1.12 The Digestive System and Enzymes: Test Pack

AQA 8464 · Calculator allowed · about 35 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 The digestive system breaks down food into small molecules that can be absorbed.

(a) Name the enzyme that begins the chemical digestion of starch in the mouth. **(1)**

(b) State the organ where most absorption of small food molecules occurs. **(1)**

(c) Give two functions of the liver in digestion or absorption. **(2)**

(Total for Question 1 is 4 marks)

2 Lipase is an enzyme that acts on fats (lipids).

(a) State the product(s) formed when lipase acts on triglyceride fat molecules. **(1)**

(b) Name the substance produced by the liver that helps emulsify fats, increasing their surface area. **(1)**

(Total for Question 2 is 2 marks)

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3 A student investigates how changing pH affects pepsin (a protease found in the stomach). The student prepares buffered solutions at pH 1.5, 2.5, 3.5 and 5.5 and measures the time taken for a fixed concentration of pepsin to hydrolyse a standard protein substrate. Results (time to complete hydrolysis): pH 1.5: 90 s; pH 2.5: 40 s; pH 3.5: 70 s; pH 5.5: 200 s.

Use these results to answer the following.

(a) State the pH at which pepsin activity is highest, and give the evidence from the data. **(2)**

(b) Explain why activity falls again at pH 1.5 and at pH 5.5. **(2)**

(Total for Question 3 is 4 marks)

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4 A student measures the mass of a piece of intestine tissue sample before and after being placed in a solution containing protease for 30 minutes. Initial mass 1.20 g, final mass 0.96 g. Calculate the percentage decrease in mass and suggest one biological reason mass decreased.

(a) Calculate the percentage decrease in mass. Show your working. **(3)**

(b) Suggest one biological reason why the tissue mass decreased after protease treatment. **(1)**

(Total for Question 4 is 4 marks)

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5 A sample of saliva contains 0.025 mg of amylase per cm3. A test solution requires 5.0 cm^3 saliva. Calculate the mass of amylase added to the test solution in micrograms (microg). Show working and state the final answer with units.

(a) Calculate the mass of amylase in mg in 5.0 cm^3 of saliva. Show working. **(2)**

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(b) Convert the mass in mg to micrograms (microg). Show working and final answer. **(3)**

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(Total for Question 5 is 5 marks)

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6 Required practical style question: A student tests how bile affects the digestion of lipid by lipase. They set up four identical tubes containing the same volume of oil emulsion and the same concentration of lipase. Tube 1: no bile, tube 2: 0.5 cm^3 bile, tube 3: 1.0 cm^3 bile, tube 4: 2.0 cm^3 bile. After 10 minutes at 37°C they measure the decrease in turbidity (arbitrary units): tube1 5 units, tube2 12 units, tube3 20 units, tube4 20 units.

Answer the following about the investigation.

(a) State the relationship between bile volume and decrease in turbidity from these results. **(1)**

(b) Suggest one control variable the student should keep constant and why. **(1)**

(c) Explain why the decrease in turbidity shows a plateau between tubes 3 and 4. **(1)**

(Total for Question 6 is 3 marks)

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7 Error analysis: A laboratory report states that 'increasing enzyme concentration always increases the rate of reaction'. A student repeats an experiment and finds that after a certain enzyme concentration, the rate no longer increases. Using scientific reasoning, critique the blanket statement and explain why the student's data show a plateau.

(a) Give two clear scientific reasons why the statement 'increasing enzyme concentration always increases the rate' is incorrect. **(2)**

(b) Explain how the student's observed plateau supports your critique. **(2)**

(Total for Question 7 is 4 marks)

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Mark scheme · 1.12 The Digestive System and Enzymes: Test Pack

Question 1

(a) amylase (salivary amylase) cao **B1**

(a) Answer: Amylase

(b) small intestine (accept small bowel) cao **B1**

(b) Answer: Small intestine

(c) produces bile, oe **B1**

(c) stores and processes nutrients (eg converts glucose to glycogen) or detoxifies substances, oe **B1**

(c) Answer: Produces bile; stores and processes nutrients (for example converts glucose to glycogen) or detoxifies substances.

Question 2

(a) glycerol and fatty acids cao **B1**

(a) Answer: Glycerol and fatty acids

(b) bile cao **B1**

(b) Answer: Bile

Question 3

(a) pH 2.5 **B1**

(a) evidence: shortest time (40 s) so fastest hydrolysis, oe **B1**

(a) Answer: pH 2.5, because the time is shortest at 40 s indicating fastest activity.

(b) pH 1.5 is too acidic and pH 5.5 is too far above the optimum (not acidic enough) so enzyme shape is altered, oe **B1**

(b) altered active site reduces ability to bind substrate, decreasing rate, oe **B1**

(b) Answer: Because both pH extremes alter the enzyme's shape and active site so it binds substrate less effectively, reducing activity.

Question 4

(a) calculates change: 1.20 - 0.96 = 0.24 g and divides by original: 0.24 / 1.20 **M1**

(a) multiplies by 100 or equivalent to find percent **M1**

(a) 20% decrease cao **A1**

(a) Answer: 20%

(b) protease broke down proteins in the tissue into soluble amino acids which diffused out, reducing mass, oe **B1**

(b) Answer: Protease broke down proteins to soluble amino acids that diffused out of the tissue, reducing mass.

Question 5

(a) multiplies concentration by volume: 0.025 mg/cm3 x 5.0 cm^3 **M1**

(a) 0.125 mg cao **A1**

(a) Answer: 0.125 mg

(b) knows conversion 1 mg = 1000 microg and multiplies: 0.125 x 1000 **M1**

(b) shows multiplication giving 125 **M1**

(b) 125 microg cao **A1**

(b) Answer: 125 microg

Question 6

(a) increase in bile volume increases the decrease in turbidity up to 1.0 cm^3; beyond that no further increase (plateau) cao **B1**

(a) Answer: Increasing bile increases decrease in turbidity up to 1.0 cm^3, after which it plateaus.

(b) temperature (eg keep at 37°C) because enzyme activity is temperature sensitive, oe **B1**

(b) Answer: Temperature, because enzyme activity changes with temperature.

(c) there is a limiting factor (eg enzyme concentration or substrate amount) so adding more bile does not increase the rate further, oe **B1**

(c) Answer: Because another factor limits digestion (for example enzyme concentration or substrate availability), so extra bile does not increase the rate.

Question 7

(a) rate can become limited by substrate concentration so extra enzyme has no substrate to act on, oe **B1**

(a) other factors such as temperature or pH can limit activity so increasing enzyme alone will not increase rate, oe **B1**

(a) Answer: Because the reaction can be limited by substrate concentration or by other conditions (temperature or pH), so extra enzyme cannot increase rate beyond a limit.

(b) plateau shows that beyond a certain enzyme concentration another factor is limiting (eg all substrate molecules are already bound), oe **B1**

(b) this demonstrates the initial blanket statement is not universally true, oe **B1**

(b) Answer: The plateau shows that beyond a certain enzyme concentration another factor, such as substrate availability, is limiting the rate; this contradicts the blanket statement.

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