CH 223 Guide to Le Chatelier's Principle

Le Chatelier's Principle: "If a stress is applied to a system, the system will change in a manner to reduce the stress"

Disturbance	Change as Mixture Returns to Equilibrium	Effect on Equilibrium	Effect on K
Addition of Reactant	Some of added reactant is consumed	Shift to **right** (products)	*No change*
Addition of Product	Some of added product is consumed	Shift to **left** (reactants)	*No change*
Decrease in Volume, Increase in Pressure, Addition of Inert Gas	Pressure increases	Shift toward **fewer gas molecules**	*No change*
Increase in Volume, Decrease in Pressure	Pressure decreases	Shift toward **more gas molecules**	*No change*
Rise in Temperature	Heat energy is consumed	Shift in the **endothermic** direction	**Change**
Drop in Temperature	Heat energy is generated	Shift in the **exothermic** direction	**Change**

Example: For $PbCl_{2(s)}$ **<=>** $Pb^{2+}_{(aq)}$ + 2 $Cl^{-1}_{(aq)}$, $K_{sp} = 1.7 * 10^{-5}$. If $Pb^{2+}_{(aq)}$ is added to the system at equilibrium, some of the added product will be consumed (Pb^{2+} and Cl^{-1}), and the reaction will shift to the left. The value of K_{sp} remains constant at $1.7 * 10^{-5}$.

Example: For $N_{2(g)}$ + $O_{2(g)}$ <=> 2 $NO_{(g)}$, $\Delta H° = +180.5$ kJ and $K = 4.5 * 10^{-31}$ at **298 K**. If the temperature is raised to **900 K**, K changes to $6.7 * 10^{-10}$ - more product favored, heat energy is consumed, and the value of K has changed.