly stressed over weeks and months, so it gradually adapts and rebuilds its tissues to cope with this repeated demand, which cannot happen from just one session.

Question 7

denser bones are stronger and can withstand greater forces before being damaged, oe — **B1**

this reduces the gymnast's risk of stress fractures or other bone injuries from the repeated high-impact forces of landings over a long career, oe — **B1**

allowing the gymnast to train and compete more consistently over time, without as many injury-enforced breaks, oe — **B1**

Answer: Denser bones are stronger and can withstand greater forces before being damaged, which reduces the gymnast's risk of stress fractures or other bone injuries from the repeated high-impact forces of landings over a long career, allowing them to train and compete more consistently without as many injury-enforced breaks.

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Question 8

(a) any one of: cardiac hypertrophy / increased stroke volume / decreased resting heart rate (bradycardia) / capillarisation **B1**

(a) Answer: For example, cardiac hypertrophy (the heart muscle enlarges).

(b) any one of: increased vital capacity / stronger respiratory muscles / increased capillarisation around the alveoli **B1**

(b) Answer: For example, an increase in vital capacity.

(c) any one of: muscle hypertrophy / increased number and size of mitochondria / increased myoglobin stores / increased glycogen stores **B1**

(c) Answer: For example, muscle hypertrophy (an increase in muscle size).

(d) any one of: increased bone density / stronger tendons and ligaments **B1**

(d) Answer: For example, increased bone density.

Question 9

without the repeated training stimulus, these adaptations will gradually reverse (detraining), oe **B1**

for example, the heart muscle will gradually reduce in size and stroke volume will fall back towards untrained levels the longer training is stopped, oe **B1**

Answer: Without the repeated training stimulus, these adaptations will gradually reverse (a process called detraining); for example, the heart muscle will gradually reduce in size and stroke volume will fall back towards untrained levels the longer training is stopped.

Question 10

cardiac hypertrophy is the enlarging/thickening of the heart muscle, particularly the wall of the left ventricle, as a result of long-term training, oe **B1**

a larger, stronger heart muscle can contract more powerfully, pumping out a greater volume of blood with each beat, which is an increased stroke volume, oe **B1**

Answer: Cardiac hypertrophy is the enlarging and thickening of the heart muscle, particularly the wall of the left ventricle, as a result of long-term training; a larger, stronger heart can contract more powerfully, pumping out a greater volume of blood with each beat, which is an increased stroke volume.

Question 11

long-term training has increased the cyclist's stroke volume, oe **B1**

because more blood is now pumped out with each beat, fewer beats per minute are needed to maintain the same resting cardiac output, so resting heart rate falls, oe **B1**

Answer: Long-term training has increased the cyclist's stroke volume; because more blood is now pumped out with each beat, fewer beats per minute are needed to maintain the same resting cardiac output, so resting heart rate falls.

Question 12

(a) (muscle) hypertrophy **B1**

(a) Answer: Muscle hypertrophy

(b) resistance training repeatedly places a high load/stress on the muscle fibres, causing microscopic damage/breakdown, oe **B1**

(b) during recovery, the muscle fibres repair and rebuild slightly thicker/larger than before, so their cross-sectional area increases over repeated cycles of training and recovery, oe **B1**

(b) Answer: Resistance training repeatedly places a high load on the muscle fibres, causing microscopic damage; during recovery, the fibres repair and rebuild slightly thicker than before, so over repeated cycles of training and recovery their cross-sectional area increases.

Question 13

myoglobin stores oxygen within the muscle cell itself, oe **B1**

having more myoglobin means the muscle can store and have a readily available supply of oxygen close to where it is needed for aerobic energy production, oe **B1**

Answer: Myoglobin stores oxygen within the muscle cell itself; having more myoglobin means the muscle has a greater readily available supply of oxygen close to where it is needed for aerobic energy production.

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