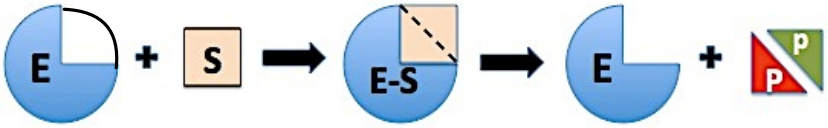
Name: Dario Baerga	Date:



Enzymes: Graphing, Critical Thinking, and Calculating Reaction Rates

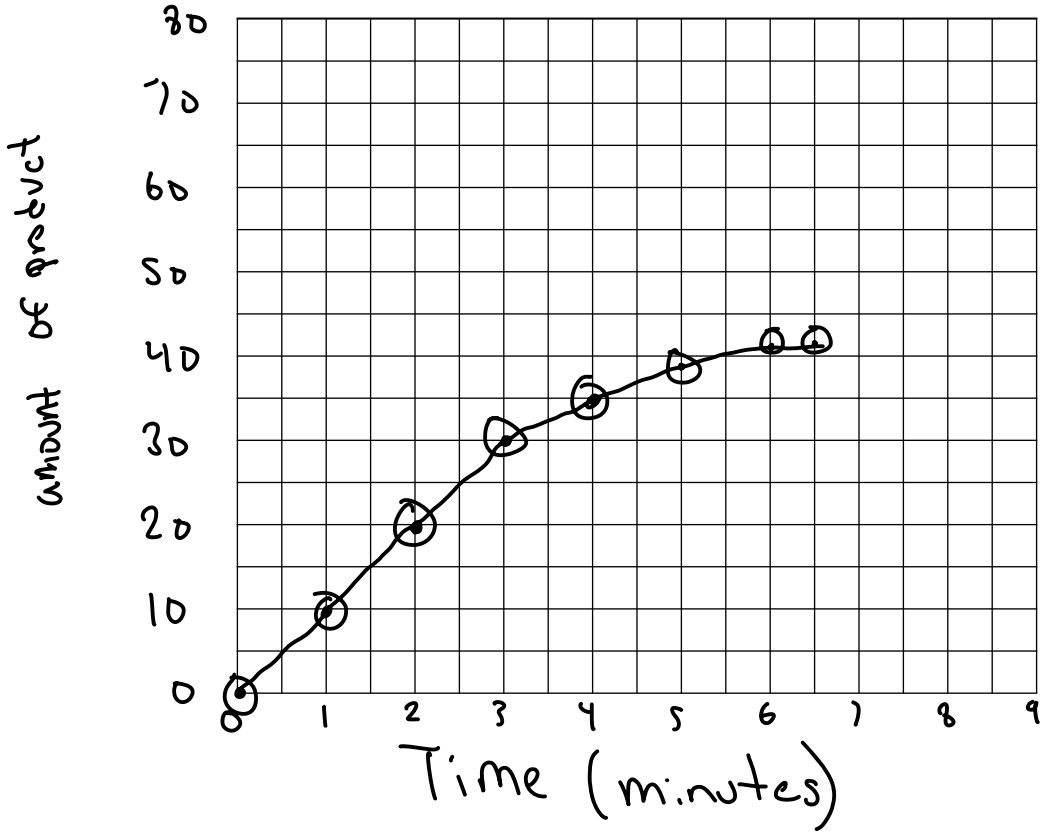
Introduction: Enzymes are proteins that are highly specialized to speed up a particular reaction within cells. Without enzymes, the reactions of a cell would proceed too slowly, and the cell would die. Enzymes have a unique three-dimensional shape. Each enzyme has a pocket or groove into which substrate molecules must fit. Substrates are reactant molecules that are being converted to new and different products. Because enzymes lower the activation energy of a reaction, the reaction takes place faster and at a lower temperature.

