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Chemical Decomposition of Hydrogen Peroxide

Background

In this experiment we want to determine how much hydrogen peroxide (H_2O_2) is in a store-bought solution of H_2O_2, because in the solution there will be some H_2O_2 and the rest is mostly water. In order to do this, we will decompose the H_2O_2 using bakers' yeast. This decomposition will give off oxygen gas (O_2), which will be collected. Once you know the volume of O_2 given off you can then use temperature, pressure, and the gas constant to calculate the number of moles of O_2 produced. From the decomposition reaction, you know the mole to mole ratios of O_2 to H_2O_2, so you can find the moles and mass of H_2O_2. Once you have that you can calculate the mass percent of H_2O_2 in the peroxide solution.

$$\mathbf{2\ H_2O_2 \rightarrow 2\ H_2O + O_2}$$

$$\mathbf{P\ V = n\ R\ T}$$

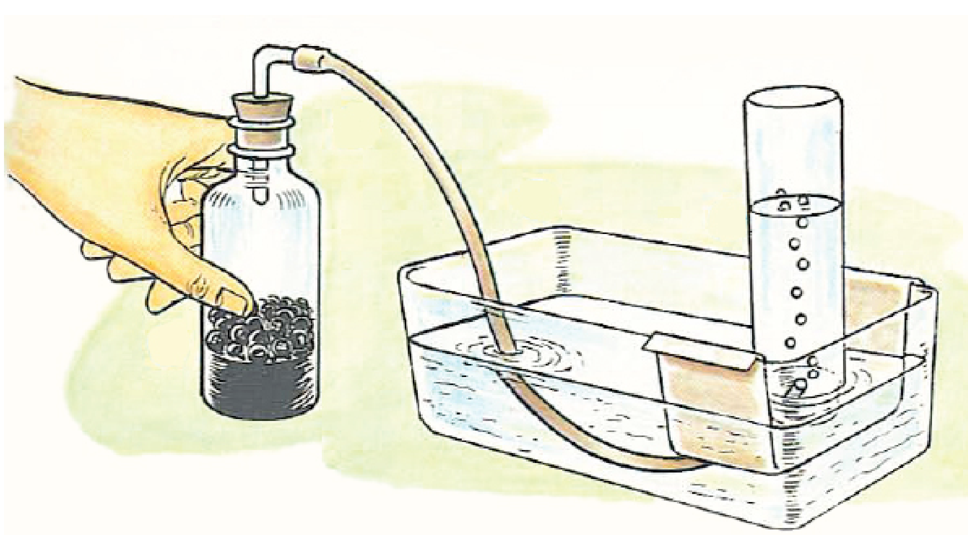
P = pressure of oxygen gas
V = volume of oxygen gas collected
n = number of moles of oxygen
R = gas constant = 0.0821 (L·atm)/(mol·K)
T = temperature of oxygen gas in Kelvin

Materials

- Bakers' yeast - spatula tip full for each group
- 5 mL of 3.0% hydrogen peroxide
- 250 mL Erlenmeyer flask
- Gas collection apparatus
- Ring stand
- Clamp
- Distilled water

Procedure

Below is a diagram of the basic apparatus we will be using to collect the gas.



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1. Set up your apparatus as shown, but DO NOT add the yeast to the H_2O_2 yet.
2. When you fill the gas collection bottle make sure there are no bubbles inside. You may need to use a glass plate to cover the opening of the bottle while turning it upside down into the pan of water.
3. Mass out about 5.0 mL of H_2O_2 solution, and record the exact volume.
4. Pour H_2O_2 solution into flask, add about 10 mL of distilled water, and swirl gently.
5. Obtain a small red cap and fill with a small scoop of yeast.
6. One member of your lab group will need to hold the gas collection bottle. The other member should then quickly drop the yeast in to the flask and **IMMEDIATELY** stopper the flask.
7. Gas flow will begin quickly through the tube into the gas collection bottle.
8. One member of the lab group should gently swirl the flask to allow a complete reaction while the other person continues to hold the collection bottle.
9. Allow the reaction to proceed for 10 minutes.
10. Take the temperature of the water in the pan when the reaction is complete and record this temperature.
11. Slide the glass plate over the bottle opening and carefully turn the bottle right-side up without spilling any of the water inside the bottle.
12. Determine the volume of water remaining in the gas collection bottle.

Data

Volume of H_2O_2 solution	mL	L
Mass of H_2O_2 solution	g	
Water Temperature	°C	K
Water Vapor Pressure	mm Hg	atm
Barometric Pressure	mm Hg	atm
Volume of Gas Collecting Bottle	mL	L
Volume of Water left after gas collection	mL	L
Volume of Water displaced	mL	L
Volume of O_2 collected	mL	L

Calculations

1. Determine the pressure of collected oxygen using Dalton's Law of Partial Pressures. (Hint: Barometric Pressure is your total pressure.)

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2. Calculate the number of moles of oxygen produced using the Ideal Gas Law.

3. Using the balanced equation, calculate the number of moles of H_2O_2 you started with using stoichiometry.

4. Calculate the number of grams of H_2O_2.

5. Using the mass of the solution you started with and the number of grams of H_2O_2 from #4, find the mass percent of H_2O_2 in the solution.

Mass Percent = (mass of H_2O_2 / mass of solution) x 100