

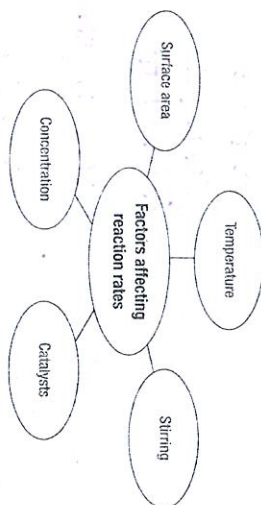
Section 7.4 Reaction Rates

(pages 212-215)

This section discusses the factors that affect reaction rates.

Reading Strategy

Building Vocabulary As you read, complete the web diagram below with key terms from this section. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.



Reactions Over Time

1. Any change that happens over time can be expressed as a(n) rate

2. What is a reaction rate? the speed at which reactants disappear or products appear

Factors Affecting Reaction Rates (pages 213-215)

3. Is the following sentence true or false? One way to observe the rate of a reaction is to observe how fast products are being formed.
True

4. Is the following sentence true or false? The rate of any reaction is a constant that does not change when the reaction conditions change.
False

5. Generally, an increase in temperature will increase the reaction rate.

6. Is the following sentence true or false? Storing milk in a refrigerator stops the reactions that would cause the milk to spoil.
True

7. How does an increase in surface area affect the exposure of reactants to one another?
There is more reactant available to react

8. Why does increasing the surface area of a reactant tend to increase the reaction rate?
see #7

9. Stirring the reactants in a reaction mixture will generally increase the reaction rate.

10. Is the following sentence true or false? Increasing the concentration of the reactants will generally slow down a chemical reaction. False

11. Is the following sentence true or false? A piece of material dipped in a concentrated dye solution will change color more quickly than in a dilute dye solution. True

12. Why does an increase in pressure speed up the rate of a reaction involving gases?
Particles collide more often

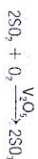
13. What is a catalyst? a substance that speeds up a reaction w/o being used up in the reaction. it lowers the activation energy

14. Circle the letters of the sentences that correctly identify why chemists use catalysts.

- (a) to speed up a reaction
b. to enable a reaction to occur at a higher temperature
c. to slow down a reaction
(d) to enable a reaction to occur at a lower temperature

15. Is the following sentence true or false? Because a catalyst is quickly consumed in a reaction, it must be added to the reaction mixture over and over again to keep the reaction going. False

16. Identify where the catalyst V_2O_5 should go in the formula shown and write it in the correct location.



17. Circle the letter of the correct answer. In the reaction represented by the equation $2H_2O_2 \xrightarrow{Pt} 2H_2O + O_2$, which substance acts as a catalyst?
a. H_2O_2 (b) Pt
c. H_2O d. O_2

18. One way that a catalyst can lower the energy barrier of a reaction is by providing a surface on which the reacting particles can come together.

Factors Affecting the Rate of Chemical Reactions

Directions: READ pages 272-277 in your text book BC Science 10 (McGraw-Hill Ryerson - 2008) and answer the following questions:

1. On a separate piece of paper, provide definitions for the following terms:

Catalyst
Rate of Reaction
Catalytic Converter
Surface Area

2. On a separate piece of paper, answer the following questions using COMPLETE SENTENCES:

- In your own words, describe what effect cooling has on the frequency at which particles of reactants can collide. Provide a real life example as to how we use temperature to alter reactions for our benefit. (2 mks for description and inclusion of an example)
- In your own words, describe why an increase in concentration can result in a change in the rate of a reaction. Provide a real life example as to how we adjust concentration to adjust a reaction for our benefit. (2 mks for description and inclusion of an example)
- Complete the following table by indicating whether each of the following scenarios would either increase or decrease the rate of reaction. The first one has been done for you. (4 mks for correctly completing the table)

Scenario	Increase or Decrease
Adding heat.	Increase
Removing heat	Decrease
Adding a catalyst	Increase
Diluting a solution	Decrease
Removing an enzyme	Decrease
Lowering the Temperature	Decrease
Decreasing the surface area	Decrease
Increasing the concentration of a solution	Increase
Breaking a reactant down into smaller pieces	Increase

- Complete the following table by indicating which factor would have the greatest impact on the rate of reaction. Choose from concentration, temperature, surface area or catalyst. The first one has been done for you. (3 mks for correctly completing the table)

Scenario	Factor that has the greatest impact on the rate of reaction.
Blowing air on a campfire to help get it going.	concentration
Raw carrots are cut into thin slices for cooking.	surface area
Protein is broken down in the stomach by the enzyme pepsin.	catalyst
A Woolly Mammoth is found, perfectly preserved, near the Arctic circle.	temperature
More bubbles appear when a concentrated solution of hydrochloric acid is added to a magnesium strip than when a dilute solution of the acid is added.	concentration
Exhaust from a car engine passes through a catalytic converter changing most of the poisonous nitrogen oxides into nitrogen gas and oxygen gas.	catalyst
A dust explosion occurs in a saw mill.	concentration

A) cooling slows down the rate of the reaction because it lowers the kinetic energy & the velocity of the particles so they do not collide/react as often.

B) keeping food in the fridge to keep it from spoiling

B) increasing concentration means there are more particles to collide/react.

Ex) Burning wood in air which is only 20% oxygen vs. the very rapid (almost explosion) of burning wood in 100% oxygen

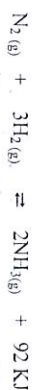
Use the following vocabulary terms to correctly fill in the blanks.

