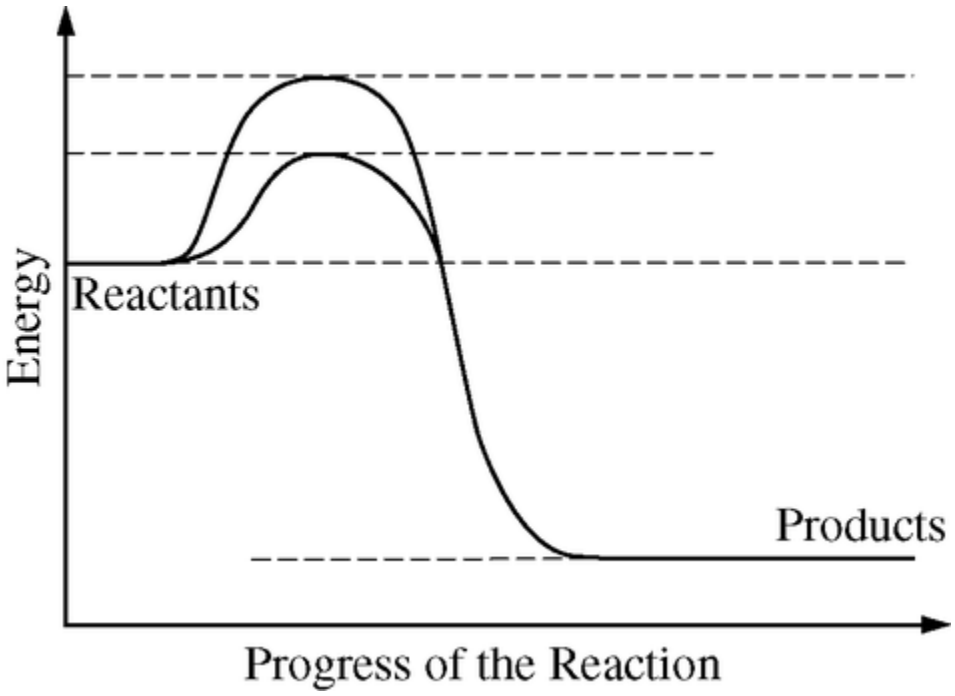
Unit 3 MCQ Review

1. The diagram below shows energy changes in a specific chemical reaction with and without the addition of an enzyme to the reaction.



Which of the following questions can best be answered by the diagram?

(A) Does the addition of an enzyme reduce the activation energy required for a reaction? ✓

(B) Does the addition of an enzyme result in the formation of covalent bonds?

(C) Does the addition of an enzyme produce a greater amount of products?

(D) Does the addition of an enzyme change the pathway for the reaction?

2. ATP serves as a common energy source for organisms because

(A) it is the smallest energy molecule

(B) it stores the least energy of any energy source

(C) its energy can be easily transferred to do cellular work ✓

(D) it is extremely stable and can be stored in the cell for long periods of time

(E) traces of it have been found in fossils of ancient organisms dating back to the beginning of life on Earth

3. During respiration, most ATP is formed as a direct result of the net movement of

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(A) potassium against a concentration gradient

(B) protons down a concentration gradient ✓

(C) electrons against a concentration gradient

(D) electrons through a channel

(E) sodium ions into the cell

4. The energy required to run the Calvin cycle reactions of photosynthesis comes from which two substances produced during the light-dependent reactions?

(A) ATP and NADPH ✓

(B) ADP and PO_4

(C) H^+ and PO_2

(D) O_2 and CO_2

(E) H_2O and CO_2

5. The carbon 'that makes up organic molecules in plants is derived directly from

(A) combustion of fuels

(B) carbon fixed in photosynthesis ✓

(C) carbon dioxide produced in respiration

(D) carbon in the lithosphere

(E) coal mines

6. Which of the following statements about mitochondrial chemiosmosis is NOT true?

(A) A proton gradient is established across the inner membrane of the mitochondrion.

(B) The potential energy released from the mitochondrial proton gradient is used to produce ATP.

(C) The mitochondrial proton gradient provides energy for muscle contraction.

(D) Proteins embedded in the inner mitochondrial membrane play an important role in ATP synthesis.

