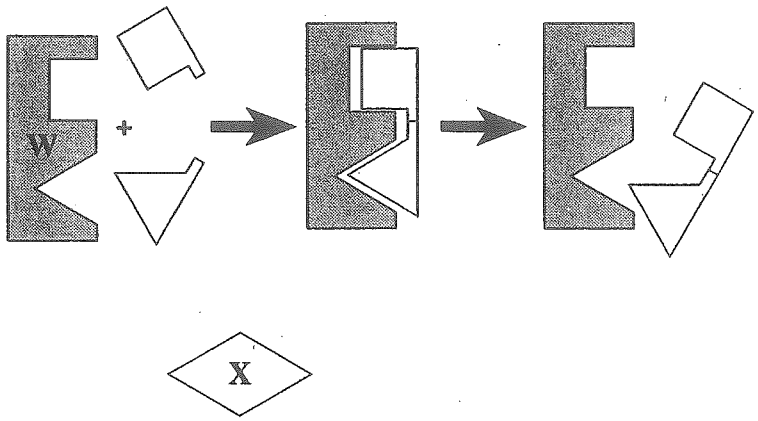
UNIT H: ENZYMES

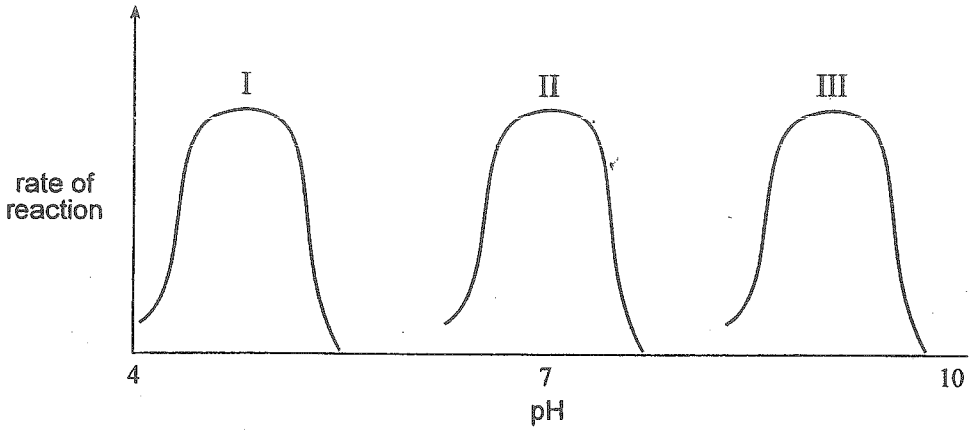
1. The following diagram represents the shapes of reacting molecules in a living system.



When molecule X was added to the system, the amount of product decreased. Molecule X must be acting

A. as a coenzyme.
B. to denature the reactants.
C. as a competitive inhibitor.
D. to synthesize more of molecule W.

Use the following graph to answer question 2.



2. The graph shows the effect of pH on three different enzyme-catalyzed reactions. Which of the following would **best** describe the effect of pH on enzyme-catalyzed reactions?

A. enzyme action increases as pH increases
B. enzyme action decreases as pH increases
C. enzymes work best in an acid environment
D. each enzyme works best within a specific pH range

3. Which enzyme speeds up the reaction between CO_2 and H_2O?

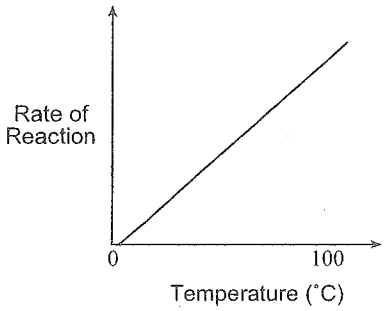
A. amylase
B. dehydrogenase
C. carbonic anhydrase
D. acetylcholinesterase

4. The location at which the substrate attaches to the enzyme is the

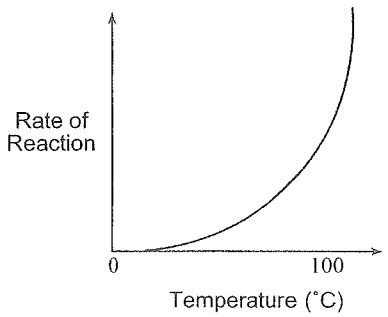
A. active site.
B. co-enzyme.
C. peptide bond.
D. hydrogen bond.

5. Which of the graphs below represents the relationship between the rate of an enzyme-catalyzed reaction and temperature?

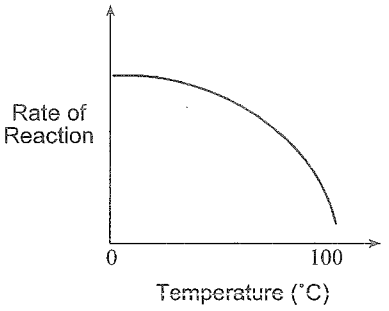
A.



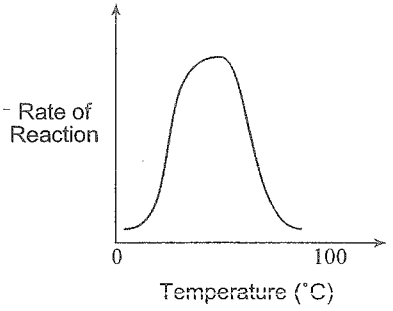
B.



