ENZYME ACTIVITY (PRESSURE)

How does the catalyzed decomposition rate of hydrogen peroxide compare with the uncatalyzed spontaneous decomposition rate?

Objectives

- Compare the spontaneous hydrogen peroxide decomposition rate with the catalyzed rate.

Materials and Equipment

- Data collection system
- Pressure sensor
- Sampling bottle, 250-mL
- Rubber stopper assembly
- Pipet, 1-mL
- Graduated cylinder, 25-mL
- 1.5% Hydrogen peroxide, H_2O_2, 40.0 mL
- Catalase suspension, 2.0 mL

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Wear safety goggles at all times.

Procedure

1. Select Sensor Data in SPARKvue.
2. Connect the pressure sensor to your device.
3. Make sure only the pressure measurement is checked and choose the Graph template.
4. Attach the rubber stopper assembly to the pressure sensor.
5. Use a graduated cylinder to measure 20.0 mL of 1.5% H_2O_2 and add it to the sampling bottle. Seal the bottle with the rubber stopper assembly and gently swirl to mix the contents.
6. Set the bottle on the table. Gently grasp the bottle without squeezing it. Slide the bottle back and forth along the table at a constant speed. Select Start to begin collecting data.

Note: Avoid squeezing the bottle during data collection to avoid introducing error in the pressure data.

7. Continue to swirl at a medium speed while collecting data. Stop collecting data after 3 minutes. Record results for Spontaneous decomposition in Table 1.
8. Pour the bottle contents into a waste container. Thoroughly rinse the sampling bottle.
9. To calculate the spontaneous decomposition rate of hydrogen peroxide, divide the change in oxygen concentration by change in time. Record the result in Table 1.
10. Measure 20.0 mL of 1.5% H_2O_2 and add it to the bottle.
11. Stir the catalase suspension. Use a pipet to add 2.0 mL of catalase to the bottle. Swirl to mix.
12. Seal the bottle with the rubber stopper and place it on the table. Select Start to begin collecting data. Gently swirl the bottle at a medium speed. Avoid squeezing the bottle while collecting data.

13. Stop collecting data after 3 minutes. Record results for Catalyzed decomposition in Table 1.

14. Pour the bottle contents into a waste container. Rinse the sampling bottle.

15. Calculate the catalyzed decomposition rate of hydrogen peroxide. Record the result in Table 1.

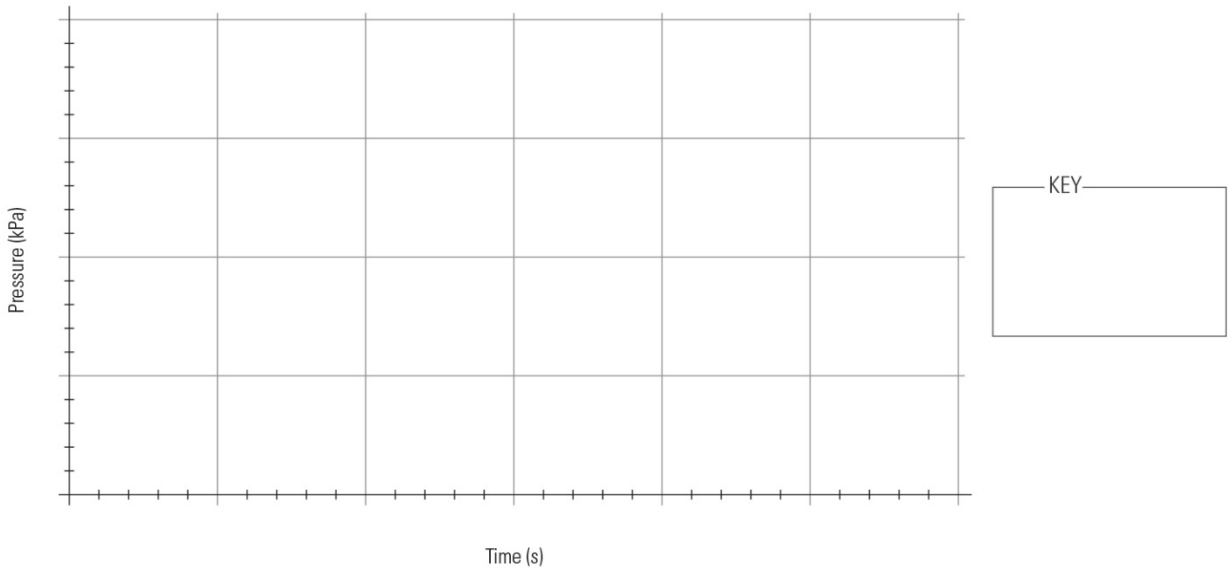
16. Show both runs in SPARKvue and scale the display. Sketch your results in Graph 1. Include numbers on the x- and y-axes. Add a key to identify each run.

Data Collection

Table 1: Comparison of hydrogen peroxide decomposition rate with and without a catalyst

Decomposition Reaction Type	Starting Pressure (kPa)	Ending Pressure kPa)	Change in Pressure (kPa)	Change in Time (sec)	Decomposition Rate (kPa/sec)
Spontaneous					
Catalyzed					

Graph 1: Pressure produced from 1.5% hydrogen peroxide with and without a catalyst



Questions and Analysis

1. Why does the addition of the yeast suspension cause a change in pressure inside the sampling bottle?

2. How much faster is the catalyzed reaction rate compared to the spontaneous decomposition rate?

3. Explain why the reaction is so much faster when an enzyme is present.

4. Is the reaction rate constant for the entire time data is recorded? Support your answer with evidence.

5. If the reaction continued to run, do you predict the reaction rate to be constant? Explain your thinking.

6. What kinds of conditions could you test in your lab classroom that might affect the rate at which catalase breaks down hydrogen peroxide?