(E) Heat energy is required to establish the electron transport chain. ✓

7. According to the chemiosmotic theory (chemiosmotic coupling), the energy required to move protons from the mitochondrial matrix to the intermembrane space against a concentration gradient comes most directly from

(A) photons of red or blue light

(B) the hydrolysis of ATP

(C) the breakdown of high-energy fatty acids in the mitochondrial matrix

(D) electrons flowing along the electron transport chain ✓

(E) substrate-level phosphorylation

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8. Which of the following best describes the function of the coenzymes NAD^+ and FAD in eukaryotic cellular respiration?

(A) They participate in hydrolysis reactions by accepting protons from water molecules.

(B) They participate directly in the phosphorylation of ADP to ATP.

(C) They serve as final electron acceptors in the electron transport chain.

(D) They aid vitamins such as niacin in the breakdown of glucose.

(E) They accept electrons during oxidation-reduction reactions. ✓

9. Students in a class measured the mass of various living organisms. They then kept the organisms in the dark for 24 hours before remeasuring them. None of the organisms were provided with nutrients during the 24-hour period. The data are as follows.

Organism	Starting Mass (g)	Final Mass (g)
Elodea (submerged aquatic plant)	15.10	14.01
Goldfish	10.10	9.84
Sea anemone	25.60	24.98

Which of the following is the best explanation for the pattern of change in mass of the organisms over time?

(A) Water loss due to evaporation

(B) Cellular respiration ✓

(C) The law of conservation of matter

(D) Growth and reproduction

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For following group of questions first study the description of the data and then choose the one best answer to each question following it and fill in the corresponding oval on the answer sheet.

To study the actions of the enzyme catalase on hydrogen peroxide, students performed the following experiment. Catalase was extracted from potatoes by blending raw potatoes in a blender with cold distilled water. The filtrate was stored on ice. The following hydrogen peroxide solutions were made: 1 percent, 5 percent, 10 percent, and 15 percent. Filter paper disks were soaked in the catalase filtrate and dropped into beakers containing the various solutions. The activity of the enzyme was measured by the amount of time it took for the disks to float to the surface of the solution on the bubbles produced by the reaction. The following data were obtained.

Hydrogen Peroxide Solution	Average Time, in Seconds, for Disks to Float
1%	30 sec
5%	25 sec
10%	20 sec
15%	10 sec

10. Which of the following best describes why the disks rose to the surface faster in the more concentrated hydrogen peroxide solutions?

(A) There was more enzyme present in the more concentrated solutions.

(B) A greater amount of heat was generated in the more concentrated solutions.

(C) The more concentrated solutions lowered the activation energy of the reaction.

(D) The higher substrate concentrations in the more concentrated solutions speeded the reaction. ✓

(E) The density of the water was lower in the more concentrated solutions.

11. Which of the following best describes why ice was used during this experiment?

(A) To increase the activity of the enzyme

(B) To retard the breakdown of the catalase ✓

(C) To purge the solution of excess air trapped during blending

(D) To slow the catalase molecules to increase the probability of contact with the hydrogen peroxide molecules

(E) To increase the size of the active site on the enzyme

12. If the potato solution was boiled for 10 minutes and cooled for 10 minutes before being tested, the average time for the disks to float to the surface of the hydrogen peroxide solution would be

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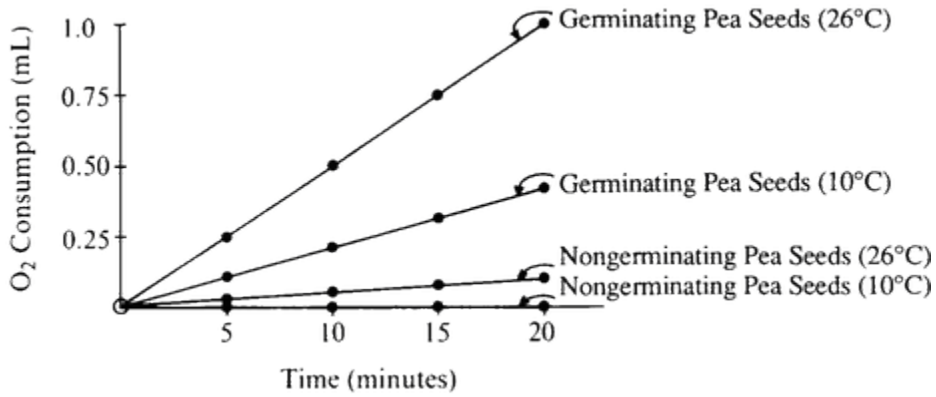
(A) less than 1 second
(B) 5 seconds
(C) 10 seconds
(D) 30 seconds
(E) more than 30 seconds ✓

13. Which of the following can be used to determine the rate of enzyme-catalyzed reactions?

(A) Rate of disappearance of the enzyme
(B) Rate of disappearance of the substrate ✓
(C) Rate of disappearance of the product
(D) Change in volume of the solution
(E) Increase in activation energy

The following questions refer to an experiment that is set up to determine the relative volume of O_2 consumed by germinating and nongerminating (dry) pea seeds at two different temperatures. The change in volume is detected by using a respirometer over a given period of time. The data are given below.



