How Does pH Affect Enzyme Activity?

Hydrogen peroxide (H_2O_2) is a poisonous byproduct of aerobic metabolism. Cells of organisms that live in an oxygen-rich environment require the enzyme catalase to protect themselves from the harmful effects of hydrogen peroxide. Catalase decomposes hydrogen peroxide into oxygen and water as shown in the reaction below:

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Notice that oxygen is a product of the reaction. This oxygen can be collected over time as a means of measuring the reaction rate. Three separate closed vessels are prepared as outlined in Table 1 and the amount of oxygen produced in each is recorded.

Table 1: Preparation of closed vessels

Vessel 1	Vessel 2	Vessel 3
1 mL water	1 ml catalase solution	1 ml catalase solution
10 mL hydrogen peroxide solution	10 mL hydrogen peroxide solution	10 mL hydrogen peroxide solution
1 mL water	1 mL water	1 mL vinegar

Questions

1. Draw a graph showing the amount of oxygen produced versus time you would expect for each of the three vessels.
2. What does your graph tell you about the effect of pH on enzyme reaction rate?
3. Why does changing the pH affect the reaction rate?
4. Design an experiment to investigate the activity of catalase at three different temperatures - 5^{o}C, 25^{o}C, and 45^{o}C.
5. Draw a bar graph to show the data you would collect from your experiment.