1. What do enzymes do? They make the reactions quickly so the cell wouldn't Die
2. What kind of compound are enzymes? have a three-dimensional shape
3. What is activation energy? enzymes lower the activation energy of a reaction, the reaction takes place faster and at a low temp
4. What is a substrate? reactant molecules that are being converted to a different product
5. What is an active site? Where the enzyme reaction takes place

Exercise 1: Graphing and Analyzing an Enzymatic Reaction

During the course of an enzymatic reaction, the substrate (reactant) is converted to new and different products. The following data shows the amount of product that is produced over time. Graph the data in the space provided below.

Time (minutes)	Amount of product formed (µmoles)
0 min	0
1 min	10
2 min	20
3 min	30
4 min	35
5 min	39
6 min	42
7 min	42



6. Notice on the graph that the time period between 0 and 3 minutes forms a straight line on the graph. What does this indicate about the rate of the reaction?

The rate increase slowly

Calculating the Rate of Reaction.

Use the equation: $\frac{\Delta_y}{\Delta_x}$ or $\frac{y_2 - y_1}{x_2 - x_1}$

The rate of an enzyme-catalyzed reaction can be measured to determine how fast the enzyme is converting substrate into product. A "rate" is the speed at which something occurs during a certain time period. To determine the rate of reaction, pick any two points on the curve. Divide the difference in the amount of product formed between these two points by the difference in time between them.

7. Calculate the initial rate of the reaction. The initial rate is the time between 0 and 1 minute.

$$\frac{10 - 0}{1 - 0} = \frac{10}{1}$$

8. Calculate the rate of reaction between 2 and 3 minutes.

$$\frac{30 - 20}{3 - 2} = \frac{10}{1}$$

9. How does the reaction rate between 0 and 1 minute compare to the reaction rate between 2 and 3 minutes?

They both have the same rate

10. Does your answer in question 9 agree with your answer in question 6?

yes both increased at same rate

11. In a graph of an enzymatic reaction, explain why the line begins as a straight line.

The line begins straigh it gains energy and is optimum rate

12. As seen on the graph, what happens to product formation between 3 and 6 minutes? Explain what is happening in the reaction at this point.

