Investigating How Concentration of Hydrogen Peroxide affects the rate of Catalase reaction.

What I am investigating

I am investigating how changing the concentration of Hydrogen Peroxide affects the rate of reaction in the enzyme Catalase. This will involve placing a set quantity of liver (a source of Catalase) into different concentrations of Hydrogen Peroxide and measuring how long it takes to produce an amount of oxygen.

Apparatus List

6% Hydrogen Peroxide concentration, water, 1000ml glass beaker, test tube, bung for sealing test tube with rubber tube extruding from the top, stopwatch, liver, 50 cm^3 measuring cylinder, measuring scales, 5ml syringe, 200ml glass beaker.

Method

1. Fill the 50cm^3 measuring cylinder with water and place it inverted into the 1000ml glass beaker which will also be filled with water, making sure that no gas is allowed to enter into the measuring cylinder. Fill the 200ml glass beaker with tap water. Leave to acclimatise.
2. Thread the rubber rube through the water and up into the measuring cylinder, allowing one end to be attached to the bung and the other under water. Situate the test tube in the 200ml glass beaker.
3. Place 10ml of the 6% Hydrogen Peroxide concentration into the test tube using a 5ml syringe.
4. Cut 1g of liver and measure it's mass accurately on the scales ensuring it is exactly 1g. Add the liver to the Hydrogen Peroxide and quickly place the bung into the opening of the test tube. At the same time start the stopwatch. Swirl the solution around to certify that the liver is in contact with the Hydrogen Peroxide.
5. Time how long it takes for the amount of oxygen produced to reach 25ml. After doing so, empty the measuring cylinder of all gases and refill with water. Place it inverted into the water (as in step 1) and repeat the test twice more.
6. Change the concentration of Hydrogen Peroxide to 5% by adding 8.3ml of Hydrogen Peroxide and 1.7ml of water. Continue with the steps described in 4 and 5.
7. Do the same with the concentrations of Hydrogen Peroxide being 4%, 3%, 2% and 1%. The table below shows how much water to add the Hydrogen Peroxide in order to make the different concentrations.

Concentration Of H_20_2	Amount of water (ml)	Amount of 6% H_20_2 (ml)
6%	0	10
5%	1.7	8.3
4%	3.3	6.7
3%	5	5
2%	6.7	3.3
1%	8.3	1.7

Reasons for the method

I decided to use $25cm^3$ of Hydrogen Peroxide because the breakdown of Hydrogen Peroxide by Catalase is quite vigorous and a substantial amount of oxygen may be produced. $25cm^3$ ensures that I will have enough time to record a trend on how long it took, and that all the results will not be bunched together.

I have decided to use 1g of liver because it increases the amount of Catalase available to convert Hydrogen Peroxide into water and oxygen, so producing a measurable amount of oxygen in a suitable amount of time.

The quick placing of the bung into the top of the test tube as soon as the liver has been added is to minimise the amount of oxygen not collected when the reaction starts. If the time took to put the bung in place was great some oxygen might be missed and not collected into the measuring syringe, so reducing the reliability of the results.

Filling the measuring cylinder with water makes sure that no other gases except the ones I will be collecting are present in the results. Since the rubber tube coming from the test tube is fed straight into the measuring cylinder it is only that gas from the test tube that is allowed to be measured. But if gas was already in the cylinder then the results would be hindered.

Leaving the water in the 200ml beaker to acclimatise ensures that the temperature of the test tube is at room temperature. This makes certain that the volume of oxygen produced is reliable by concentration of Hydrogen Peroxide alone.

A $50cm^3$ measuring cylinder has been used for collecting the oxygen due to the accuracy of the markings. They are good enough to allow sufficient precision in the readings taken.

Repeats are taken to increase the accuracy of the results obtained. If any inaccurate results are taken then the two accurate results reduce the inaccuracy on the average produced. It also makes it much easier to see anomalous results.

Six different concentrations of Hydrogen Peroxide are being investigated. This means the results can be plotted on a line graph with sufficient points to allow a trend to be identified. Too few points would make it hard to see the trend. Using a maximum of 6% concentration ensures that the chemical is not too dangerous to work with.

Factors to keep constant

Factor	How kept constant	Scientific reason for doing so
Temperature of reaction.	By placing the test tube containing the reactants into a water bath at room temperature.	The hotter the particles, the more kinetic energy the particles have, which makes the probability of them colliding into each other higher. When the particles have more energy, they are more likely to react when they collide into each other. If the temperature is decreased, the particles slow down. This will make the reaction slower, as they will have less kinetic energy.
Factor	How kept constant	Scientific reason for doing so
Amount of gas collected	Always get time when $25cm^3$ have been produced	If the time is not stopped after it gets to $25cm^3$ after every experiment

Shape of liver samples	By measuring the amount of liver reacting	If the surface area to volume ratio is the same on each piece of liver then the Hydrogen Peroxide will reach the entirety of the tissue in the same amount of time for each result. The larger the surface area the quicker the gas will be released.
Concentration of the Catalase	Using the same liver for all the experiments	Because of biological variation, some livers will have different concentrations of Catalase in them. Using the same liver ensures that the concentration will not differ because it comes from the same source.

