

# Inquiry

Kinetics

&

Equilibrium



Click on:

<http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/equil/8perform.htm>

- Go to the URL link above.
- Scroll down to find “Equilibrium and LeChatelier’s Principle.”
- Click on the “Experiments” tab.

# Click on the “Cobalt System”

## Performing the Experiment and Results



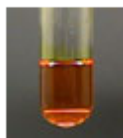
[I. Cobalt system](#)



[II. Ammonium system](#)



[III. Iron thiocyanate system](#)



[IV. Chromate system](#)



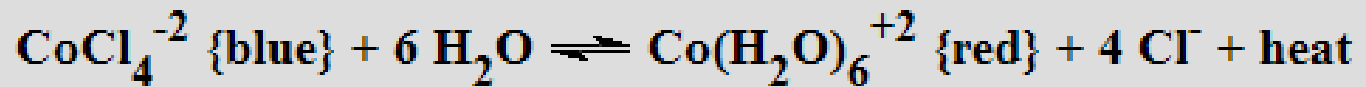
[V. Nitrogen dioxide system](#)



[VI. Copper sulfate system](#)



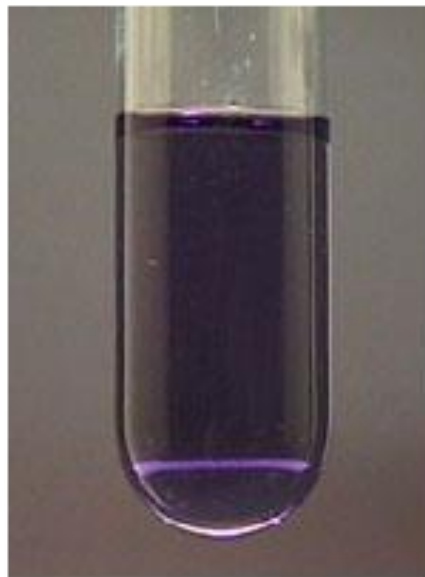
# Cobalt System



heat



cold



H<sub>2</sub>O

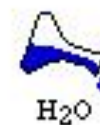
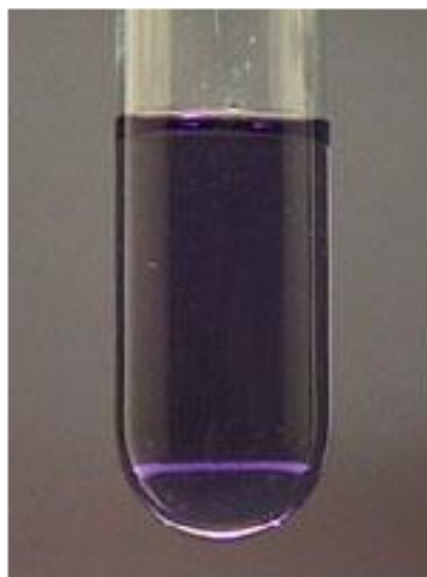
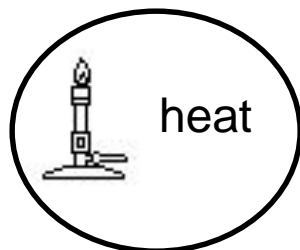
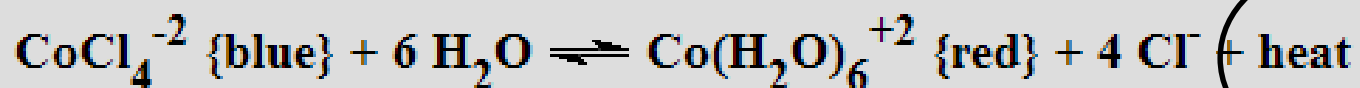


