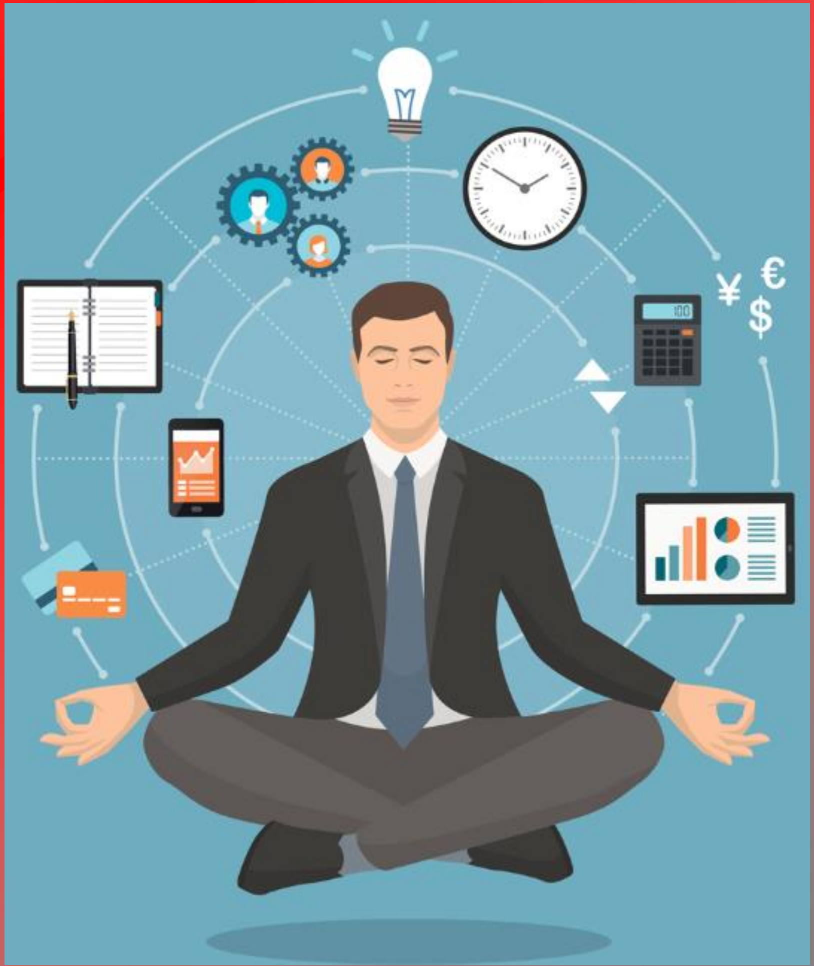
Lab

Stressing

Equilibrium



Click on:

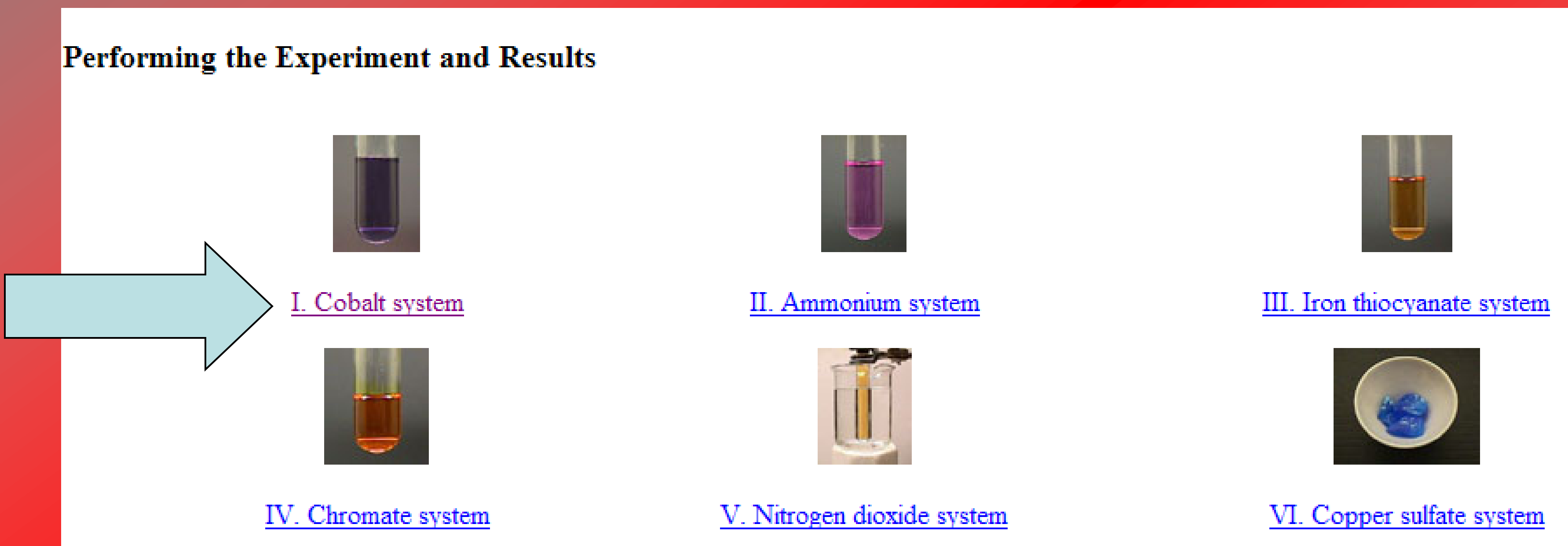
http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/equil/8perform.htm

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

OR

http://somup.com/cYhhY3jcmo

Click on the “Cobalt System”



Cobalt System

$$CoCl_4^{-2}\ \{blue\} + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2}\ \{red\} + 4\ Cl^- + heat$$

This chemical equation has "Heat" on the right side of the arrows, meaning that heat is given off or released as a product.

This is an EXOthermic reaction.

Notice that BEFORE the reaction proceeds, the solution is BLUE.

$$CoCl_4^{-2} \text{ \{blue\}} + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2} \text{ \{red\}} + 4\ Cl^- + \text{heat}$$

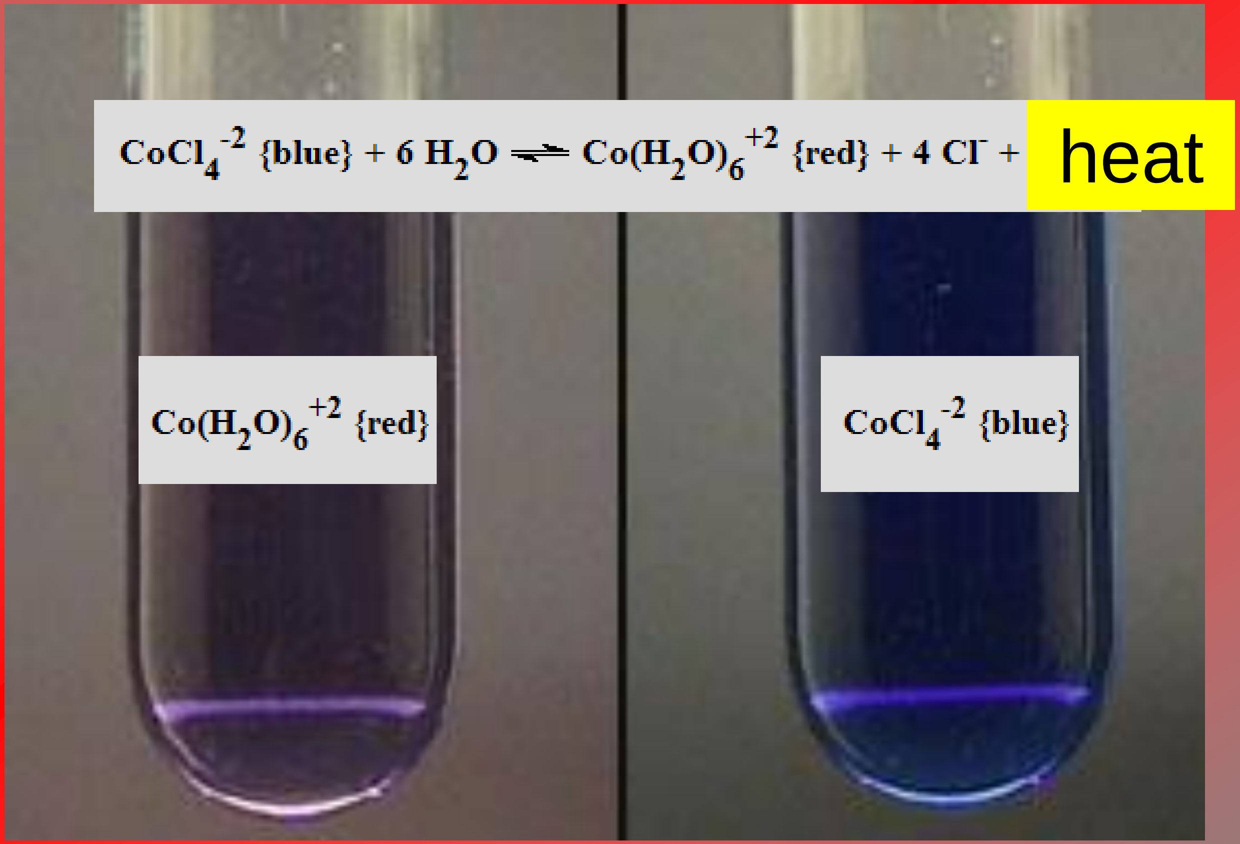
Cobalt system

Predict what will happen if you ADD heat to the system.