14. The rate of oxygen consumption in germinating pea seeds at 26ºC is

(A) 0.05 mL / min ✓
(B) 0.25 mL / min
(C) 0.50 mL / min
(D) 0.75 mL / min
(E) 1.00 mL / min

15. Which of the following conclusions is best supported by the data?

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(A) Nongerminating pea seeds have a higher rate of respiration than germinating pea seeds do.

(B) Light is required for pea seed germination.

(C) In the nongerminating pea seeds, oxygen consumption is directly proportional to oxygen concentration.

(D) Less carbon dioxide is produced by germinating pea seeds at 26ºC than at 10ºC.

(E) In pea seeds an increase in temperature results in an increase in oxygen consumption. ✓

A student placed 20 tobacco seeds of the same species on moist paper towels in each of two petri dishes. Dish A was wrapped completely in an opaque cover to exclude all light. Dish B was not wrapped. The dishes were placed equidistant from a light source set to a cycle of 14 hours of light and 10 hours of dark. All other conditions were the same for both dishes. The dishes were examined after 7 days, and the opaque cover was permanently removed from dish A. Both dishes were returned to the light and examined again at 14 days. The following data were obtained.

	Dish A		Dish B	
	Day 7 Covered	Day 14 Uncovered	Day 7 Uncovered	Day 14 Uncovered
Germinated seeds	12	20	20	20
Green-leaved seedlings	0	14	15	15
Yellow-leaved seedlings	12	6	5	5
Mean stem length below first set of leaves	8 mm	9 mm	3 mm	3 mm

16. According to the results of this experiment, germination of tobacco seeds during the first week is

(A) increased by exposure to light ✓

(B) unaffected by light intensity

(C) prevented by paper towels

(D) accelerated in green-leaved seedlings

17. Additional observations were made on day 21, and no yellow-leaved seedlings were found alive in either dish. This is most likely because

(A) yellow-leaved seedlings were unable to absorb water from the paper towels

(B) taller green-leaved seedlings blocked the light and prevented photosynthesis

(C) yellow-leaved seedlings were unable to convert light energy to chemical energy ✓

(D) a higher rate of respiration in yellow-leaved seedlings depleted their stored nutrients

18. Which of the following is an important difference between light-dependent and light-independent reactions of photosynthesis?

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(A) The light-dependent reactions occur only during the day; the light-independent reactions occur only during the night.

(B) The light-dependent reactions occur in the cytoplasm; the light-independent reactions occur in chloroplasts.

(C) The light-dependent reactions utilize CO_2 and H_2O; the light-independent reactions produce CO_2 and H_2O.

(D) The light-dependent reactions depend on the presence of both photosystems I and II; the light-independent reactions require only photosystem I.

(E) The light-dependent reactions produce ATP and NADPH; the light-independent reactions use energy stored in ATP and NADPH. ✓

