

2005 AP[®] BIOLOGY FREE-RESPONSE QUESTIONS

BIOLOGY

SECTION II

Time—1 hour and 30 minutes

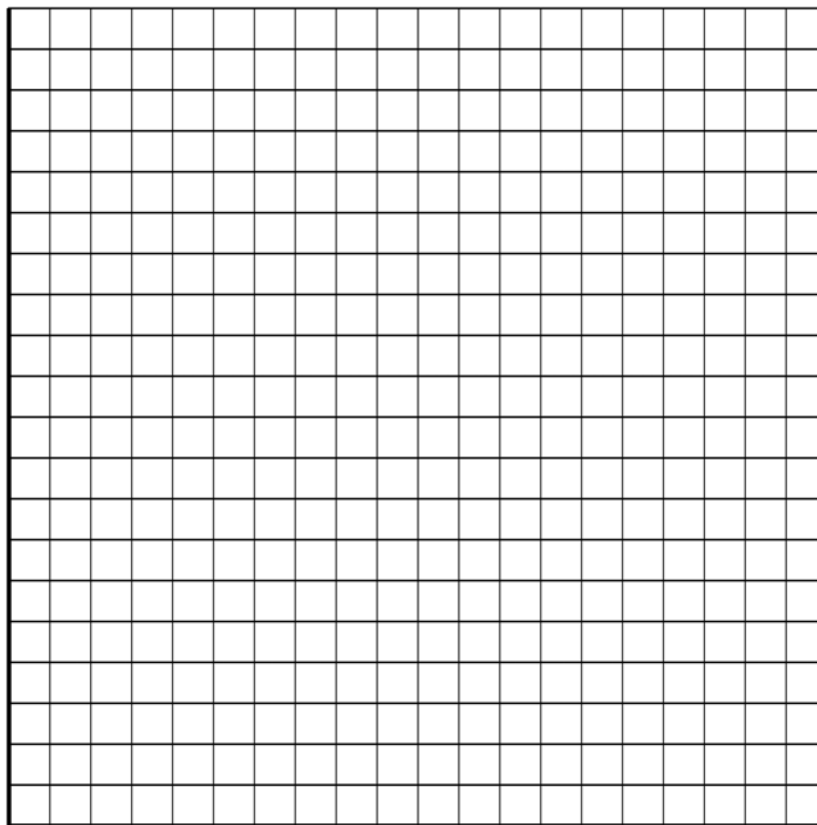
Directions: Answer all questions.

Answers must be in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement discussion, but in no case will a diagram alone suffice. It is important that you read each question completely before you begin to write. Write all your answers on the pages following the questions in the pink booklet.

1. Yeast cells are placed in an apparatus with a solution of sugar (a major nutrient for yeast metabolism). The apparatus detects bubbles of gas released by the yeast cells. The rate of respiration varies with the surrounding temperatures as indicated by the data below.

Temperature (°C)	0	10	20	30	40	50	60	70
Number of bubbles of gas produced per minute	0	3	7	12	7	4	1	0

- (a) **Graph** the results on the axes provided. **Determine** the optimum temperature for respiration in the yeast.
- (b) Respiration is a series of enzyme-catalyzed reactions. Using your knowledge of enzymes and the data above, **analyze** and **explain** the results of this experiment.
- (c) **Design** an experiment to test the effect of varying the pH of the sugar solution on the rate of respiration. Include a prediction of the expected results.



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Question 1

Part A: Graph and Optimum Temperature (3 points maximum)

Graph Setup (1 point)

Must contain:

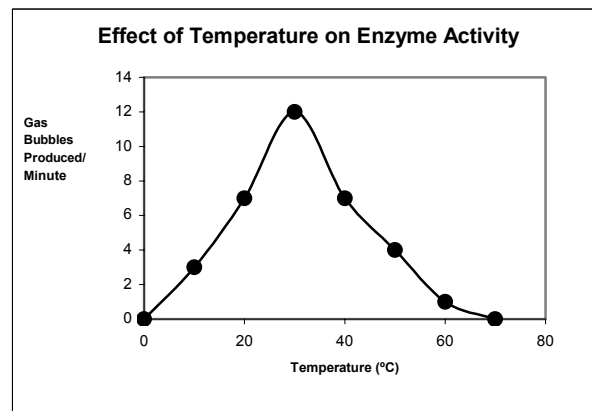
- Title/Legend and Y-axis [Bubbles of gas/Min]
- X-axis [Temperature (°C)]
- Correct measurement units and scaling for axes

Data Plotted (1 point)

- Correctly plotted points in proper orientation
- Points may or may not be connected with a line
- Bar graph acceptable

Optimum Temperature (1 point)

- 30° C, or between 20° C and 40° C either clearly indicated on the graph or in a sentence



Part B: Analyze and Explain the Results

(4 points maximum)

Analysis (1 point)

- Provide range of the change in respiration activity (increase and decrease) to temperature change (increase and decrease)

Explanations (1 point each)

- Below optimum—Increase in molecular movement leads to increase in reaction rate
- Above optimum—Denaturing of enzymes leads to decrease in reaction rate

Elaboration (2 points maximum, 1 point each)

- Relating enzyme function (effect on reaction rates) to allosteric site, active site, H⁺ bond, R groups
- Gas production due to respiration (can use either aerobic respiration or fermentation)
- Induced fit
- Lowering energy of activation
- Enzyme specificity

Part C: Experimental Design (4 points maximum)

NOTE: Experiment must be feasible. Must include sugar solutions of varying pH and an organism. If experiment is not reasonable, no points are awarded in the design structure section below.

Design Structures (3 points maximum, 1 point each)

- Two experimental constants—constant amounts of yeast or sugar, or temperature held constant
- Independent variable tested—reasonable pH range must be stated, including acid through base

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Question 1 (continued)

- Control—identification of a control treatment, e.g., no sugar, no yeast, pH 7
- Measurable product per unit of time—gas production, color change, etc.
- Multiple trials—repeat trials, several samples, stats, etc.

Prediction (1 point)

- Designate a pH at which enzymes will function optimally