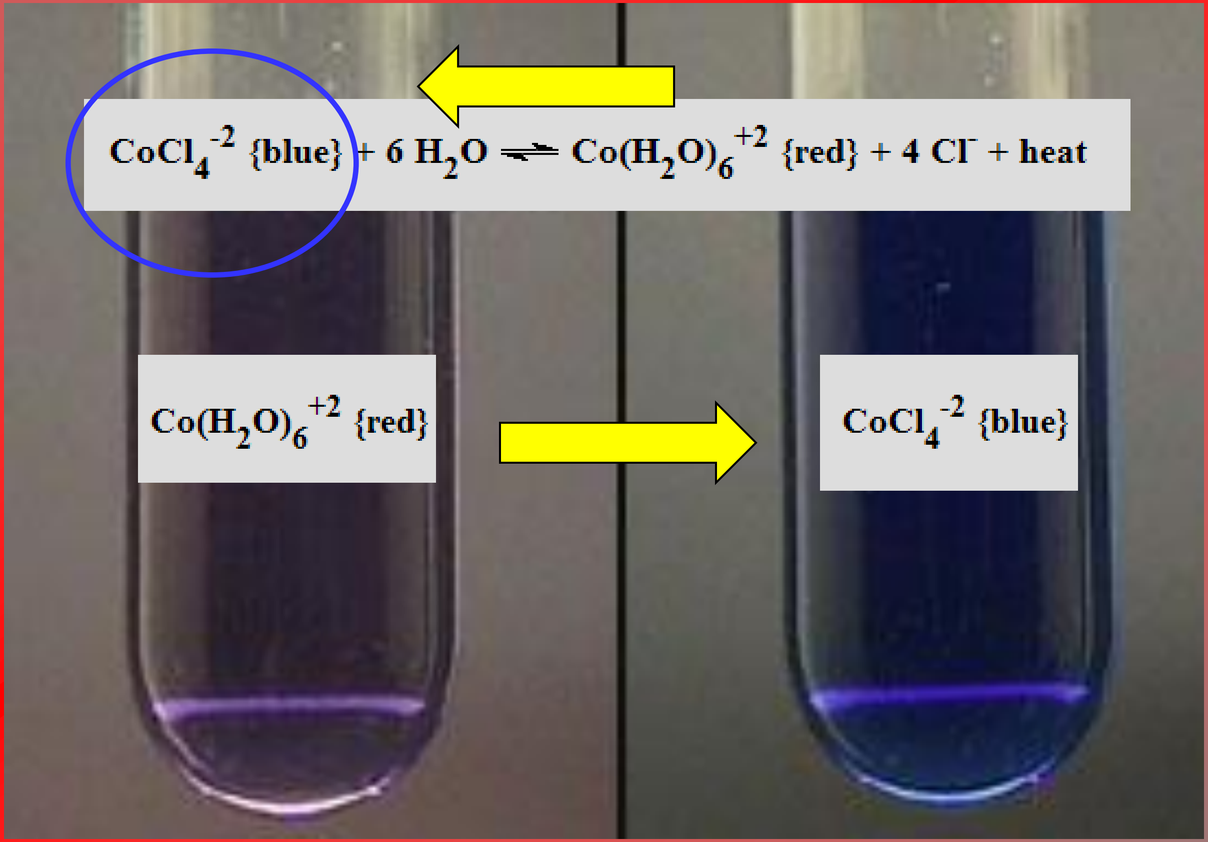
$$CoCl_4^{-2}\ \{blue\} + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2}\ \{red\} + 4\ Cl^- + heat$$

Cobalt system

This reaction is EXOthermic (heat is a product). Therefore, adding heat will STRESS the system.



To relieve the stress, the reaction will go toward the reactants to remove the heat.



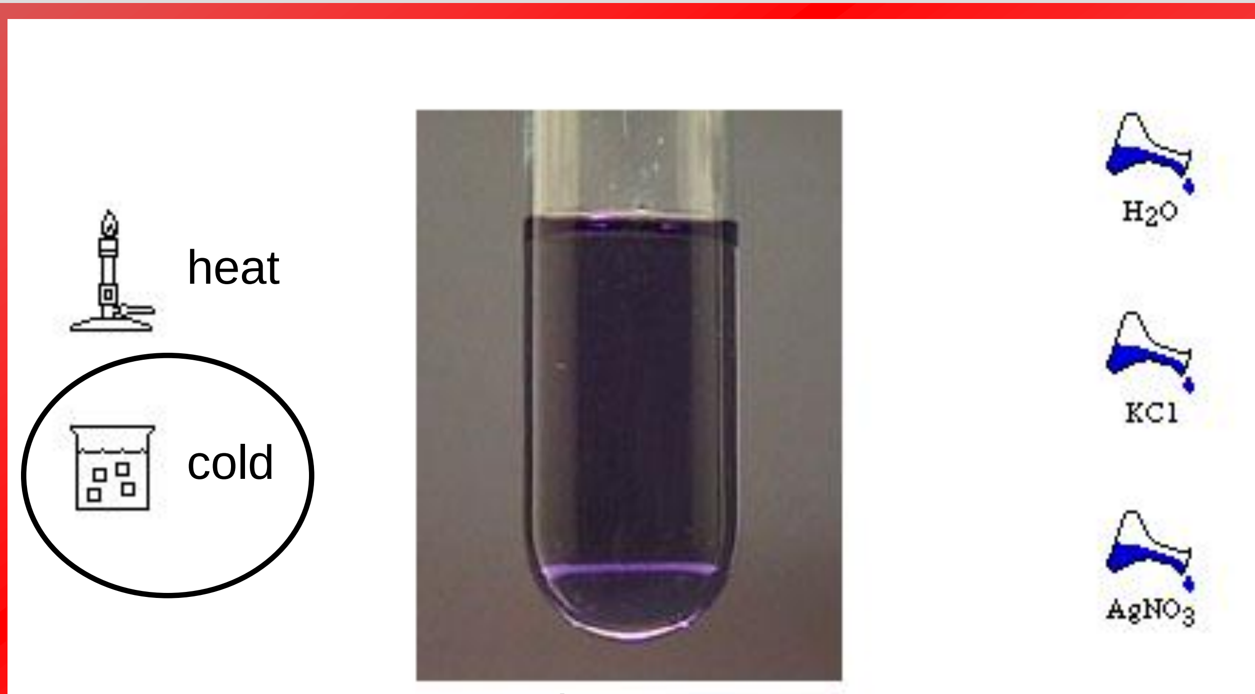
Predict what will happen if you click on the COLD.

$$CoCl_4^{-2} \text{ \{blue\} } + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2} \text{ \{red\} } + 4\ Cl^- + \text{heat}$$

Cobalt system

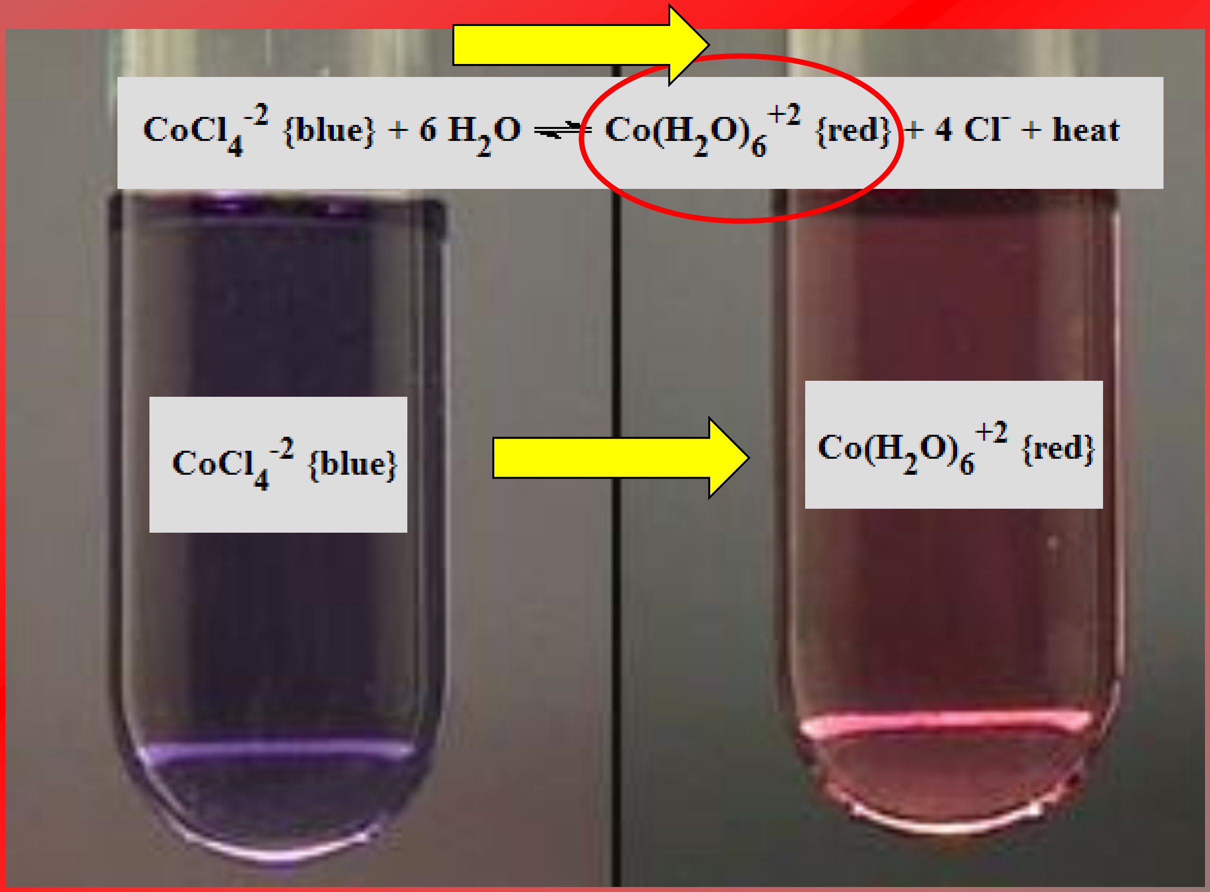
This reaction is ENDOthermic (taking heat away from the product side) and STRESSing the system.