KCl

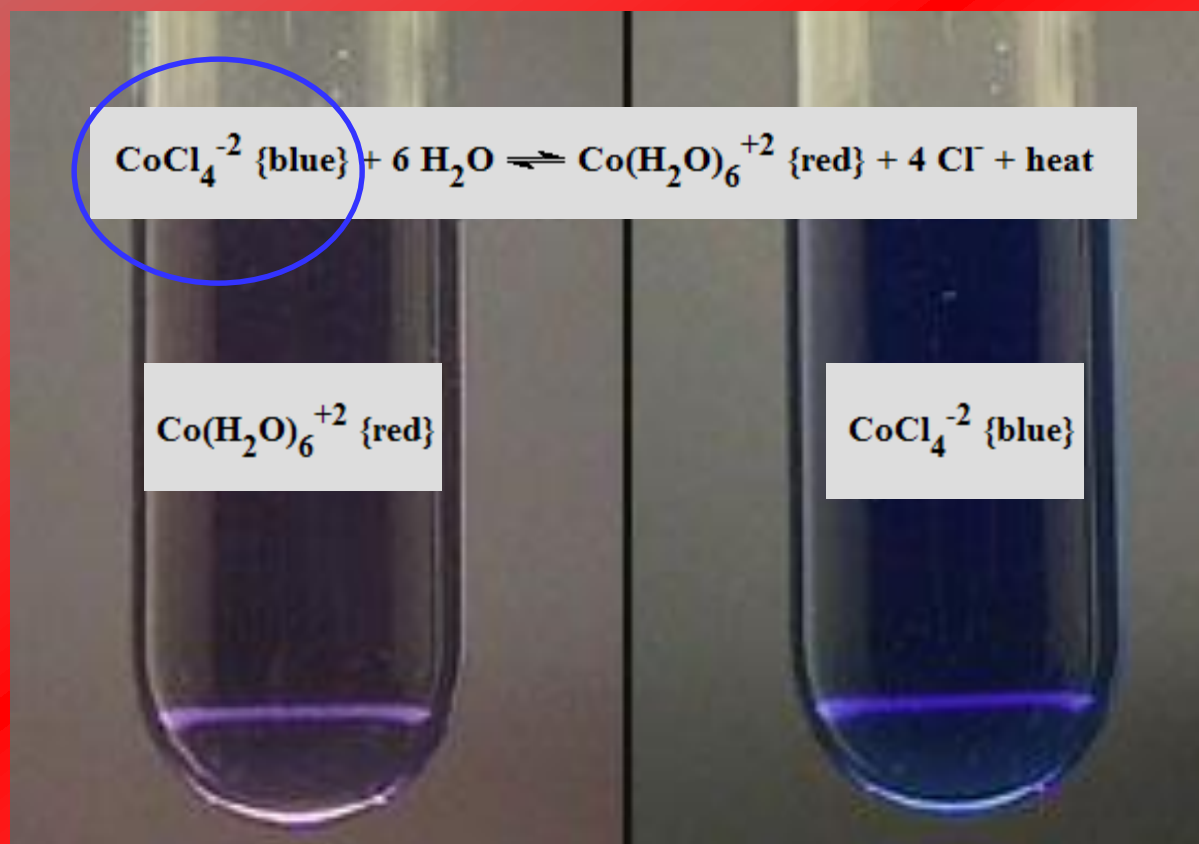


AgNO<sub>3</sub>

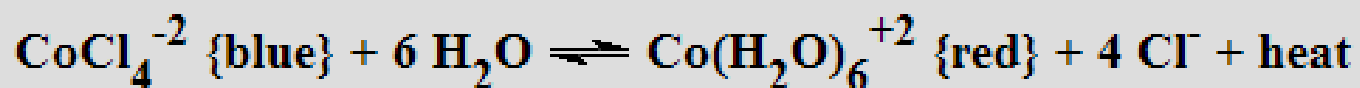
Predict what will happen if you click on the heat.



This reaction is **EXO**thermic (heat is a **product**). Therefore, heat will push the reaction **toward the reactants**

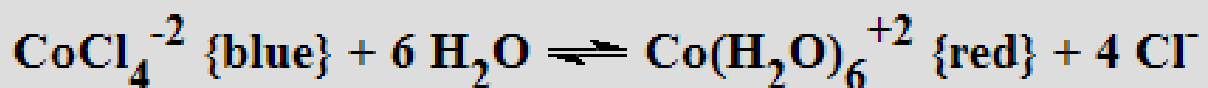


Predict what will happen if you click on the **COLD**.



The diagram illustrates the chemical equilibrium between the blue tetrachlorocobaltate(II) ion and the red hexa-aquacobalt(II) ion. A central test tube contains a red solution. To the left, a Bunsen burner icon is labeled 'heat', and a beaker icon with a circle around it is labeled 'cold'. To the right, three beaker icons are labeled 'H<sub>2</sub>O', 'KCl', and 'AgNO<sub>3</sub>', representing substances that can be added to the solution.

