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# IB Chemistry Lab

## To plan and carry out an investigation into the decomposition of Hydrogen Peroxide, $H_2O_2$

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**Aim:** To investigate the rate of decomposition of $H_2O_2$ with different amounts of catalyst ($MnO_2$).

**Hypothesis:** When $H_2O_2$ and a catalyst are mixed together, the catalyst would break down $H_2O_2$ into water and oxygen. This will result in bubbles being produced. With the data of these oxygen bubbles, the rate at which $H_2O_2$ decomposed could be found out.

$2H_2O_2\,(l) \rightarrow 2H_2O + O_2$

**The control** would be to maintain the same temperature (room temperature) and to use the same amount of hydrogen peroxide (10ml) in all the tubes.

**The variable** is the use of different amount of catalyst in different test tubes.

**Equipment:** 10% v/v solution of $H_2O_2$
- Catalyst – $MnO_2$
- 5 test tubes
- Stopwatch
- Beaker with distilled water
- Glass tube
- 5 single-holed rubber stoppers

**Procedure:**
1) Fill all 5 test tubes with 10 ml of $H_2O_2$
2) Measure 0.01g of $MnO_2$ using a filter paper and pour this into the first test tube. Immediately close the test tube with the single-holed rubber stopper in which one end of a glass tube must be inserted. The other end of the glass tube must lead to a beaker with distilled water.
3) We can see oxygen bubbles being let through the glass tube into the beaker. This shows the decomposition of $H_2O_2$. Start the stopwatch and also start counting the no. of bubbles produced.
4) Note down the results for every minute, up to 5 minutes.
5) Repeat steps 2, 3 and 4 by using different amounts of $MnO_2$. i.e. 0.02g, 0.03g, 0.04g and 0.05g.

**Data Collection:**

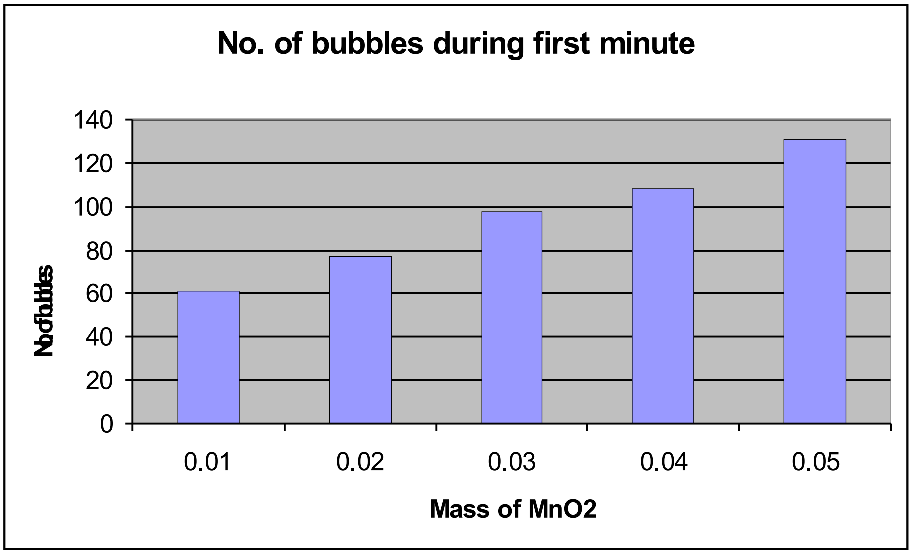
For data collection we counted the number of oxygen bubbles that is being produced for each amount of $MnO_2$. We did this for each minute up to five minutes because we thought that this would give a wider range of data, which would later be used in processing and interpreting. We have also mentioned the two areas of uncertainties. One of which we thought of was time (+/- 1s) because when we were recording the results the best accurate we could be was only up to a second. Another one was the mass of $MnO_2$ (+/- 0.005g). This was because our weighing machine was rounded to 2 decimal places. Our raw data is then recorded in the table below:

| Bubbles produced | | | | | | |
|---|---|---|---|---|---|---|
| | Time (min) +/- 1s | 1 | 2 | 3 | 4 | 5 |
| Test tube | Mass of $MnO_2$ (g) +/- 0.005g | | | | | |
| 1 | 0.01 | 61 | 36 | 28 | 25 | 21 |
| 2 | 0.02 | 77 | 43 | 39 | 33 | 29 |
| 3 | 0.03 | 98 | 67 | 53 | 48 | 42 |
| 4 | 0.04 | 108 | 74 | 61 | 55 | 47 |
| 5 | 0.05 | 131 | 85 | 69 | 61 | 55 |

