1.4 Bioenergetics: 30-minute Pack

AQA 8461 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Raw materials for photosynthesis are taken from the air and the soil.

(a) State two raw materials (reactants) needed for photosynthesis. **(2)**

(Total for Question 1 is 2 marks)

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2 Photosynthesis is the process by which green plants and algae make glucose using energy transferred from light.

(a) Complete the word equation for photosynthesis: carbon dioxide + _____ --[light energy]--> _____ + oxygen **(2)**

(b) State whether photosynthesis is an exothermic or endothermic reaction, and explain your answer in terms of energy transfer. **(2)**

(Total for Question 2 is 4 marks)

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3 After a 400 m race, an athlete's oxygen consumption took 12 minutes to return to the resting rate. During this recovery period, the athlete repaid a total oxygen debt of 21.6 dm^3. Calculate the mean rate of repayment of the oxygen debt, in dm^3 per minute.

(Total for Question 3 is 3 marks)

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4 Metabolism describes all the chemical reactions that take place in the cells of the body.

(a) Define the term 'metabolism'. **(1)**

(b) State the name of the large molecule formed when: (i) many glucose molecules join together for storage in the liver and muscles (ii) many amino acid molecules join together (iii) glycerol and fatty acid molecules join together **(3)**

(c) Excess amino acids cannot be stored in the body. Describe what happens to them. **(2)**

(Total for Question 4 is 6 marks)

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5 A student used a respirometer to investigate the effect of temperature on the rate of respiration of germinating pea seeds. The respirometer contained a tube of soda lime, and coloured liquid in a capillary tube that moved as the volume of gas in the apparatus changed. An identical respirometer, but containing glass beads instead of seeds, was set up alongside as a control.

(a) Explain why the respirometer contains soda lime. **(2)**

(b) Explain why a control respirometer, containing glass beads instead of seeds, was set up alongside. **(2)**

(c) At 25°C, the coloured liquid moved 24 mm along the capillary tube in 8 minutes. Calculate the rate of movement of the liquid, in mm per minute. **(2)**

(d) Predict and explain what would happen to the rate of movement of the liquid if the temperature were increased to 45°C. **(1)**

(Total for Question 5 is 7 marks)

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6 In a greenhouse at high light intensity and constant temperature, the rate of photosynthesis of tomato plants can be increased by raising the carbon dioxide concentration of the air.

(a) Explain, in terms of collisions between carbon dioxide molecules and enzyme molecules, why increasing the carbon dioxide concentration increases the rate of photosynthesis. **(3)**

(b) Explain why, above a certain carbon dioxide concentration, further increases have no additional effect on the rate of photosynthesis. **(2)**

(Total for Question 6 is 5 marks)

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Mark scheme · 1.4 Bioenergetics: 30-minute Pack

Question 1

(a) carbon dioxide **B1**

(a) water **B1**

(a) Answer: Carbon dioxide and water.

Question 2

(a) water **B1**

(a) glucose **B1**

(a) Answer: water; glucose

(b) endothermic **B1**

(b) energy (light energy) is transferred from the environment into the chloroplast/the products, so overall energy is absorbed rather than released, oe **B1**

(b) Answer: Endothermic; light energy is transferred from the environment into the plant and stored as chemical energy in glucose.

Question 3

values identified: 21.6 dm^3 and 12 minutes **M1**

21.6 / 12 calculated, oe **M1**

1.8 dm^3/min, cao (units required) **A1**

Answer: 1.8 dm^3 per minute

Question 4

(a) the sum of all the chemical reactions that take place in the cells of the body/organism, oe **B1**

(a) Answer: Metabolism is the sum of all the chemical reactions that take place in the cells of an organism.

(b) (i) glycogen **B1**

(b) (ii) proteins **B1**

(b) (iii) lipids (fats and oils) **B1**

(b) Answer: (i) glycogen (ii) proteins (iii) lipids

(c) excess amino acids are broken down (deaminated) in the liver, oe **M1**

(c) converted into urea, which is excreted from the body (by the kidneys, in urine), oe **A1**

(c) Answer: Excess amino acids are broken down (deaminated) in the liver and converted into urea, which is excreted by the kidneys in urine.

Question 5

(a) soda lime absorbs/removes the carbon dioxide produced by the respiring seeds, oe **M1**

(a) so any change in gas volume/movement of the liquid is due only to the oxygen used up during respiration, oe **A1**

(a) Answer: Soda lime absorbs the carbon dioxide produced by respiration, so any movement of the liquid is caused only by the oxygen being used up.

(b) to check whether any movement of the liquid is caused by changes in temperature or air pressure, oe **M1**

(b) rather than by the respiration of the seeds, allowing a fair/valid comparison to be made, oe **A1**

(b) Answer: The control checks whether liquid movement is caused by temperature or pressure changes in the surroundings rather than by seed respiration, so a fair comparison can be made.

(c) 24 / 8 calculated, oe **M1**

(c) 3 mm/min, cao (units required) **A1**

(c) Answer: 3 mm per minute

(d) the rate would increase at first (more enzyme/respiration activity at higher temperature) but may then decrease as enzymes begin to denature at this higher temperature, oe; accept either well-reasoned prediction **B1**

(d) Answer: The rate may initially increase as respiration enzymes work faster, but could then decrease if enzymes start to denature at 45°C.

Question 6

(a) increasing carbon dioxide concentration means there are more carbon dioxide molecules in a given volume of air/space, oe **M1**

(a) this increases the frequency of collisions between carbon dioxide molecules and enzyme molecules (active sites), oe **M1**

(a) more successful collisions per unit time means the enzyme-controlled reactions of photosynthesis proceed at a faster rate, oe **A1**

(a) Answer: More carbon dioxide molecules per unit volume increases the frequency of collisions with enzyme active sites, so more successful reactions occur per unit time and the rate of photosynthesis increases.

(b) all/most of the available enzyme active sites are already reacting at their maximum rate (saturated), oe; OR another factor such as light intensity or temperature has become limiting **M1**

(b) so adding more carbon dioxide cannot increase the rate any further, oe **A1**

(b) Answer: Once the enzyme active sites are working at their maximum rate (or another factor such as light intensity/temperature becomes limiting), adding more carbon dioxide cannot increase the rate further.

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