C.



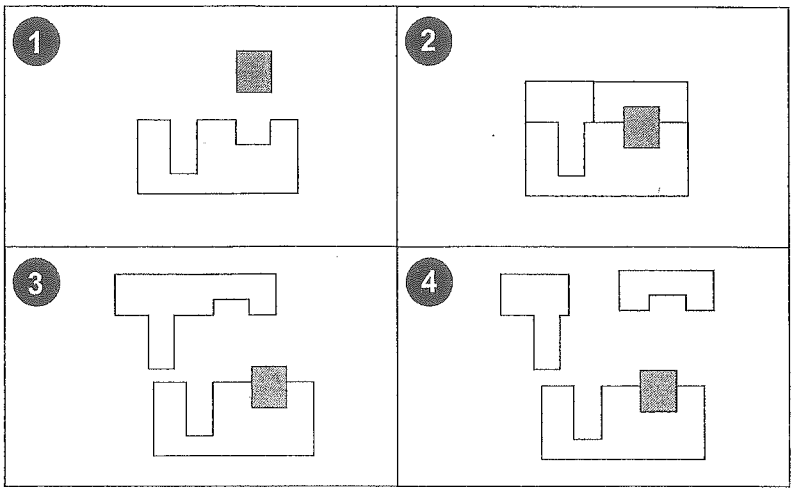
D.



6. A substance that lowers the energy of activation for a metabolic reaction is called

A. an enzyme.
B. an initiator.
C. a promoter.
D. an inhibitor.

Use the following diagrams to answer question 7.



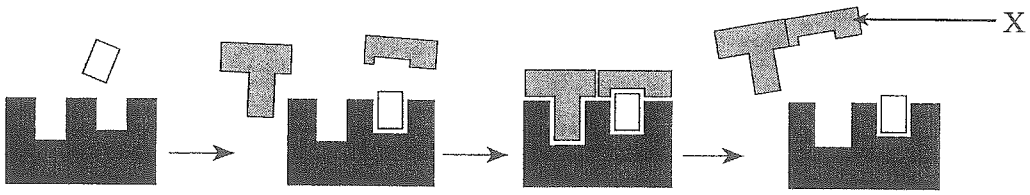
7 To represent the "lock and key" model of enzymatic action, in which order would the diagrams above have to be placed?

A. 1 → 2 → 3 → 4
B. 1 → 4 → 2 → 3
C. 2 → 3 → 4 → 1
D. 2 → 4 → 3 → 1

8. The hormone responsible for increasing the rate at which cells release energy from carbohydrates is

A. ATP.
B. ADH.
C. thyroxin.
D. aldosterone.

Use the following diagram to answer question 9.



9 The structure labelled X is the

A. product.
B. enzyme.
C. substrate.
D. enzyme-substrate complex.

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

A. increase in activation energy
B. increase in product over time
C. increase in enzyme over time
D. increase in coenzyme over time

11. When the active site of an enzyme is denatured,

A. substrates cannot be formed.
B. a quaternary structure is achieved.
C. the activation energy is decreased.
D. an enzyme-substrate complex cannot be formed.

12. Vitamins function as

A. enzymes.
B. coenzymes.
C. emulsifiers.
D. competitive inhibitors.

13. The reactant in an enzyme-catalyzed reaction can also be called

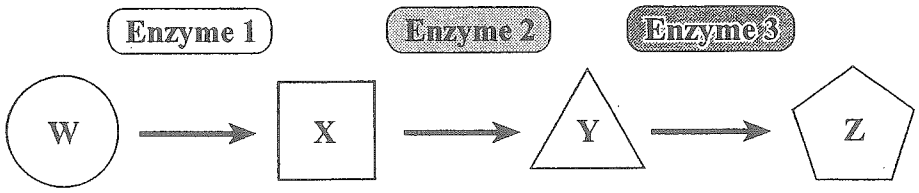
A. a complex.
B. a substrate.
C. an enzyme.
D. a coenzyme.

14. Overall metabolic rate would increase with increased secretion of

A. trypsin.
B. thyroxin.
C. nuclease.
D. acetylcholine.

Use the following diagram to answer question 15.

Metabolic Pathway



15. If substance Z inhibits enzyme 2, this will in turn inhibit the production of

A. enzyme 1.
B. enzyme 2.
C. substance W.
D. substance Y.

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16. Which of the following is a function of thyroxin?

