

Factors Affecting the Rate of Chemical Reactions

A. TEMPERATURE – How does temperature affect the rate of a reaction?

As temp increases, the rate of reaction increases.

Examples: Cooking food – \uparrow reaction rate
Refrigerating food – \downarrow reaction rate.

Why does temperature affect reaction rate?

\uparrow temp = \uparrow molecules moving
so more molecule interactions take place
= \uparrow rate of reaction



B. CONCENTRATION – Define "Concentration":

how much solute is dissolved in a solution ex. salt in water

How does the concentration of the reactants affect the reaction rate?

We measure concentration by knowing the mass of a substance in 1 Litre of water. In order for new substances to be formed, the reactant atoms and molecules must be able to make

contact with each other.

Greater Concentrations \rightarrow \uparrow # of reactant molecules = greater chance collision will occur

Lower Concentrations \rightarrow \downarrow # of reactants = lower reaction rate

C. SURFACE AREA – Define "Surface Area":

the measure of how much area is exposed

How does the Surface Area of the reactants affect the rate of a chemical reaction? (Note: For the same mass, many small particles have more total surface area than one large particle.)

\uparrow S.A. = \uparrow rate of reaction

Surface area can also be important if the reaction occurs between two liquids that do not mix very well. This is because the reaction can only occur at the boundary where the two liquids meet. If both reactants are gases or liquids that mix together, then surface area and surface area is not a factor.

D. CATALYSTS – Define "Catalyst":

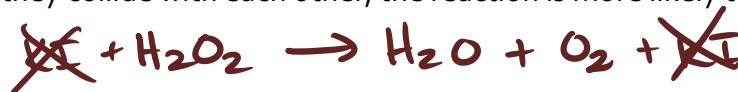
a chemical substance that speeds up the rate of a reaction

How do catalysts speed up reactions?

\rightarrow energy is needed to break bonds

\rightarrow Catalyst make it possible for reactions to occur using ^{less} energy

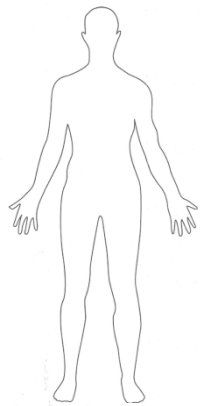
In the presence of a catalyst, molecules of reactants line-up better so that when they collide with each other, the reaction is more likely to take place.



Do we need to include the catalyst in a chemical equation?

No, A catalyst generally is not included directly when we write the chemical equation of a reaction.

Examples of Catalysts:



Your body contains thousands of different biological ~~enzymes~~ ^{proteins} called enzymes, which speed up reactions in living cells.

Example: Amylase – (in saliva)
break down starches

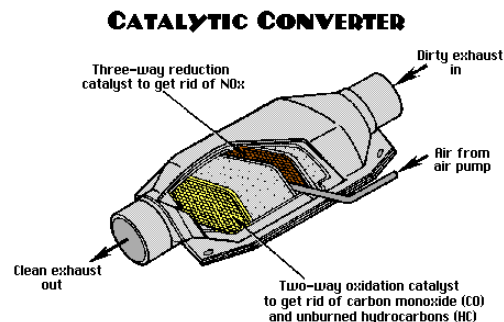
Many chemical reactions in living organisms would not occur quickly enough quickly enough to sustain life at normal temperatures if it were not for the presence of enzymes.

Catalytic Converters:

In automobiles built in North America since the 1980s have pollution control devices built into their exhaust systems. A **catalytic converter** is a stainless steel device, shaped like a muffler, located underneath the frame of the vehicle. Inside is a ceramic or wire honeycomb that provides a large surface area for reactions to take place. The surface of the honeycomb is coated with a thin layer of **metallic catalysts** such as platinum, rhodium and palladium.

As exhaust passes through the catalytic converter, several reactions occur.

1. $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
(poisonous)
2. $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
3. $2\text{N}_2\text{O}_3 \rightarrow 2\text{N}_2 + 3\text{O}_2$
(poisonous)



Questions:

1. What happens to the rate of a chemical reaction when the temperature is raised?

The rate increases because more collisions happen...this is because the molecules have more energy at higher temperatures and are moving faster.

2. What does cooling do to the frequency (how often) at which particles of reactants can collide?

The molecules have less movement (energy) and collide less frequently; therefore, reaction rate decreases.

3. How does increasing concentration result in an increase in reaction rate? Explain fully.

Increases reaction rate because there are more reactants so therefore, more collisions occur.

4. How does increasing the surface area of a reactant increase the reaction rate?

Increases surface area for reaction to occur on; therefore, increases reaction rate.