1.5 Energy Systems: ATP-PC, Lactic Acid and Aerobic: 30-minute Pack

Total Marks

AQA 8582 · Calculators not allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Table 1 gives sporting examples with the main energy system used missing.

Table 1

Part	Sporting example	Approximate duration
(a)	A golf swing	Under 1 second
(b)	A 400 m sprint	Around 45-60 seconds
(c)	A cross-country running race	Over 20 minutes

(a) Name the main energy system used for the action described in row (a) of Table 1. **(1)**

(b) Name the main energy system used for the action described in row (b) of Table 1. **(1)**

(c) Name the main energy system used for the action described in row (c) of Table 1. **(1)**

(Total for Question 1 is 3 marks)

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2 Explain why the ATP-PC system can only supply energy for a very short period of time before the muscle must rely on another energy system.

(Total for Question 2 is 2 marks)

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3 A tennis player plays a long rally involving a sprint to the net, followed by a period of standing and light movement while waiting for the next point.

(a) Name the energy system most likely used during the explosive sprint to the net. **(1)**

(b) Name the energy system most likely used during the light movement between points. **(1)**

(Total for Question 3 is 2 marks)

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4 Which of the following is a by-product of the lactic acid system, but NOT a by-product of the aerobic system?

- ☐ A) Carbon dioxide
- ☐ B) Water
- ☐ C) Lactic acid
- ☐ D) Oxygen

(Total for Question 4 is 1 mark)

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5 A 400 m runner starts the race at a fast, near-maximal pace, then has to fight to maintain their speed over the final 100 m as their legs feel heavy.

(a) Name the energy system that dominates in the first few seconds of the race. **(1)**

(b) Explain why the runner's legs feel heavy in the final part of the race. **(2)**

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(Total for Question 5 is 3 marks)

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6 A weightlifter performs a single maximal one-repetition lift, taking only a few seconds. Explain two advantages of the ATP-PC system, rather than the lactic acid system, for this type of effort.

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(Total for Question 6 is 2 marks)

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7 A boxer trains at high altitude, where the air contains a lower concentration of oxygen than at sea level.

(a) State what happens to the amount of oxygen available to the boxer's working muscles at altitude, compared with at sea level. **(1)**

(b) Suggest how this might affect how much the aerobic system can contribute during a hard training session, compared with training at sea level. **(2)**

(Total for Question 7 is 3 marks)

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8 Exercise can be classified as aerobic or anaerobic depending on whether oxygen is used to produce energy.

(a) State what is meant by the term 'aerobic exercise'. **(1)**

(b) State what is meant by the term 'anaerobic exercise'. **(1)**

(Total for Question 8 is 2 marks)

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9 The ATP-PC system and the lactic acid system are both anaerobic energy systems, but they differ in other ways.

(a) State one difference between the ATP-PC system and the lactic acid system in terms of the by-product each one produces. **(1)**

(b) State one difference between the ATP-PC system and the lactic acid system in terms of how long each can supply energy for. **(1)**

(Total for Question 9 is 2 marks)

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10 A hockey player performs repeated 20-30 metre sprints during a match, each followed by a short recovery period of jogging or standing.

(a) Name the energy system that dominates during each individual sprint. **(1)**

(b) Explain why the recovery periods of jogging or standing between sprints are important for the player's ability to keep sprinting throughout the match. **(1)**

(Total for Question 10 is 2 marks)

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11 A javelin thrower's whole throwing action, from the final stride to the release of the javelin, lasts less than 2 seconds and requires a maximal, explosive effort.

(a) Name the energy system used for this action. **(1)**

(b) Explain why this energy system is well suited to a single explosive throw like this, but could not fuel an entire training session of repeated throws with only very short rests. **(2)**

(Total for Question 11 is 3 marks)

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12 The body uses three energy systems to produce ATP for muscle contraction, each suited to different intensities and durations of exercise.

(a) Name the energy system that provides energy immediately for very short, maximal-intensity efforts. **(1)**

(b) Name the energy system that provides energy for high-intensity exercise lasting up to a few minutes, producing lactic acid as a by-product. **(1)**

(c) Name the energy system that provides energy for long-duration, lower-intensity exercise using oxygen. **(1)**

(Total for Question 12 is 3 marks)

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13 State the fuel used, and the by-product (if any), of the ATP-PC system.

(Total for Question 13 is 2 marks)

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14 State the fuel used, and the main by-product, of the lactic acid system.

(Total for Question 14 is 2 marks)

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15 State the fuels used, and the by-products, of the aerobic system.

(Total for Question 15 is 2 marks)

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Mark scheme · 1.5 Energy Systems: ATP-PC, Lactic Acid and Aerobic: 30-minute Pack

Question 1

(a) ATP-PC system **B1**

(a) Answer: ATP-PC system

(b) lactic acid system **B1**

(b) Answer: Lactic acid system

(c) aerobic system **B1**

(c) Answer: Aerobic system

Question 2

the muscle can only store a small, limited amount of phosphocreatine (PC), oe **B1**

this limited store is used up within about 10 seconds of maximal effort, after which the muscle must switch to the lactic acid system to continue producing energy at a high rate, oe **B1**

Answer: The muscle can only store a small, limited amount of phosphocreatine; this is used up within about 10 seconds of maximal effort, after which the muscle must switch to the lactic acid system to keep producing energy quickly.

