Lab 1 - Catalytic Decomposition of H_2O_2 – Elephant's Toothpaste

Due Date: _____ **Name:** _____ **Partner name(s):** _____

***Prior to the lab beginning complete the "Lab Equipment" worksheet to familiarize yourself with the equipment and location in the lab**

Description: The iodide ion (from KI or NaI) is used as a catalyst to decompose H_2O_2, liberating water, oxygen and heat.

Safety: Wear proper protective equipment including safety glasses when preparing and performing this demonstration. Concentrated hydrogen peroxide can cause burns. Also, the cylinder may be hot as the reaction is exothermic. Any horseplay may get you removed from the lab along with a 0% grade.

Materials:

30% H_2O_2	Large Graduated cylinder
KI or NaI	Food coloring
Liquid dish detergent	Wood splint
small beaker	Lighter
Balance (electronic or manual)	Paper towel

Procedure:

*Record your quantitative data (number measurements, etc) and all qualitative observations throughout the procedure (sights, sounds, smells, temperature (hot/cold if not measuring), colour, etc)

1. Pour approximately 30 mL of 30% H_2O_2 in cylinder (place 2 layers of paper towel under the cylinder). Record the actual volume.
    - Remember to view the lowest point of the meniscus (liquid level in the cylinder) from a horizontal point of view. Add one digit of estimate beyond the gradations shown.
2. Add 3 drops of food coloring.
3. Add a small layer (approx. 2 mL) of liquid dish soap directly to the colored H_2O_2 solution.
4. Measure 5 g of KI (or NaI)
    - Use the electronic or manual balance and a small piece of paper towel to act as a dish.
    - Weigh the paper towel first and record the mass (if your scale can detect)
    - Obtain a sample of KI (small scoop) from stock at the teacher's desk using a small beaker
5. To generate toothpaste, add the iodide compound to the H_2O_2 solution.
    - Oxygen gas will readily liberate from the H_2O_2 and will create large amounts of colored foam which will rise out of the beaker / flask.
6. To test for oxygen gas, a light a splint and blow it out. Move the glowing wood splint near the emerging foam. The presence of released Oxygen will reignite the splint if you place the splint in the foam. You may drop the burning splint into the cylinder or flask.

Analysis: The decomposition of hydrogen peroxide yields oxygen and water. The reaction is catalyzed by the iodide ion (I^{1-}) from KI (or NaI) as shown in the two-step process below. The oxygen generated creates bubbles in the soap to produce a toothpaste like foam. A glowing splint can be used to test that the gas produced is oxygen. This experiment demonstrates the concept and utility of catalysts.

$$H_2O_2\ (aq) + I^-\ (aq) \rightarrow H_2O\ (l) + IO^-\ (aq)$$

$$IO^-\ (aq) + H_2O_2\ (aq) \rightarrow H_2O\ (l) + O_2\ (g) + I^-\ (aq)$$

Overall Reaction: $2\ H_2O_2\ (aq) \rightarrow 2\ H_2O\ (l) + O_2\ (g)$

Disposal and Clean up: Remaining solution can be flushed down drain with plenty of water. Clean and dry all glassware and equipment, return to proper storage area.

Questions: If you are unsure of the answers to these questions from your lab work today you may look them up.

1. What was the catalyst in this reaction:
2. What does exothermic mean?
3. Why did the glowing splint reignite? Or if it didn't, what could have caused its re-ignition?
4. Explain why are there 3 reactions above?
5. Why is Potassium iodide (or Sodium iodide) required in this reaction? What would happen if we didn't have it in the solution?
6. What does decomposition mean?
7. What does the 30% mean in 30% H_2O_2?
8. What would have happened differently is you used 3% H_2O_2?
9. What did you learn or practice well in this experiment? Name and explain 3 things?
10. Name and give possible explanations for any observations that were unexpected.

Required to be submitted:

1. Original observations and neat organized observations (if original is not neat)
2. Answers to all questions on a separate piece of paper.

Video:
http://www.youtube.com/watch?v=tnB-uU3w6g8
http://www.youtube.com/watch?v=ezsur0L0L1c

Reference:
Shakhashiri, B. Z. In Chemical Demonstrations: A Handbook for Teachers of Chemistry; The University of Wisconsin Press: 1983; Vol. 1, p 180-185.
Trujillo, C. A. J. Chem. Educ. ***2005****, 82, 855.*
Conklin, A. R.; Kessinger, A. J. Chem. Educ. ***1996****, 73, 838.*
Lister, T. In Classical Chemical Demonstrations; The Royal Society of Chemistry: 1996; p 145-146.

Adapted from NCSU Department of Chemistry Demo Lab

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