Ensuring that the evidence is reliable and accurate

To make sure that the results are able to be compared the factors mentioned in the table above will be carefully upheld to throughout the investigation.
The taking of repeat readings will allow to me verify that the results are reliable and accurate. To do this, I will check the repeats to certify that the consistency is to an acceptable accuracy.
If any of the results turn out to be anomalous I will take a reading at that level of Hydrogen Peroxide concentration to deny of confirm the inaccuracy.
Since I have a belief of what results I should get, if any results seem to disobey this trend I can take that reading again to ensure that it is correct.
There are some possible times where error could occur in my experiment and if these are limited then the results are to be more accurate. Some examples in this department include:

- Making sure that the measuring cylinder is completely full of water and that no air is trapped inside before the collection of the gas.
- Making sure the scales are set to zero prior to measuring the mass of the liver. If they are slightly out then different amounts of liver may be processed.

Preliminary work's influences

The plan above was based upon several experiments I conducted preceding the writing.

Firstly to see how much liver should be used. For this I used $10cm^3$ of 6% Hydrogen Peroxide. I used 10 because it is a nice round number. I also used $10cm^3$ collection of oxygen produced because again it was a nice round number.

Mass of Liver (g)	Time taken to produced $10cm^3$ Oxygen (s)
0.5	>1
1.0	2.24

I decided to go for 1g of liver to be used because using 0.5g of the substance led to results which were hard to be timed. So for accuracy's sake 1g gave the best results.

I then decided to see what concentrations of Hydrogen Peroxide to use. The maximum concentration I could use safely was 6% so I was limited resource wise to this. To find a good trend at least 5 results are needed. Since 6% was the largest I decided to

take 6 readings, each at an interval of 1%. I tested out 3 of them to see if they were far apart enough to set the trend. I used 1g of liver and took the time at a volume of gas at $10cm^3$

Concentration Of Hydrogen Peroxide (%)	Time taken to reach $10cm^3$ (s)
6	2.51
4	4.70
2	15.69

These results seemed plot able so I decided to stick with them and use them for the experiment.

I was then left to decide what volume of gas to collect. Since I was using a $100cm^3$ measuring cylinder at the time of the preliminary work I tried $25cm^3$ because it was a large figure but small enough not to take too long. $10cm^3$ had worked fine, but did seem too little to be using for the experiment.

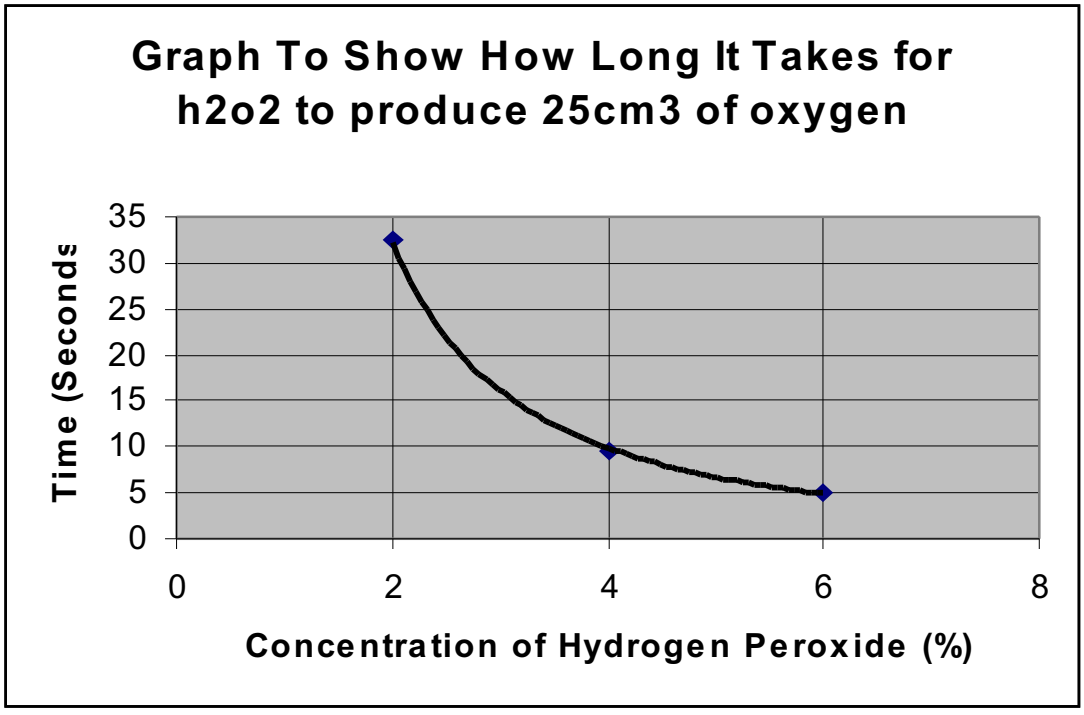
I used 1g of liver and the concentrations of H_2O_2 stated below.

Concentration Of Hydrogen Peroxide (%)	Time taken to reach $25cm^3$ (s)
6	5.01
4	9.63
2	32.34

These results seemed to be good to plot so I chose to use them in the experiment.

Prediction

Since I had 3 rough readings of time for different concentrations of Hydrogen Peroxide I plotted them on a graph to see if a trend was forming so I could make a prediction.



From seeing this, I predict that as the concentration of Hydrogen Peroxide decreases the amount of oxygen produced per second will decrease. Therefore the time taken to produce 25cm^3 of oxygen will increase.