1.20 Respiration, Exercise and Metabolism: Test Pack

AQA 8464 · Calculator allowed · about 40 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Cells obtain energy from food by a process called respiration.

(a) State two differences between aerobic respiration and anaerobic respiration in animal cells. **(2)**

(b) Give the waste product produced in human cells during anaerobic respiration. **(1)**

(Total for Question 1 is 3 marks)

2 The overall word equation for aerobic respiration in cells is:

glucose + oxygen -> ..... + water

(a) State the missing product of aerobic respiration shown above that is not water. **(1)**

(b) State the purpose of glucose in respiration. **(1)**

(Total for Question 2 is 2 marks)

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3 A student measures their breathing rate at rest and after moderate exercise. They count breaths per minute. The student records 12 breaths per minute at rest and 28 breaths per minute immediately after exercise.

(a) Calculate the percentage increase in breathing rate caused by the exercise. Give your answer to one decimal place. **(2)**

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(b) Give one physiological reason why breathing rate increases during exercise. **(1)**

(Total for Question 3 is 3 marks)

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4 Metabolic rate varies with activity and with body mass. State two factors, other than exercise, that can increase basal metabolic rate.

(a) Give two factors that increase basal metabolic rate. **(2)**

(Total for Question 4 is 2 marks)

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5 During intense exercise some muscle cells respire anaerobically. A sample of muscle produces 18 mmol of lactate in 10 minutes.

(a) Calculate the rate of lactate production in mmol per minute. **(2)**

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(b) Suggest one effect on muscle function of accumulating lactate during prolonged intense exercise. **(1)**

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(Total for Question 5 is 3 marks)

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6 An investigation into the effect of exercise on heart rate involves measuring pulse before and after exercise. In one trial a student recorded resting heart rate 64 beats per minute, immediately after 3 minutes of step-ups the heart rate was 128 beats per minute, and after 6 minutes rest it was 78 beats per minute.

(a) Describe one control variable the student should keep the same between trials and explain why. **(2)**

(b) Suggest one safety precaution that should be included for this practical and give the reason. **(1)**

(Total for Question 6 is 3 marks)

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7 A student is troubleshooting a respiration practical where a gas syringe should measure CO_2 produced by germinating seeds. They notice the syringe reading increases when the seeds are removed, which is unexpected.

(a) Suggest two possible experimental errors or reasons that could cause the syringe reading to increase when seeds are removed. **(2)**

(b) Give one improvement to reduce the chance of this error occurring. **(1)**

(Total for Question 7 is 3 marks)

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8 A respiration experiment measures oxygen consumption of yeast under aerobic and anaerobic conditions. Results for one trial are shown: aerobic oxygen consumed 2.4 cm³ in 10 minutes; anaerobic oxygen consumed 0.0 cm³ in 10 minutes. The experiment used the same mass of yeast and same glucose concentration.

(a) Explain why oxygen consumption is greater in the aerobic trial compared with the anaerobic trial. **(2)**

(b) Give two improvements to the method that would make the comparison between aerobic and anaerobic trials fairer. **(2)**

(Total for Question 8 is 4 marks)

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9 A fitness coach compares recovery heart rates for two athletes after the same exercise. Athlete A recovery heart rate after 5 minutes is 70 bpm, Athlete B recovery heart rate after 5 minutes is 86 bpm. Resting heart rate for both is 56 bpm. The coach defines 'percent recovery' as (reduction in heart rate from peak to 5 min) / (peak - resting) x 100. For both athletes peak heart rate immediately after exercise was 160 bpm.

(a) Calculate percent recovery for Athlete A and Athlete B. Give answers to one decimal place. **(3)**

(Total for Question 9 is 3 marks)

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10 Higher only: Balance the chemical equation for anaerobic respiration in yeast (fermentation) that produces ethanol and carbon dioxide from glucose.

(a) Balance the symbol equation for fermentation: $C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2$ **(4)**

(Total for Question 10 is 4 marks)

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Mark scheme · 1.20 Respiration, Exercise and Metabolism: Test Pack

Question 1

(a) one valid difference between aerobic and anaerobic respiration in animal cells, e.g. aerobic uses oxygen whereas anaerobic does not; aerobic produces more ATP per glucose; aerobic produces carbon dioxide and water whereas anaerobic produces lactic acid; aerobic breaks down glucose completely whereas anaerobic breaks it down incompletely. Accept any other valid difference, oe **B1**

(a) a second distinct valid difference between aerobic and anaerobic respiration in animal cells from the examples above or another valid comparison, oe; do not credit the same difference twice **B1**

(a) Answer: Aerobic uses oxygen while anaerobic does not; aerobic produces more ATP per glucose than anaerobic.