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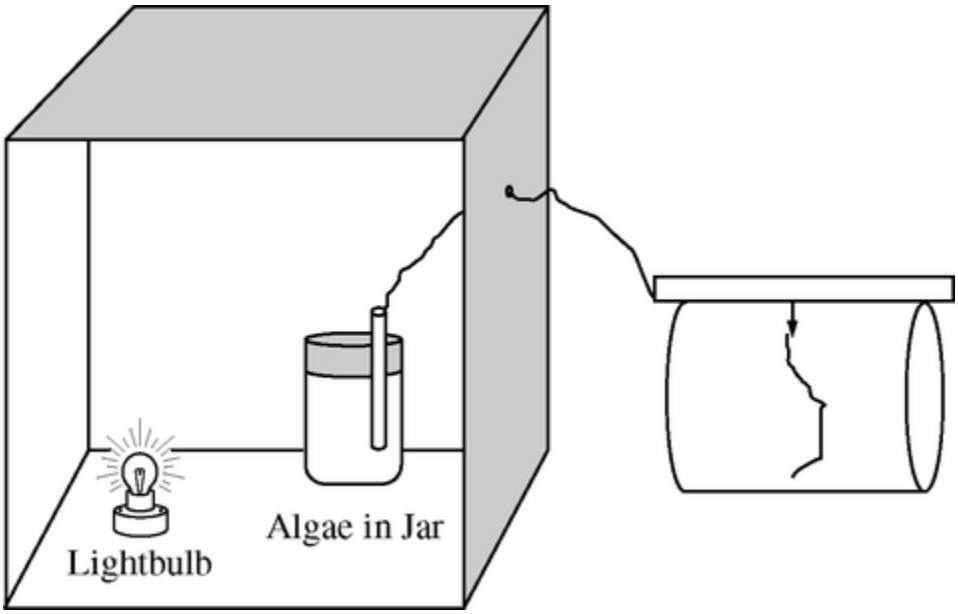
For following group of questions first study the description of the situation and diagrams and then choose the one best answer to each question following it and fill in the corresponding oval on the answer sheet.

A student studied the effects of light intensity on oxygen production in green algae. The algae were suspended in water inside a sealed glass jar, and the jar was placed into a constant-temperature, lightproof box containing a light source. A probe was inserted into the jar to record the concentration of oxygen. The probe was connected to a recording device. The setup is shown below.



The student decreased the intensity of the light hourly and recorded the corresponding changes in oxygen concentration. The graph below shows the results from the recording device.

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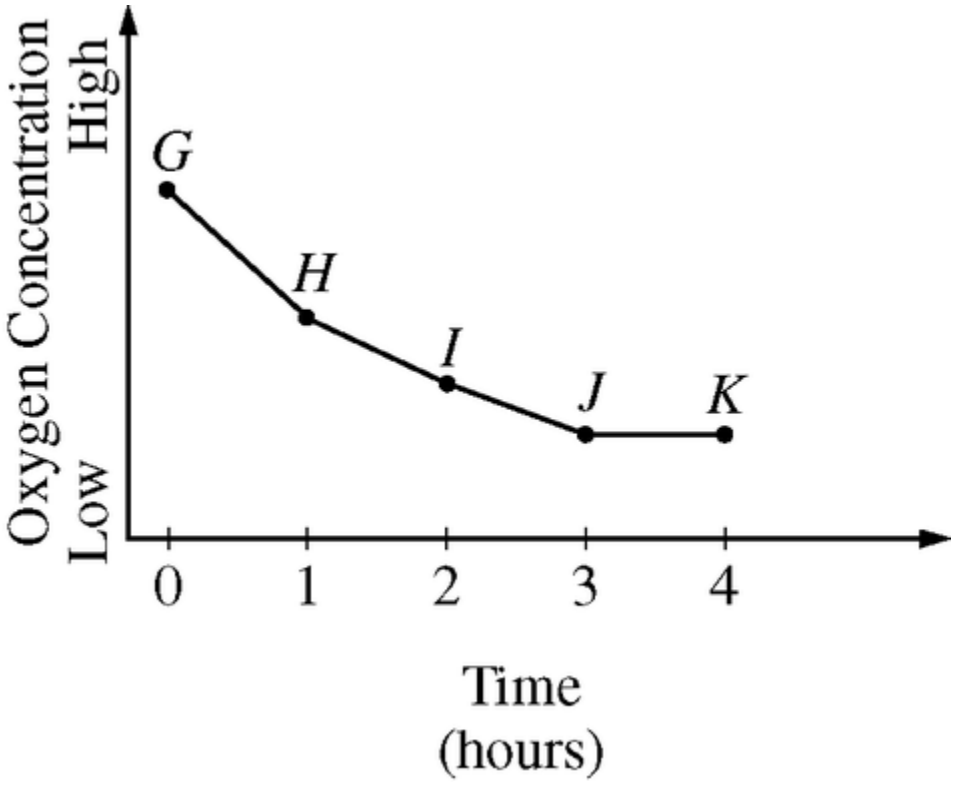

19. Based on the data shown, changes in the light intensity resulted in changes in the rate of which of the following processes?

