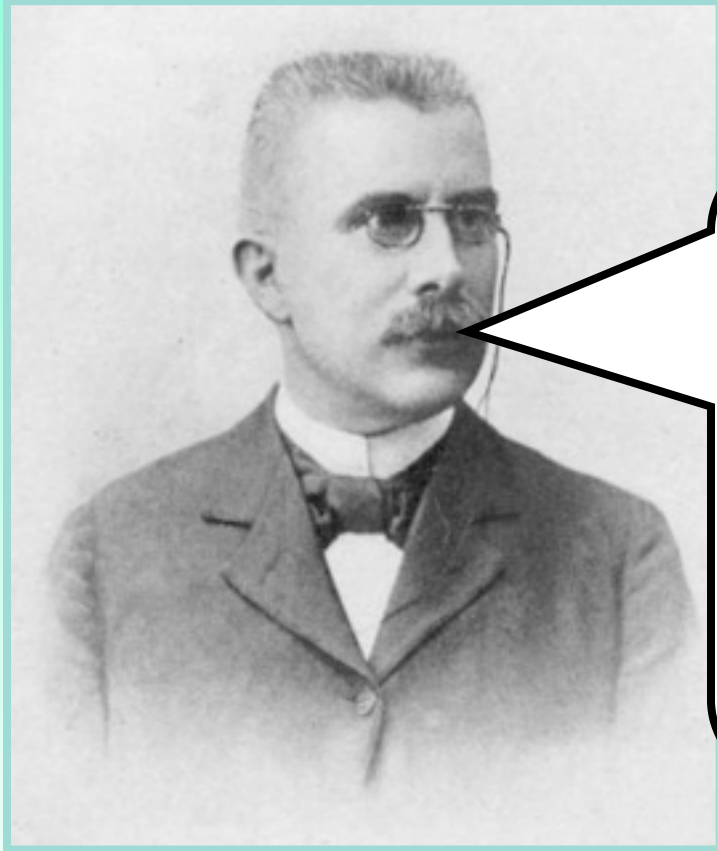


# LE CHÂTELIER'S PRINCIPLE

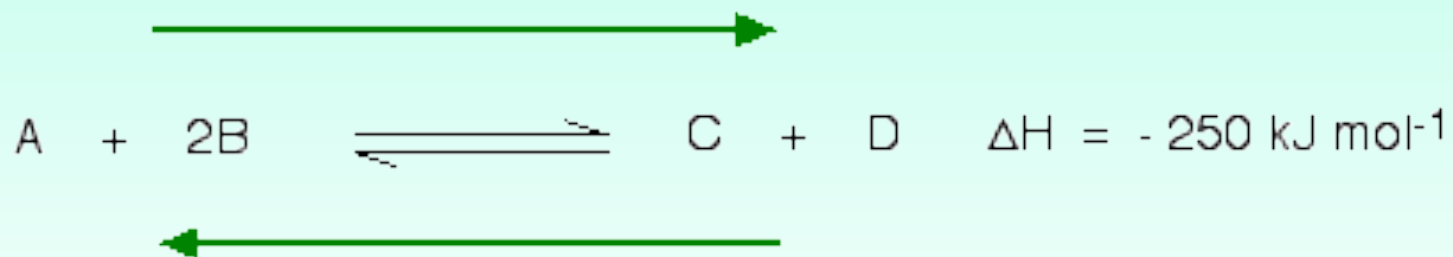


If an outside influence upsets an equilibrium, the system undergoes a change in the direction that counteracts the disturbing influence, and, the system reaches a new state of equilibrium.

# LE CHÂTELIER'S PRINCIPLE

- disturbances to the equilibrium are said to shift to the right (\_\_\_\_\_ ) or to the left (\_\_\_\_\_ )

250 kJ is **evolved** when A and B react completely to give C and D.



250 kJ is **absorbed** when C and D react completely to give A and B.