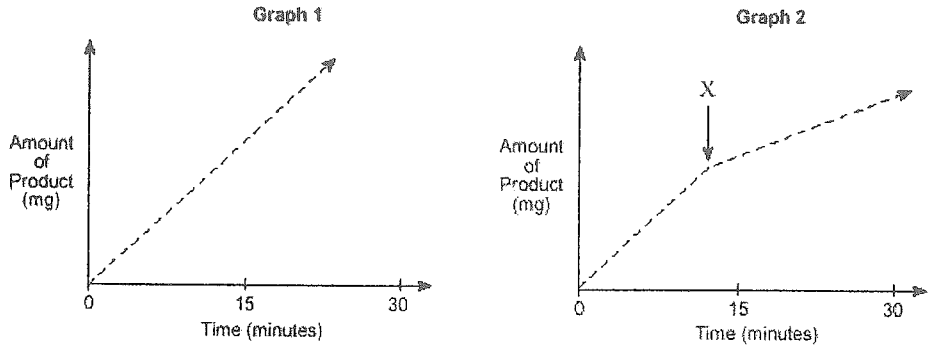
A. to decrease body temperature
B. to increase the amount of ATP used by the cells
C. to increase the reabsorption of water by the kidneys
D. to decrease the breakdown of proteins in the small intestine

17. Which of the following is **not** a part of the theory of how an enzyme functions?

A. The shape of the active site facilitates a reaction.
B. The enzyme and substrate fit like a lock and key.
C. The enzyme lowers the activation energy required for the reaction.
D. The shape of the enzyme is permanently changed by the chemical reaction.

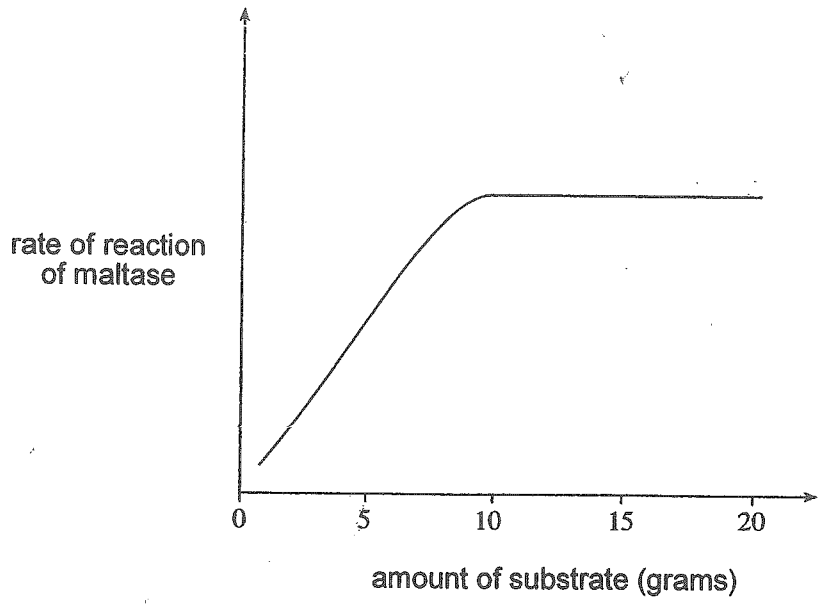
18. Enzymes function to increase the rate of a metabolic reaction by
A. denaturing the substrate.
B. adding energy to the reaction.
C. decreasing the energy of activation.
D. increasing the concentration of the reactants.

Use the following graphs to answer question 19.



19. Graph 1 represents the rate of reaction between lipase and its substrate. In graph 2, what occurred at time X that caused the change in the reaction?
A. Fat was added.
B. The pH was changed from 5 to 8.
C. A competitive inhibitor was added.
D. The temperature of the reaction was raised to 100° C.

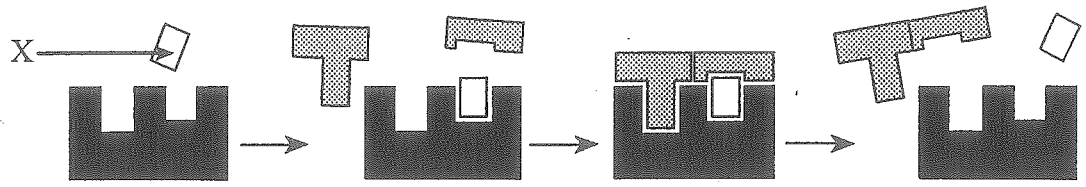
Use the following graph to answer question 20.



20. When 10 or more grams of maltose were added to a test tube containing maltase,

A. the saturation of maltase active sites occurred.
B. the enzyme-substrate complex became unstable.
C. maltase was inactivated by high substrate concentrations.
D. high glucose product inhibited maltase by negative feedback.

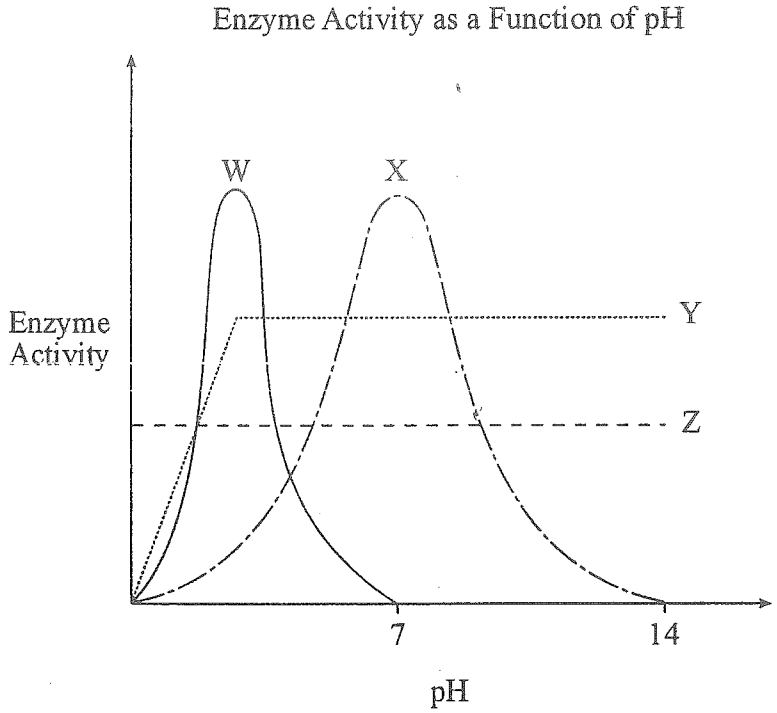
Use the following diagram to answer question 21.