(A) Excretion

(B) Photosynthesis ✓

(C) Respiration

(D) Translation

(E) Transcription

20. The rate of oxygen production equaled the rate of oxygen consumption during which of the following time periods?

(A) *G* to *H*

(B) *H* to *I*

(C) *I* to *J*

(D) *J* to *K* ✓

(E) *G* to *K*

21. An increase in the rate of oxygen production by algae would be accompanied by a comparable increase in the rate of production of which of the following substances?

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(A) $C_6H_{12}O_6$ ✓

(B) CO_2

(C) CH_4

(D) NH_3

(E) H_2O

22. Carbohydrate-synthesizing reactions of photosynthesis directly require

(A) light

(B) products of the light reactions ✓

(C) darkness

(D) O_2 and H_2O

(E) chlorophyll and CO_2

23. Two nutrient solutions are maintained at the same pH. Actively respiring mitochondria are isolated and placed into each of the two solutions. Oxygen gas is bubbled into one solution. The other solution is depleted of available oxygen. Which of the following best explains why ATP production is greater in the tube with oxygen than in the tube without oxygen?

(A) The rate of proton pumping across the inner mitochondrial membrane is lower in the sample without oxygen. ✓

(B) Electron transport is reduced in the absence of a plasma membrane.

(C) In the absence of oxygen, oxidative phosphorylation produces more ATP than does fermentation.

(D) In the presence of oxygen, glycolysis produces more ATP than in the absence of oxygen.

24. Oxygen consumption can be used as a measure of metabolic rate because oxygen is

(A) necessary for ATP synthesis by oxidative phosphorylation ✓

(B) necessary to replenish glycogen levels

(C) necessary for fermentation to take place

(D) required by all living organisms

(E) required to break down the ethanol that is produced in muscles

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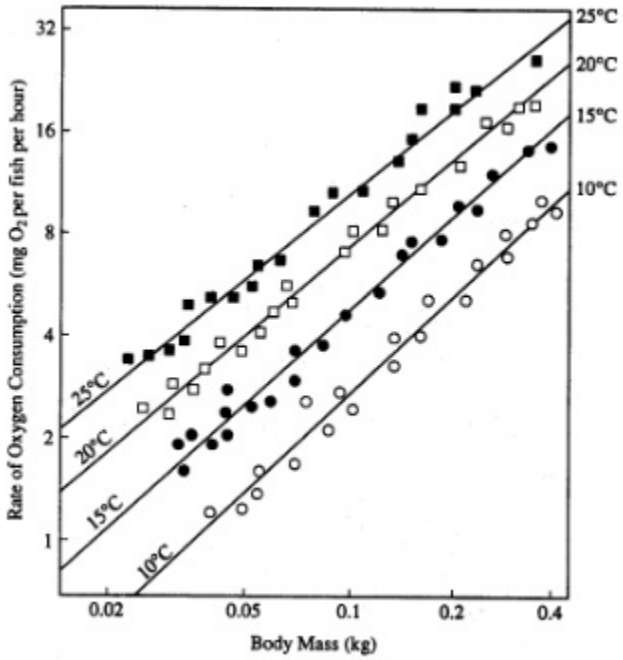
- Directions: Each group of questions below concerns an experimental or laboratory situation or data. In each case, first study the description of the situation or data. Then choose the one best answer to each question following it.

The following questions refer to the following information and graph.

The data presented in the figure below are measurements of the rate of oxygen consumption at differing body masses in a species of fish. Each point represents measurements from a different fish. Measurements were taken at different temperatures. (○= 10°C,●= 15°C, □= 20°C, ■= 25°C.)



25. The fact that each line on the graph rises from left to right means that

(A) higher temperatures produce higher rates of metabolism

(B) there were more large fish in the samples taken at high temperatures

(C) larger fish consume more oxygen than smaller fish at all four temperatures ✓

(D) when measurements are taken for larger fish late in the day, observed values are higher

(E) larger fish prefer to live at higher temperatures than do smaller fish

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26. It is estimated that oxygen production first evolved in photosynthetic prokaryotes approximately 2.7 billion years ago. The first photosynthetic prokaryotes are presumed to be similar to today's cyanobacteria.

Which of the following best supports the claim that photosynthetic prokaryotes were responsible for the oxygen in Earth's atmosphere?

(A) The light reactions of photosynthesis split carbon dioxide into carbon and oxygen.

(B) The light reactions of photosynthesis split water into hydrogen ions and oxygen. ✓

(C) The Calvin cycle splits glucose into carbon, hydrogen, and oxygen.

(D) The Calvin cycle splits water into hydrogen ions and oxygen.