**Data processing and presentation:**

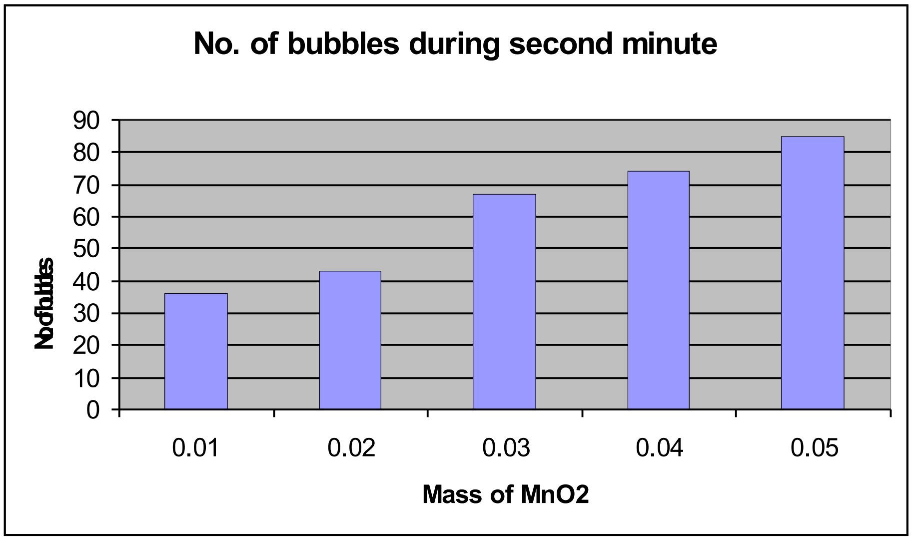
Our raw data can now be presented in graphs, so that we can look at the trend and compare them.

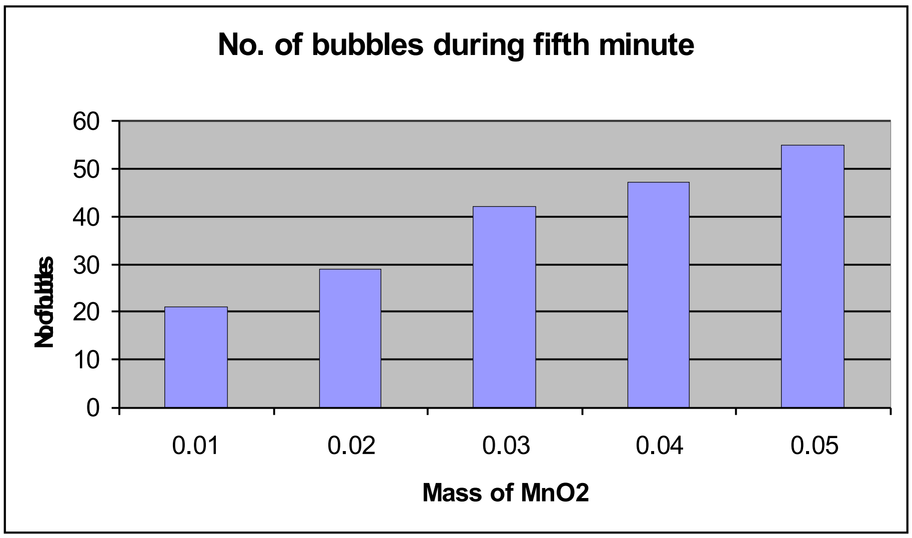
Below is a graph for the number of bubbles produced in different test tubes for the first minute:




In general, the number of oxygen bubbles shows how much hydrogen peroxide has been decomposed. In the first test tube there are only 61 bubbles produced for one minute. In the second one there are 77. Third - 98. Fourth - 108. Fifth – 131. This shows that as the amount of $MnO_2$ increases, so does the number of bubbles. With this graph we can see the general trend for the first minute:
The more catalyst we use, more decomposition takes place.

Now we need to check whether this trend works for other time spans or not.
The next page shows graphs for second and fifth minutes respectively.
This is to check whether this trend is applicable to other time spans.