21. The structure labelled X in the reaction above is

A. a vitamin.
B. the substrate.
C. the active site.
D. a competitive inhibitor.

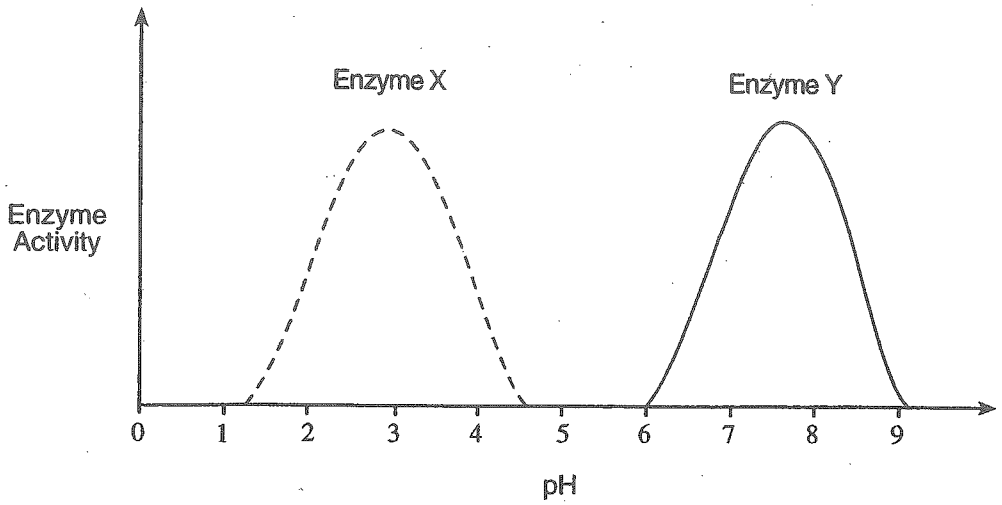
Use the following graph to answer question 22.



22. Which line on the graph above represents the data from an experiment exploring the effect of pH on the activity of pepsin?

A. W
B. X
C. Y
D. Z

Use the following graph to answer question 23.



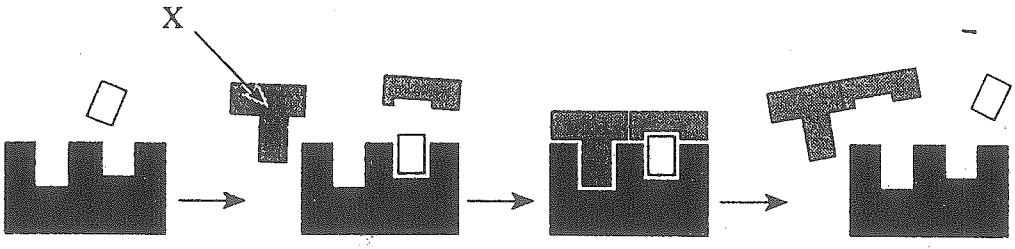
23. The graph shows the activity of two different enzymes in the digestive tract that have the same substrate. What is enzyme Y?

A. pepsin
B. trypsin
C. amylase
D. peptidase

24. An increase in thyroxin will have which of the following effects?

A. increased CO_2 production
B. increased glycogen production
C. decreased rate of ATP production
D. decreased rate of glucose metabolism

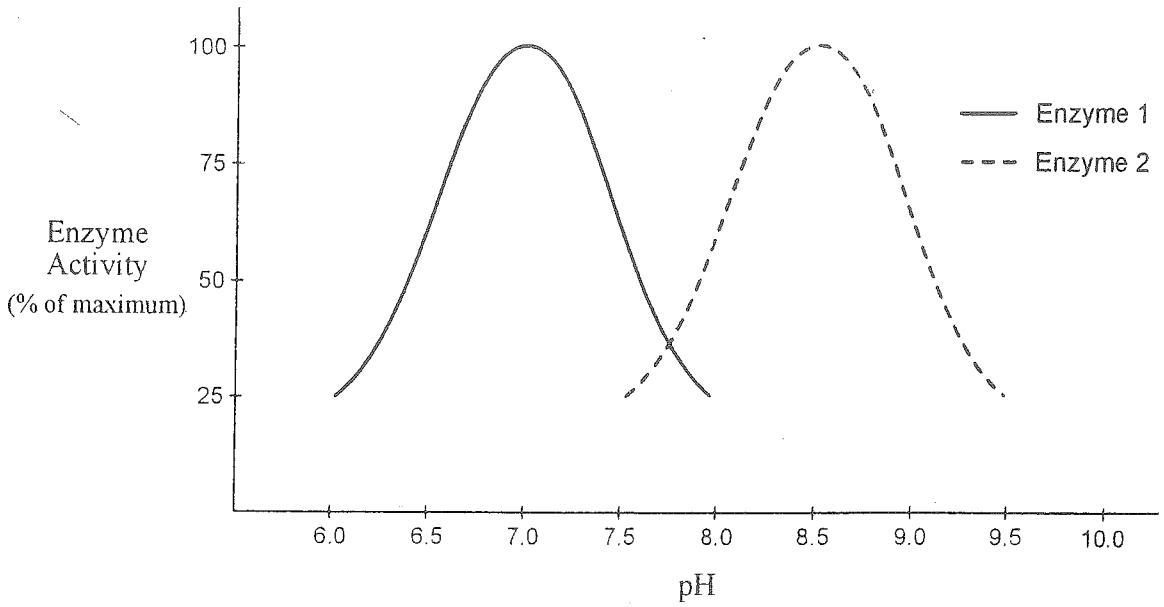
Use the following diagrams to answer question 25.