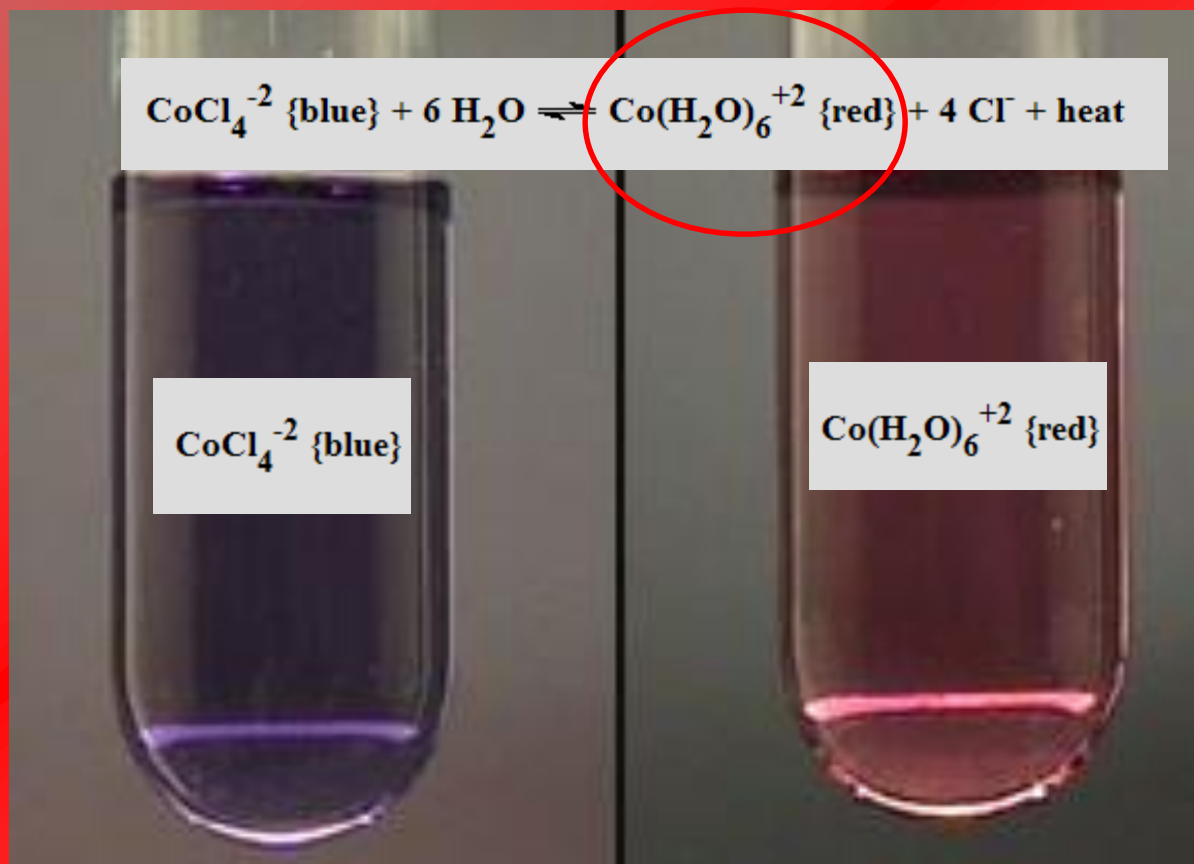
This reaction is **ENDO**thermic  
(taking heat away from the product side).



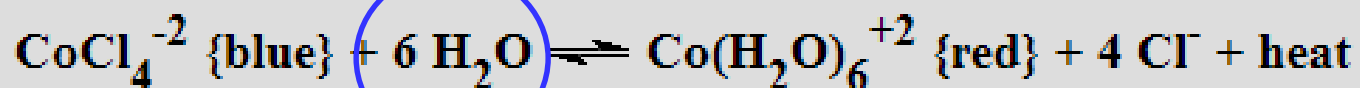
The diagram illustrates the equilibrium between the blue  $\text{CoCl}_4^{2-}$  complex and the red  $\text{Co}(\text{H}_2\text{O})_6^{+2}$  complex in a test tube. The test tube contains a purple liquid, representing the equilibrium mixture. To the left of the test tube, a Bunsen burner is labeled "heat", and a beaker with ice cubes is labeled "cold". To the right of the test tube, three beakers are shown, each containing a different substance:  $\text{H}_2\text{O}$ ,  $\text{KCl}$ , and  $\text{AgNO}_3$ .