(b) lactic acid (lactate) cao **B1**

(b) Answer: Lactic acid (lactate)

Question 2

(a) carbon dioxide cao **B1**

(a) Answer: Carbon dioxide

(b) to provide a chemical store of energy (oxidised to release energy for ATP), oe **B1**

(b) Answer: To provide a store of chemical energy that is released during respiration.

Question 3

(a) substitutes into percentage change: (28 - 12) / 12 x 100 **M1**

(a) 133.3% cao **A1**

(a) Answer: 133.3%

(b) to increase oxygen uptake for increased aerobic respiration/energy release, or to remove the additional carbon dioxide produced by increased respiration, oe **B1**

(b) Answer: To increase oxygen uptake for increased aerobic respiration and energy release.

Question 4

(a) one valid factor that increases basal metabolic rate, e.g. higher body mass, more muscle mass, higher thyroid hormone levels or fever/infection, oe **B1**

(a) a second distinct valid factor that increases basal metabolic rate from the examples above or another valid factor, oe; do not credit the same factor twice **B1**

(a) Answer: Higher muscle mass/body mass; higher thyroid hormone levels or fever/infection.

Question 5

(a) substitutes: rate = 18 mmol / 10 min **M1**

(a) 1.8 mmol per minute cao **A1**

(a) Answer: 1.8 mmol per minute

(b) muscle fatigue or cramp or decreased contraction efficiency due to lowered pH, oe **B1**

(b) Answer: Muscle fatigue or cramp due to accumulation of lactate lowering pH and reducing contraction efficiency.

Question 6

(a) identifies a control variable, e.g. same step height or same duration of exercise or same rest period **M1**

(a) explains that changing it would affect heart rate and confound comparison between trials, oe **A1**

(a) Answer: Keep step height and exercise duration the same so that differences in heart rate are due to other variables, not different exercise intensity.

(b) ensure a clear area and supervised step-ups to prevent trips or falls, oe **B1**

(b) Answer: Ensure a clear area and supervision during step-ups to prevent trips and falls.

Question 7

(a) a leak in the apparatus allowing air in when the seal is disturbed, oe **B1**

(a) temperature change increasing gas volume when seeds are removed, oe **B1**

(a) Answer: Possible errors: a leak or disturbed seal letting air in when removing seeds; also a temperature increase causing gas expansion.

(b) seal apparatus thoroughly and allow temperature to stabilise before measuring; remove seeds using a side port or pause measurement, oe **B1**

(b) Answer: Seal the apparatus thoroughly and allow temperature to stabilise; remove seeds via a side port or pause measurement to avoid disturbing the seal.

Question 8

(a) states that aerobic respiration uses oxygen to fully oxidise glucose **M1**

(a) contrasts this with anaerobic respiration, which does not use oxygen, so no oxygen is consumed in the anaerobic trial, oe **A1**

(a) Answer: Aerobic respiration uses oxygen to fully oxidise glucose, so oxygen is consumed; anaerobic respiration does not use oxygen, so no oxygen is consumed.

(b) one additional control that makes the comparison fairer, e.g. keep both trials at the same temperature using a water bath or maintain the same pH using a buffer, oe **B1**

(b) a second distinct valid additional control, e.g. the other control above, oe; yeast mass, glucose concentration and measurement duration are already controlled, and repeats and a mean reduce random error rather than make the comparison fairer **B1**

(b) Answer: Keep both trials at the same temperature using a water bath; maintain the same pH in both trials using a buffer.

Question 9

(a) calculates reduction A = 160 - 70 = 90; peak-rest = 160 - 56 = 104; percent = 90/104 x 100 **M1**

(a) calculates reduction B = 160 - 86 = 74; percent = 74/104 x 100 **M1**

(a) A = 86.5% and B = 71.2% cao **A1**

(a) Answer: Athlete A 86.5%; Athlete B 71.2%

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Question 10

(a) shows 2 molecules of C_2H_5OH and 2 molecules of CO_2 to account for carbon: $C_6H_{12}O_6$ -> $2C_2H_5OH + 2CO_2$ suggested **M1**

(a) checks hydrogen: LHS 12 H; RHS 2 x 6 H = 12 H **M1**

(a) checks oxygen: LHS 6 O; RHS 2 x 1 O in ethanol = 2 + 2 x 2 O in CO_2 = 4; total 6 O **M1**

(a) fully balanced equation: $C_6H_{12}O_6$ -> $2C_2H_5OH + 2CO_2$ cao **A1**

(a) Answer: $C_6H_{12}O_6$ -> $2C_2H_5OH + 2CO_2$

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