**Le Chatelier’s Principle Simulation**

**Introduction:** In this online simulation you will examine Le Chatelier’s principle in equilibrium systems. Remember some reactions do not go to completion and are reversible causing the reforming of reactants. You will look at various chemical systems and look at the effect of various factors on the reversibility of the chemical system. The simulation can be found here: <https://tinyurl.com/yb8xmlaj>

Changes that disturb a system at equilibrium are called stresses. We can predict the outcome of applying a stress to an equilibrium system using Le Chatelier's Principle*. It states that when an equilibrium system is disturbed, the system will shift in such a way as to relieve the applied stress.* The three most common ways to stress a system at equilibrium are changing the concentration of a reactant or product, changing the temperature of the system, or changing the pressure on the system. As the last stress applies primarily to gaseous systems, we will concern ourselves with only the first two stresses.

|  |
| --- |
| **I. Cobalt System:** CoCl42- {blue} + 6 H2O http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/eqarrow.gif Co(H2O)62+ {red} + 4 Cl- + heat |
| What color is the original solution? | What do you predict will happen if you use the stressor to the right? | Stress | What happened when you used this stressor? |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/bunsen.gifHeat solution |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/ice.gifCool solution |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addwat.gifAdd H2O |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addkcl.gifAdd Cl- |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addsn.gifRemove Cl- |  |

|  |
| --- |
| **II.** **Chromate System:** 2 CrO4-2 {yellow} + 2 H+ http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/eqarrow.gif Cr2O7-2 {red} + H2O |
| What color is the original solution? | What do you predict will happen if you use the stressor to the right? | Stress | What happened when you used this stressor? |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addhcl.gifAdd H+ |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addnaoh.gifRemove H+ |  |

|  |
| --- |
| **III.** **Ammonium System:** heat + NH4+ + OH- (more purple) http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/eqarrow.gif NH3 + H2O (less purple) |
| What color is the original solution? | What do you predict will happen if you use the stressor to the right? | Stress | What happened when you used this stressor? |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addnh4.gifAdd NH4+ |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addhcl.gifRemove OH- |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addnaoh.gifAdd OH- |  |

|  |
| --- |
| **IV.** **Iron Thiocyanate:** Fe3+ {pale yellow} + SCN- http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/eqarrow.gif FeSCN2+ {red/brown} + heat |
| What color is the original solution? | What do you predict will happen if you use the stressor to the right? | Stress | What happened when you used this stressor? |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addkscn.gifAdd SCN- |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addfeno3.gifAdd Fe3+ |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/bunsen.gifHeat solution |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addhpo4.gifRemove Fe3+ |  |

|  |
| --- |
| **V.** **Nitrogen Dioxide System:** 2 NO2 {brown} http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/eqarrow.gif N2O4 {colorless} + heat |
| What color is the original solution? | What do you predict will happen if you use the stressor to the right? | Stress | What happened when you used this stressor? |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/ice.gifCool mixture |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/bunsen.gifHeat mixture |  |

|  |
| --- |
| **VI.** **Copper Sulfate System:** CuSO4.5 H2O (blue crystal) + heat http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/eqarrow.gif CuSO4 (white powder)+ 5 H2O |
| What color is the original solution? | What do you predict will happen if you use the stressor to the right? | Stress | What happened when you used this stressor? |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/bunsen.gifHeat mixture |  |
|  |  | http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/addwat.gifAdd H2O |  |

Analysis:

1. See if you determine any general rules about how equilibrium will shift if you do the following:

Adding… reactant:

 product:

Removing… reactant:

 product:

2. See if you determine any general rules about how equilibrium will shift if you do the following:

Exothermic reaction… heating:

 cooling:

Endothermic reaction… heating:

 cooling:

**Practice Questions**

1. Methanol has the formula CH3OH and can be produced by the reaction of carbon monoxide with hydrogen gas.

CO + 2 H2  CH3OH + heat

In an attempt to maximize the yield of methanol (amount of methanol produced), a chemist would try to shift the equilibrium as far to the right as possible. Which of the following would accomplish this?

a. heating the mixture

b. adding more CO

c. removing the CH3OH as it is formed

d. adding a substance that reacts with CO which removes CO from the reaction

2. Mystery Scenarios: For each mystery scenario on the same page, predict what stressors or changes could have caused the shift in equilibrium.

|  |  |  |
| --- | --- | --- |
| **Copper and Bromide**heat + Cu(H2O)62+ {blue} + 4 Br-  6 H2O + CuBr42- {green} | **Magnesium Hydroxide**Mg(OH)2 {white solid}  Mg2+ {clear solution} + 2 OH- | **Copper**Cu2+ {light blue} + 4 NH3  Cu(NH3)42+ {deep blue} |

Simulation originally from: dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/equil/equil.htmWorksheet from: http://crhsibchemistry.weebly.com/uploads/2/9/6/2/29626527/lechateliers\_principal\_virtual\_lab.pdf