Enzyme Lab Analysis

You may work with your partner, but each of you should submit a report to turnitin. Your data and graph can be the same, but your answers should be your own. Create a word doc with the following sections:

A. DATA AND GRAPHS

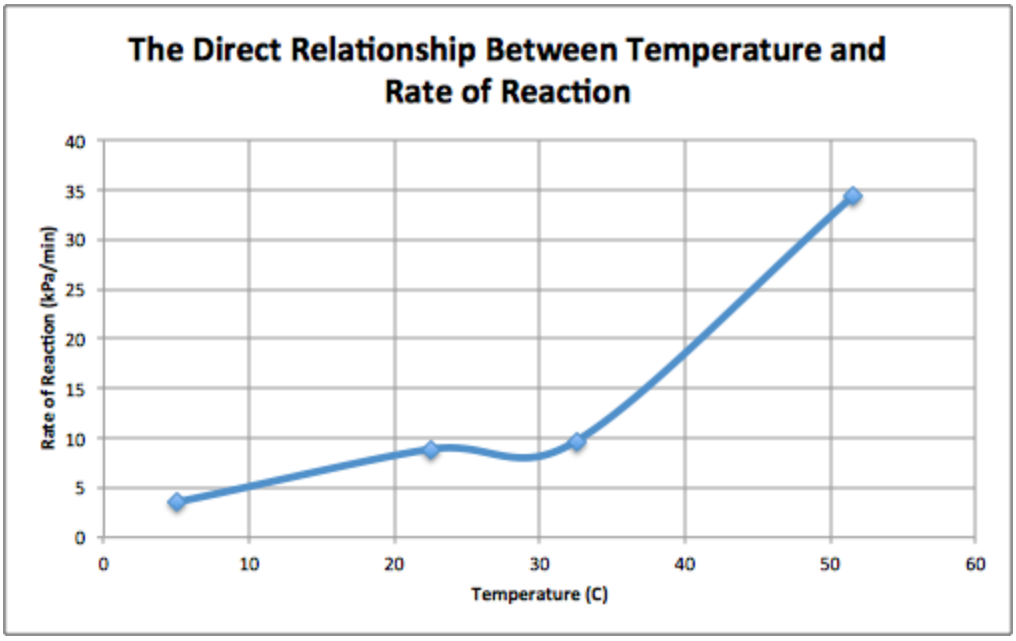
1. Data table: Create a data table that includes your temperature data and pH and enzyme concentration data that is either belongs to you or someone else in the class. You can find other groups' data on the shared google spreadsheet. (Stephen)

Volume of Enzyme (mL)	O2 Production (kPa/min)
0.1	2.041
0.25	6.357
0.5	8.88
0.75	11.805

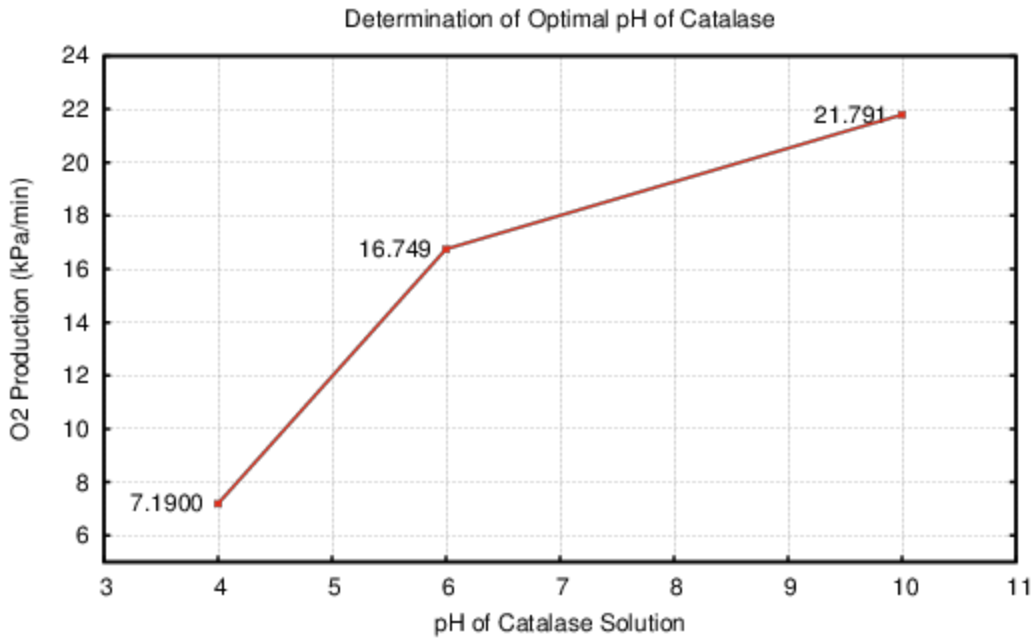
Temperature of Solution (ºC)	O2 Production (kPa/min)
5	3.475
22.5	8.88
32.5	9.685
51.5	34.309