$CoCl_4^{-2}$ {blue} + 6 $H_2O \rightleftharpoons Co(H_2O)_6^{+2}$ {red} + 4 Cl^- + ~~heat~~



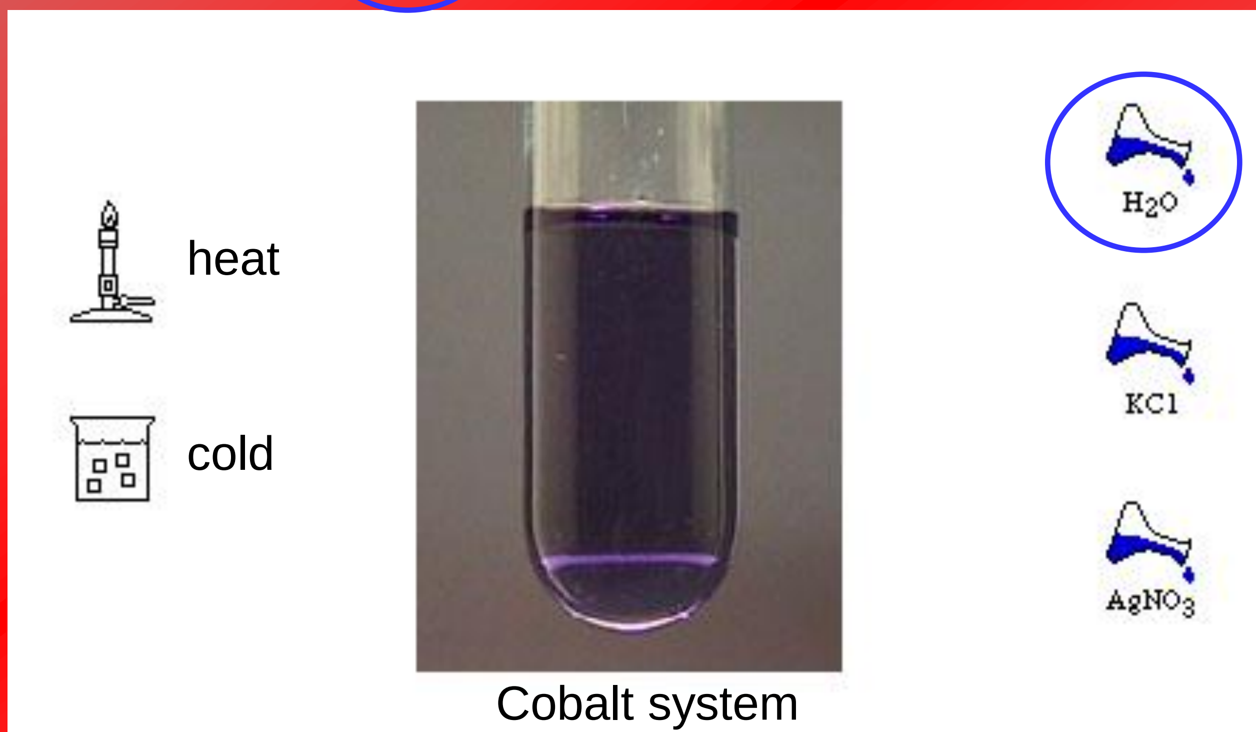
Cobalt system

To relieve the stress, the reaction will go toward the products to replace the heat.

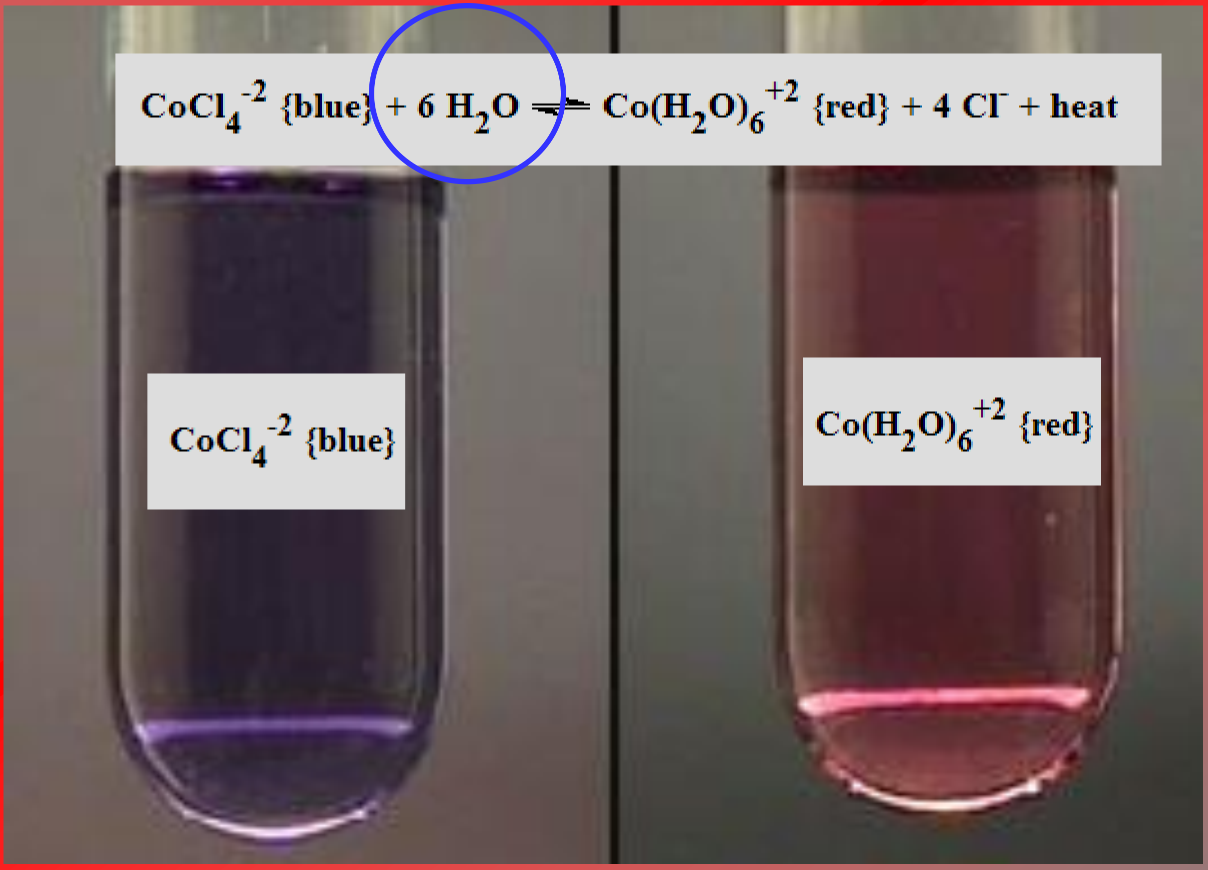


Predict what will happen if you click on the water.

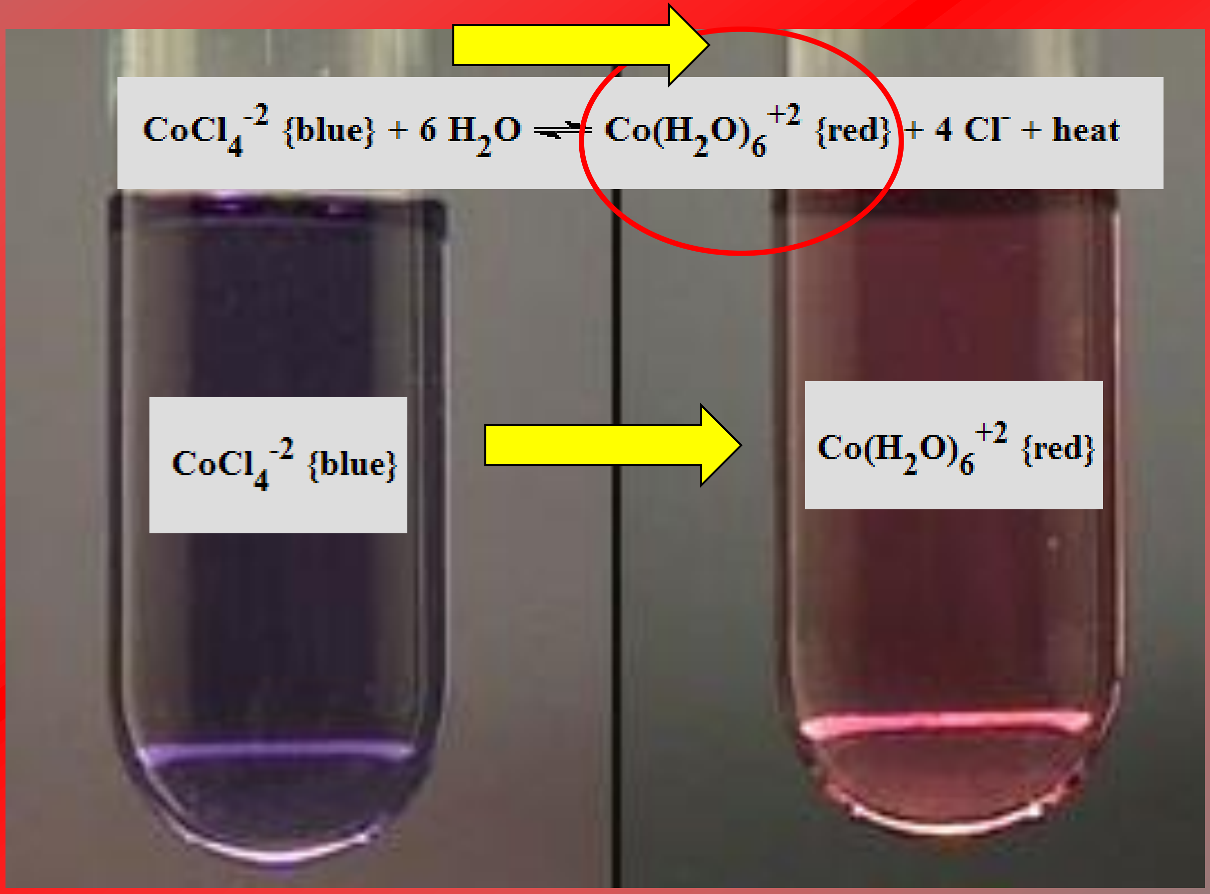
$$CoCl_4^{-2}\ \{blue\} + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2}\ \{red\} + 4\ Cl^- + heat$$



Adding water (REACTANT) will STRESS the system with too much reactant.

