CHEMISTRY LAB REPORT

GRADE 11C

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SUBMITTED TO: MR. ABERA
SUBMISSION DATE: 06/03/24

EXPERIMENT 5

Title: The Effect of Temperature on Reaction Rate

Objective: To study the effect of temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.

Theory: The rate of a chemical reaction measures the change in concentration of a reactant or a product per unit time. This means that the rate of a reaction determines how fast the concentration of a reactant or product changes with time. Reaction rate is change in an observable property over time, which can be a color change, a temperature change, a pressure change, a mass change, or the appearance of a new substance (for example, amount of precipitate formed). The observable (measurable) properties can be used to determine the change in concentration over time.

$$rate = \Delta c/\Delta t$$

Δ denotes the difference between the final and initial state, c denotes concentration of reactant and t denotes time.

The rates at which reactants are consumed and products are formed during chemical reactions vary greatly. Even a chemical reaction involving the same reactants may have different rates under different conditions. Some of the factors that affect rate are: change in temperature, concentration, nature of reactant, surface area and presence of a catalyst, result in changes in rate of reaction. In this experiment we tested for the effect of temperature. Temperature usually has a major effect on the rate of reaction. Molecules at higher temperatures have more thermal energy. Generally, an increase in the temperature of a reaction mixture increases the rate of chemical reactions. This is because, as the temperature of the reaction mixture raises, the average kinetic energy of the reacting particles increases. So, they collide more frequently and with greater energy. The effect of temperature on rate of reaction can be experienced in our daily life. For example, foods cook faster at higher temperature than at lower ones. We use a burner or a hot plate in the laboratory to increase the speed of reactions that proceed slowly at ordinary temperatures. In many cases, the rate of a reaction in a homogeneous system is approximately doubled by an increase in temperature of only 10 °C. To test this, we had a control group where the HCl and thiosulphate were at room temperature and an experimental group where the 2 compounds were in cold and hot(50^{o}C).

Materials:

Chemicals	Apparatus
HCl	Test tubes, a stirrer and beakers
Sodium thiosulphate solution	Paper and pencil

Ice	Water bath and thermometer

Procedure:

- 25 mL of 0.1M Na2 S2 O3 solution and 25 mL of 0.5M HCl acid were measured and put into 3 different test tubes. (HCl in 3 different test tubes and thiosulphate in 3 other different test tubes).
- 3 such sets were prepared and maintained at different temperatures. One set was put in room temperature, another set was put into ice and the last in a water bath of 50^0C.
- x was drawn 3 times on a piece of paper.
- The sets were each transferred into their own beakers and were put on the x markings.
- All 3 beakers were stirred until the reaction was able to shield the x.
- As they were stirred, each of them was monitored using a stop watch.

Observation: reaction 1 (will be a designation of the solution that was in the ice from now on) was really slow and it took very long to shield the x. reaction 2 (will be a designation of the solution that was room temperature from now on) was faster and it took a significantly shorter period of time to shield the x compared to reaction 1. Reaction 3 (will be a designation of the solution that was in a water bath now on) was the fastest of them all and took a very short amount of time to shield the x.

Result/discussion: When comparing the 3 reactions, we saw that reaction 3 and 2 react better than reaction 1. This was because of the temperature. Reaction 1, recording 7mins and 30secs, had a temperature that was very low which means there is a low amount of kinetic energy for the particles, thus; the rate decreases. Reaction 2, recording 2mins and 21secs, was better than 1 because the temperature is hotter at room temperature and there is more kinetic energy of particles which leads to faster rate. Reaction 3, recording 22secs only, was faster than all of them, since the temperature was very high, which means high kinetic energy between particles.
Temperature has a major effect on rate. Generally, an increase in the temperature of a reaction mixture increases the rate of chemical reactions. When the temperature is increased, the average kinetic energy of the reactant molecules also increases. This leads to more frequent and energetic collisions between the particles, which in turn increases the rate at which they react. The increased kinetic energy allows more molecules to overcome the activation energy barrier. That being said, there are a few specific scenarios in which an increase in temperature can actually slow down a reaction like decomposition reactions or reversible reactions.