rate is starting to curve to its top temparture

13. What is the rate of reaction *after* 6 minutes? Show the calculation for this.

$$\frac{42-42}{7.6} = \frac{0}{1} = 0$$

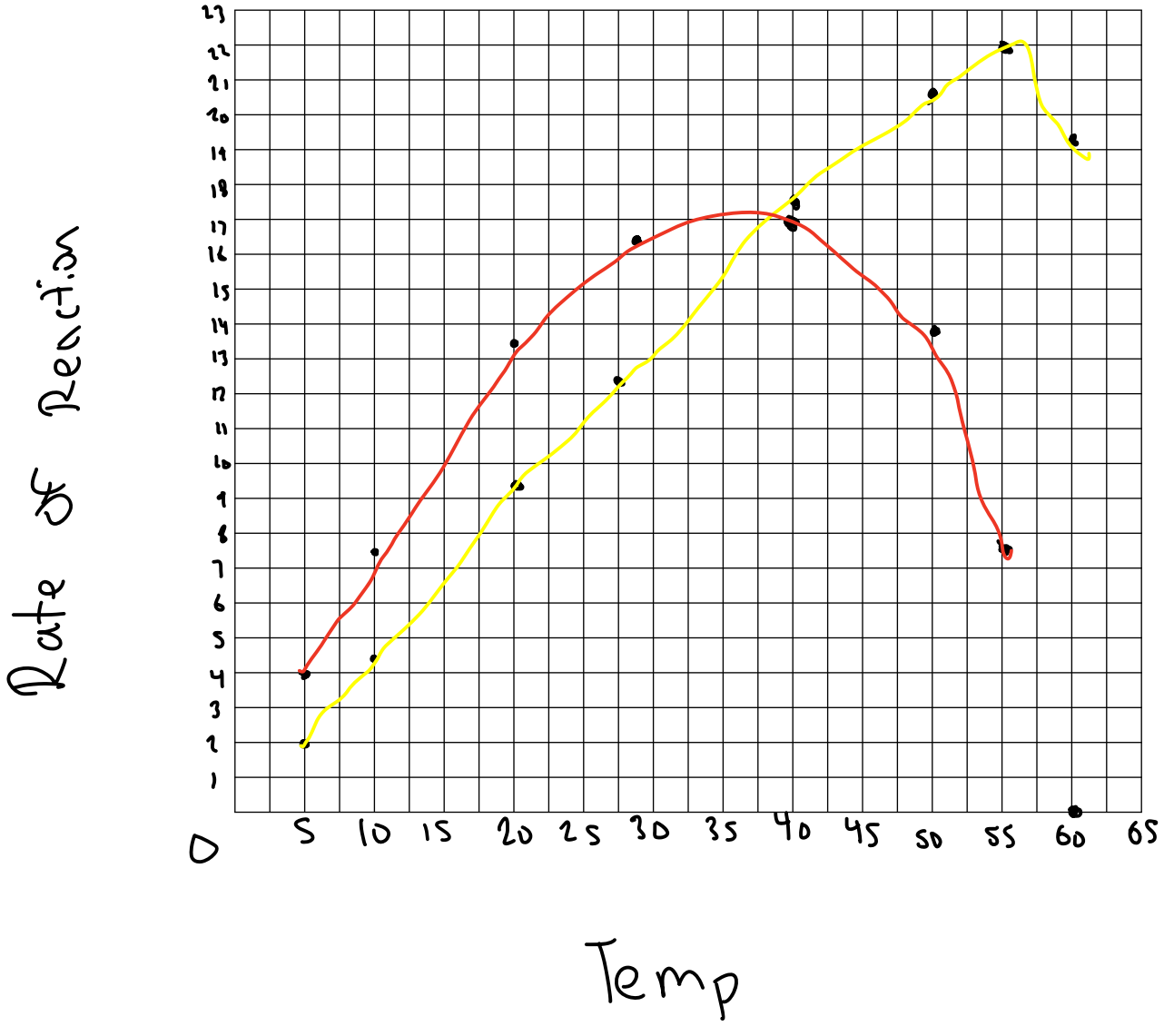
14. As seen on the graph and by your calculation above, what happens to the reaction rate after 6 minutes? Explain what is happening in the reaction at this point.

The reaction decreases after reaching the max

Exercise 2: The Effect of Temperature on Enzyme Functioning

Every enzyme has an optimum temperature at which it functions the best. Below is the data showing the effect of temperature on two different enzymes. Graph the data in the space provided, and answer the questions below.

Temperature (°C)	Rate of Reaction for Enzyme A (mmol/min)	Rate of Reaction for Enzyme B (mmol/min)
5 °C	4	2.2
10 °C	7.5	4.7
20 °C	13.5	9.5
28 °C	16.4	12.8
40 °C	17.4	17.8
50 °C	12.9	20.8
55 °C	7.5	22
60 °C	0	19.5



15. What is the optimum temperature for the functioning of enzyme A? 40 C

16. What is the optimum temperature for the functioning of enzyme B? 55 c

17. At what temperature do enzymes A and B have equal reaction rates? 40 c

18. What conclusion can you draw from the data on enzyme A? Didn't peak as high as enzyme B did.

19. In both enzyme A and B the reaction rate increases to a point and then begins to decrease. Explain why the reaction rate begins to decrease.