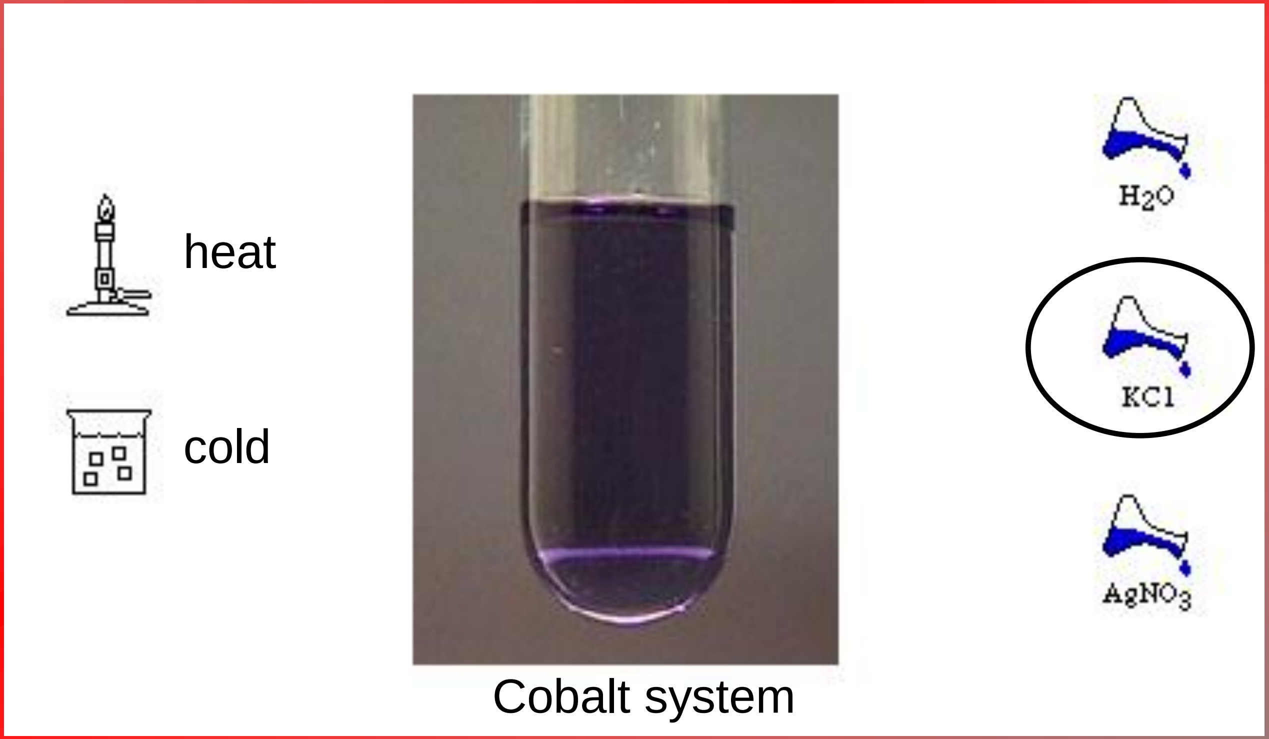


To relieve the stress the reaction will go towards more product to remove the excess water.



Predict what will happen if you click on the KCl.

$$CoCl_4^{-2}\ \{blue\} + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2}\ \{red\} + 4\ Cl^- + heat$$

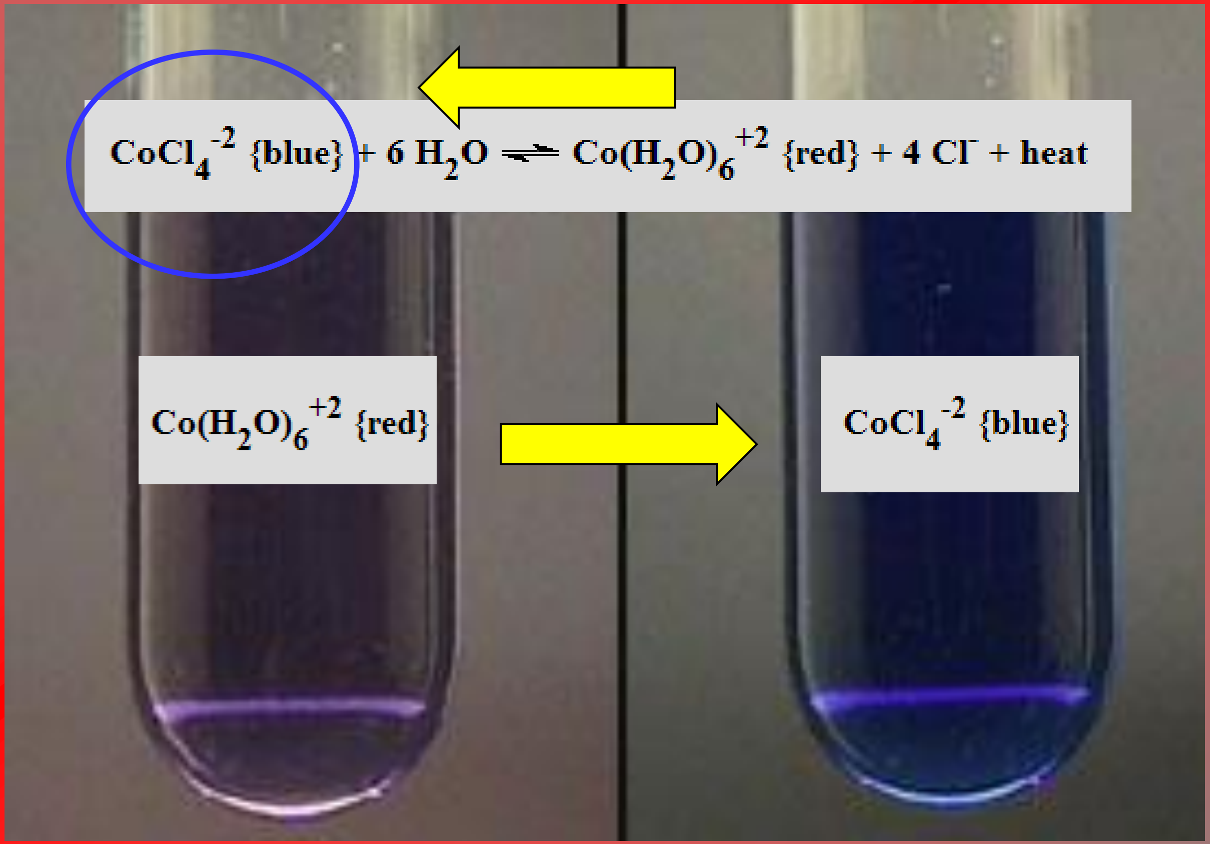


KCl dissociates (splits up) into K+ and Cl- ions, making more Cl- ions available on the product side, and STRESSING the system.

$$CoCl_4^{-2}\ \{blue\} + 6\,H_2O \rightleftharpoons Co(H_2O)_6^{+2}\ \{red\} + 4\,Cl^- + heat$$

Cobalt system

Adding KCl will, therefore, push the reaction towards the reactants to remove the excess Cl- ions.