# LE CHÂTELIER'S PRINCIPLE

## Factors Affecting Equilibrium

1.

2.

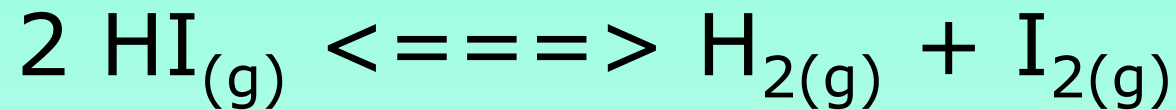
3.

4.

5.

# LE CHÂTELIER'S PRINCIPLE

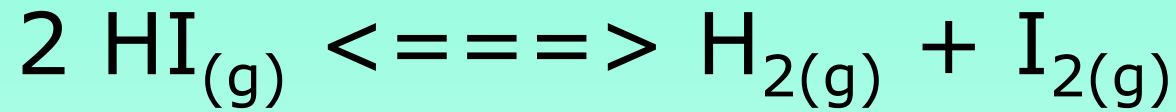
1.



Given the equilibrium above, if more HI is added to the system, how will the reaction rates respond to achieve a new equilibrium?

# LE CHÂTELIER'S PRINCIPLE

1.



What happens to the equilibrium if  $\text{H}_2$  is removed from the system?

# LE CHÂTELIER'S PRINCIPLE

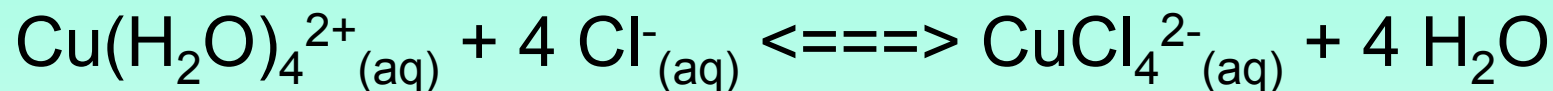
1.

The equilibrium will always shift to consume the substance that is added or to replace a substance that is removed.

# LE CHÂTELIER'S PRINCIPLE

## 1. Concentration

### Example #1



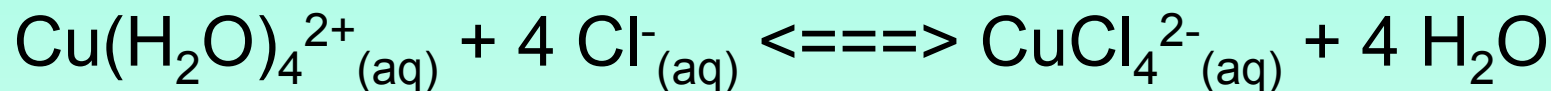
1. What happens when  $\text{Cl}^-$  is added?

2. What happens when  $\text{CuCl}_4^{2-}$  is removed?

# LE CHÂTELIER'S PRINCIPLE

## 1. Concentration

### Example #2



What happens when  $\text{Ag}^+$  ions are added?  
(Hint: examine your solubility rules)



# LE CHÂTELIER'S PRINCIPLE

## 2. Pressure

- pressure is changed if volume is changed
- pressure changes have limited effect on liquids or solids

# LE CHÂTELIER'S PRINCIPLE

## 2. Pressure



Given the equilibrium above, if the pressure on the system is increased, how will the reaction rates respond to achieve a new equilibrium?

■

# LE CHÂTELIER'S PRINCIPLE

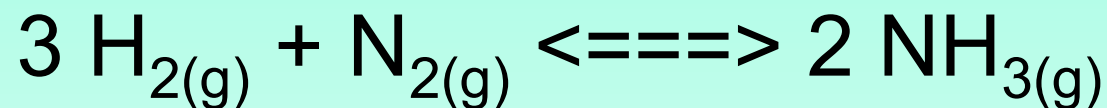
## 2. Pressure

The equilibrium will always shift to relieve an increase in pressure or to fill up space when pressure is decreased.

