

Name: _____

Date: _____

Collision Theory & Rate of Reaction

Homework Unit 9 - Topic 4

Collision Theory Basics

Match a Rate Factor to a "Collision Theory says" explanation.

	Rate Factor	Collision Theory says
_____	Increase Temperature	a) More frequent collisions because more particles are "exposed"
_____	Increase Concentration	b) Perfect angle collisions, every time
_____	Use a catalyst	c) More frequent collisions AND more effective ones at that!
_____	Crush solid reactants	d) More frequent collisions because more particles are in the reaction

A collision between reacting particles will not cause a chemical change UNLESS it _____ the bonds of the individual reactant particles. Such a collision is called an " _____ " collision.

WHY is it harder to activate endothermic reactions? _____

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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? _____

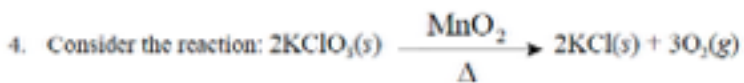
(c) Is the reaction fast or slow? Explain. _____

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. _____

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- 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 MnO₂? What effect does it have on the reaction rate? _____

5. Sodium carbonate [Na₂CO₃(s)] and calcium chloride [CaCl₂(s)] are soluble salts. What steps should be taken to get them to react as quickly as possible to form calcium carbonate [CaCO₃(s)], an insoluble salt? _____

6. What should be done to speed up a reaction between carbon dioxide gas [CO₂(g)] and water [H₂O(l)] to form carbonic acid [H₂CO₃(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? _____

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Rate of Reaction Practice

Explain how each of the following affects reaction rate. Explain in terms of Collision Theory (frequency and effectiveness of collisions).

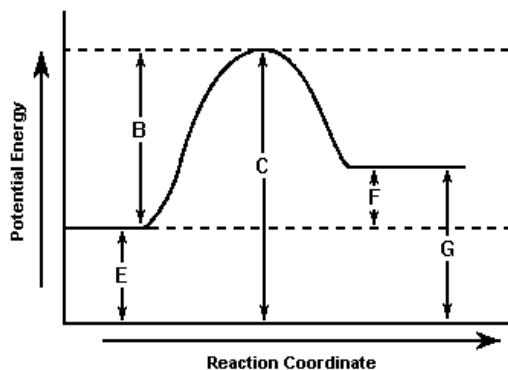
1. Temperature: _____

2. Concentration: _____

3. Surface Area: _____

4. Catalyst: _____

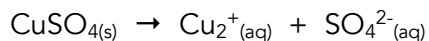
5. Sketch how the diagram at the right would change if a catalyst was added.



6. When a catalyst is added to a chemical reaction, there is a change in the

1. heat of reaction
2. rate of reaction
3. potential energy of the reactants
4. potential energy of the products

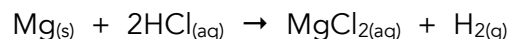
7. Given the reaction:



The $\text{CuSO}_{4(s)}$ dissolves more rapidly when it is powdered because the increased surface area due to powdering permits.

1. increased solvent contact
2. increased solute solubility
3. the equilibrium to shift to the left
4. the equilibrium to shift to the right

8. Given the reaction:



The reaction occurs more rapidly when a 10 gram sample of Mg is powdered rather than in one piece because powdered Mg has

1. less surface area
2. more surface area
3. a lower potential energy
4. a higher potential energy

9. Increasing the temperature increases the rate of a reaction by

1. lowering the activation energy
2. increasing the activation energy
3. lowering the frequency of effective collisions between reacting molecules
4. increasing the frequency of effective collisions between reaction molecules

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10. In most aqueous reactions, as temperature increases, the effectiveness of collisions between reacting particles
1. decreases
 2. increases
 3. remains the same
11. Which statement explains why the speed of some chemical reactions is increased when the surface area of the reactant is increased?
1. This change increases the density of the reactant particles.
 2. This change increases the concentration of the reactant.
 3. This change exposes more reactant particles to a possible collision.
 4. This change alters the electrical conductivity of the reactant particles.
12. Which conditions will increase the rate of a chemical reaction?
1. decreased temperature and decreased concentration of reactants
 2. decreased temperature and increased concentration of reactants
 3. increased temperature and decreased concentration of reactants
 4. increased temperature and increased concentration of reactants.
13. Which event must *always* occur for a chemical reaction to take place?
1. formation of a precipitate
 2. formation of a gas
 3. effective collisions between reacting particles
 4. addition of a catalyst to the reaction system
14. Raising the temperature speeds up the rate of a chemical reaction by increasing
1. the effectiveness of the collisions, only
 2. the frequency of the collisions, only
 3. both the effectiveness and the frequency of the collisions
 4. neither the effectiveness nor the frequency of the collisions.