

PRE-LAB DISCUSSION

A chemical equilibrium is obtained in a chemical system when the rates of opposing reactions become equal. At equilibrium no further change can be observed as far as a stress is applied to the system. The establishment of equilibrium is due to the tendency of minimum energy and maximum entropy.

PURPOSE

To learn how to recognize equilibrium state and what factors change the state of equilibrium.

EQUIPMENT

100mL beaker
test tube rack
tripod

watch glass
test tube holder
burner

4 test tubes
wire gauze
6 dropper

MATERIALS

iodine
2 M NaOH solution
0.2 M potassium chromate solution

concentrated HCl
distilled water

2 M HCl solution
0.2 M cobalt chloride solution

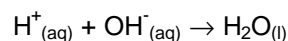
PROCEDURE**PART A: Phase Change Equilibrium; Sublimation of Iodine**

1. Put 2-3 small crystals of I₂ into a clean and dry beaker.
2. Place the beaker on the wire gauze.
3. Cover the beaker with a watch glass having some water on it.
4. Heat the solid crystals for 2 minutes and allow to cool.
5. After 10-15 minutes observe the beautiful crystals reformed at the bottom of the watch glass.

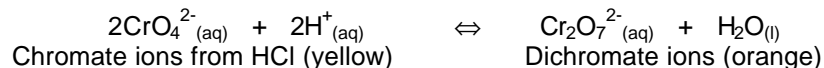
PART B: Chemical Equilibrium

Chromate and dichromate equilibrium

1. Put 4-5 drops of 0.2 M K_2CrO_4 solution into a test tube.
2. Add 4-5 drops of 2 M HCl acid solution (1). HCl completely dissociates into H^+ and Cl^- ions in water.
3. Add 20-25 drops of 2 M NaOH solution (2). NaOH exists as Na^+ and OH^- ions in aqueous solutions. OH^- ions coming from NaOH react with the H^+ ions according to the following reaction:



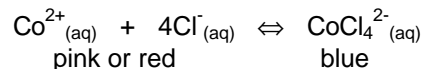
Chemical reaction occurring is:



Cobalt (II) and Chloride Equilibrium

1. Put 4-5 drops of 0.2M $CoCl_2$ solution into a test tube.
2. Add 20-25 drops of concentrated HCl acid (3).
3. Add 10-12 drops of water (4).
4. Heat the solution for 1-2 minutes (5).
5. Cool the solution under a tap for 1 minute (6).

Chemical reaction occurring is:



OBSERVATIONS AND DATA:

PART A: Phase Change Equilibrium; Sublimation

Write an equation for the reversible state change of I_2 solid and indicate the effect of temperature for this change.

PART B: Chemical Equilibrium

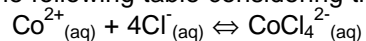
Chromate and Dichromate Equilibrium

For the equilibrium reaction: $2\text{CrO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightleftharpoons \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$ fill in the following table considering the new equilibrium states. Write 'less' or 'more' for molar concentrations of the ions.

Effect	Color	Shift to left or right	$[\text{CrO}_4^{2-}]$	$[\text{Cr}_2\text{O}_7^{2-}]$
Adding H^+ (1)				
Adding OH^- (removal of H^+) (2)				

Cobalt (II) and Chloride Equilibrium

1. Fill in the following table considering the new equilibrium states of the cobalt(II)-chloride reversible reaction:



Effect	Color	Shift to left or right	$[\text{Co}^{2+}]$	$[\text{Cl}^-]$	$[\text{CoCl}_4^{2-}]$
Adding Cl^- (3)					
Adding H_2O (4)					
Increasing temperature (5)					
Decreasing temperature (6)					

2. Is the reaction given above exothermic or endothermic?