pH of Solution	O2 Production (kPa/min)
4	7.19
6	16.749
10	21.791

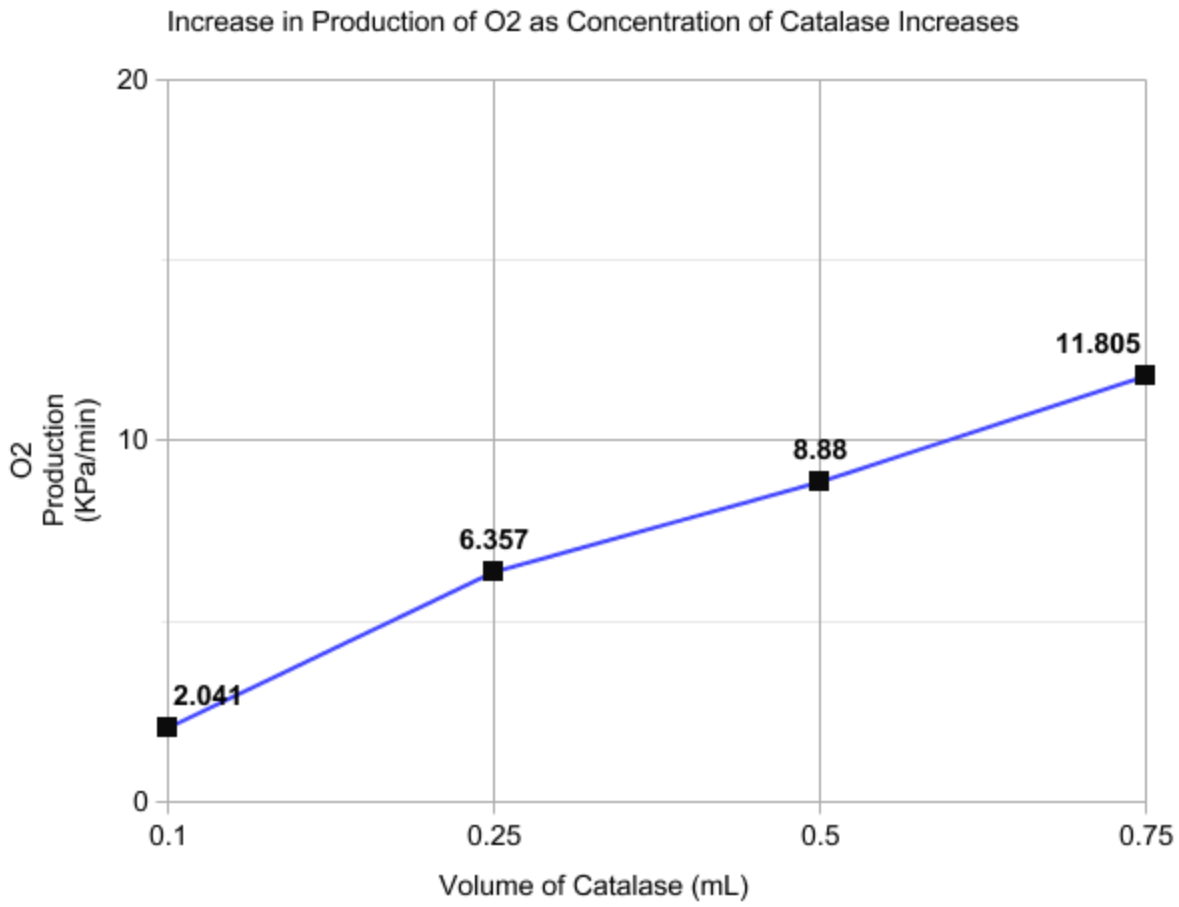
2. Temperature plot: Create a graph of the rate of enzyme activity vs. temperature. The rate values should be plotted on the y-axis, and the temperature on the x-axis. The rate values are the same as the slope values in your data table. (Zach)



3. pH plot: Create a graph of rate of enzyme activity vs. pH. The rate values should be plotted on the y-axis, and the pH on the x-axis. The rate values are the same as your data table. (Stephen)



4. Enzyme concentration plot: Create a graph of the rate of enzyme activity vs. enzyme concentration. The rate values should be plotted on the y-axis, and the volume of enzyme on the x-axis. The rate values are the same as the slope values in your data table. (Rohil)



B. ANALYSIS QUESTIONS

1. How does changing the temperature affect the rate of enzyme activity? Why might the enzyme activity decrease at very high temperatures (OVER 80°C)?