Conclusion: Chemical reaction involving the same reactants may have different rates under different conditions. Some of the factors that affect rate are: change in temperature, concentration, nature of reactant, surface area and presence of a catalyst, result in changes in rate of reaction. In this experiment, we tested the effect of temperature and found that, in most cases, the higher the temperature, the faster the rate based on: reaction 1 being very slow and taking a long time to shield the "x" symbol on the paper. Reaction 2 being faster than reaction 1, taking a significantly shorter time to shield the "x." Reaction 3 being the fastest, with a very short time to shield the "x."

EXPERIMENT 5

Title: The Effect of a Catalyst on the Rate of Reaction

Objective: To investigate the effect of a catalyst on rate of decomposition of hydrogen peroxide.

Theory: The rate of a chemical reaction measures the change in concentration of a reactant or a product per unit time. This means that the rate of a reaction determines how fast the concentration of a reactant or product changes with time. Reaction rate is change in an observable property over time, which can be a color change, a temperature change, a pressure change, a mass change, or the appearance of a new substance (for example, amount of precipitate formed). The observable (measurable) properties can be used to determine the change in concentration over time.

$$rate = \Delta c/\Delta t$$

Δ denotes the difference between the final and initial state, c denotes concentration of reactant and t denotes time.

The rates at which reactants are consumed and products are formed during chemical reactions vary greatly. Even a chemical reaction involving the same reactants may have different rates under different conditions. Some of the factors that affect rate are: change in temperature, concentration, nature of reactant, surface area and presence of a catalyst, result in changes in rate of reaction. In this experiment we tested for the effect catalyst. A catalyst is a substance that changes reaction rate by providing a different reaction mechanism one with a lower activation energy, Ea. An activation energy is the minimum energy required to start a chemical reaction. Catalysts are not used up by the reactions, rather they are recovered at the end of the reaction. Although a catalyst speeds up the reaction, it does not alter the position of equilibrium. Chemical catalysts can be either positive or negative. Positive catalysts increase the rate of reaction by lowering the Ea-. To test catalysts' positive property, we used manganese dioxide as a catalyst for the decomposition of hydrogen peroxide.

Materials:

Chemicals	Apparatus
H_2O_2	Conical flask and delivery tube
MnO_2	Gas syringe and stop watch

Procedure:

- 25ml of hydrogen peroxide was measured and put into a flask.
- The flask was connected to a delivery tube which was connected to a gas syringe that was set to 0ml.
- The same thing was repeated but with the addition of manganese dioxide to the hydrogen peroxide.

- The reactions were observed.

Observation: the reaction without MnO_2 was very slow, while the one with the catalyst was very fast. The catalyst only reacted but was not used up at the end. As the pressure built up the syringe was elongated and it blew away.

Result/discussion: When comparing the two reactions, we saw that the one with catalyst reacts better than the one with out. This is because of catalysts' ability to fasten reactions. Catalysts work by providing an alternative reaction pathway with a lower activation energy, making it easier for the reactants to convert into products. In this experiment, the catalyst (MnO2) facilitated the reaction and allowed it to proceed at a faster rate compared to the reaction without the catalyst. The catalyst itself was not consumed during the reaction, meaning it remained unchanged and available for further use. In the reaction: 2 H2O2 → 2 H2O + O2, there was releasing of gases that led to an increase in pressure in the syringe. The catalyst accelerated the production of this oxygen gas, resulting in a more rapid pressure buildup and a more forceful expulsion of the syringe.

Catalysts are another major factors affecting the rate of reactions. Positive catalysts accelerate reactions, but negative catalysts decelerate reactions

Conclusion: The rate of a reaction determines how fast the concentration of a reactant or product changes with time. It is change in an observable property over time. a chemical reaction involving the same reactants may have different rates under different conditions. Some of the factors that affect rate are: change in temperature, concentration, nature of reactant, surface area and presence of a catalyst, result in changes in rate of reaction. In this experiment, we tested the effect of the catalyst manganese dioxide on the rate of decomposition of hydrogen peroxide. Catalysts are substances that can speed up chemical reactions without being consumed in the process. We compared the decomposition with and with out the catalyst and found that the reaction without the catalyst was very slow, while the reaction with the catalyst was significantly faster and also the catalyst only facilitated the reaction but was not consumed or changed in the process. By lowering the activation energy, catalysts make it easier for the reactants to convert into products, resulting in a faster reaction rate.