# LE CHÂTELIER'S PRINCIPLE

## 2. Pressure

Example #3

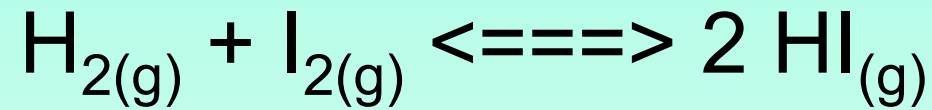


What happens if the volume of the system is reduced?

# LE CHÂTELIER'S PRINCIPLE

## 2. Pressure

Example #4

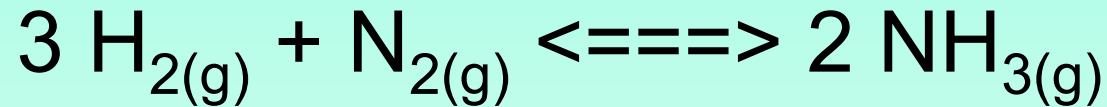


What happens if the volume of the system is increased?

# LE CHÂTELIER'S PRINCIPLE

## 3. Addition of inert gases

Example #5

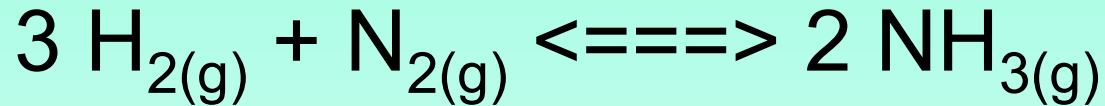


What happens if neon gas is added?

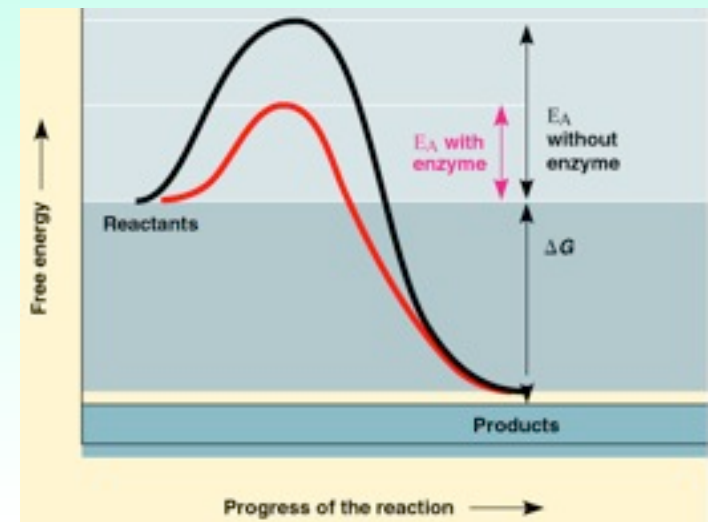
# LE CHÂTELIER'S PRINCIPLE

## 4. Presence of catalysts

### Example #6



What happens when a catalyst is added?



# LE CHÂTELIER'S PRINCIPLE

## 5. Temperature

Example #7:



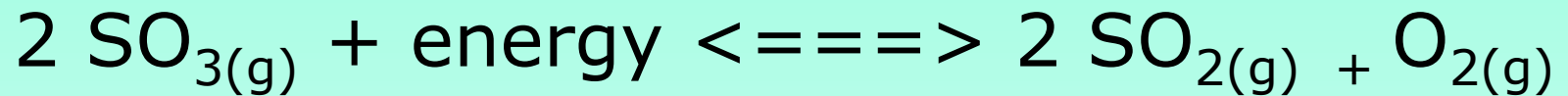
How does the system compensate when the temperature is increased?



# LE CHÂTELIER'S PRINCIPLE

## 5. Temperature

Example #8:



How does the system compensate when the temperature is decreased?