AP BIOLOGY • EXERCISE SHEET

3.2 Environmental Impacts on Enzyme Function

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **environmental impacts on enzyme function**.

You must be able to:

- describe how **temperature** and **pH** affect enzyme rate
- explain **denaturation** 变性 at extremes
- describe the effect of substrate concentration (saturation)

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

Temperature

Rate rises with temperature up to an **optimum**, then falls sharply as the enzyme **denatures** (its shape and active site are destroyed). Too cold = slow; too hot = denatured.

pH

Each enzyme has an **optimum pH**. Far from it, the active site's shape is disrupted, lowering the rate; extreme pH can denature the enzyme.

Substrate concentration

Rate rises with more substrate until all active sites are busy (**saturation**); then adding more substrate does not increase the rate (the plateau).

A worked graph reading

An enzyme's rate-vs-temperature curve rises to a peak at ~37°C (human optimum) and then drops steeply —the drop is denaturation, not just slowing.

2 Practice

Now apply the methods above.

2.1 What happens to an enzyme's shape at very high temperature? [1]

2.2 What is meant by an enzyme's optimum pH? [1]

2.3 Why does rate level off at high substrate concentration? [1]

3 Exam-style questions

3.1 Above its optimum temperature, an enzyme's rate falls sharply because the enzyme [1]

- **A** speeds up
- **B** denatures
- **C** gains substrate
- **D** freezes

3.2 An enzyme's activity is measured at pH 2, 7, and 11, with the highest activity at pH 7.

(a) State the optimum pH. [1]

(b) Explain why activity is low at pH 2 and pH 11. [2]

3.3 Describe and explain the shape of a graph of reaction rate against substrate concentration. [3]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **3.2 Environmental Impacts on Enzyme Function** lesson on the **Learn** page;
- read the **Environmental Impacts on Enzyme Function** section of the AP Biology handout on the **Know** page.

Solutions

2.1 It denatures (the active site loses its shape).

2.2 The pH at which the enzyme works fastest.

2.3 All the active sites are occupied (saturated), so more substrate cannot be processed faster.

3.1 B —denatures.

3.2 (a) pH 7. (b) At pH 2 and 11 the active site's shape is disrupted (or the enzyme denatures), so the substrate no longer fits and the rate falls.

3.3 Rate rises steeply with substrate at first (more collisions with active sites), then levels off once all active sites are saturated, so adding more substrate has no further effect.