**Elephant Toothpaste**

## Aim

To follow the progress of a decomposition reaction.

## Background

“Elephant toothpaste” is an experiment to study catalysed decomposition reaction. Detergent solution is added to the hydrogen peroxide solution with the presence of catalyst. The mixture will produce thick foam.

In particular, the decomposition reaction can be followed by measuring the amount of the foam produced in a container at regular time intervals. Hence, students can roughly estimate the change in rate of reaction.

## Curriculum Link

Topic IX Rate of Reaction (Chemistry)

## Apparatus and Equipment (per group)

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| * One spatula | |  | * One filter funnel |
| * One 10 cm3 measuring cylinder | |  | * One stopwatch |
| * One 50 cm3 measuring cylinder | |  | * Weighing papers |
| * One 500 cm3 measuring cylinder | |  | * Digital balance (readability 0.01 g) |
| * One 250 cm3 beaker | |  |  |
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## Chemicals (per group)

* 0.5 g of MnO2 solid (catalyst)
* 30 cm3 of 4.5% H2O2 solution
* 3 cm3 dish detergent (soap solution)
* 1-2 cm3 glycerol

## Procedure

1. Add about 0.5 g of the catalyst to the 500 cm3 measuring cylinder with a filter funnel
2. Add 30 cm3 of 4.5% H2O2 solution, 3 cm3 of dish detergent and 1-2 cm3 of glycerol to a 250 cm3 beaker.
3. Swirl the mixture from step (2) for a while and then add it into the 500 cm3 measuring cylinder as quickly as possible.
4. Start the stopwatch immediately and swirl the mixture for a few seconds.
5. At regular time intervals (e.g. every 30 seconds), observe and record the volume of the foam produced as indicated by the measuring cylinder reading.

## Safety precautions

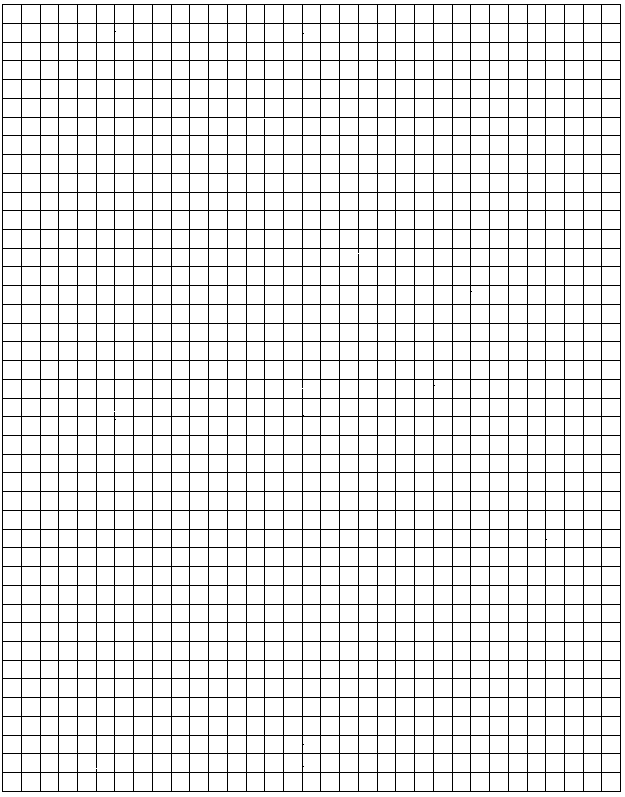
Conduct a risk assessment for this experiment, and summarise the key precautions below.

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## Data analysis and questions

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| Time after the addition of hydrogen peroxide to the catalyst (seconds) | 10 | 40 | 70 | 100 | 130 | 160 | 190 | 220 | 250 | 280 | 310 |
| Volume of foam produced / measuring cylinder reading (cm3) |  |  |  |  |  |  |  |  |  |  |  |

1. Plot a graph of volume of foam produced (cm3) against time (seconds).



1. (a) Rising of foam in the measuring cylinder is related to the gas produced during the decomposition of hydrogen peroxide. Estimate the volume of foam produced during:

(i) 10 to 40 seconds (ii) 130 to 160 seconds

(iii) 280 to 310 seconds

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1. What can you conclude with reference to the above calculation?

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**Discussion questions**

1. Write down a balanced equation for the decomposition of hydrogen peroxide. Hence, suggest a chemical test to confirm the identity of the gas given off in the experiment.

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1. Comment on the following statement concerning to the experiment:

“The decomposition reaction of hydrogen peroxide can be accurately followed by measuring the volume of foam produced in different periods of time during the experiment.”

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**Assessment**

Based on the following information, complete the plots in (a) and (b) to represent the expected experimental results:

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| Catalytic decomposition of 30 cm3 of 4.5% H2O2  solution at room conditions |

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| (a)  Catalytic decomposition of 30 cm3 of 9% H2O2 solution at room conditions | (b)  Catalytic decomposition of 60 cm3 of 4.5% H2O2 solution at room conditions |