

The Speed of Chemistry

The speed of chemical reactions is influenced by the nature of the reactants, the concentration of the reactants, the surface area of the reactants, the temperature, and catalysts. ► **NATURE OF REACTANTS.** Chemical reactions occur by breaking and rearranging existing bonds. The less electrons need to be rearranged, the faster the reaction is. As a result, reactions between ionic substances in aqueous solution, such as double replacement reactions, are rapid. On the other hand, reactions in which covalent bonds are broken, such as the decomposition of hydrogen peroxide, occur slowly at room temperature.

► **CONCENTRATION.** An increase in concentration results in an increase in the frequency of collisions. When the concentration of particles that enter the rate determining step increases, the reaction rate increases. If the concentration of only the reactants that are NOT involved in the rate determining step are increased, the number of collisions are increased without effecting the reaction rate. Increasing the pressure increases the concentration of gases only. ►

SURFACE AREA. Increasing the surface area of reactants increases the opportunity for collisions. ► **TEMPERATURE.** Increasing temperature increases kinetic energy of the particles increasing both the frequency and effectiveness of collisions and increasing the reaction rate. An increase in temperature of 10°C approximately doubles the speed of many reactions. ► **CATALYSTS.** Catalysts speed up reactions without being permanently altered by changing the reaction mechanism so less activation energy is required.



... and the winner is *Aqueous Ion!!*

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Answer the questions below based on the reading above and on your knowledge of chemistry.

1. Consider the reaction: $\text{NaCl}(aq) + \text{AgNO}_3(aq) \rightarrow \text{NaNO}_3(aq) + \text{AgCl}(s)$.

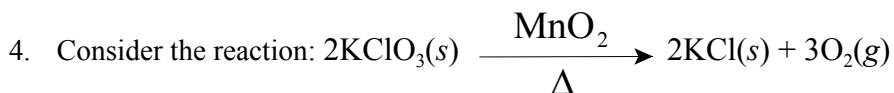
a. Are the reactants ionic or covalent compounds? _____

b. What happens to the particles of the reactants when they dissolve in water? _____

c. Is the reaction fast or slow? Explain. _____

2. What effect will increasing the pressure have on the rate of the following reaction: $\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)$? Explain.

3. Before dissolving salt in water [$\text{NaCl}(s) \rightarrow \text{NaCl}(aq)$], the salt is crushed. What effect does crushing have on the rate of solution. Explain. _____



a. As the temperature increases from 120°C to 150°C, what happens to the rate of the reaction? _____

b. Why does raising the temperature effect the reaction rate? _____

c. What is the function of the MnO_2 ? What effect does it have on the reaction rate? _____

5. Sodium carbonate [$\text{Na}_2\text{CO}_3(s)$] and calcium chloride [$\text{CaCl}_2(s)$] are soluble salts. What steps should be taken to get them to react as quickly as possible to form calcium carbonate [$\text{CaCO}_3(s)$], an insoluble salt? _____

6. What should be done to speed up a reaction between carbon dioxide gas [$\text{CO}_2(g)$] and water [$\text{H}_2\text{O}(l)$] to form carbonic acid [$\text{H}_2\text{CO}_3(aq)$]? _____

7. Digestive enzymes are actually a type of catalyst. What do they do during digestion? _____

8. Explain how heat and concentration effect reaction rates based on collision theory? _____