Vocabulary	
catalyst	energy
catalytic converter	heat
collisions	rate of reaction
concentration	surface area
dilute	temperature

1. A freshly exposed surface of metallic sodium tarnishes almost instantly if exposed to air and moisture, while iron will slowly turn to rust under the same conditions. In these two situations, the rate of reaction refers to how quickly or slowly reactants turn into products.
2. Adding heat will increase the rate of reaction because this causes the particles of the reactants to move more quickly, resulting in more collisions and more energy.
3. Removing heat will lower the temperature, causing the particles of the reactants to slow down, resulting in less frequent collisions.
4. Concentration refers to how much solute is dissolved in a solution. If there is a greater concentration of reactant particles present, there is a greater chance that collisions among them will occur. More collisions mean a higher rate of reaction.
5. A concentrated acid solution will react more quickly than a dilute acid solution because there are more molecules present, increasing the chance of collisions.
6. Grains of sugar have a greater surface area than a solid cube of sugar of the same mass, and therefore will dissolve quicker in water.
7. A catalyst, for example an enzyme, is used to speed up a chemical reaction but is not used up in the reaction itself.
8. A catalytic converter in car has metallic catalysts where several reactions occur. Carbon monoxide, which was produced in the combustion of gasoline, is changed into carbon dioxide and water in the presence of these metallic catalysts.

Worksheet #2 Le Chatelier's Principle

Describe the changes that occur after each stress is applied to the equilibrium.



Stress	Shifts			Shifts to the Reactants or Product
	$[\text{N}_2]$	$[\text{H}_2]$	$[\text{NH}_3]$	
1. $[\text{N}_2]$ is increased	↑	↓	↑	R Product
2. $[\text{H}_2]$ is increased	↓	↑	↑	R Product
3. $[\text{NH}_3]$ is increased	↑	↓	↓	L Reactant
4. Temp is increased	↑	↓	↓	L Reactant
5. $[\text{N}_2]$ is decreased	↓	↑	↓	L Reactant
6. $[\text{H}_2]$ is decreased	↑	↓	↓	L Reactant
7. $[\text{NH}_3]$ is decreased	↓	↑	↑	R Product
8. Temp is decreased	↓	↑	↑	R Product
9. A catalyst is added	—	—	—	— Product

10. Solve for K_{eq} if $[\text{NH}_3] = 1.25 \text{ M}$, $[\text{H}_2] = 0.020 \text{ M}$, and the concentration of $[\text{N}_2]$ is 1.90 M .

$$K_{eq} = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} = \frac{[1.25]^2}{[1.90][0.020]^3} = \boxed{3.00}$$

11. If $K_{eq} = 10900$ and the $[\text{N}_2]$, $[\text{H}_2]$, and the $[\text{NH}_3]$ = 0.020 M , what is the $[\text{NH}_3]$?

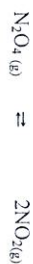
$$.0900 = \frac{[\text{NH}_3]^2}{[0.0600][0.0200]^3}$$

$$(4.8 \times 10^{-7}) \cdot 0900 = \frac{[\text{NH}_3]^2}{4.8 \times 10^{-7}} \quad (4.8 \times 10^{-7})$$

$$4.32 \times 10^{-8} = [\text{NH}_3]^2$$

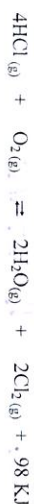
$$\sqrt{4.32 \times 10^{-8}} = \sqrt{[\text{NH}_3]^2}$$

$$\boxed{2.08 \times 10^{-4}} = [\text{NH}_3]$$



$$\Delta H = + 92 \text{ KJ}$$

Stress		Shifts Right or Left	Shifts to Favour the Reactants or Products
1. $[\text{N}_2\text{O}_4]$ is increased	\uparrow	R	Products
2. $[\text{NO}_2]$ is increased	\uparrow	L	Reactants
3. Temp is increased	\downarrow	R	Products
4. $[\text{N}_2\text{O}_4]$ is decreased	\downarrow	L	Reactants
5. $[\text{H}_2]$ is decreased	no effect		
6. $[\text{NO}_2]$ is decreased	\downarrow	R	Products
7. Temp is decreased	\downarrow	L	Reactants



Stress		Shifts Right or Left	Shifts to Favour the Reactants or Products
1. $[\text{HCl}]$ is increased	\downarrow	R	Products
2. $[\text{H}_2\text{O}]$ is increased	\uparrow	R	Products
3. $[\text{O}_2]$ is increased	\uparrow	R	Products
4. Temp is increased	\uparrow	L	Reactants
5. $[\text{H}_2\text{O}]$ is decreased	\downarrow	R	Products
6. $[\text{HCl}]$ is decreased	\downarrow	L	Reactants
7. $[\text{O}_2]$ is decreased	\downarrow	R	Products
8. Temp is decreased	\downarrow	L	Reactants
9. A catalyst is added	no effect		

10. Write the K_{eq} expression

$$K_{eq} = \frac{[\text{H}_2\text{O}]^2 [\text{Cl}_2]^2}{[\text{HCl}]^4 [\text{O}_2]}$$

If total is K_{eq} of $\text{CH}_3\text{COOH} + \text{CO}_2 = 0.1011$, $\text{CH}_3\text{COOH} + \text{CO}_2$ and the K_{eq} is 0.8011?

$$K_{eq} = \frac{[0.010]^2 [0.080]^2}{[0.0050]^4 [0.010]} = \boxed{102,400}$$

$\rightarrow [\text{N}_2\text{O}_4]$ will end up increasing because equilibrium shifts to make more N_2O_4