PE.AP6 Short-Term Effects of Exercise on the Body Systems

Total Marks

AQA 8582 · Calculators not allowed · about 50 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 What happens to heart rate during a single session of exercise, compared with the resting value immediately beforehand?

- ☐ A) It decreases
- ☐ B) It increases
- ☐ C) It stays exactly the same
- ☐ D) It stops responding to exercise

(Total for Question 1 is 1 mark)

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2 Exercise produces a number of immediate, short-term effects on the body's muscular-skeletal, cardiovascular and respiratory systems.

(a) State one short-term effect of exercise on the cardiovascular system. **(1)**

(b) State one short-term effect of exercise on the respiratory system. **(1)**

(c) State one short-term effect of exercise on the muscular system. **(1)**

(d) State one short-term effect of exercise on the skeletal system, specifically the joints. **(1)**

(Total for Question 2 is 4 marks)

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3 A sprinter's heart rate begins to rise while they are still standing in the blocks, before the starting gun has fired.

(Total for Question 3 is 2 marks)

4 During exercise, heart rate typically rises very rapidly in the first few seconds, then continues to rise more gradually if the exercise continues at a steady, sub-maximal intensity. Explain why heart rate rises so quickly at the very start of exercise.

(Total for Question 4 is 2 marks)

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5 During exercise, blood flow is redistributed around the body, a process sometimes called the vascular shunt.

(a) State what happens to the blood vessels supplying the working muscles during exercise. **(1)**

(b) State what happens to the blood vessels supplying organs not essential during exercise, such as the digestive system. **(1)**

(c) Explain why this redistribution of blood flow is beneficial during exercise. **(1)**

(Total for Question 5 is 3 marks)

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6 A cyclist's stroke volume rises noticeably during a hard climb. Explain how this short-term increase in stroke volume affects cardiac output, and why this is beneficial during the climb.

(Total for Question 6 is 2 marks)

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7 A swimmer's breathing rate and depth both increase noticeably during a hard interval set. Explain how this short-term change increases the amount of oxygen taken into the body each minute.

(Total for Question 7 is 2 marks)

8 A rugby player's muscle temperature rises noticeably during a warm-up and the first few minutes of a match. Explain how this short-term rise in muscle temperature can benefit performance.

(Total for Question 8 is 2 marks)

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9 A weightlifter performs several heavy, near-maximal lifts in a row, with only short rests between them. Explain why lactic acid builds up in their muscles during this type of exercise.

(Total for Question 9 is 2 marks)

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10 A netball player takes part in a fast-paced 60-minute match, involving repeated sprinting, jumping and sudden changes of direction.

Evaluate how the short-term effects of exercise on the cardiovascular, respiratory and muscular systems work together to help the player meet the physical demands of the match.

(Total for Question 10 is 6 marks)

11 Table 1 lists short-term effects of exercise, with the body system it mainly affects missing.

Table 1

Part	Short-term effect of exercise
(a)	An increase in heart rate and stroke volume
(b)	An increase in breathing rate and tidal volume
(c)	A build-up of lactic acid

(a) Name the body system mainly affected by the change described in row (a) of Table 1. **(1)**

(b) Name the body system mainly affected by the change described in row (b) of Table 1. **(1)**

(c) Name the body system mainly affected by the change described in row (c) of Table 1. **(1)**

(Total for Question 11 is 3 marks)

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12 A gymnast feels sore leg muscles two days after an intense competition, a condition often called delayed onset muscle soreness (DOMS).

(a) State approximately when DOMS is typically felt after unaccustomed or intense exercise. **(1)**

(b) State the current understanding of what causes DOMS. **(1)**

(Total for Question 12 is 2 marks)

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13 Explain why blood flow to the digestive system is reduced during exercise, even though this could make someone feel less like digesting a large meal at that time.

(Total for Question 13 is 2 marks)

14 A footballer waiting in the tunnel before kickoff notices their heart rate rising, even though they have not yet started moving.

(a) Name this rise in heart rate that occurs before exercise begins. **(1)**

(b) Explain the mechanism that causes this rise. **(2)**

(Total for Question 14 is 3 marks)

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15 A runner's breathing rate stays higher than resting levels for several minutes after they finish a hard interval session. Explain why breathing rate remains elevated during this recovery period.

(Total for Question 15 is 2 marks)

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16 Suggest one reason why the short-term rise in cardiac output during exercise is important for delivering energy to the working muscles.

