


Reaction kinetics notes

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Rate = $k[A]^m[B]^n$ where: K is a constant, and m, n shows the orders of the reaction regarding each reagent. It is an experimentally determined equation as information (n, m, k etc.) can be found only through experimentation and not through theoretical considerations. The equation of the rate shows the relationship between the speed of a reaction and the concentrations of individual reagents. Once you find orders, they provide information about the mechanism of the specific reaction. The total order of the reaction is the total of M + N above. K is the rate constant. This provides a measure of how quickly the reaction proceeds. External factors such as temperature, pressure, particle size and catalysts influence the value of the speed constant. Graphics results If a time reaction concentration chart is drawn a curve is obtained while the reagent is exhausted during the reaction. The rate of any reaction is larger at the beginning (Time = 0). As reagents are exhausted the rate decreases. If a rate chart is drawn against time, the form obtained will depend on the overall order of the reaction. 0th graphic order: - straight flat line 1st order chart: - straight line All other orders: curve If a curve is obtained, further mathematical treatment of results is required. How: Rate = $K[A]^m[B]^n$ If [B] is kept constant, then: $\log \text{Rate} = \log K + M \log [A]$ and a log frequency chart against the register [A] will give a line of gradient M (the graph has the $Y = MX + C$) Maintain constant and treating the speed results when [B] varies allow a similar determination of the order compared to B. Once the two orders are Accerted then the constant K tariff can be found. Half-life Half-life is the time used for concentration of reagents to reach half of its original value. For most reactions, half of life changes as reaction procedures, but this is not the case of reactions of the first orders where half of life is constant. (short half life = fast speed) By using half of life to find the constant rate The constant rate is possible to find from a graph of concentration/time taking a point, finding its concentration, then finding a point on the chart that corresponds to half this concentration. Half of life is time between these two points. Half of life is also equal to $\ln 2 / K$ where K is the constant rate (equation provided in the data book). Solve the rate equation for inspection If a number of experimental results are obtained at rate at different reatrimony concentrations, the rate variation can be ascertained for such reactions when the concentration of one of the reagents is maintained constant while it has changed Reagent concentration. Example of experiment concentration of a low concentration b 1 0.1m 0.1m 6 x 103 2 0.2m 0.1m 1.2 x 104 3 0.4m 0.1m 2.4 x 104 4 0.1m 0.2m 6 x 103 5 0.2m 0.2 M 1.2 x 104 In experiments 1.2 and 3 the concentration of a change while the concentration of B is maintained constant. constant. means that the rate equation can be written as: Rate = $k[A]^m$ for these three experiments. If we check the rate of experiments 1.2 and 3 we see that as the concentration of A is doubled so that the rate doubles. In other words, the reaction order must be 1 so that whatever happens to the concentration must also occur in quantities equal to the rate. Similar inspection of experiments 1 and 4 (or 2 and 5) show that while A is kept constant there is no effect on the rate when the concentration of B is changed. The order with respect to B must be 0. Orders can now be substituted in the rate equation: Rate = $k[A]^1[B]^0$ To get a value of the rate constant, we simply substitute the values of one of the above experiments with the newly determined orders. (Choose the experiment with the simplest numbers - in this case experiment 1) Values from experiment 1 $6 \times 103 = k \times [0.1]^1 \times [0.1]^0$ $k = 6 \times 103 / 0.1$ $k = 6 \times 104$ Solve the tariff equation - test yourself 16.2 - Reaction mechanism The mechanism of a reaction is a series of reactions between the particles of a reaction which eventually lead to the final products. A reaction can have many steps in the mechanism. Rate of pitch determination The slowest step in a reaction. Determines the rate of the general reaction. (note 1) Molecularity The number of particles that react in the rate determining the stage of a reaction. Activated Complex Since two particles collide (with enough energy to react and in the correct orientation) they form an intermediate called activated complex...not literally a chemical, but an intermediate in which the bonds are in the process of breaking and forming. The Order of Reaction This provides information about the particles involved in the velocity determination step (which is a step in the mechanism). For example, if two of a particle type collide, the order relative to that particle will be 2 (and zero to any other). 16.3 - Energy of activation Arrhenius equation: $k = Ae^{-Ea/RT}$ (data book) where: A is a constant relative to the number, orientation and frequency of collisions occurring between the particles in the reaction. k is the constant rate R is the universal gas constant T is the absolute temperature Determination of the energy of activation If the rate experiments are performed at different temperatures, the results can be plotted on a graph to get a value for the activation energy for a specific reaction. $k = Ae^{-Ea/RT}$ then: $\ln k = \ln A - Ea/RT$ A natural register plot of k versus (1/T) will give a straight line of gradient - Ea/R Enthalpy level diagrams These show a curve representing the path between the reagents and products in terms of energy. Energy is shown on the y-axis. The reagents and products are of Chemical energies and the curve goes between the two levels (the reagents and the products) with a maximum of energy (with the distance between the highest point and the highest point) high) be equal to the energy of activation of the reaction forward.) an energy chart showing an esoteric reaction reactions occur only when the reactivative particles have greater energy than the activation energy and are able to overcome the energy barrier of activation. catalysis catalysts provide an alternative mechanism with a lower activation energy. This means that a greater number of collisions will be successful and the reaction proceeds at a faster rate homogeneous catalysts - catalysts in the same state (that is, solid, liquid or gas) as reactionaries. etrogenous catalysts - catalysts in a different phase (usually a solid) from reagents. homogeneous catalysts work by reacting with reagents and finally producing a path of reaction of less activation energy (and also regenerated at the end of this process.) etrogenous catalysts provide a reactive site on which complex forms are activated, weaken ties and increase the collision rate thus increasing the reaction rate. Examples of catalyzed processes type of oate contact catalyst process (sulphur trioxide) vanadium pentoxide heterogen haber (ammonia) heterogenous alcheni iron hydrogenation nichel heterogen polymerization pt (zeigler natta) heterogenous oxygen polymerization homogeneous catalysts rice resources solve the equation - test 1. Why the slowest step of a mechanism said to be the determination of speed? acts as a bottleneck as it prevents other processes from reaching the end of the reaction and thus determines the overall rate. is similar to the idea of a car journey that must go through a zone of road works. the car will be slowed down directly from the roadworks and this is therefore the crucial factor in determining the overall time of the trip. return this is a digital download, no physical product will be shipped. This set of notes is designed to help you understand kinetics and help you know when and how to use all formulas. then we cut your study time in half and help you pass the test! diFREE preview: kinetics notes preview page 12 50 + pages of examples and explanations on: rates of reaction factors affecting reaction rates endothermic and esothermic reactions rate of laws and reaction orders how to find the law of rate how to find the constant rate find the law of rate with three responsives the integrated laws of evaluation mechanisms reaction each page is full of: detailed examples explaining each step common talk and questions Note: There are no refunds on digital notes since there is no way to download them. if you're not sure!t's what you need, send me your program here and e-mail my recommendations. 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