25. The structure labelled X is a(n)

A. product.
B. enzyme.
C. complex.
D. substrate.

Use the following ph to answer question 26



26. The two digestive enzymes shown in the graph have the same substrate. What would the substrate be?

A. Starch.
B. Protein.
C. Maltose.
D. Peptides.

27. A non-protein molecule that aids the action of an enzyme to which it is loosely bound is called a(n)

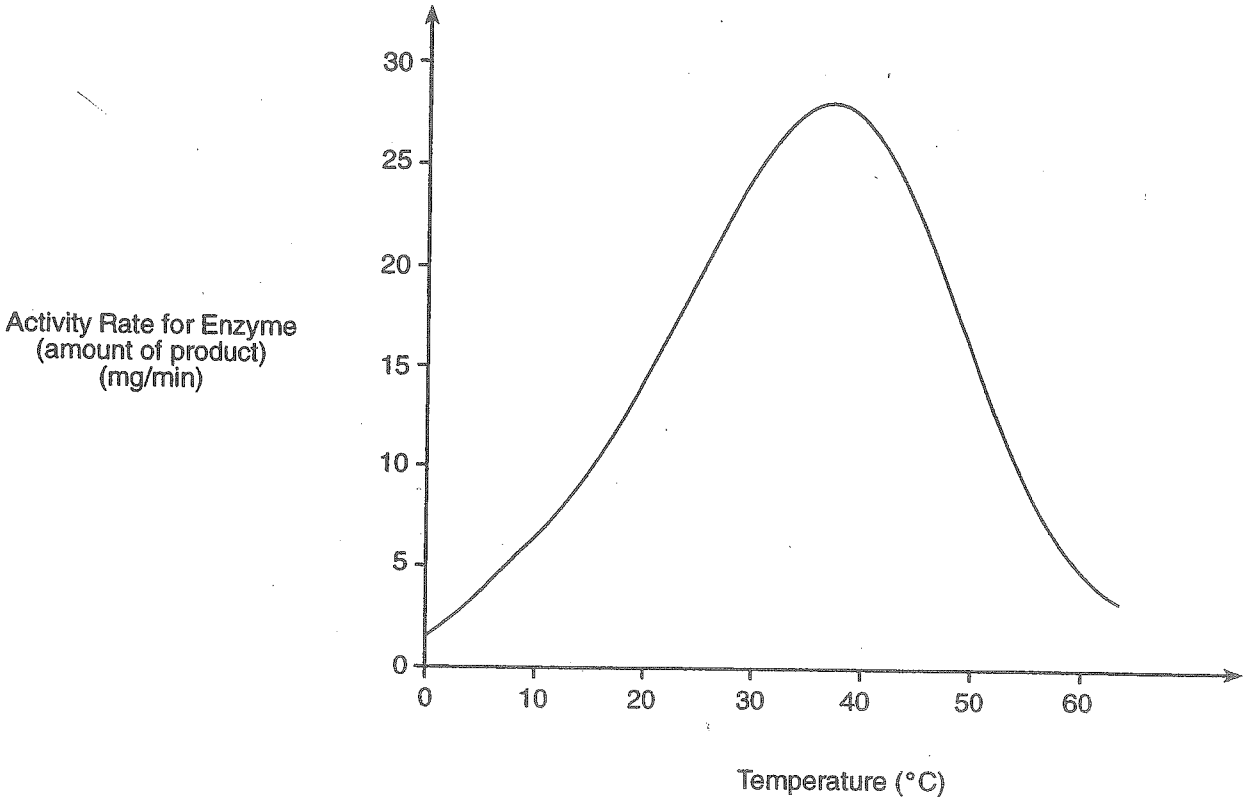
A. initiator.
B. coenzyme.
C. competitive inhibitor.
D. enzyme-substrate complex.

28 The area of an enzyme into which a substrate fits is called the
A. catalyst.
B. product.
C. active site.
D. activated complex.

29 The role of an enzyme in a chemical reaction is to
A. emulsify fats.
B. prevent denaturation.
C. speed up the reaction.
D. buffer any acids or bases.