(Total for Question 16 is 2 marks)

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17 A basketball player notices their leg muscles feel noticeably warmer partway through a game. Explain how increased blood flow to the muscles (vasodilation) contributes to this rise in temperature.

(Total for Question 17 is 2 marks)

18 Suggest one way in which the short-term respiratory response to a 100 m sprint is likely to differ from the short-term respiratory response during a marathon, in terms of how quickly breathing rate rises.

(Total for Question 18 is 2 marks)

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19 Table 2 shows typical values for a hockey player at rest and during a match.

Table 2

Variable	At rest	During the match
Heart rate (bpm)	68	165
Breathing rate (breaths/min)	14	42
Tidal volume (ml)	500	2200
Muscle temperature (degrees Celsius)	37.0	38.5

(a) State the direction of change (increase or decrease) shown for heart rate during the match. **(1)**

(b) State the direction of change shown for breathing rate during the match. **(1)**

(c) State the direction of change shown for tidal volume during the match. **(1)**

(d) State the direction of change shown for muscle temperature during the match, and suggest one reason for this change. **(2)**

(Total for Question 19 is 5 marks)

20 A 10,000 m runner finishes a hard race, but their heart rate takes over ten minutes to fall back down to its resting level. Explain why heart rate takes this long to return to resting levels after exercise stops.

(Total for Question 20 is 3 marks)

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21 A coach insists that players complete a thorough warm-up before every match, arguing that it triggers many of the short-term effects of exercise before the match itself becomes intense.

Explain one benefit of triggering short-term effects such as increased muscle temperature and increased blood flow to the muscles during a warm-up, before the match reaches its most demanding moments.

(Total for Question 21 is 2 marks)

Mark scheme · PE.AP6 Short-Term Effects of Exercise on the Body Systems

Question 1

- **B1** B (it increases)
- **Answer: B (it increases)**

Question 2

- (a) **B1** any one of: increased heart rate / increased stroke volume / increased cardiac output / redistribution of blood flow to the working muscles
- **(a) Answer: For example, an increase in heart rate.**
- (b) **B1** any one of: increased breathing rate / increased tidal volume/depth of breathing
- **(b) Answer: For example, an increase in breathing rate.**
- (c) **B1** any one of: increased muscle temperature / build-up of lactic acid / muscle fatigue
- **(c) Answer: For example, an increase in muscle temperature.**
- (d) **B1** increased production of synovial fluid, which lubricates the joints more during exercise, oe
- **(d) Answer: An increase in the production of synovial fluid, which lubricates the joints more during exercise.**

Question 3

- **B1** this is called the anticipatory rise in heart rate, oe
- **B1** it happens because the nervous system releases adrenaline in response to nerves/excitement about the upcoming race, which increases heart rate before exercise has even begun, oe
- **Answer: This is called the anticipatory rise in heart rate; it happens because the nervous system releases adrenaline in response to nerves and excitement about the upcoming race, raising heart rate before exercise has even begun.**

Question 4

- **B1** the working muscles' demand for oxygen increases very suddenly as soon as exercise begins, oe
- **B1** the nervous system responds quickly to this by increasing heart rate rapidly, to try to increase the delivery of oxygenated blood to the muscles as fast as possible, oe
- **Answer: The working muscles' demand for oxygen increases very suddenly as soon as exercise begins, so the nervous system responds quickly by increasing heart rate rapidly, to try to increase the delivery of oxygenated blood to the muscles as fast as possible.**

Question 5

- (a) **B1** they vasodilate (widen), oe
- **(a) Answer: They vasodilate (widen).**
- (b) **B1** they vasoconstrict (narrow), oe
- **(b) Answer: They vasoconstrict (narrow).**
- (c) **B1** it directs more oxygenated blood towards the working muscles, which need it most, and away from organs (such as the gut) that need less blood during exercise, oe
- **(c) Answer: It directs more oxygenated blood towards the working muscles, which need it most during exercise, and away from organs such as the gut, which need less blood while exercising.**

Question 6

- **B1** because cardiac output = stroke volume x heart rate, an increase in stroke volume increases cardiac output (with heart rate also rising), oe
- **B1** a higher cardiac output delivers more oxygenated blood to the leg muscles each minute, helping meet their greater demand for oxygen during the climb, oe
- **Answer: Because cardiac output = stroke volume x heart rate, the rise in stroke volume (alongside the rise in heart rate) increases cardiac output; a higher cardiac output delivers more oxygenated blood to the leg muscles each minute, helping meet their greater oxygen demand during the climb.**

