

Investigation - Catalysts for the decomposition of hydrogen peroxide

Student Handout

Objective

- To facilitate students in interpreting results qualitatively from experiments on factors affecting rate of reaction due to the use of catalysts;
- To provide opportunity for students to discuss on difference of the catalytic properties of common catalysts in chemical industries and biological systems.

Background

Hydrogen peroxide decomposes slowly in air to give oxygen and water. In this investigation, the effect of different catalysts on the decomposition of hydrogen peroxide will be studied.

Curriculum link

Topic IV Acids and Bases (Combined Science – Chemistry)

Safety precautions

- Handle all chemicals with care. The experiment should be performed in a well-ventilated area.
- Wear eye protection and disposable nitrile gloves when handling the catalyst and hydrogen peroxide solution.

Materials and apparatus (per group)

3% H_2O_2 solution



100 cm^3

One of the following catalysts:

Powdered manganese(IV) oxide (MnO_2) 0.5 g

A small piece of fresh potato 10 – 15 cm^3

A small piece of fresh celery 10 – 15 cm^3

A small piece of fresh pig liver about 1 cm^3

1 M $\text{Fe}(\text{NO}_3)_3(\text{aq})$ / $\text{FeCl}_3(\text{aq})$ 10 cm^3

1 M $\text{KI}(\text{aq})$ 10 cm^3

Spatula x 1

25 cm^3 measuring cylinder x 1

Stop watch x 1

100 cm^3 gas syringe x 1

250 cm^3 conical flask with side arm x 1

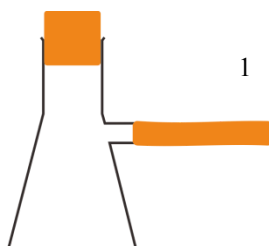
Delivery tube and stopper x 1

Pestle and mortar x 1 (for fresh celery / potato)

Stand and clamp x 1

Procedure

- Measure 50 cm^3 of the 3 % hydrogen peroxide solution using measuring cylinder and transfer it into the conical flask.
- Transfers the catalyst into the conical flask, quickly reassemble the apparatus and start the stop watch.



⇒ to gas syringe



For groups preparing fresh celery / potato extract:

Blend the celery / potato provided using pestle and mortar. Transfer the extracted liquid into a beaker and measure 10 cm³ of the extract. The extract can be used to transfer into the conical flask in step 2 for the experiment.



- Record the time required to collect 60 cm³ of gas.

Results

- Obtain the experimental data of the experiment using different catalysts from your classmates in other groups. Complete the table below:

Catalyst	Quantity	Time required to collect 60 cm ³ of gas (seconds)
MnO ₂	0.5 g	
A piece of fresh pig liver	1 cm ³	
Fresh celery extract	10 cm ³	
Fresh potato extract	10 cm ³	
1 M Fe(NO ₃) ₃ (aq) / FeCl ₃ (aq)	10 cm ³	
1 M KI(aq)	10 cm ³	

- What conclusion can be drawn from this experiment?

Discussion questions

- 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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2. Suggest a procedure to prepare 100 cm³ of 3% hydrogen peroxide solution from 6% hydrogen peroxide solution.

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3. Comment on the following statement concerning to the experiment:
“The progress of the decomposition reaction can be followed by recording the time required to collect 60 cm³ of gas.”

Assessment

1. Suggest an experiment to confirm the following statement:
“Fresh pig liver contains an active enzyme that catalyzes the decomposition of hydrogen peroxide.”