Changing the temperature affects the rate of enzyme activity (measured by Production of O2 in kPa/min) directly. The collected data shows that as temperature increases, enzyme activity increases. This is most likely because the enzyme catalase has evolved to function best at the temperature of its environment and there is a higher chance of the H2O2 colliding wint the enzyme. Over 80°C however, the enzyme catalase will likely denature or be less functional due to interference of hydrogen bonds effecting the secondary, tertiary, and potentially the quaternary structures of catalase and therefore changing its function (no longer able to decompose H2O2).

2. How does changing the pH affect the rate of enzyme activity? Does this follow a pattern you anticipated?

As pH is increased (the solution becomes more basic), the rate of enzyme activity (measured by Production of O2 in kPa/min) increases. This is not completely expected and because the test was not repeated a sufficient number of times, the data may be inaccurate. The reason this data seems inaccurate is because the pH of the liver is about 7.4 and catalase is most abundant i the liver. Therefore it would be expected that catalase functions best at the pH of the liver, and while this is true, it seems that catalase carries out its function even better at a higher pH.
3. How does changing the concentration of enzyme affect the rate of decomposition of H_2O_2?

With an increase in enzyme concentration, the rate of decomposition of H2O2 increases. This result is to be expected because with a higher enzyme concentration, there are more enzymes able to decompose the H2O2 into water and oxygen.

4. What do you think will happen to the rate of reaction if the concentration of enzyme is increased to 1.5 ml? Predict what the rate would be for 1.5 ml.

Following the trend of increasing rate of reaction(measured by Production of O2 in kPa/min) with increased enzyme concentration, with 1.5 mL fo enzyme, the rate of reaction will be proportionally larger.

11.805=m*.75
11.805/.75=m
m=15.74
x=15.74*1.5
x=23.61
The rate of reaction (measured in production of O2) for 1.5 mL of catalase would be 23.61 kPa/min.

5. Presumably, at higher concentrations of H2O2, there is a greater chance that an enzyme molecule might collide with H2O2. If so, the concentration of H2O2 might alter the rate of oxygen production. Briefly design a series of experiments to investigate how differing concentrations of the substrate hydrogen peroxide might affect the rate of enzyme activity.

To test for effects of H2O2 concentration on the rate of reaction of catalase, a constant volume of catalase with different levels of H2O2 (0.1mL, 0.25mL, 0.5mL, 0.75mL) will be tested by placing the H2O2 catalase solution in a test tube with the same setup as in the enzyme concentration part of this lab. From this, the concentration of H2O2 on rate of catalase's decomposition of H2O2 could be analyzed.

6. Design an experiment to determine the effect of boiling the catalase on the reaction rate.

The same experimental setup for measuring temperatures effect on rate of reaction of catalase would be used, but an extra data point would be taken at a different temperature. First water would be boiled in a beaker on a hot plate. Then the test tube with the catalase - H_2O_2 solution would be submerged into the boiling water. Then it would be necessary to wait for the test tube to reach the same temperature before starting the measurement. From this lab, data for the effects of boiling catalase could be seen.

C. CONCLUSION:

Write a discussion that describes and explains the effects of these factors on the rate of the catalase enzyme.

From the data collected from this lab it can be concluded that as the temperature of solution increases, the rate of reaction increases due to an increased change of the H_2O_2 colliding, because of the increased movement, with the catalase in the right orientation and because catalase evolved to function best around normal body temperatures. The rate of H_2O_2 decomposition increased as pH of solution increased. This may be because with too many H^+ ions (protons) the enzyme may denature due to the interference of H^+ with hydrogen bonds. As the concentration of enzyme increases, there is a increase in rate of reaction. This is probably due to increased likelihood of collisions of H_2O_2 in catalase's active site (location where substrates (molecule that can bind to an enzyme to be acted upon) bond to and enzyme) and more catalase available to decompose H_2O_2. From all of these trends, it can be concluded that the best conditions for catalase to most rapidly decompose H_2O_2 would be at ~52.5C, a pH of 10, and with the highest enzyme concentration possible.