Question 7

- **B1** a greater depth of breathing (tidal volume) means more air, and so more oxygen, enters the lungs with each breath, oe
- **B1** a faster breathing rate means this happens more often each minute, so overall more oxygen reaches the lungs (and diffuses into the blood) per minute, oe
- **Answer: A greater depth of breathing means more air (and oxygen) enters the lungs with each breath, and a faster breathing rate means this happens more often each minute, so overall more oxygen reaches the lungs and diffuses into the blood every minute.**

Question 8

- **B1** a warmer muscle allows the chemical reactions that release energy to occur faster, oe
- **B1** a warmer, more pliable muscle can also contract and relax more quickly and stretch further with less risk of injury, oe
- **Answer: A warmer muscle allows the chemical reactions that release energy to happen faster, and a warmer, more pliable muscle can also contract and relax more quickly and stretch further with less risk of injury.**

Question 9

- **B1** the high intensity of the lifts means the muscles rely heavily on the lactic acid system (anaerobic glycolysis) for energy, oe
- **B1** this produces lactic acid as a by-product, which builds up in the muscle faster than it can be removed during the short rests, oe
- **Answer: The high intensity of the lifts means the muscles rely heavily on the lactic acid system for energy, which produces lactic acid as a by-product; with only short rests between lifts, it builds up in the muscle faster than it can be removed.**

Question 10

- **Level 3** (5-6): A detailed and coherent evaluation that explains at least three short-term effects across different body systems (e.g. increased heart rate/stroke volume, increased breathing rate/depth, vascular shunt, increased muscle temperature, lactic acid build-up) and clearly links each to how it helps meet the demands of the match, using accurate terminology throughout.
- **Level 2** (3-4): At least two short-term effects are explained with reasonable accuracy, with some link made to the demands of the match, but the evaluation may be underdeveloped.
- **Level 1** (1-2): One or two relevant points about short-term effects of exercise are made, with little explanation or clear link to the match.
- **Level 0** (0): No relevant content.
- **Indicative content:**
  - Heart rate and stroke volume both increase, raising cardiac output so more oxygenated blood is delivered to the working muscles each minute.
  - Breathing rate and tidal volume both increase, moving more air (and so more oxygen) into the lungs each minute to keep pace with the muscles' oxygen demand.
  - Blood flow is redistributed (vascular shunt): vasodilation increases blood flow to the working muscles, while vasoconstriction reduces blood flow to organs less essential during exercise, such as the digestive system.
  - Muscle temperature rises, speeding up the chemical reactions that release energy and increasing the elasticity of the muscles, helping with the sudden accelerations and direction changes needed in netball.
  - During the most intense bursts (sprints, jumps), lactic acid builds up in the muscles from the lactic acid system, contributing to fatigue that the player must manage between less intense passages of play.
  - A balanced evaluation might conclude that these short-term effects work together as an interconnected system: the cardiovascular and respiratory changes work to delay the point at which the muscular system must rely heavily on anaerobic energy and lactic acid build-up, but during the match's most intense moments some build-up is unavoidable and must be managed through brief lower-intensity recovery periods.

Question 11

- (a) **B1** cardiovascular system
- **(a) Answer: Cardiovascular system**
- (b) **B1** respiratory system
- **(b) Answer: Respiratory system**

Question 12

- (a) **B1** around 24 to 72 hours (one to three days) after exercise, oe
- **(a) Answer: Around 24 to 72 hours (one to three days) after exercise.**
- (b) **B1** microscopic damage to the muscle fibres/tissue during unaccustomed or intense exercise, leading to inflammation and soreness (NOT simply lactic acid remaining in the muscle), oe
- **(b) Answer: Microscopic damage to the muscle fibres during unaccustomed or intense exercise, leading to inflammation and soreness (not, as is commonly and incorrectly believed, lactic acid remaining in the muscle).**

Question 13

- **B1** digestion is not essential for the exercise being performed, so the body prioritises sending its available blood elsewhere, oe
- **B1** the arterioles supplying the digestive system vasoconstrict, freeing up blood to be redirected (via vasodilation) to the working muscles, which need the extra oxygen more urgently, oe
- **Answer: Digestion is not essential for the exercise being performed, so the body prioritises sending its available blood elsewhere; the arterioles supplying the digestive system vasoconstrict, freeing up blood to be redirected to the working muscles, which need the extra oxygen more urgently.**