This reaction is **ENDO**thermic  
(taking heat away from the product side).  
Therefore, pushing the reaction back  
toward the products



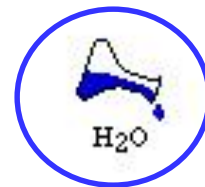
Predict what will happen if you click on the water.



heat



cold



H<sub>2</sub>O

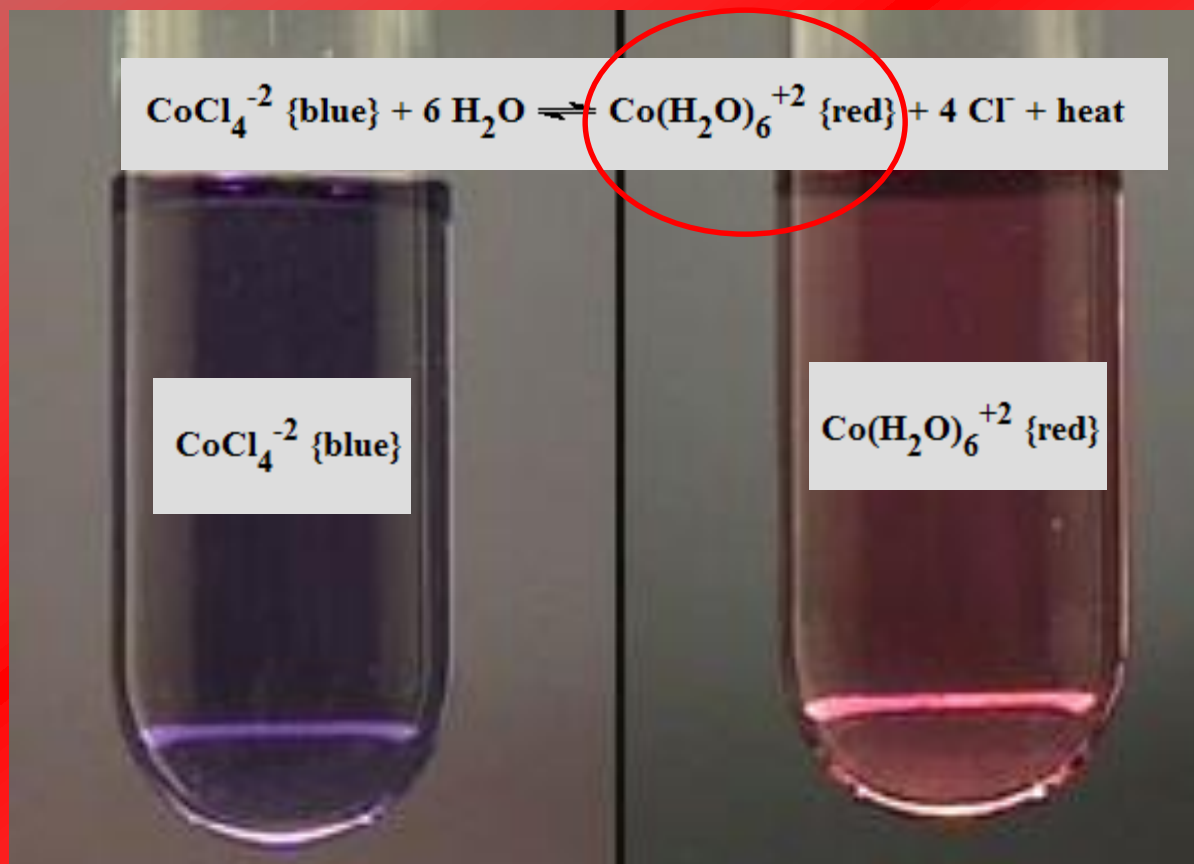


KCl

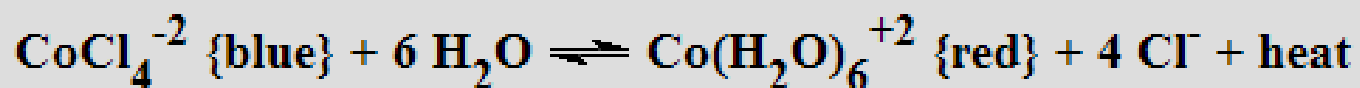


AgNO<sub>3</sub>

Adding **water** (REACTANT)  
will push the reaction to make more product.