27. When hydrogen ions are pumped out of the mitochondrial matrix, across the inner mitochondrial membrane, and into the space between the inner and outer membranes, the result is

(A) damage to the mitochondrion

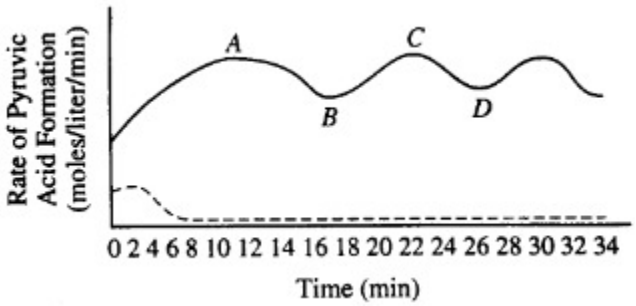
(B) the reduction of NAD

(C) the restoration of the Na-K balance across the membrane

(D) the creation of a proton gradient ✓

(E) the lowering of pH in the mitochondrial matrix

- **Directions:** Each group of questions below concerns an experimental or laboratory situation or data. In each case, first study the description of the situation or data. Then choose the one best answer to each question following it.



A tissue culture of vertebrate muscle was provided with a constant excess supply of glucose under anaerobic conditions starting at time zero and the amounts of pyruvic acid and ATP produced were measured. The solid line in the graph above represents the pyruvic acid produced in moles per liter per minute. ATP levels were also found to be highest at points *A* and *C*, lowest at *B* and *D*. A second culture was set up under the same conditions, except that substance **X** was added, and the results are indicated by the dotted line.

28. Which of the following best accounts for the shape of the solid line between points *A* and *D*?

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(A) After ten minutes the cellular enzymes became ineffective.
(B) Respiration became uncontrolled.
(C) ATP acted as an allosteric inhibitor on one or more of the enzymes. ✓
(D) The measurements of pyruvic acid were unreliable.
(E) The cells required more glucose than was being provided.

29. It is most reasonable to hypothesize that, in the breakdown of glucose, substance **X** is

(A) an activator
(B) an inhibitor ✓
(C) a substrate
(D) a coenzyme
(E) a cofactor

30. Which of the following questions is most relevant to understanding the Calvin cycle?

(A) How does chlorophyll capture light?
(B) How is ATP used in the formation of 3-carbon carbohydrates? ✓
(C) How is $NADP^+$ reduced to NADPH?
(D) How is ATP produced in chemiosmosis?

31. Which metabolic process is common to both aerobic cellular respiration and alcoholic fermentation?

(A) Krebs cycle
(B) Glycolysis ✓
(C) Electron transport chain
(D) Conversion of pyruvic acid to acetyl CoA
(E) Production of a proton gradient

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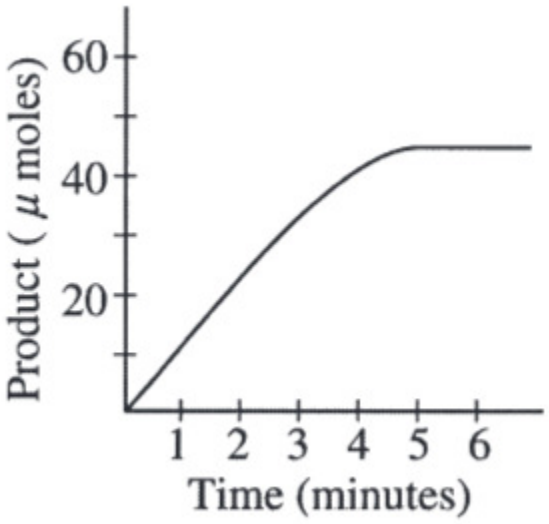
32. A scientist determined the rate of an enzyme-catalyzed reaction by measuring the amount of product formed over time. The following curve was generated from the data collected.



The rate of the reaction could also be determined by

(A) measuring the change in the amount of enzyme

(B) measuring the change in the amount of substrate ✓

(C) measuring the change in salt concentration

(D) adding more substrate

(E) adding more enzyme

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33. The enzyme trypsin aids in protein digestion in the small intestine. The relative activity of trypsin at different pH values is shown in Figure 1.