Question 14

- (a) **B1** anticipatory rise (in heart rate)
- **(a) Answer: Anticipatory rise**
- (b) **B1** the nervous system responds to the footballer's nerves/excitement about the upcoming match, oe
- (b) **B1** by releasing adrenaline, a hormone which increases heart rate even though the footballer's muscles are not yet working any harder, oe
- **(b) Answer: The nervous system responds to the footballer's nerves and excitement about the upcoming match by releasing the hormone adrenaline, which increases heart rate even though their muscles are not yet working any harder.**

Question 15

- **B1** the body has an oxygen debt to repay following the intense exercise, oe
- **B1** the extra oxygen taken in through continued faster breathing is used to help break down/remove the lactic acid that built up and to replenish the muscle's stores of ATP and phosphocreatine, oe
- **Answer: The body has an oxygen debt to repay following the intense exercise, so it continues breathing faster than resting levels to take in the extra oxygen needed to help break down the lactic acid that built up and to replenish the muscle's stores of ATP and phosphocreatine.**

Question 16

- **B1** a higher cardiac output means more blood, and so more oxygen and glucose/fuel, is delivered to the working muscles every minute, oe
- **B1** this supports the aerobic system in producing energy at the faster rate needed during exercise, helping delay fatigue, oe
- **Answer: A higher cardiac output means more blood, and so more oxygen and fuel, is delivered to the working muscles every minute; this supports the aerobic system in producing energy at the faster rate needed during exercise, helping delay fatigue.**

Question 17

- **B1** vasodilation increases the volume of warm blood flowing through the working muscles, oe
- **B1** combined with heat produced by the muscles' own increased metabolic activity, this raises the overall temperature of the muscle tissue, oe
- **Answer: Vasodilation increases the volume of warm blood flowing through the working muscles; combined with the heat produced by the muscles' own increased metabolic activity, this raises the overall temperature of the muscle tissue.**

Question 18

- **B1** in a 100 m sprint, breathing rate has very little time to rise significantly at all before the race is already over, oe
- **B1** whereas in a marathon, breathing rate rises early on and is then sustained at an elevated level throughout the much longer race, allowing the aerobic system time to respond, oe
- **Answer: In a 100 m sprint, there is very little time for breathing rate to rise significantly before the race is already**

Question 19

- (a) **B1** increase
- **(a) Answer: Increase**
- (b) **B1** increase
- **(b) Answer: Increase**
- (c) **B1** increase
- **(c) Answer: Increase**
- (d) **B1** increase
- (d) **B1** increased metabolic activity/energy production in the working muscles produces heat, and increased blood flow to the muscles also carries warm blood into them, oe
- **(d) Answer: Increase; this is because increased metabolic activity in the working muscles produces heat, and increased blood flow to the muscles also carries warm blood into them.**

Question 20

- **B1** the body has built up an oxygen debt during the hard, sustained effort of the race, oe
- **B1** an elevated heart rate is needed during recovery to keep delivering the extra oxygen required to help remove lactic acid and replenish the muscle's ATP and phosphocreatine stores, oe
- **B1** only once this recovery process is largely complete does heart rate gradually fall back down towards its normal resting level, oe
- **Answer: The body has built up an oxygen debt during the hard, sustained effort of the race, and an elevated heart rate is needed during recovery to keep delivering the extra oxygen required to help remove lactic acid and replenish the muscle's ATP and phosphocreatine stores; only once this recovery process is largely complete does heart rate gradually fall back towards its normal resting level.**

Question 21

- **B1** raising muscle temperature and blood flow gradually during a warm-up means the muscles are already warmer, more elastic and better supplied with oxygen before the match's most intense moments begin, oe
- **B1** this can reduce the risk of injury (e.g. muscle strains) and mean the player is not starting the most demanding actions of the match 'cold', helping performance from the very first sprint or tackle, oe
- **Answer: Raising muscle temperature and blood flow gradually during a warm-up means the muscles are already warmer, more elastic and better supplied with oxygen before the match's most intense moments begin; this can reduce the risk of injury and means the player is not starting demanding actions 'cold', helping performance from the very first sprint or tackle.**