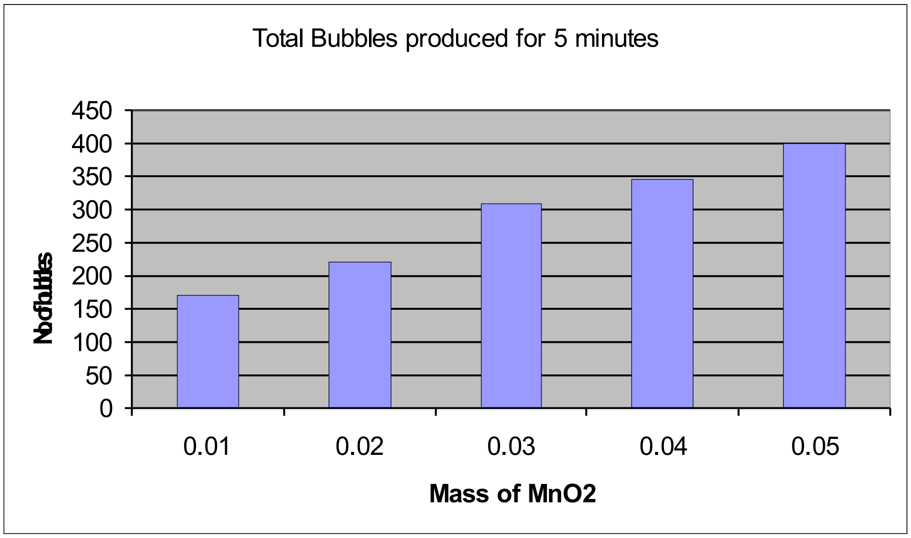




As we can see with these two graphs, the trend 'The more catalyst we use, more decomposition takes place' does work.

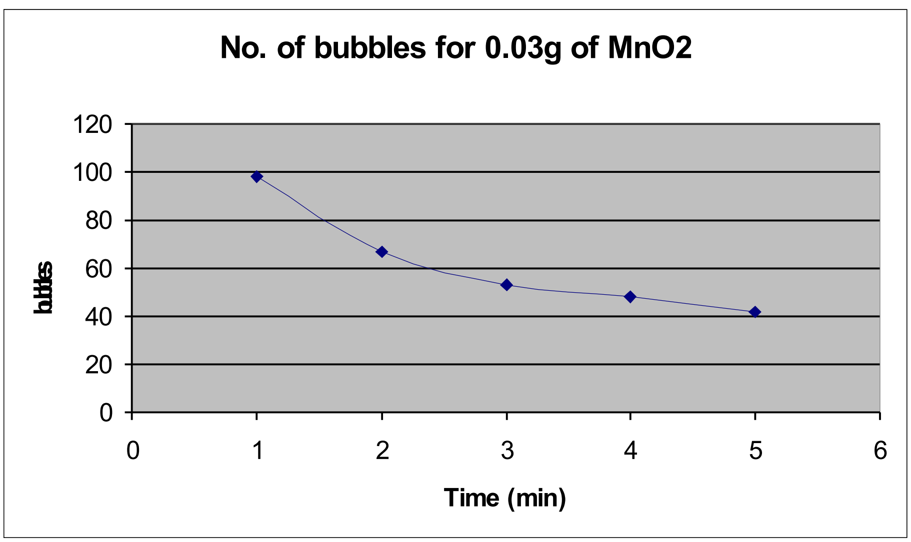
Using our raw data we can find more data. We can calculate the total number of bubbles produced during the first five minutes:

| Test tube | Mass of $MnO_2$ (g) | Total Bubbles produced for 5 minutes |
|---|---|---|
| 1 | 0.01 | 171 |
| 2 | 0.02 | 221 |
| 3 | 0.03 | 308 |
| 4 | 0.04 | 345 |
| 5 | 0.05 | 401 |

This can also be shown in a graph. With this we can see the power of the catalyst. It shows that even with such small amounts of catalyst, so much hydrogen peroxide can be decomposed.




Finally, I want to see the rate of change in the effect of catalyst as the time increases. Here I am taking one particular amount of catalyst (0.03g) and seeing how after every minute there is a change in the decomposition rate. This can be seen with the use of a line graph:




This graph clearly shows that as the time increases, the effect of catalyst on the decomposition steadily decreases. The catalyst is very effective in the beginning but as time goes on, it is less effective.

**Conclusion:**

As we can see from the graphs, I have found out two important trends on the decomposition of Hydrogen Peroxide:

1) The more catalyst reacts, more hydrogen peroxide is decomposed.
   The less catalyst reacts, less hydrogen peroxide is decomposed.
2) As the time increases, the effect of catalyst on the decomposition steadily decreases.

**Evaluation:**

On the completion of this experiment, I have gained more knowledge on catalysts and on hydrogen peroxide. As this was my first self-planned chemistry lab, my partner and me exchanged our views very well and came up with a good procedure. The procedure is quite simple and clear and I think we have obtained a lot of results that were quite useful in processing and presentation. The weaknesses we came across in the beginning was that we mistakes when counting the bubbles. We also spilt some catalyst when pouring into the test tube. So we had to do the experiment again.

In future, taking proper care and attention can rectify these mistakes.

Safety was maintained throughout the experiment and we did not come across any accidents. Overall, this was a really good experiment and I enjoyed it.

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