

Genie in a Bottle

The Exciting Nature of Chemistry



Introduction

When sodium iodide is dropped into a flask containing 30% hydrogen peroxide, a “magical” genie appears in the form of water vapor and oxygen.

Concepts

- Exothermic reaction
- Catalysis
- Decomposition reactions

Materials (for each demonstration)

Hydrogen peroxide, 30%, H_2O_2 , 50 mL

Filter paper

Sodium iodide, NaI, 4 g

Volumetric flask, Pyrex®, 1000-mL

Graduated cylinder, 50-mL or 100-mL

Safety Precautions

Hydrogen peroxide, 30%, will act as an oxidizing agent with practically any substance. It deserves the science teacher's special handling and storage attention. This substance is severely corrosive to the skin, eyes and respiratory tract; a very strong oxidant; and a dangerous fire and explosion risk. Do not heat this substance. Sodium iodide is mildly toxic, LD_{50} : 4340 mg/kg. The reaction flask will get extremely hot; use only a Pyrex flask and hold with a towel around it to prevent burns. Do not point the mouth of the flask towards yourself or anyone else. Never tightly close a vessel containing hydrogen peroxide—it may explode. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Wrap 4 g of sodium iodide in a small piece of filter paper or tissue. Staple the filter paper so that no sodium iodide leaks out.
2. Add 50 mL of the 30% hydrogen peroxide solution to a 1000-mL Pyrex volumetric flask. **Caution:** Wear rubber gloves when handling 30% H_2O_2 . Contact with skin may cause burns.
3. Set the flask on a counter and hold the flask with a thick cloth towel. Drop in one packet of the sodium iodide solid. Point the flask up and in a safe direction away from yourself and your students as the magic genie (water vapor) emerges from the flask. The flask will get extremely hot. The towel will hide the flask contents as well as protect your hand from the heat produced.

Disposal

Immediately clean up any liquid which may have splattered on the floor. Pour any liquid remaining in the flask down the drain with excess water. Rinse the flask thoroughly with water. Remove any remains of the sodium iodide packet and place it in the trash. Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste.

Tips

- It is very important that this demonstration be done in a borosilicate (i.e., Pyrex) flask. A flask that is not borosilicate glass can crack from the evolution of heat.
- A large flask (1000-mL) is necessary because a brownish liquid can spurt out at the end of the reaction. A large flask will help to prevent this from happening. The brown liquid results from the presence of free iodine produced from the extreme oxidizing ability of the 30% hydrogen peroxide.

- A thick cloth towel will prevent your students from seeing what is happening in the flask, as well as protect you from the heat evolved in the reaction. Another option is to wrap the flask in aluminum foil and decorate it like a “Genie bottle”.
- Manganese(IV) oxide can be substituted for sodium iodide in the demonstration. Both chemicals catalyze the reaction and will cause the release of oxygen from hydrogen peroxide.
- The sodium iodide packet can also be attached to a piece of thread and hung inside the flask. Attach the thread to the outside of the flask with tape or a stopper. *Warning:* Do not use a solid stopper or cap. If the reaction starts prematurely, the pressure buildup may explode the flask. Use a one- or two-holed stopper and place it loosely on the flask.

Discussion

Genie in a Bottle demonstrates the decomposition of hydrogen peroxide into oxygen gas and water vapor. The decomposition is catalyzed by iodide (I^-), which is not changed during the reaction. It is an exothermic reaction and will evolve a lot of heat. The reaction is:



Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Constancy, change, and measurement

Content Standards: Grades 5–8

Content Standard B: Physical Science, properties and changes of properties in matter, transfer of energy

Content Standards: Grades 9–12

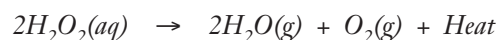
Content Standard B: Physical Science, structure and properties of matter, chemical reactions, interactions of energy and matter

Answers to Worksheet Questions

1. Describe what happened in this demonstration.

A hydrogen peroxide solution was poured into a volumetric flask. Sodium iodide solid, enclosed in filter paper, was dropped into the flask, and a great deal of water vapor was produced.

2. Write the chemical equation for the decomposition of hydrogen peroxide. Include heat in the equation, after determining if the reaction was endothermic or exothermic. *Hint:* The towel was necessary to hold the flask because the flask got very hot.



3. What is a catalyst? Name the catalyst in this demonstration. Could it be included as a reactant in the chemical equation?

A catalyst is a substance that increases the reaction rate but is not consumed in the course of the reaction. The catalyst in this demonstration was the iodide (I^-) in the sodium iodide. It would not be included as a reactant, because it was all recovered after the experiment, therefore it is a catalyst.

Acknowledgment

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Reference

Stone, Charles, H. *J. Chem. Ed.*, **1944**, *21*, 300.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Genie in a Bottle* activity, presented by John Little, is available in *The Exciting Nature of Chemistry*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Genie in a Bottle* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Magic Genie—Chemical Demonstration Kit* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
AP2092	Magic Genie—Chemical Demonstration Kit
H0037	Hydrogen Peroxide, 30%, 100 mL
H0008	Hydrogen Peroxide, 30%, 500 mL
S0083	Sodium Iodide, 25 g
GP4045	Pyrex Volumetric Flask, 1000-mL

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