Predict what will happen if you click on the KCl.



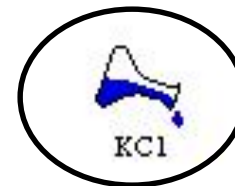
heat



cold



H<sub>2</sub>O

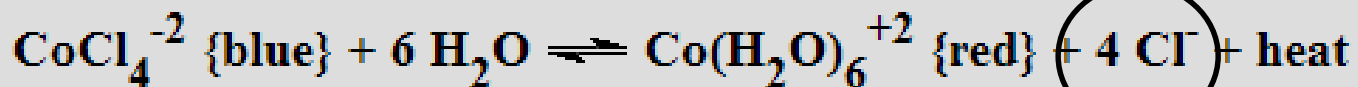


KCl



AgNO<sub>3</sub>

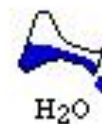
KCl dissociates into  $K^+$  and  $Cl^-$  ions,  
making more  $Cl^-$  ions  
available on the product side



heat



cold



$H_2O$

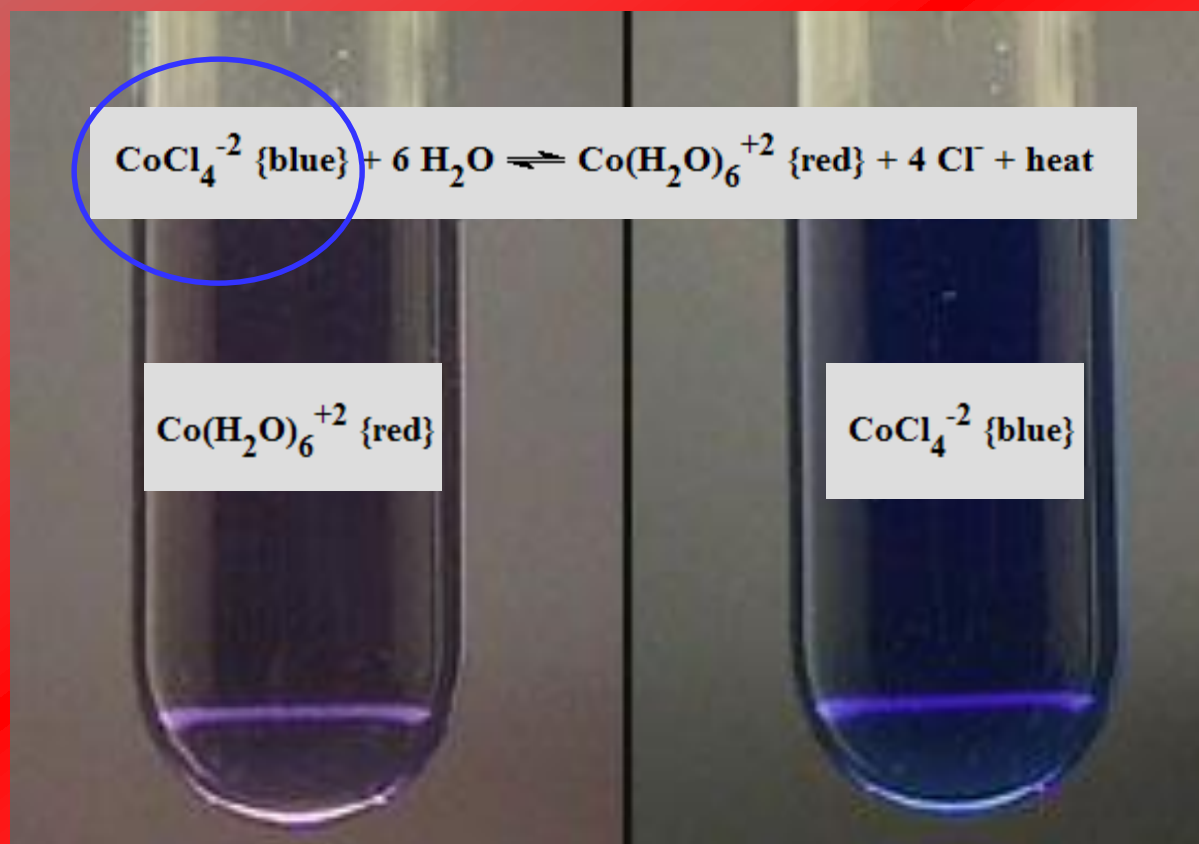


KCl

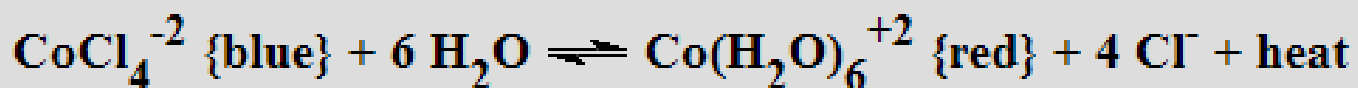