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

$$CoCl_4^{-2}\ \{blue\} + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2}\ \{red\} + 4\ Cl^- + heat$$

NOTES:

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

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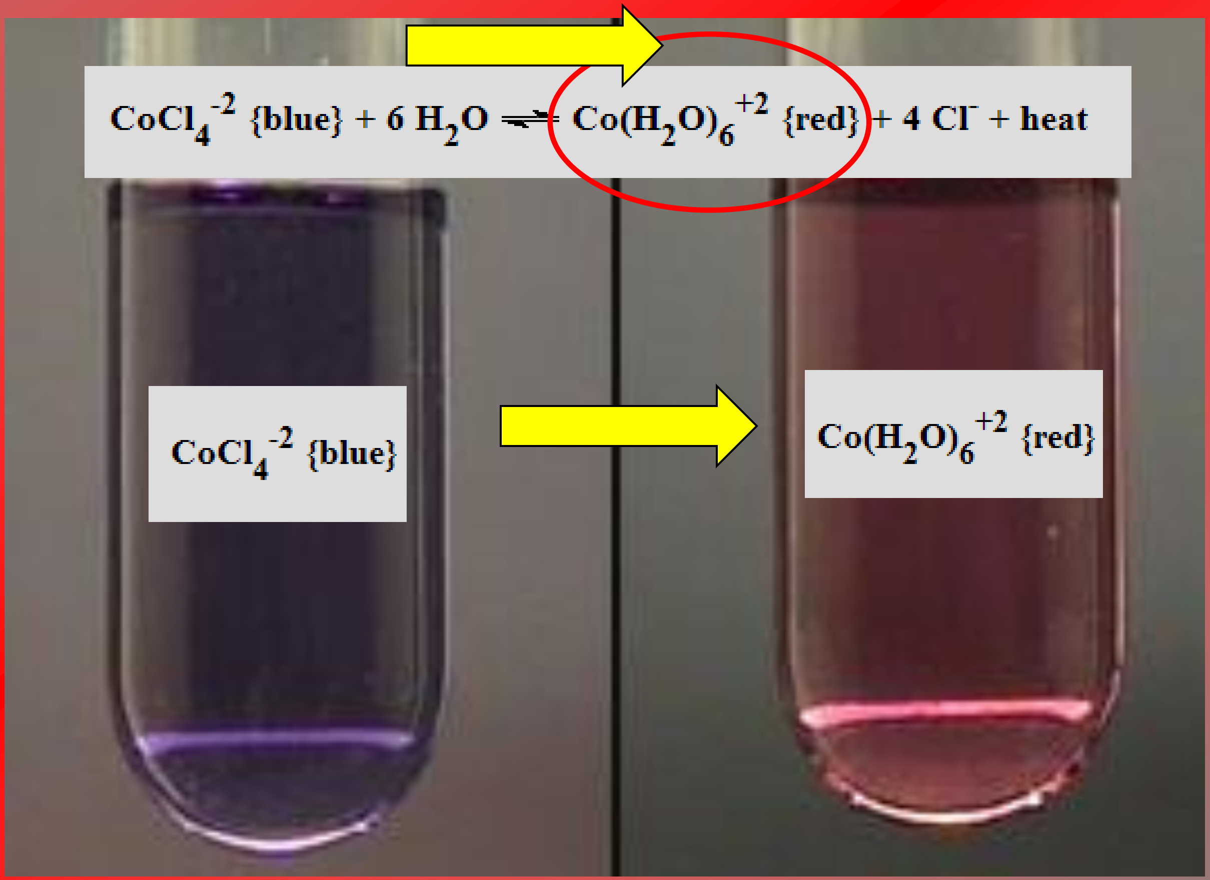
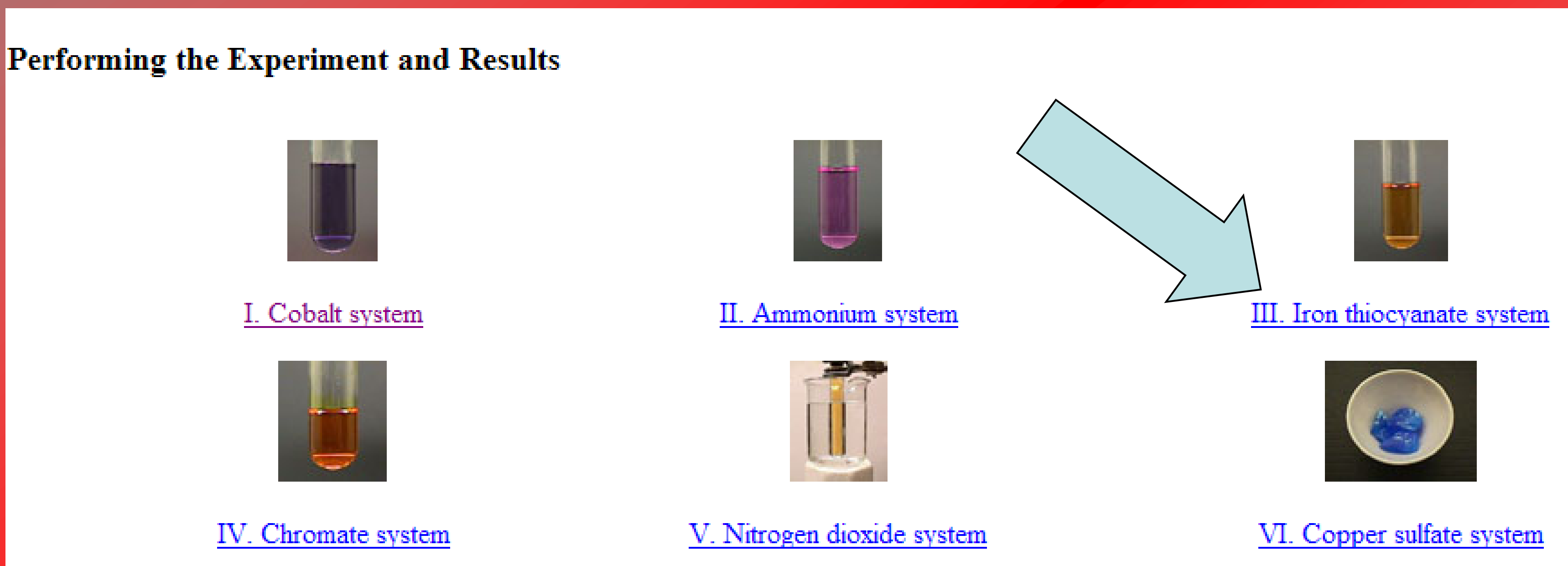
$$CoCl_4^{-2} \text{ \{blue\}} + 6\ H_2O \rightleftharpoons Co(H_2O)_6^{+2} \text{ \{red\}} + 4\ Cl^- + \text{heat}$$

Silver Nitrate dissociates (splits up) into cations/anions. The Silver (Ag+) cations bond with the Cl- ions, removing them from solution. The STRESS is that now there are not enough Cl- ions on the product side of the reaction.

Adding silver nitrate removes the Cl- ions from the product side. To remove the STRESS, the reaction adjusts to make more Cl- ions (product).



Click on the Iron Thicyanate system



Iron Thiocyanate system

Fe^{+3} {pale yellow} + SCN^{-} $\rightleftharpoons$ $FeSCN^{+2}$ {red} + heat

This chemical equation has "Heat" on the right side of the arrows, meaning heat is given off or released as a product.

This is an EXOthermic reaction.

Notice that the product is RED in color as the reaction proceeds.

