Mark each point independently. Accept alternative correct responses. Underlined words are required. [1] per bullet point unless stated. ★ = Higher Tier only.

Question 1 [0 marks]

Context: A student uses starch solution, amylase and buffer solutions to investigate enzyme activity....

Q: A student investigates the effect of pH on the rate of amylase activity. The table below shows her results.

[0 marks]

Question 2 [2 marks]

Q: Using the data in the table, identify the optimum pH for amylase activity. Explain your answer.

• Optimum pH = 7 [1]

• Because at pH 7 the time for starch digestion is shortest / rate is fastest [1]

[2 marks]

Question 3 [3 marks]

Q: At pH 10, the iodine solution always remained blue-black. Explain why no starch was digested at pH 10.

• At pH 10 the pH is very different from the optimum [1]

• The bonds holding the enzyme in its 3D shape break / active site changes shape permanently (denaturation) [1]

• The substrate (starch) can no longer fit/bind to the active site so no reaction occurs [1]

[3 marks]

Question 4 [2 marks]

Q: Explain why the student used a buffer solution in this experiment rather than adjusting pH with acid or alkali.

• Buffer solutions maintain a constant/stable pH throughout the experiment [1]

• Without a buffer, pH might change as the reaction proceeds, making it an unfair test [1]

[2 marks]

Question 5 [2 marks]

Q: Calculate the mean rate of reaction at pH 7. Give your answer in s■¹. Show your working.

• Rate = 1 divided by time [1]

• = 1 / 98 = 0.0102 s■¹ (accept 0.010 to 0.011) [1]

Note: Accept any answer in range 0.010 to 0.011. Do not penalise for rounding.

[2 marks]

Question 6 [2 marks]

Q: State TWO variables the student must control in this investigation to make it a fair test.

• Temperature / concentration of amylase / concentration of starch / volume of solutions used [1 each — any two]

[2 marks]

Question 7 ★ Higher Tier [3 marks]

Q: Explain, using the induced fit model, how amylase catalyses the hydrolysis of starch.

• The starch molecule (substrate) enters the active site of amylase [1]

• The active site changes shape slightly to mould around the substrate — forming a tighter enzyme-substrate complex [1]

• The reaction occurs and starch is broken into maltose. Products are released and active site returns to original shape [1]

[3 marks]

END OF QUESTIONS — Total: 14 marks