# Equilibrium

**Unit 13D:** Le Châtelier’s Principle

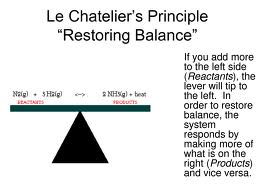
### Skills:

* predict a shift in equilibrium using Le Châtelier’s Principle

### Notes:

If a reaction is at equilibrium, the reaction will \_\_\_\_\_\_\_\_ any change with a corresponding change that \_\_\_\_\_\_\_\_\_\_\_ the reaction back to its equilibrium. Because *Keq* is a constant, after the equilibrium shifts, the value of *Keq* will be the \_\_\_\_\_\_\_\_ as it was before the change.

In plain English, if you change something, the equilibrium will shift to partly undo the change.



For example, consider the reaction:

N2 (g) + 3 H2 (g)  2 NH3 (g)  ΔH = -91.9 kJ

For this reaction,

Suppose we started at equilibrium with:

, , and .

(This works out to the correct value for *Kp*.)

If we add enough hydrogen gas to make  = 10 atm at equilibrium, the new partial pressures of the other gases would be:

=  and =

(You could prove this by solving for “x” from the Kp equation)

As you can see, \_\_\_\_\_\_\_\_\_\_\_ more H2 caused the reaction to \_\_\_\_\_\_ up more N2 and \_\_\_\_\_\_\_\_\_\_ more NH3.

Le Châtelier tells us that we don’t have to do the equilibrium calculation to predict what will happen. We can just look at the equation:

N2 (g) + 3 H2 (g)  2 NH3 (g) + 91.9 kJ

if we add more H2, the reaction will try to use some of it up. This means the equilibrium will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, using up more N2 and making more NH3.

On the other hand, if we added NH3, the equilibrium would instead \_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to use up some of the NH3, and make more N2 and H2.

|  |  |
| --- | --- |
| **Action** | **Equilibrium shift** |
| Add N2 or H2 |  |
| Remove N2 or H2 |  |
| Add NH3 |  |
| Remove NH3 |  |
| Increase the temperature (add heat) |  |

Note that the value of *K* is different at different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Adding reactants or products doesn’t change the value of *K*, but changing the temperature does. The fact that adding heat shifts the equilibrium to the *left* means that increasing the temperature would result in a lower value of *K* for this particular equation.