30. Which of the following would inhibit trypsin's ability to form an enzyme-substrate complex?
A. pH of 3.
B. Temperature of 37° C.
C. Increased bile production.
D. Decreased numbers of villi.

31. An experiment was conducted to measure the effect of temperature on an enzyme isolated from the small intestine. Data was collected and graphed as shown below.



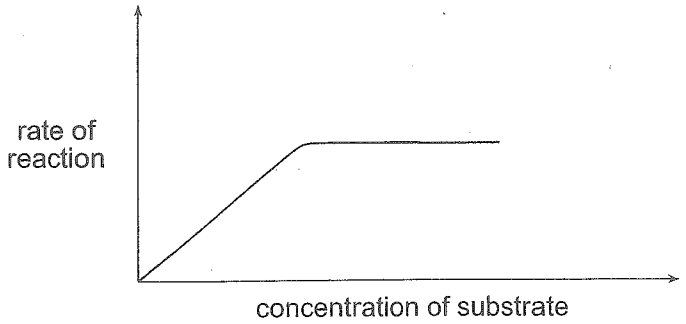
Explain why the following temperatures change the activity rate of the enzyme.

0°C to 35°C: **(1 mark)**

37°C: **(1 mark)**

45°C to 55°C: **(2 marks)**

Use the following graph to answer question 32.



32. a) The graph represents data collected from an enzyme-catalyzed reaction in the small intestine. Explain the results. **(2 marks)**

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_____

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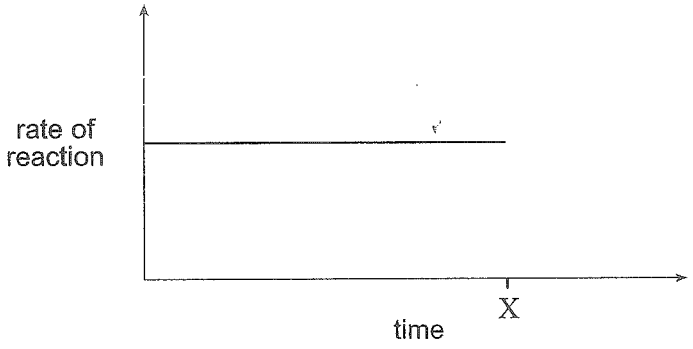
b) How would the shape of the graph below change if a large amount of concentrated acid were added to the enzyme-catalyzed reaction at time X? **Draw** the change on the graph and explain your answer. **(3 marks)**



Explanation:

_____

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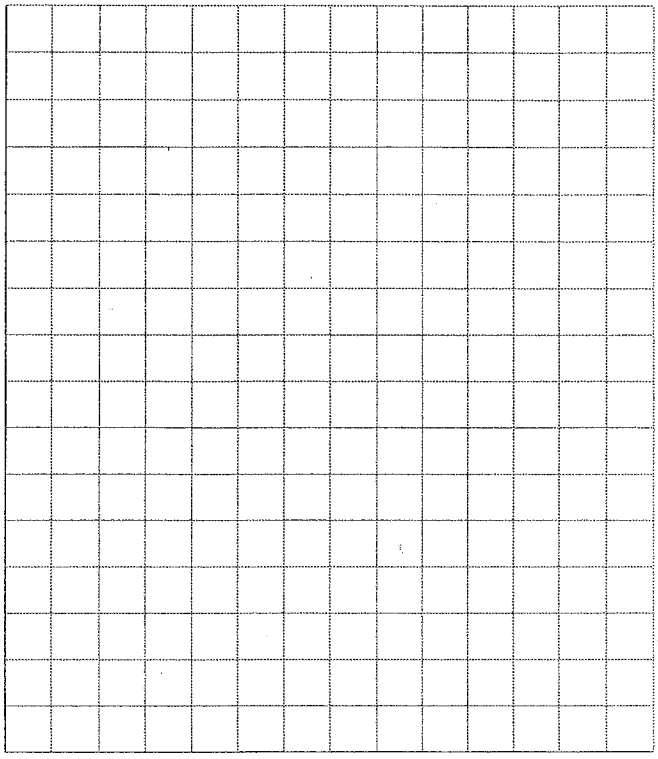
33 a) Draw a graph that compares the time taken to collect 10 mL of oxygen gas (O_2) produced to the pH of the solution. Label the *x*-axis as pH of solution. **(2 marks)**
(Use a pencil to graph the data.)



b) Using your graph, estimate the time it takes to collect 10 mL of oxygen gas (O_2) at pH 6.5. **(1 mark)**

_____

c) Explain what causes the results observed between pH 8 and pH 12. **(2 marks)**

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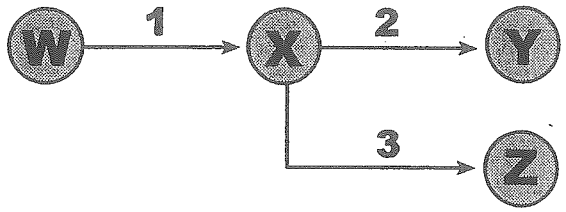
34. An experiment investigating enzyme activity is carried out. A test tube is prepared containing substrate solution W and enzyme solutions 1, 2 and 3. The reactions that occur in the test tube are summarized below.