$AgNO_3$

Adding KCl will, therefore, push the reaction towards the reactants



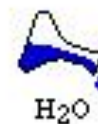
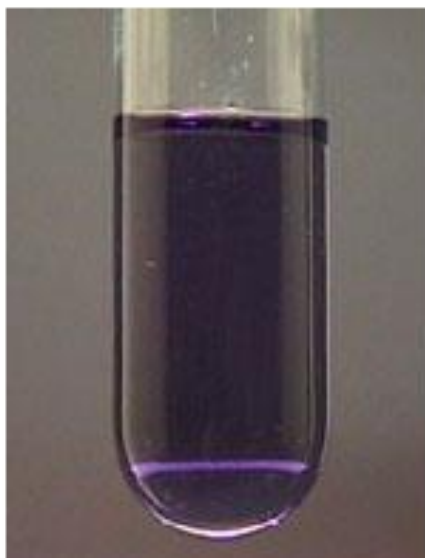
Predict what will happen if you click on the Silver Nitrate.



heat



cold



H<sub>2</sub>O



KCl



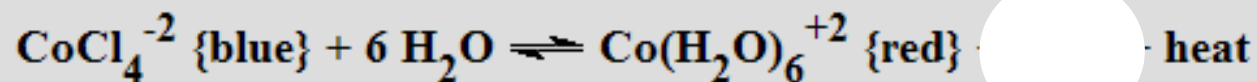
AgNO<sub>3</sub>

NOTES:

- Silver ions react with chloride ions to form the insoluble compound silver chloride.

