Le Chatelier's Principle: The Effect of Concentration and Temperature

When external stress is applied on a system at dynamic equilibrium, the system shifts the position of equilibrium so as to nullify the effect of stress.

Stress can be applied on chemical systems by changing the concentration, temperature or pressure. Therefore Le Chatelier's principle can also be stated as:

When a chemical system at dynamic equilibrium is disturbed by changing the concentration of either reactants or products; or by changing the partial pressures of any of gaseous reactants or of gaseous products; or temperature, the position of equilibrium is changed in that direction so as to establish a new equilibrium state i.e., either forward reaction or reverse reaction is favored.

In this lab the factors that will be investigated are concentration for,

Reaction Part A: $Co(H_20)_6{}^{2}\,(aq) + 4\ Cl^{-}\,(aq) \leftrightarrow CoCl_4{}^{2-}\,(aq) + 6H_2O\,(l)$

Pink Blue

and temperature for,

Reaction Part B: $CuCl_2\,(aq) \leftrightarrow Cu^{2+}\,(aq) + 2\ Cl^{-}\,(aq)$

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Purpose:_____

_____

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Materials:

Part A

Distilled Water bottle	50 ml beaker (for water) and dropper
HCl concentrated	2 Spot plates + White Paper
$CoCl_2$ solution	Stirring rod

$AgNO_3$ solution (careful this solution stains)

Part B

$CuCl_2$ solution

2 test-tubes & rack

1 beaker 100mL (for icy water and hot water)

1 graduated cylinder (10mL)

Procedure:

Part A

Using 2 spot plates, place 5 drops of $CoCl_2$ in 20 wells.

Add 2, 4, 6, 8, 10 drops of HCl to the $CoCl_2$ in each column.

Mix the contents of each well with a stirring rod, rinse the stirring rod with distilled water between each well. Record observations.

In second row, add one more drop of HCl to each well, and stir. Clean rod between each well. Record observations.

Place distilled water in a 50 ml beaker.
In third row, add five drops of distilled water to each well and stir. Clean rod between each well. Record observations.

In fourth row, add five drops of $AgNO_3$ in each well and stir. Clean rod between each well. Wait 2 minutes. Record observations.

5 drops $CoCl_2$ + 2 HCl	5 drops $CoCl_2$ + 4 HCl	5 drops $CoCl_2$ + 6 HCl	5 drops $CoCl_2$ + 8 HCl	5 drops $CoCl_2$ + 10 HCl	→ Control
5 drops $CoCl_2$ + 2 HCl	5 drops $CoCl_2$ + 4 HCl	5 drops $CoCl_2$ + 6 HCl	5 drops $CoCl_2$ + 8 HCl	5 drops $CoCl_2$ + 10 HCl	→ 1 more drop of HCl
5 drops $CoCl_2$ + 2 HCl	5 drops $CoCl_2$ + 4 HCl	5 drops $CoCl_2$ + 6 HCl	5 drops $CoCl_2$ + 8 HCl	5 drops $CoCl_2$ + 10 HCl	→ 5 drops of water
5 drops $CoCl_2$ + 2 HCl	5 drops $CoCl_2$ + 4 HCl	5 drops $CoCl_2$ + 6 HCl	5 drops $CoCl_2$ + 8 HCl	5 drops $CoCl_2$ + 10 HCl	→ 5 drops of $AgNO_3$

Results: Write the colour observed for each well. Note any formation of a precipitate as well as how much precipitate was formed.

Part B

Place 2 mL of $CuCl_2$ in 2 test tubes, keep one as a control.

Place test tube in a 100 ml beaker of hot water.

Record observations, compare with your control.

Put your test-tube in a beaker with one ice cube and water until a color change occurs. Record observations, compare with your control.

Dispose all chemicals and clean up your work area.

Analysis:

Refer to the reaction below to answer questions 1-3:

$$Co(H_20)_6^{\ 2}\ (aq) + 4\ Cl^-\ (aq) \leftrightarrow CoCl_4^{\ 2-}\ (aq) + 6H_2O\ (l)$$

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1. In what direction was the equilibrium shifted by

a. the addition of HCl?

b. the addition of water?

c. the addition of AgNO3?

2. How do you explain the results described in answers 1a and 1b?

3. Explain the results observed when $AgNO_3$ was added.

Refer to the reaction below to answer question 4.

$$CuCl_2\ (aq) \leftrightarrow Cu^{2+}\ (aq) + 2\ Cl^-\ (aq)$$

Green Blue

4. Is the reaction and endothermic or exothermic reaction? Explain your answer.

5. Write the equilibrium expressions for the systems studied in Parts A and B.

Conclusion: