

Part 3 - LeChateliers Principle - pgs 690-695

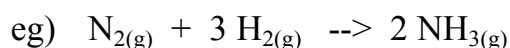
- Controlling the extent of equilibrium by manipulating properties is very desirable because it leads to more efficient and economic processes

- According to Le Châtelier's principle, when a chemical system at equilibrium is disturbed by a change in a property of the system, the system always appears to react in the direction that opposes the change, until a new equilibrium is reached

- Using this simple and completely empirical approach, chemical engineers could produce more of the desired products, making technological processes more efficient and more economical

Le Châtelier's Principle and Concentration Changes

- an increase in the [] of the products or reactants favors the other side of the equation



↑ [N_{2(g)}] or [H_{2(g)}] will shift the equilibrium to produce NH_{3(g)}

↑ [NH_{3(g)}] will shift the equilibrium to produce the reactants

- A decrease in the [] of the products or reactants favors that side of the equation

If you take away products more products will form

If you take away reactants more reactants will form

Read Collision–Reaction Theory and Concentration Changes on pg 692

Thymol Blue Demo

Le Châtelier's Principle and Temperature Changes


- energy is treated like a reactant or product



- Heating or cooling a system adds or removes thermal energy from the system.
- In either situation, the equilibrium shifts to minimize the change
- if cooled, the equilibrium shifts so more heat is produced
correct
- if heated, the equilibrium shifts away from the heat so it cools down

Read Collision–Reaction Theory and Energy Changes on pg 693

<http://www.tutorvista.com/content/chemistry/chemistry-ii/chemical-equilibrium/chemical-equilibrium-animation.php>

 [N₂O₄-NO₂ Demo](#)

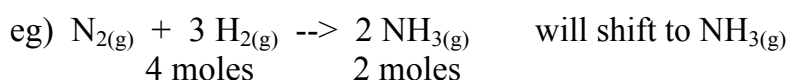
<http://www.youtube.com/watch?v=0XQVXFL4uoo>

Le Châtelier's Principle and **Gas** Volume Changes

$$C = \frac{n}{V}$$

With **gases**, volume, pressure and concentration are related

- an **increase in pressure** caused by a drop in volume **causes a shift towards the side of the equation with fewer moles**



Increased pressure causes a shift to the right, which decreases the total number of gas molecules (4 moles to 2 moles) and, thus, reduces the pressure

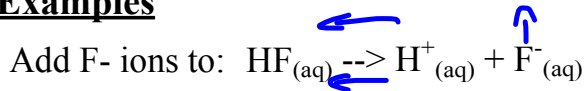
- if the number of moles are the same on both sides of the reaction, a change in volume (pressure) has no effect

Read Collision-Reaction Theory and Gas Volume Changes on pg 694

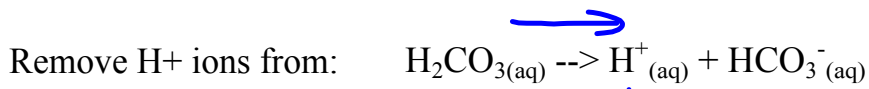
[N₂O₄-NO₂ Demo](#)

 <http://www.youtube.com/watch?v=YMqyG9QG6oc>

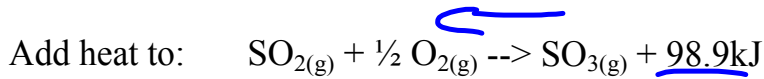
Examples



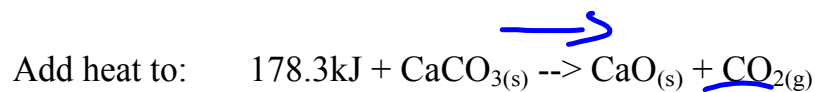
Shifts to: products or reactants
[HF_(aq)] ↓ or ↑



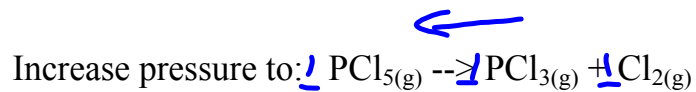
Shifts to: products or reactants
[H₂CO_{3(aq)}] ↓ or ↑



Shifts to: products or reactants
[SO_{2(g)}] ↓ or ↑
[SO_{3(g)}] ↓ or ↑



Shifts to: products or reactants
[CO_{2(g)}] ↓ or ↑



Shifts to: products or reactants
[PCl_{3(g)}] ↓ or ↑
[PCl_{5(g)}] ↓ or ↑