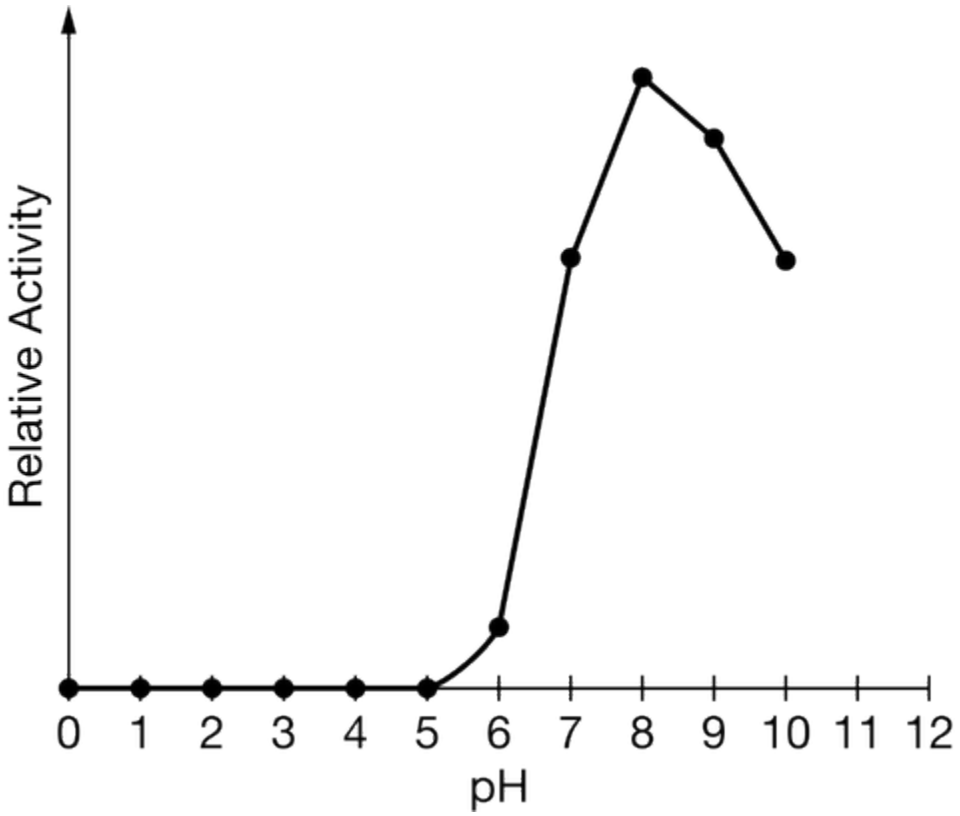

Figure 1. Effect of pH on the activity of trypsin

Which of the following statements best explains the activity levels of trypsin shown in Figure 1 ?

(A) The small intestine releases inhibitor molecules that block the activity of trypsin unless it is at its optimum pH.

(B) The number of effective collisions between trypsin and its substrate increase at higher pH values.

(C) As pH values increase, the substrate concentration decreases, leading to an eventual decline in the rate of the trypsin-catalyzed reaction.

(D) At extremely low pH values, trypsin is denatured and cannot function efficiently. ✓

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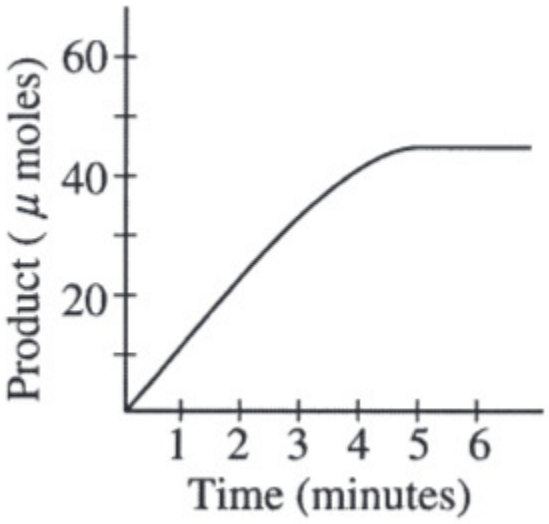
34. A scientist determined the rate of an enzyme-catalyzed reaction by measuring the amount of product formed over time. The following curve was generated from the data collected.



What is the most likely explanation for the change in the slope of the line between 3 and 5 minutes?

(A) The enzyme had denatured.

(B) The enzyme had achieved its maximum velocity.

(C) A large amount of the substrate had been consumed. ✓

(D) An allosteric inhibitor appeared.

(E) There was a dramatic change in the pH.