a) Describe two ways in which the rate of production of product Y can be increased. **(2 marks)**

i) _____

_____

ii) _____

_____

b) A substance is added to the test tube. As a result, no product Y is formed, but product Z is still formed. Explain why. **(3 marks)**

_____

_____

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35 What effect would each of the following changes have on the rate of an enzyme-catalyzed reaction occurring in the stomach? Give an explanation for the effect.

a) The temperature is increased from 35°C to 37°C. **(2 marks)**

b) A competitive inhibitor is added. **(2 marks)**

c) The pH is increased from 3 to 8. **(2 marks)**

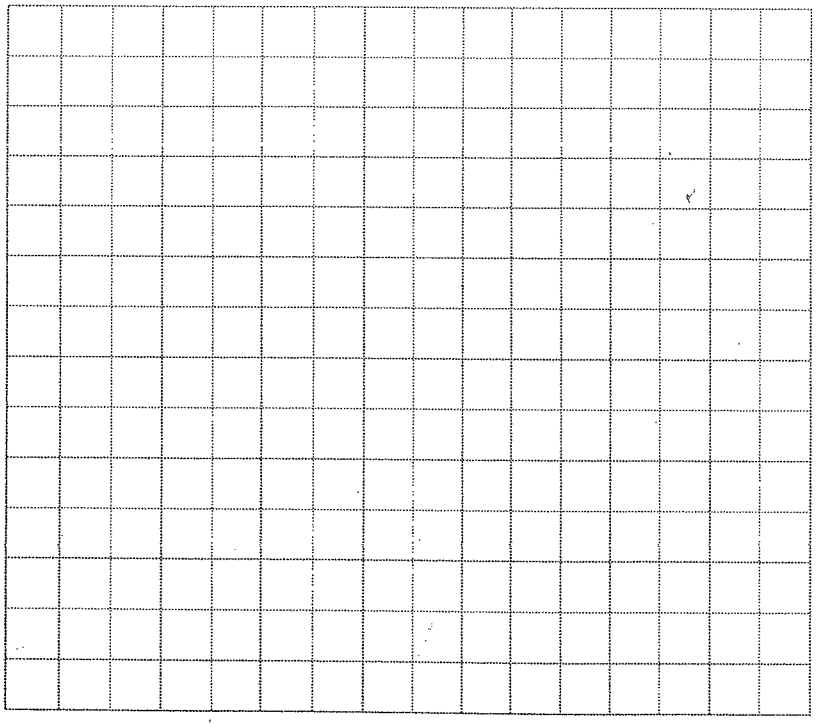
36 An experiment was conducted to measure the effects of the presence of thyroxin and temperature on oxygen use in human tissue cells. Two tissue samples were prepared as shown below.

Sample A: 50 grams of muscle tissue was added to a nutrient solution.
Sample B: 50 grams of muscle tissue was added to a thyroxin and nutrient solution.

Oxygen consumption was measured at various temperatures. The results are shown below.

Temperature (°C)	Consumption of oxygen (mL/hour)	
	Sample A muscle tissue	Sample B muscle tissue + thyroxin
15°C	6	12
25°C	8	16
35°C	12	24
45°C	7	14
55°C	2	4

a) Use the grid provided to graph the data in the table above. Label the x-axis as temperature.
(2 marks: 1 mark for correct scale and labels; 1 mark for plotting and lines)



Use the following lines to plot your data:
Sample A — — — —
Sample B ————

b) Based on your graph of the data for sample **B**, predict the amount of oxygen consumed per hour at 20°C. **(1 mark)**

Amount of oxygen consumed: _____

c) Explain the difference observed in the results of samples **A** and **B**. **(1 mark)**

_____

_____

_____

d) Explain the results for sample **B** at each of the following temperatures.
(3 marks: 1 mark each)

15° C:

_____

_____

_____

35° C:

_____

_____

_____

55° C:

_____

_____

_____

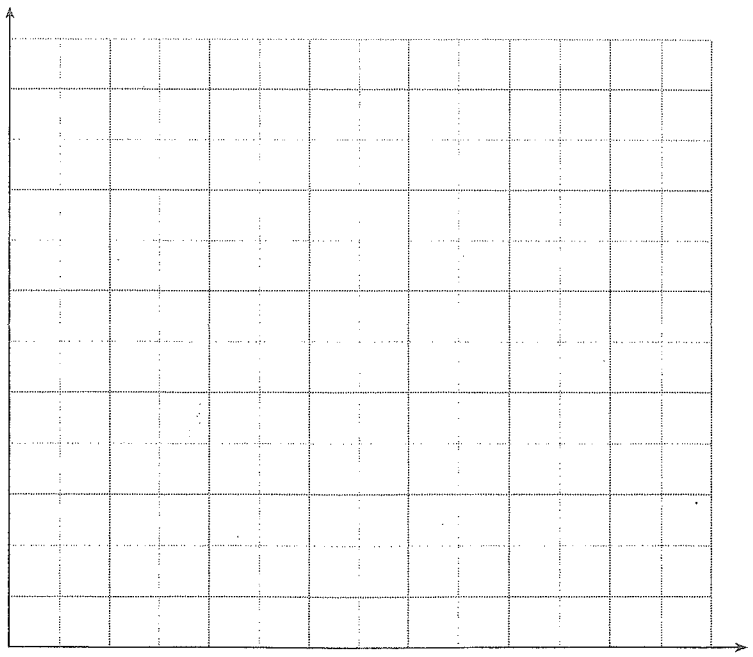
37. The following experiment was conducted to observe the effect of temperature on the rate of enzyme activity.

