Determination of the activation energy essay sample

Science, Chemistry

Introduction:

Chemical kinetics is the study of chemical reaction rates, how reaction rates are controlled and the pathway or mechanism by which a reaction proceeds from its reactants to its products.

Reaction rates vary from the very fast, which is may complete in microseconds or even nanoseconds, to very slow, in which the reaction requires years to complete. There are several factors that affecting the rate of reactions, that is nature of the reactants, temperature of the chemical system, presence of a catalyst, concentration of the reactants and surface area of the reactants.

In this experiment, we are study about the temperature related to activation energy.

In order to activate reaction, there are two criteria needed to achieve, that is species are orientated properly and achieve or over the activation energy. Activation energy of a reaction is the amount of energy required to initiate the reaction. It represents the minimum energy needed to form an activated complex during collisions between reactant molecules. In slow reactions, the fraction of molecules in the system moving fast enough to form an activated complex when a collision occurs is low so that most collisions do not produce a reaction. However, in a fast reaction the fraction is high and therefore, collisions produce a reaction.

In 1889, Svante Arrhenius demonstrated that the rate constant k is related to the temperature of the system by what is known as the Arrhenius equation: k= A where R is the ideal gas constant [8. 314 J/(mol oK)], T is the

temperature in degrees Kelvin, Ea is the activation energy in joules per mol, and A is a constant called the frequency factor, which is related to the fraction of collisions between reactants having the proper orientation to form an activated complex. Thus, from this equation, we can obtain the activation energy of an experiment.

Apparatus and materials:

Test tube, Water bath, Measuring cylinder, Stopwatch, Thermometer 0. 02 M Potassium permanganate, 1 M Sulphuric acid, 0. 5 M Oxalic acid Procedures:

1. 2 cm^3 of 0. 02 M potassium permanganate and 4 cm^3 of 1 M sulphuric acid were measured into a test tube.

2. In another test tube, 2 cm^3 of oxalic acid was placed.

3. The test tubes were placed in a water bath at 28. 5°C.

4. When the solutions have attained this temperature, the oxalic acid was poured into the acidified permanganate solution and the time was started immediately. 5. The time taken for the permanganate to decolorize was recorded. 6. The experiment was repeated at higher temperatures of 38°C, 48°C, 52°C, 55°C and 61°C.

Discussion:

Generally, at the molecular level, the determining factors of the speed of chemical reactions are the collisions between molecules. The more frequently they collide, the greater the likelihood that a reaction will take place. In this experiment, a reaction between potassium permanganate and oxalic acid is carried out at different temperatures. The permanganate ion in its reaction with oxalic acid goes from MnO4- to Mn2+ by seeing the purple

colour of potassium permanganate disappear. Noted that the sulphuric acid added to all of six sets experiment is as catalyst, which is a control variable, thus it is not affected the result. $2MnO4^{-} + 16H+ + 5C2O42^{-}$

$2Mn2+ + 8H2O + 10CO2$

In this reaction, it involves bond breakage which requires energy. It is not sufficient that the molecules just collide, they must collide with sufficient energy so that the reaction may occur. This energy barrier that must overcome is the activation energy. By increasing the temperature not only increases the number of collisions but also increase the energy of the collisions and thus there is greater probability that some of those collisions have sufficient energy to overcome this barrier. In this experiment, the one of the error that we may conduct is we don’t know whether that both of the test tubes has achieve the thermal equilibrium.

So when we mixing up both of the solution, there may be slightly affected the record of time when the potassium permanganate turn to colourless. Secondly, when we mixing up the solution, we were conducted in the water bath, and since the water in the water bath is a little bit cloudy, it affect our observation for the potassium permanganate to turn colourless and thus we were recorded the time a little bit slower or faster. The precaution step that should be taken is if the temperature increases or decreases during the reaction, the starting temperature and the final temperature should be taken as the reaction temperature without consider the temperature of water

bath. Next, in order to achieve thermal equilibrium, the test tubes should be placed in a water bath for at least five minutes before mixing the chemicals in them. We can improved this experiment by changing the water bath such as using thermocol containers which can maintain almost uniform temperatures for a period of 5 – 10 minutes and of course, one container for one group of students. This suggestion should be carried out because the water bath’s temperature that we were using is not uniform due to some students continuosly put in their test tubes.

Conclusion:

Activation energy of a reaction is the amount of energy required to initiate the reaction. From the experiment, the activation energy that I obtained is Ea = 80. 7646 k

J/mol. By increasing the temperature of an experiment, it will increases the number of collisions but also increase the energy of the collisions and thus there is greater probability that some of those collisions have sufficient energy to overcome the activation energy.

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