



Name: _____

Class: 4E____

Practical 6: R1 – Decomposition of Hydrogen Peroxide

Skills:
MMO : Manipulation, measurement, and observation
PDO: Presentation of data and observations
ACE: Analysis, conclusions and evaluation
P: Planning

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Aim: To investigate the speed of decomposition of hydrogen peroxide using different metal oxides

Apparatus and chemicals:

apparatus setup shown in diagram	50 cm ³ measuring cylinder	stopwatch
spatula	hydrogen peroxide (3%)	
powdered manganese(IV) oxide	powdered iron(III) oxide	

Procedure:

Hydrogen peroxide decomposes into water and oxygen gas according to the equation below:

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

This reaction is greatly speeded up by the use of catalyst.

In this experiment, you are going to find out how the speed of reaction is affected by the different types of catalyst, using the apparatus shown below:



- 1 Set up the apparatus as shown in the diagram.
- **2** Use a measuring cylinder to place 50 cm^3 of hydrogen peroxide solution in the conical flask.
- **3** Measure out 0.2 g of manganese(IV) oxide using a piece of recycled paper.
- 4 Tip the manganese(IV) oxide into the flask and quickly re-insert the rubber bung. *Start timing immediately*.
- 5 Gently swirl the flask while recording the volume of gas collected in the gas syringe every 10s. Do this until 120 cm³ of oxygen gas has been collected or 2 minutes. Take care not to undo the rubber tube connector. Record your results in an appropriate table.
- 6 Repeat steps 2 to 5 using 0.2 g of iron(III) oxide.

Results:

(a) Record the results for the above experiment in an appropriate format in the space provided below.

time interval / s	volume of <mark>oxygen</mark> gas collected using MnO₂ catalyst / cm³	volume of oxygen gas collected using Fe ₂ O ₃ catalyst / cm ³
0		
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

[5]

(b) On the same axes, plot a graph of volume of gas evolved against time, for both reactions, labelling each one clearly.



(c) From the graphs, draw your conclusions on the effect of different metal oxides on the speed of decomposition of hydrogen peroxide.

<u>MnO₂ helps to speed up the decomposition of H₂O₂, whereas Fe₂O₃ does not speed up the decomposition of H₂O₂.</u>

(d) State **three** conditions which were kept the same in both experiments to ensure that any differences in the results of the two-experiments were due only to the different amount of catalyst used.

<u>Concentration of H₂O₂, volume of H₂O₂, temperature of the reaction mixture, particle size of the catalyst used</u>

(e) Identify one key source of error and state how it affects your results.

Human reaction time due to the delay in starting the stopwatch. As such, the time taken will be shorter than expected to measure the fixed volume of gas.

(f) Suggest a way to improve the experiment to improve the accuracy of the readings.

<u>Repeat the experiment for a few times [1] and calculate the average volume of gas</u> collected at fixed intervals of time [1].

- (g) Suggest how you would show that the manganese(IV) oxide is unchanged at the end of each experiment (you are **not** expected to carry out this experiment).
 - 1. Filter the reaction mixture to obtain the residue MnO₂.
 - 2. <u>Wash the residue with cold deionised water to remove soluble impurities before</u> drying MnO₂ with sheets of filter paper.
 - 3. <u>Measure the mass of MnO₂ obtained from the end of the reaction.</u>
 - 4. If the mass remains the same, MnO₂ remains unchanged.
- (h) Describe an experiment to determine the identity of the cation in an unknown sample X which is suspected to be iron(III) oxide. You are assume that all the apparatus and reagents normally found in a school laboratory are available. You should include the expected observations and explain how you can conclude the identity of the cation in sample X. State an assumption made.

To the unknown sample X, add excess dilute hydrochloric acid to react X completely. A pale yellow solution should be obtained. To the solution, add excess aqueous sodium hydroxide / aqueous ammonia.

If a reddish-brown precipitate is formed that is insoluble in excess aqueous sodium hydroxide / aqueous ammonia, Fe³⁺ ions are present.

Assumption: There are no other cation impurities present in X