- 10 mL of a starch solution was added to each of five lettered test tubes.
- Each test tube was placed in a different water bath as shown in the table below.
- An equal amount of salivary amylase was added to test tubes W, X, Y and Z.
- A sample was taken from each test tube every minute and tested with IKI, an indicator that turns from yellow to black when mixed with starch.

Test Tube	Temperature of Water Bath (°C)	1 min.	2 min.	3 min.	4 min.	5 min.
V	20	black	black	black	black	black
W	0	black	black	black	yellow	yellow
X	20	black	black	yellow	yellow	yellow
Y	40	black	yellow	yellow	yellow	yellow
Z	60	black	black	black	black	yellow

a) What is the purpose of test tube V? **(1 mark)**

b) Using the grid provided, draw a graph that relates the time it takes for the indicator to turn yellow to the temperatures of test tubes W, X, Y and Z. **(2 marks)**



temperature (°C)

c) Explain the results of the experiment. (3 marks)

38. An experiment was carried out to measure the effect of pH on enzyme activity. The following steps were performed:

1. An equal volume of hydrogen peroxide was added to eight numbered test tubes at 20°C.
2. The contents of each test tube were maintained at a different pH.
3. An equal mass of liver was added to each test tube. Liver, which contains the enzyme catalase, catalyzes the following reaction:

$$\text{hydrogen peroxide} \rightarrow \text{oxygen gas } (O_2) \text{ and water}$$

The time to collect 10 mL of oxygen gas (O_2) from each tube was measured and recorded in the table below.

TEST TUBE	pH OF SOLUTION	TIME TO COLLECT 10 mL of O_2 (SECONDS)
1	5	120
2	6	90
3	7	50
4	8	30
5	9	40
6	10	60
7	11	90
8	12	140

a) Explain the "lock and key" model of enzymatic action. **(2 marks)**

b) Explain how denaturation stops enzymatic action. **(1 mark)**

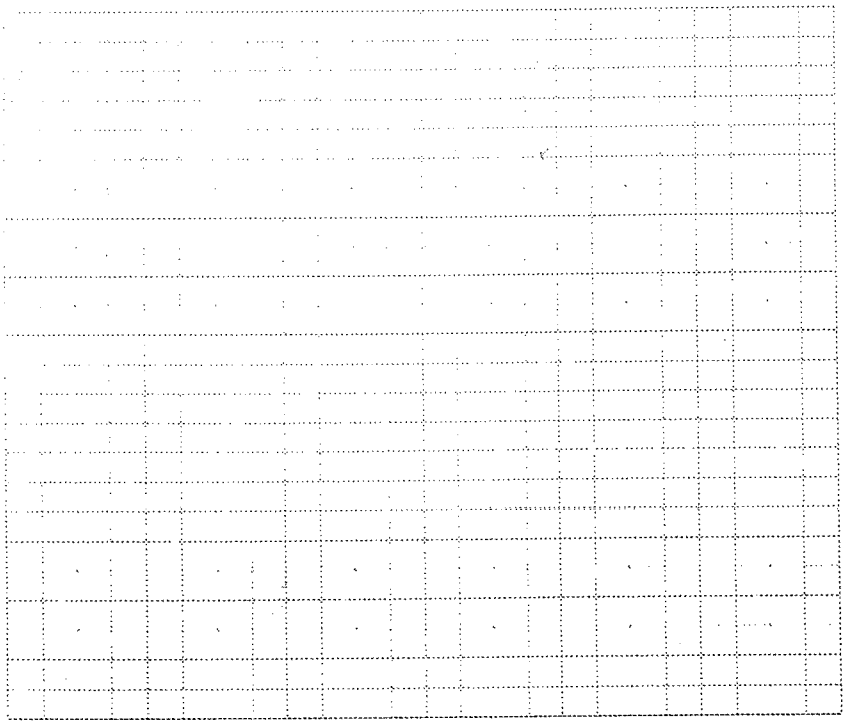
39. An experiment was conducted to determine the effects of pH on pepsin. The following steps were performed:

1. Five test tubes were numbered and equal amounts of egg white and water were added to each.
2. A buffer was added to each test tube to maintain its pH at the level given in the table below.
3. An equal amount of pepsin was added to each test tube.

After one hour, the mass of egg white **remaining** in each test tube was determined. The results are recorded below:

TEST TUBE	pH	MASS OF EGG WHITE (in grams)
1	1	2.8
2	2	1.3
3	3	2.7
4	5	3.9
5	7	5.8

a) Draw a graph that compares the pH to the amount of egg white remaining in each test tube. Label the *x*-axis (horizontal axis) as pH. **(2 marks)**



b) What appears to be the optimum pH for pepsin? **(1 mark)**

_____

c) Explain what happens to pepsin at a pH of 7, and why this affects its activity. **(2 marks)**

_____

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