Question 3

(a) ATP-PC system **B1**

(a) Answer: ATP-PC system

(b) aerobic system **B1**

(b) Answer: Aerobic system

Question 4

C (lactic acid) **B1**

Answer: C (lactic acid)

Question 5

(a) ATP-PC system **B1**

(a) Answer: ATP-PC system

(b) by this stage the lactic acid system is providing most of the energy, oe **B1**

(b) lactic acid has been building up in the muscles, which interferes with muscle contraction and causes fatigue/a heavy feeling in the legs, oe **B1**

(b) Answer: By this stage in the race the lactic acid system is providing most of the energy, and lactic acid has been building up in the muscles; this build-up interferes with muscle contraction, causing the fatigue and heavy feeling the runner experiences.

Question 6

the ATP-PC system can release energy immediately and at a very high rate, which suits the short, maximal force needed for the lift, oe **B1**

it produces no fatiguing by-products (unlike the lactic acid system, which produces lactic acid), so the muscle is not fatigued by using it and can recover quickly for another attempt, oe **B1**

Answer: The ATP-PC system can release energy immediately and at a very high rate, which suits the short, maximal force needed for the lift, and it produces no fatiguing by-products, so the muscle is not left fatigued and can recover quickly for another attempt.

Question 7

(a) it decreases (less oxygen is available/delivered to the working muscles), oe **B1**

(a) Answer: It decreases; less oxygen is available to the working muscles.

(b) with less oxygen delivered to the working muscles, the aerobic system may not be able to produce energy as quickly as at sea level, oe **B1**

(b) so the boxer may have to rely more on the anaerobic (lactic acid) system sooner than they would at sea level, oe **B1**

(b) Answer: With less oxygen delivered to the working muscles, the aerobic system may not be able to produce energy as quickly as at sea level, so the boxer may have to rely on the anaerobic (lactic acid) system sooner than they would at sea level.

Question 8

(a) exercise performed at a low enough intensity that the body can supply enough oxygen to produce the energy needed, oe **B1**

(a) Answer: Exercise performed at a low enough intensity that the body can supply enough oxygen to produce the energy needed.

(b) high-intensity exercise where energy is produced without using oxygen, oe **B1**

(b) Answer: High-intensity exercise where energy is produced without using oxygen.

Question 9

(a) the ATP-PC system produces no fatiguing by-product, whereas the lactic acid system produces lactic acid, oe **B1**

(a) Answer: The ATP-PC system produces no fatiguing by-product, whereas the lactic acid system produces lactic acid.

(b) the ATP-PC system can only supply energy for up to about 10 seconds, whereas the lactic acid system can supply energy for longer, up to a few minutes, oe **B1**

(b) Answer: The ATP-PC system can only supply energy for up to about 10 seconds, whereas the lactic acid system can supply energy for longer, up to a few minutes.

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Question 10

(a) ATP-PC system **B1**

(a) Answer: ATP-PC system

(b) the lower-intensity recovery periods allow the aerobic system to help replenish the muscle's stores of phosphocreatine, so the ATP-PC system is ready to fuel the next maximal sprint, oe **B1**

(b) Answer: The lower-intensity recovery periods allow the aerobic system to help replenish the muscle's phosphocreatine stores, so the ATP-PC system is ready to provide immediate energy again for the next sprint.

Question 11

(a) ATP-PC system **B1**

(a) Answer: ATP-PC system

(b) it is well suited because it releases energy immediately and at a very high rate, matching the sudden, maximal force needed for one throw, oe **B1**

(b) but it could not fuel repeated throws with only very short rests because the muscle's small phosphocreatine store takes time to be replenished (using the aerobic system), so without enough recovery time between throws the store would stay partly depleted, reducing power on later throws, oe **B1**

(b) Answer: It is well suited to a single throw because it releases energy immediately and at a very high rate, matching the sudden, maximal force needed. It could not fuel repeated throws with only very short rests, because the muscle's small phosphocreatine store takes time to be replenished, so without enough recovery time it would stay partly depleted, reducing power on later throws.

Question 12

(a) ATP-PC system (alactic system) **B1**

(a) Answer: ATP-PC system (alactic system)

(b) lactic acid system (anaerobic glycolysis) **B1**

(b) Answer: Lactic acid system (anaerobic glycolysis)

(c) aerobic system **B1**

(c) Answer: Aerobic system

Question 13

fuel: stored ATP and phosphocreatine (PC) already present in the muscle, oe **B1**

by-product: none/no fatiguing by-products are produced, oe **B1**

Answer: Fuel: stored ATP and phosphocreatine (PC) already present in the muscle. By-product: none (no fatiguing by-products are produced).

Question 14

fuel: glucose/glycogen, oe **B1**

by-product: lactic acid, oe **B1**

Answer: Fuel: glucose/glycogen. By-product: lactic acid.

Question 15

fuel: carbohydrates and fats, oe **B1**

by-products: carbon dioxide and water, oe **B1**

Answer: Fuels: carbohydrates and fats. By-products: carbon dioxide and water.

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