## NOTES:

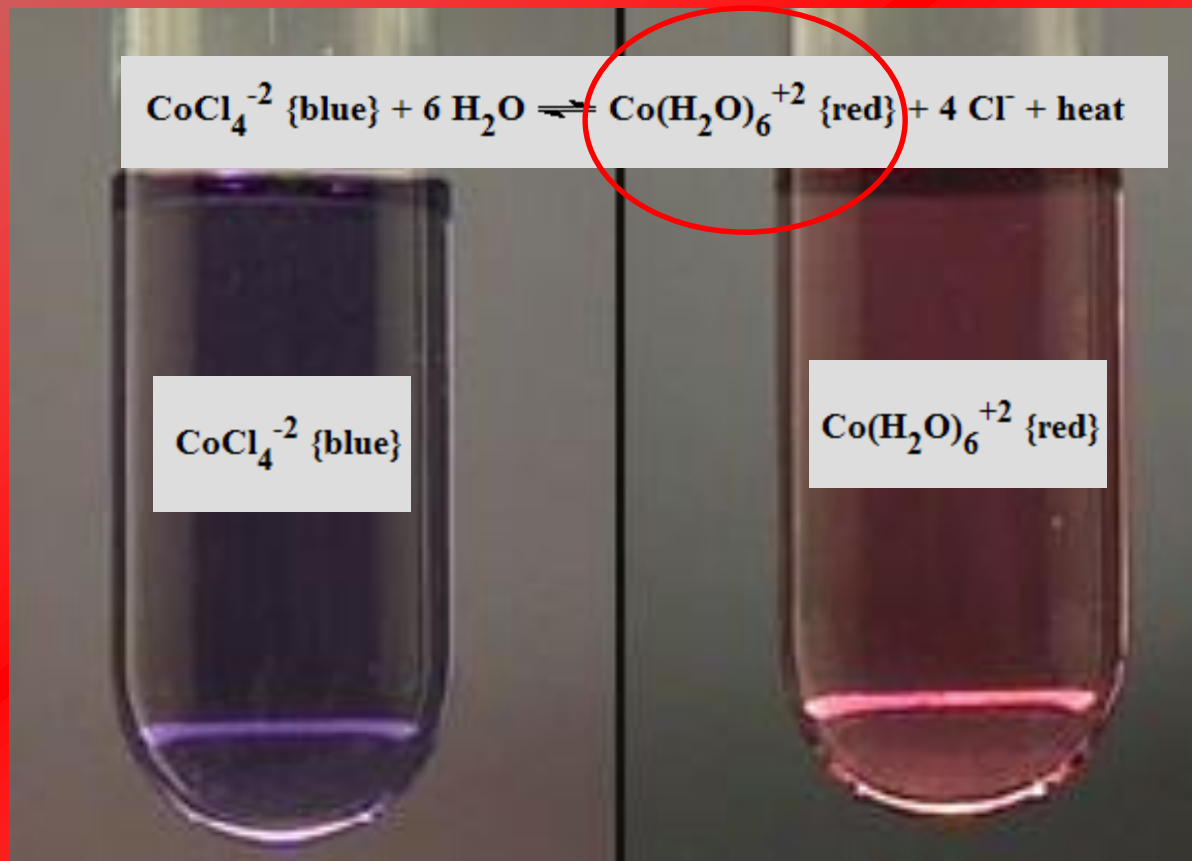
- Silver ions react with chloride ions to form the insoluble compound silver chloride.



Adding **silver nitrate** removes the **Cl- ions** from the product side and will push the reaction to make more **product**.



Adding **silver nitrate** removes the **Cl<sup>-</sup> ions** from the product side and will push the reaction to make more **product**.



Click on each system one at a time.  
**PREDICT** the results and then  
perform the experiment

**Performing the Experiment and Results**



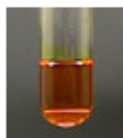
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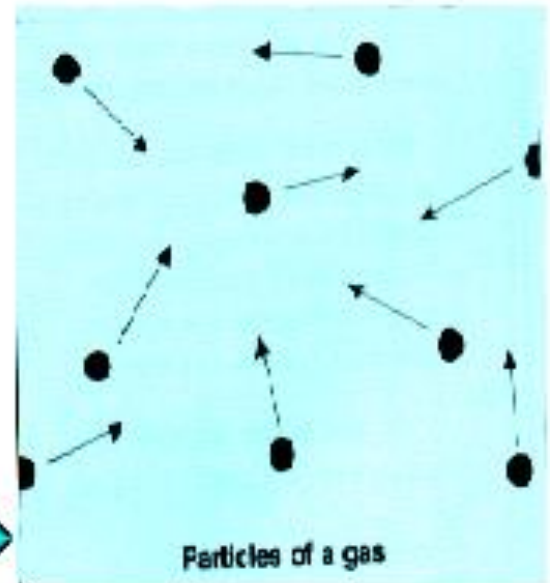


[V. Nitrogen dioxide system](#)



[VI. Copper sulfate system](#)

# Consider Gases



Assume a reaction is taking place  
in the **gas** phase

- What would be the effect on equilibrium position of increasing the **pressure** inside the container?

# Assume a reaction is taking place in the **gas** phase

- What would be the effect on equilibrium position of increasing the **pressure** inside the container?

**Pressure would affect the gases IF there is an unequal number of moles of reactants than products.**

**e.g. squeeze a balloon on the left side and it pushes to the right ... and vice versa**

# Define “Pressure” in terms of molecules in a container

- How does pressure affect a **solid**?
- How does pressure affect a **liquid**?
- How does pressure affect a **gas**?

# Define “Pressure” in terms of molecules in a container

- How does pressure affect a **solid**?

**Very little**

- How does pressure affect a **liquid**?

**Very little**

- How does pressure affect a **gas**?

**Gases are extremely compressive and expansive**