Fe^{+3} {pale yellow} + SCN^{-} $\rightleftharpoons$ $FeSCN^{+2}$ {red} + heat

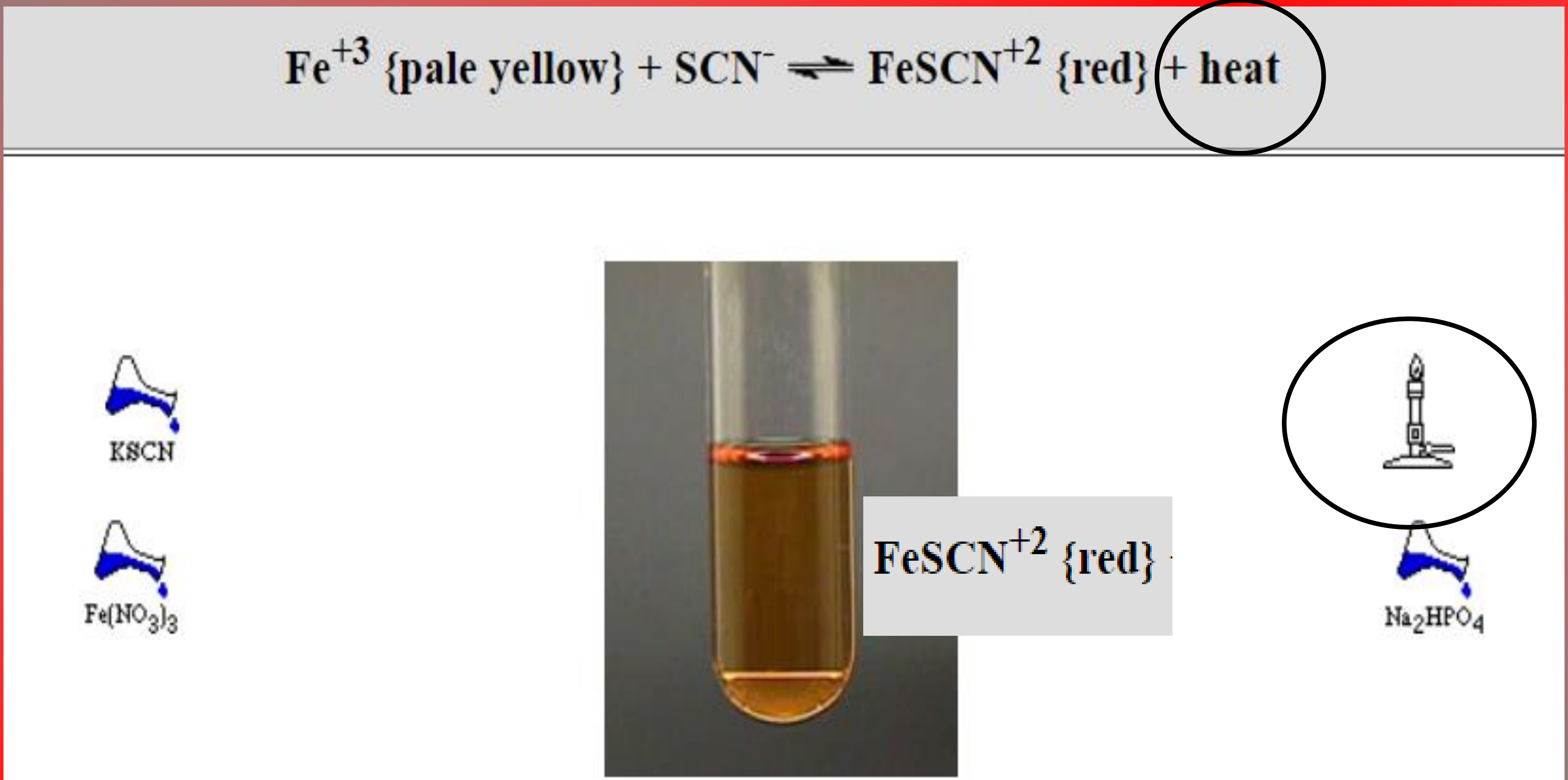
KSCN

$Fe(NO_3)_3$

Na_2HPO_4

Iron Thiocyanate system

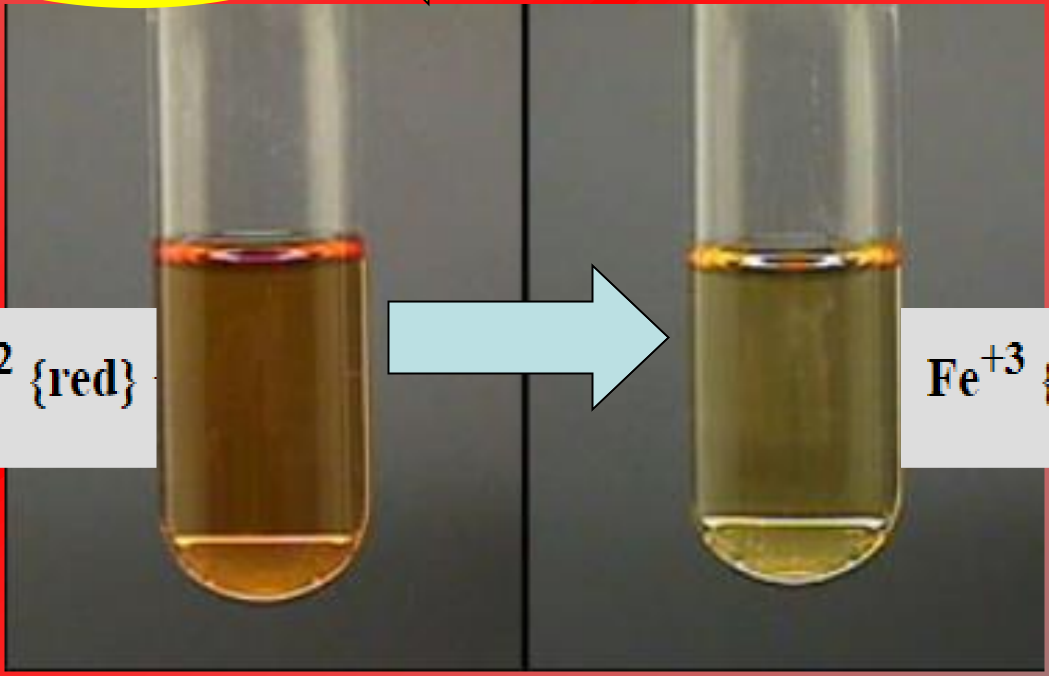
Predict what will happen if you ADD heat to the system.



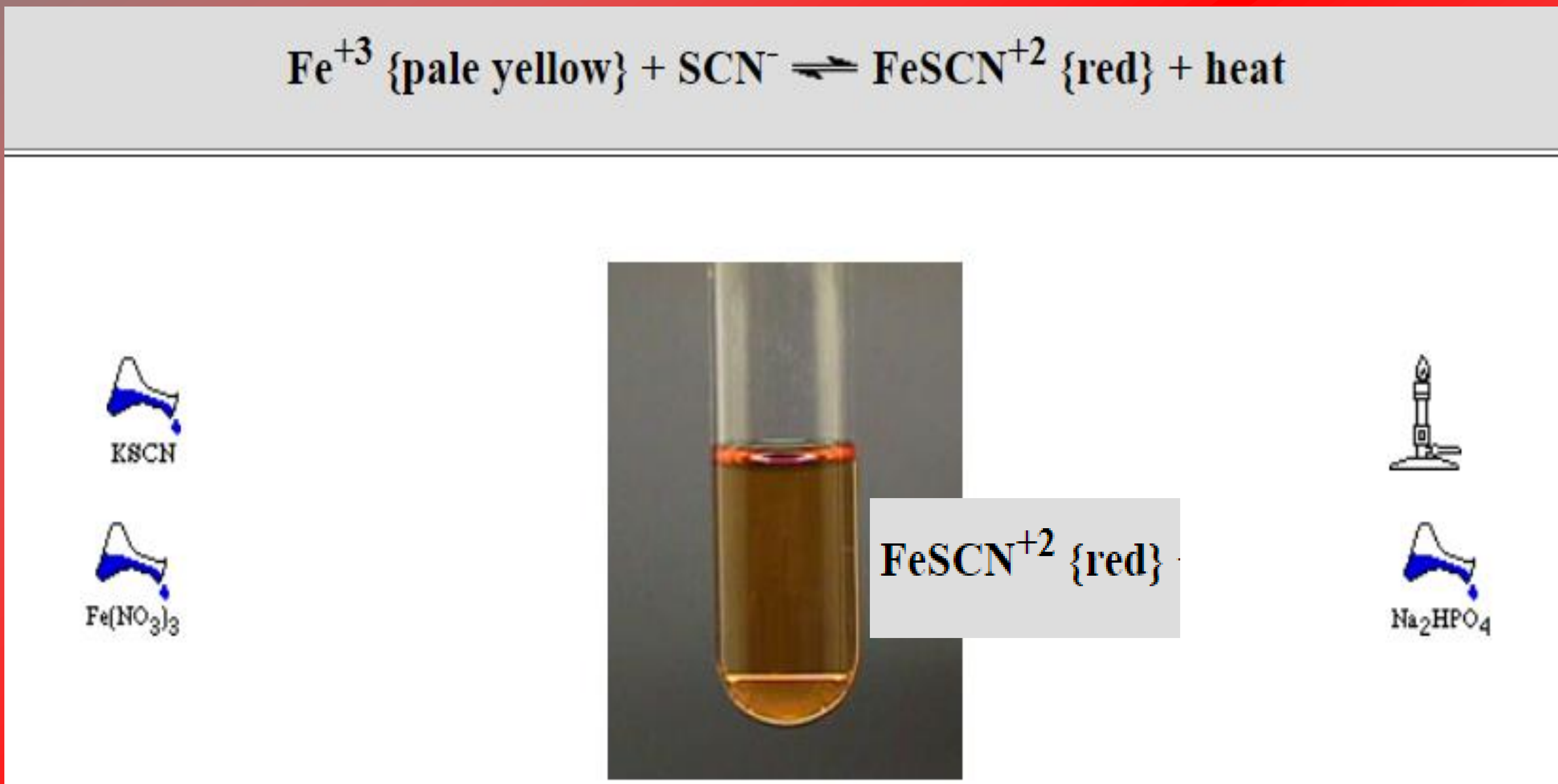
Iron Thiocyanate system

This reaction is EXOthermic (heat is a product). Therefore, adding heat will push the reaction toward the reactants to remove the heat.

Fe^{+3} {pale yellow} + SCN^{-} $\rightleftharpoons$ $FeSCN^{+2}$ {red} + heat



Predict what will happen if you click on the KSCN.



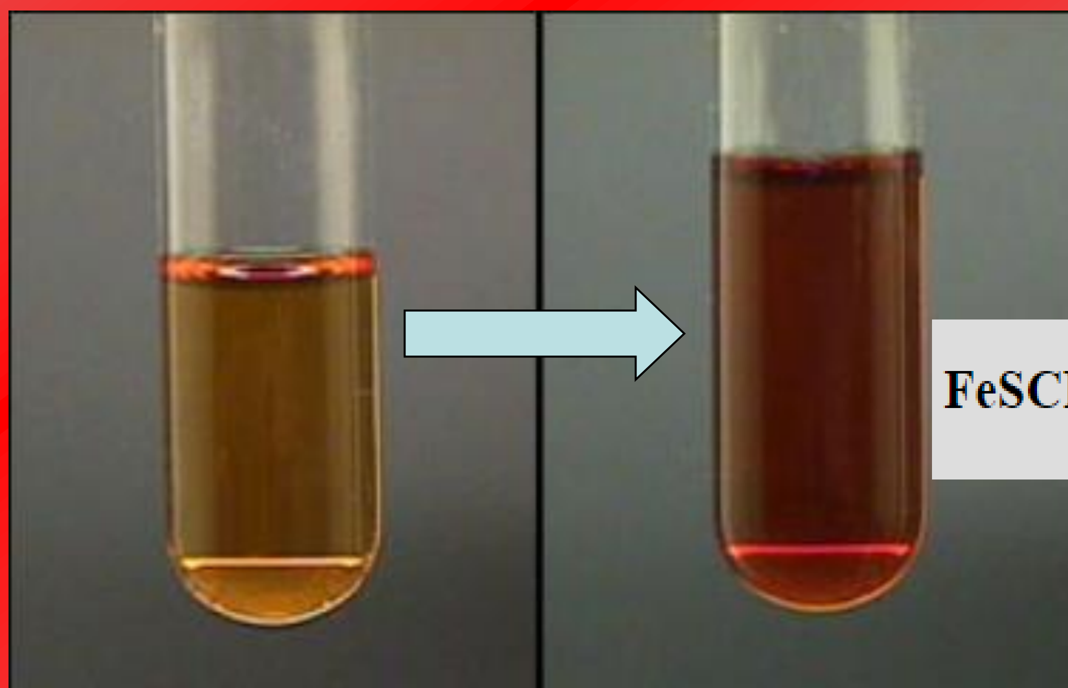
Iron Thiocyanate system

Fe^{+3} {pale yellow} + SCN^{-} $\rightleftharpoons$ $FeSCN^{+2}$ {red} + heat

KSCN dissociates (splits up) into cations/anions. Potassium (K+) cations form and SCN- anions also form, meaning there is MORE SCN- reactants in solution. This stresses the system.

