Relationship between factors affecting rate of reaction and collision theory

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Total surface area

When a dilute acid is added to marble chips and to powdered marble, the acid reacts more vigorously and faster with the powdered marble than with the marble chips. The powdered marble offers a greater area of contact with the acid than the marble chips so that more marble particles can react with the acid in a given time.

Concentration of reactant

Reactants particles will collide more often if they are crowed in a small space. An increase or decrease in the concentration of the reactants will result in a corresponding increase or decrease in effective collisions of the reactants and hence in the reaction rate.

Temperature of reaction

Reactions are faster at higher temperatures and slower at low temperatures. The reverse effect of cooling a reaction in order to slow it down is true. For example, the refrigerator has low temperatures to slow down the chemical reactions that spoil food. Increasing the temperature of a system can lead to an increase in reaction rate in two ways. When the temperature is raised, energy in the form of heat is supplied to the reactant particles, so that the number of particles with energies equal to or greater than the activation energy increases and the average speed of all the reactant particles increases due to the greater kinetic energy, leading to a higher frequency of collision. As a result, the number of effective collisions increases and the reaction proceeds at a faster rate.

Use of catalyst

A catalyst is a substance which alters the rate of a reaction but itself does not undergo any permanent change at the end of the reaction. In the preparation of oxygen by heating potassium trioxochlorate(V). in the presence of a small amount of the catalyst, manganese(IV)oxide, only moderate heat is needed to decompose potassium trioxochlorate (V). in the absence of the catalyst, potassium trioxochlorate(V) must be heated to a much higher temperature and for a longer time in order to obtain similar results. A positive catalyst usually acts by lowering the energy barrier of a chemical reaction. Thus, in the presence of a catalyst, more reactant particles are able to react when they collide.

Pressure

Pressure affects the concentration of gaseous reactants. For example, a mixture of hydrogen and chlorine gases will react twice as fast if the partial pressure of hydrogen or chlorine is increased from 0.5 to 1.0 atm. The concentration of solid and liquid reactants is unaffected by changes in pressure.