

Le Chatelier's Principle

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Le Chatlier's Principle

When a system in equilibrium is subjected to a stress the system readjusts itself such that it negates the effect of the stress

Le Chatelier's Principle

What factors effect equilibrium

- ◆ Concentration Reactants/Products
- ◆ Pressure / Volume (They are related)
- ◆ Temperature
- ◆ Catalyst
- ◆ Inert gas

Adding a reactant or a product



Into a system in equilibrium, if we add a reactant or a product the equilibrium will shift in the direction so as to consume the added chemical.

If $\text{N}_2 \uparrow$ is added equilibrium will shift right so as to consume the added reactant or we say the equilibrium shifts right

Adding a reactant or product



- ◆ If $\text{H}_2 \uparrow$ is added equilibrium will shift right so as to consume the added reactant or we say the equilibrium shifts right
- ◆ If we add $\uparrow \text{NH}_3$ the equilibrium will shift so as to consume the product added or we will say the equilibrium shifts left.

Removing a reactant or product



- ◆ If $\text{N}_2 \downarrow$ is removed equilibrium will shift left so as to increase the reactant removed or we say the equilibrium shifts left \leftarrow
- ◆ If we remove $\text{NH}_3 \downarrow$ the equilibrium will shift so as to produce more NH_3 or increase the product removed or we will say the equilibrium shifts right \rightarrow .

Effect of volume or pressure changes

When at least one of the reactants or products involves is a gas changing the volume of the container can cause a change in pressure.

Take both of these aspects in predicting shift in equilibrium.

Effect of volume or pressure changes

If pressure goes up in the closed system, the equilibrium will shift in such a way so as to minimize the increase in pressure

Pressure always decrease when there is less number of moles of the gas $P = F/A$

So when pressure increases or volume decreases the equilibrium will shift in the direction where there is less number of moles.

Increasing Volume or Decreasing Pressure



On the reactant side we have $1 + 3 = 4$ moles

On the product side we have 2 moles

If volume is decreased or pressure increased equilibrium will shift in the direction of less number of moles or equilibrium will shift right.

Decreasing Volume or Increasing Pressure



On the reactant side we have $1 + 3 = 4$ moles

On the product side we have 2 moles

If volume is increased or pressure decreased equilibrium will shift in the direction of more number of moles or equilibrium will shift left



Effect of temperature



For exothermic reactions heat is a produced

For endothermic reaction heat is a consumed

The shift in equilibrium will have the same effect an increase in reactant or product has.

Increasing \uparrow T for Exothermic reactions



If the temperature is increased in this reaction the reaction will try to consume the heat or absorb heat.

The backward reaction is endothermic

The equilibrium will shift left \leftarrow

Decreasing \downarrow T for Exothermic reactions



If the temperature is decreased in this reaction the reaction will try to produce the lost heat.

The Forward reaction is exothermic so produces heat.

The equilibrium will shift right

Increasing \uparrow T for Endothermic reactions



If the temperature is increased in this reaction the reaction will try to consume the heat or absorb heat.

The forward reaction is endothermic

The equilibrium will shift right \rightarrow

Decreasing \downarrow T for Endothermic reactions



If the temperature is decreased in this reaction the reaction will try to produce more heat or reaction becomes exothermic.

The backward reaction is exothermic

The equilibrium will shift left \leftarrow

Decreasing \downarrow T for Endothermic reactions



If the temperature is decreased in this reaction the reaction will try to produce more heat or reaction becomes exothermic.

The backward reaction is exothermic

The equilibrium will shift left \leftarrow

Effect of Catalyst

A catalyst is a substance that increases or decreases the rate of a reaction.

It does not effect the equilibrium position.

So the catalyst has not effect on a reversible reaction, it only helps in achieving the equilibrium faster.

Adding an Inert Gas

Adding an inert gas does not alter the equilibrium position.

Inert gases are used as carrier gases during the manufacture of products like ammonia. But it does not initiate a shift in equilibrium in any direction.



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