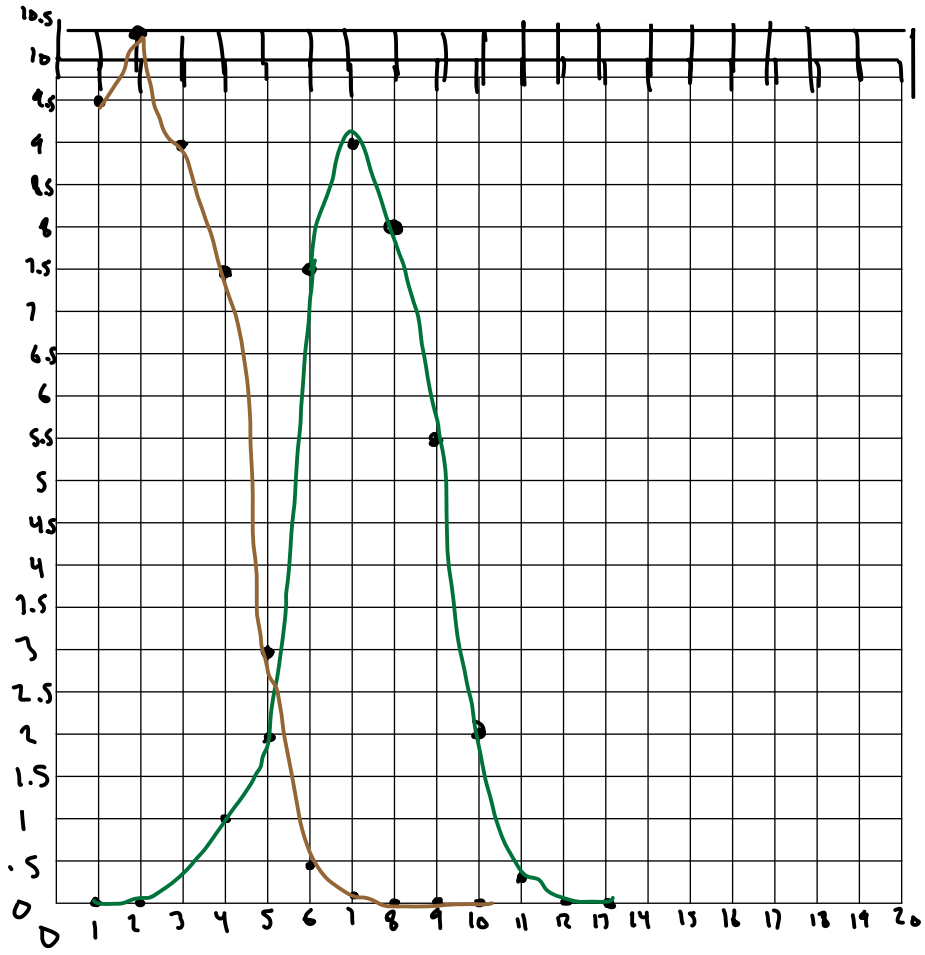
Enzymes rates decrease. The enzymes start to denatured

20. What is the rate of reaction for enzyme A when the temperature is 15 °C? 10.5

Exercise 3: The Effect of pH on Enzyme Functioning

Every enzyme has an optimum pH at which it functions the best. Below is the data showing the effect of pH on two different digestive enzymes, amylase and pepsin. Graph the data in the space provided, and answers the questions below.

pH	Amylase Reaction Rates (mmol/min)	Pepsin Reaction Rates (mmol/min)
1	0	9.5
2	0	10.5
3	.5	9
4	1	7.5
5	3	2
6	7.5	.5
7	9.0	.2
8	8	0
9	5.5	0
10	2	0
11	.2	0
12	0	0
13	0	0



21. What is the optimum pH for the functioning of amylase? 7

22. What is the optimum pH for the functioning of pepsin? 2

23. Which enzyme works best in a highly acidic environment? pepsin

24. Both amylase and pepsin are enzymes found in the digestive system of mammals. However, these enzymes are found in different locations of the digestive system. Given the data in the data table, suggest a possible location as to where these enzymes might be found.

The location is stomach acid

25. What happens to an enzyme that is placed in an environment drastically different from its optimum pH? struggle to preform and not work. It's in a whole different environment