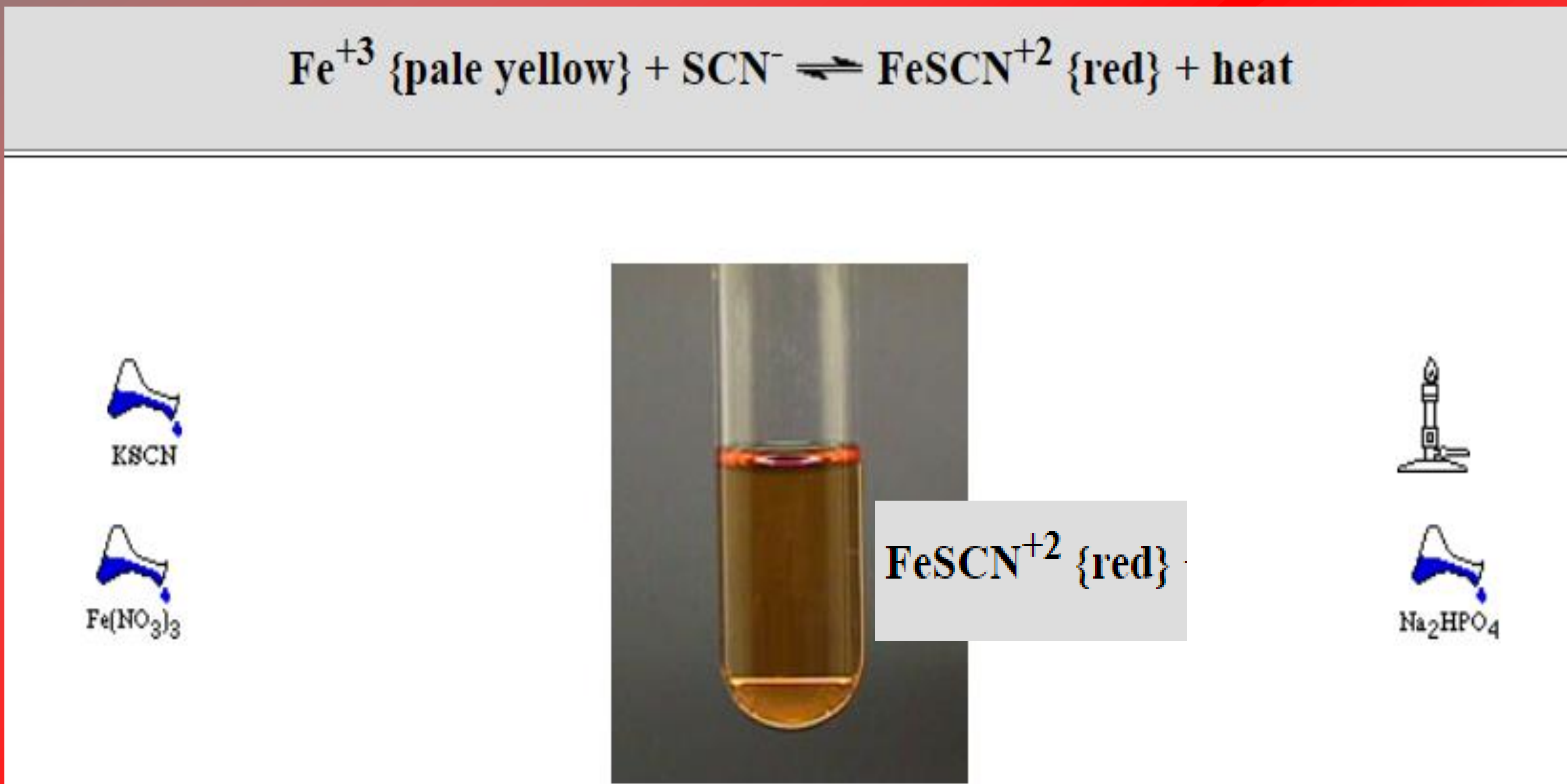
To relieve the stress, the reaction will go toward the products to remove the excess SCN- anions.

$$Fe^{+3} \text{ \{pale yellow\}} + SCN^{-} \rightleftharpoons FeSCN^{+2} \text{ \{red\}} + \text{heat}$$



$FeSCN^{+2}$ {red}

Predict what will happen if you click on the $Fe(NO_3)_3$.



