

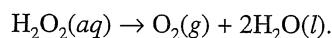
Experiment

36

Factors affecting the rate of decomposition of hydrogen peroxide

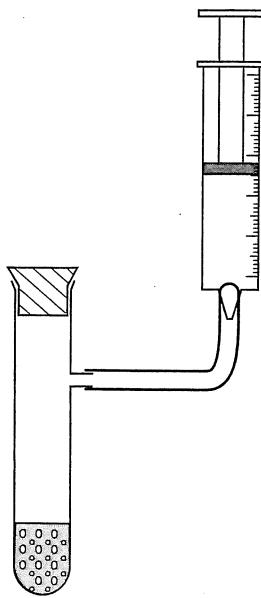
Background

Some contact lenses are sterilised with hydrogen peroxide. A metal disc acts as a catalyst to speed up the reaction in which the hydrogen peroxide sterilises the contact lenses. The catalyst also ensures that all the hydrogen peroxide has decomposed to form oxygen gas and water before the contact lens wearer inserts the clean lens into their eye. Several metal compounds also speed up the rate at which hydrogen peroxide decomposes to form oxygen gas and water. The equation for the reaction is:



The rate of this reaction can be measured in terms of the rate at which oxygen gas is released and collected using the equipment shown below.

Fig. 36.1



The purpose of this activity is to investigate factors that affect the rate at which hydrogen peroxide reacts to form oxygen gas and water.

Equipment required

Test tube rack

Plastic syringe (30–50 mL)

Stoppered side arm test tube with the side arm connected with a tightly fitting 30–40 cm length 5 mm diameter plastic hose to a 30 mL plastic syringe as shown in Figure 36.1

Hydrogen peroxide [H_2O_2] 10 volume (100 mL)

Potassium iodide [KI] (about 1 g)

Stop clock

Electronic balance

10 mL graduated cylinder or graduated pipette and pipette filler

Dropper

Groups investigating the amount of catalyst will also need:

Potassium iodide [KI] (another 2 g)

Groups investigating the type of catalyst will also need:

Manganese(IV) oxide [MnO_2] (about 1 g)

Liver (about 1 g)

Groups investigating the effect of temperature will also need:

Test tubes (eight)

Beakers (four 250 mL)

Ice (100 g)

Kettle to produce hot water

Thermometer (-10–110 °C)

Preliminary trial—measuring the rate of decomposition of H_2O_2

You will need to conduct the following trial to become familiar with the reaction and the equipment you will use. The trial illustrates how the collection of oxygen gas can be used to measure the rate of the reaction.

- 1 Weigh out about 0.3 g of KI onto a filter paper.
- 2 Set up the equipment shown in the diagram with the plunger of the syringe pushed in.
- 3 Transfer the weighed KI to the test tube.
- 4 Measure 5 mL of 10 vol H_2O_2 into a graduated cylinder or graduated pipette.
- 5 Quickly transfer the H_2O_2 into the test tube, stopper firmly, start the stop clock and swirl the contents in the test tube to ensure mixing and dissolving of the KI.
- 6 Observe and record the rate at which oxygen gas is collected in the syringe.

Planning the investigation

- 1 List the variables (factors) that could affect the rate of decomposition of hydrogen peroxide.
- 2 Plan an investigation to determine how one of these factors affects the rate of decomposition of hydrogen peroxide to form oxygen gas and water. Write a hypothesis for your investigation.
- 3 Copy and fill in the following table.

Variable/s	Unit/s	How the variable/s will be measured
Independent variable		
Dependent variable		
Factors kept constant (controlled variables)		

- 4 Briefly outline your preliminary plan to test the hypothesis. List the chemicals and equipment you need and identify the safety requirements. Remember that you may need to modify your plan after your preliminary trials.
- 5 Check your proposed plan with your teacher.

Safety Note

- Check your plan with your teacher before you commence.
- Hydrogen peroxide can cause burns if it comes into contact with your skin—handle the H₂O₂ solution carefully.
- Manganese(IV) oxide is a much more effective catalyst than KI; if your plan involves the use of MnO₂ use smaller masses, otherwise the rate of production of oxygen will be too rapid.

Conducting the investigation—preliminary trials

- 1 Carry out preliminary trials to refine your technique and to determine the ranges for the variables involved.
- 2 Describe what you learned from the preliminary trials and any modifications you make to your initial plan. You may have determined factors such as the range over which you will collect data, the number of trials to conduct, how to accurately use the equipment, how to work cooperatively together and so on.

Conducting the investigation—collecting data

- 1 Carry out the investigation and record your results in a table. If time allows replicate the data collection and average the results.

Processing the data

- 1 Draw a graph to illustrate your data (plot the independent variable on the horizontal axis).
- 2 Discuss your data and relate your findings to your hypothesis.

Evaluating the investigation

- 1 Evaluate the effectiveness of your procedure and describe any modifications you would make to improve it. You may discuss factors that would improve the accuracy of your results such as sample size and selection, measurement errors and the control of variables. As well, you may address more general organisational factors such as the allocation of tasks among group members and the nature of the apparatus and how it was set up.