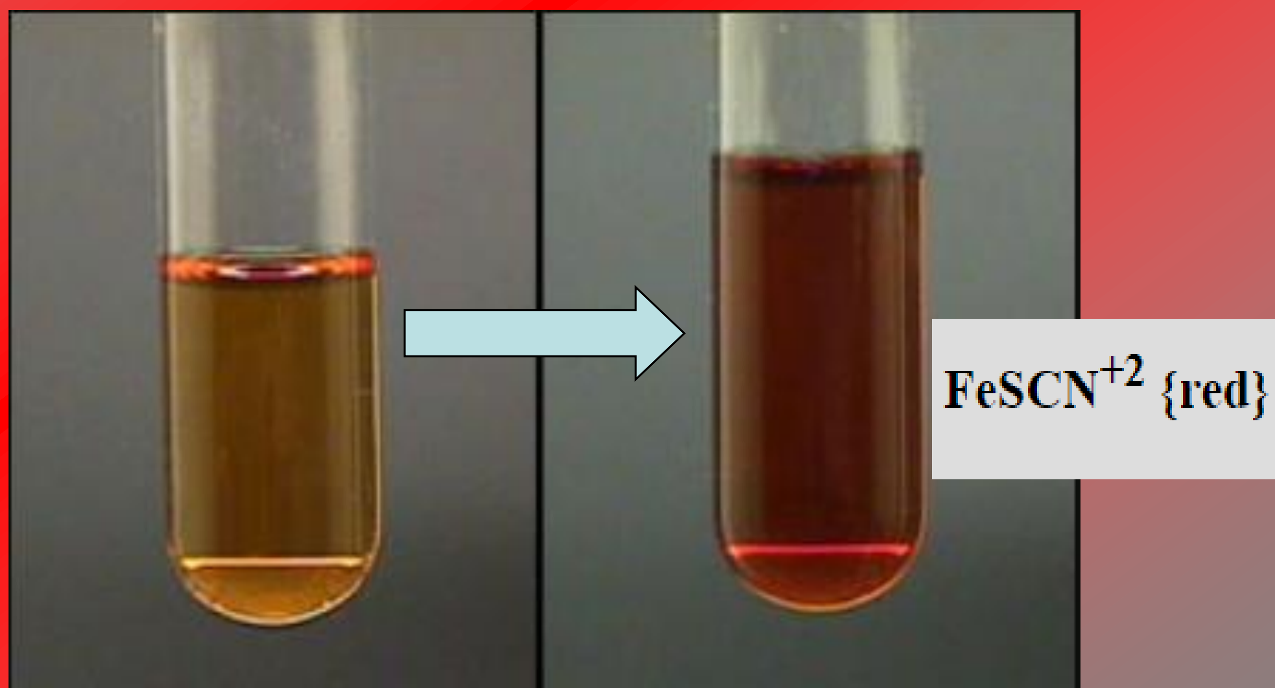
Iron Thiocyanate system

Fe^{+3} {pale yellow} + SCN^{-} ⇌ $FeSCN^{+2}$ {red} + heat

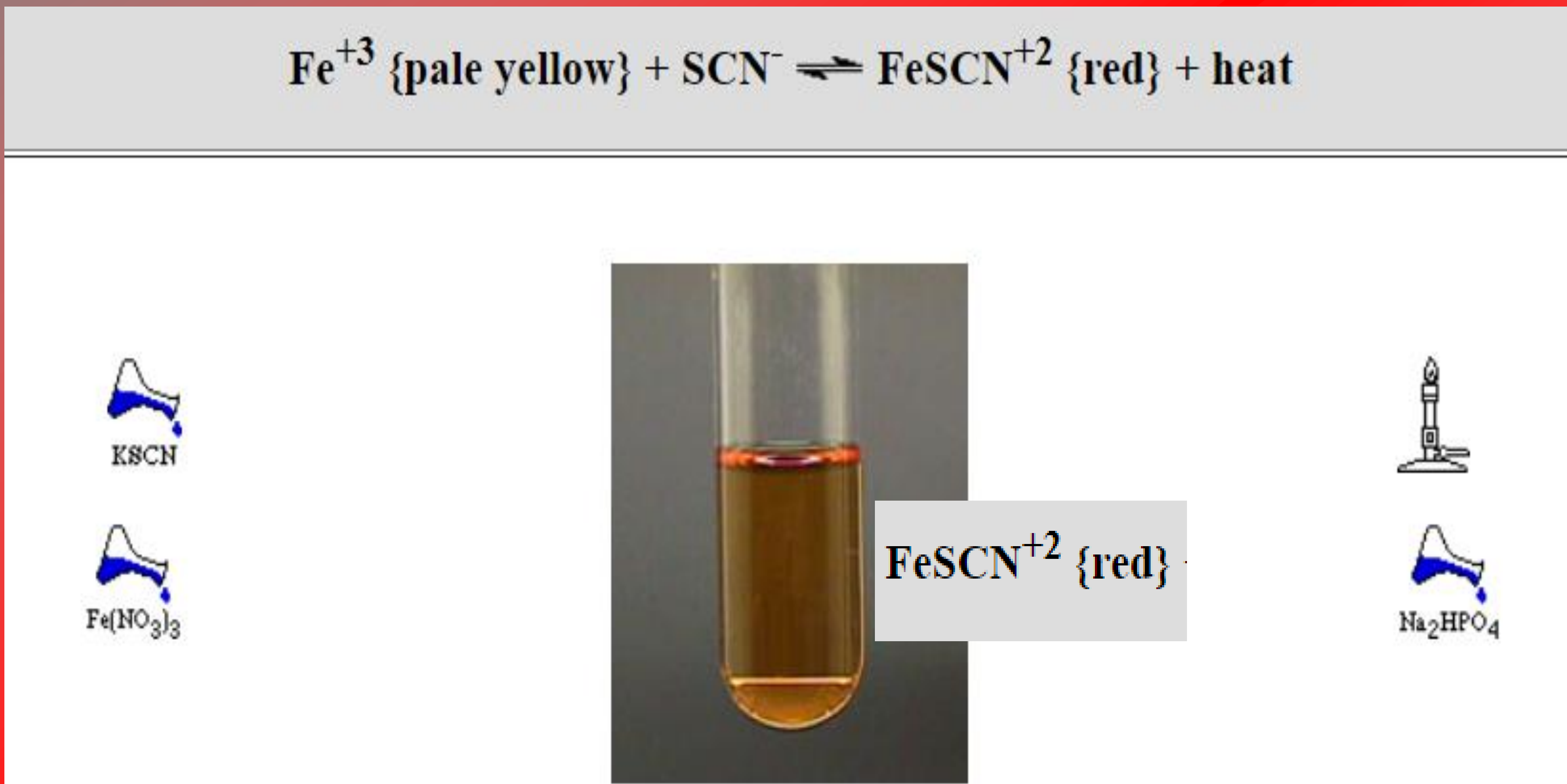
$Fe(NO_3)_3$ dissociates (splits up) into cations/anions. Iron (Fe^{+3}) cations form, meaning there are MORE Fe^{+3} reactants in solution. This stresses the system.

To relieve the stress, the reaction will go toward the products to remove the excess Fe^{+3} anions.

$$Fe^{+3} \text{ \{pale yellow\}} + SCN^{-} \rightleftharpoons FeSCN^{+2} \text{ \{red\}} + \text{heat}$$



Predict what will happen if you click on the $Na_2(HPO_4)$.



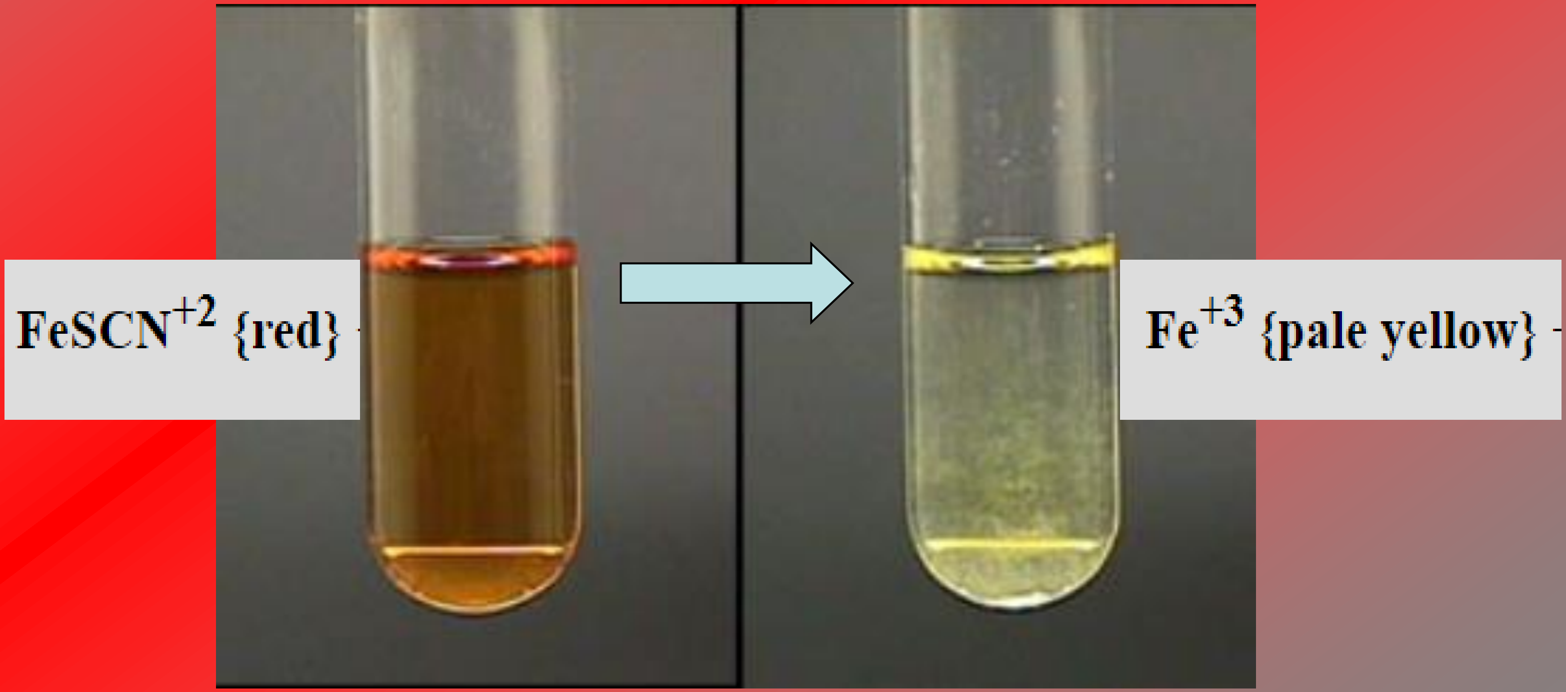
Iron Thiocyanate system

~~Fe^{+3} {pale yellow}~~ + SCN^- $\rightleftharpoons$ $FeSCN^{+2}$ {red} + heat

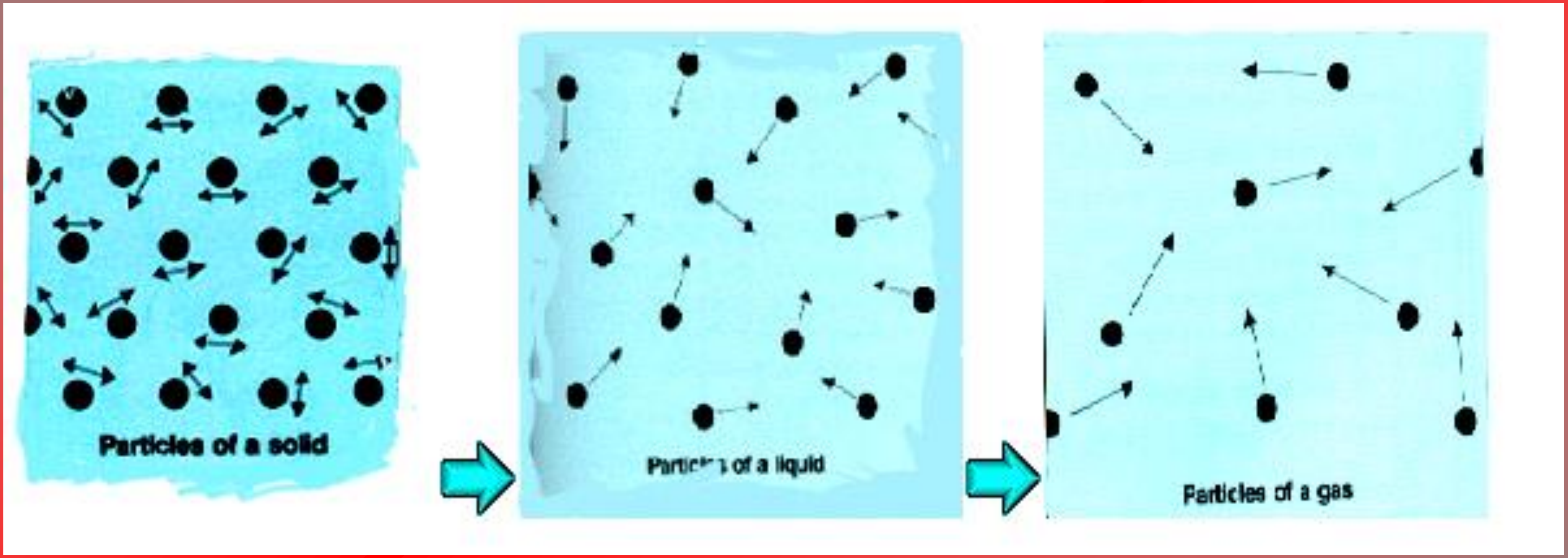
$Na_2(HPO_4)$ dissociates (splits up) into cations/anions. HPO_4 bonds with the Iron (Fe^{+3}) cations, removing the (Fe^{+3}) cations from the reactant side. This stresses the system.

To relieve the stress, the reaction will go toward the reactants to replace the Fe^{+3} anions.

$$Fe^{+3}\ \{\text{pale yellow}\} + SCN^{-} \rightleftharpoons FeSCN^{+2}\ \{\text{red}\} + \text{heat}$$



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