# REPORT

# EXPERIMENT 4: CHEMICAL EQUILIBRIUM

Group: 3 Class: IELS22IU41 Date: 2/16/2023

Group members:

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| 2 | Nguyễn Thành Trí | IELSIU22112 | TEMPERATURE EFFECTS ON EQUILIBRIA |  |
| 3 | Đỗ Minh Duy | ITITSB22029 | Conclusions  TEMPERATURE EFFECTS ON EQUILIBRIA |  |
| 4 | Nguyễn Phan Tuấn Anh | BTFTIU22164 | ACID/BASE EQUILIBRIA  TEMPERATURE EFFECTS ON EQUILIBRIA |  |
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Total score: \_\_\_\_\_\_\_/100

**Part 1. Introduction**

A reversible reaction is a chemical reaction where the reactants form products that, in turn, react together to give the reactants back. Reversible reactions will reach an equilibrium point where the concentrations of the reactants and products will no longer change.

Le Chatelier’s principle: a reversible reaction at equilibrium can be disturbed if stresses are applied to it. Stresses can be changes in concentration, temperature, or pressure. The composition of the reaction mixture will shift until equilibrium has been reestablished. In this experiment, the effect of applying stresses to a variety of chemical systems at equilibrium will be observed, and we will also see if the results are consistent with Le Chatelier’s principle.

**Part 2. Materials and Methods**

**Materials**

* One 10mL pipette
* Graduated cylinder
* Graduated pipette
* Pipette
* Beakers
* Test tubes
* Test tube holder
* One test tube rack
* Ice bath
* Water bath
* Label

**Reagent**

* 0.5M K2CrO4
* 6M HCl
* Concentrated HCl
* 6M NaOH
* Methyl violet
* 0.1M FeCl3
* 0.1M KSCN
* 0.1M CaCl2
* 0.1M Na2C2O4
* 0.1M H2C2O4
* 6M NH4OH
* 0.1M AgNO3
* 0.1M CoCl2
* Distilled water

**Part 3. Results and Discussion**

**1. ACID/BASE EQUILIBRIA**

| Equilibrium System: **2CrO42− + 2H+ (aq)** ⇌ **Cr2O72− + H2O(l)** | | | |
| --- | --- | --- | --- |
| **Description of conditions** | **Predicted outcome** | **Observation** | **Discussion** |
| Initial solution | Light yellow |  | The solution contains ion **2CrO42−**  , which is the cause of the color |
| + Conc. HCl | Red |  | Since the acid HCl is added, the solution increased the number of ion H+. So the solution turn into orange |
| + 6 N NaOH | orange |  | When adding NaOH into the solution, OH- reacts with H+. Then the ion H+ decreases. |

**Note:**

The equilibrium equation : **2CrO42− + 2H+ (aq)** ⇌ **Cr2O72− + H2O**

* With anion CrO42−, the colour is yellow and with anion Cr2O72−, the colour is orange.
* After adding the concentrated HCl solution into the initial solution, the colour changed from yellow to orange.
* Then, we continued on adding the 6N NaOH solution in the previous mixture, the colour slightly changed from orange into a light-coloured orange.

**2. EQUILIBRIA OF ACID/BASE INDICATORS**

| Equilibrium System: **H(MV)(aq) + H2O(l)** ⇌ **H3O+(aq) + MV−(aq)** | | | |
| --- | --- | --- | --- |
| **Addition** | **Predicted outcome** | **Observation** | **Discussion** |
| None (control) | Dark purple |  | When distilled water was added, the color of methyl violet became lighter because the solution was diluted. |
| 6 M HCl | yellow |  | The solutio changes from purple to blue, then green, then yellow. Because the more acid HCL added into the solution, the more H+ ions appears. |
| 6 M NaOH | purple |  | The solution changes to light purple after adding NaOH. The concentration of OH- increase and decrease the concentration of H+ |
| 6 M HCl | mostly transparent |  | After added HCL, the solution turn into green transparent. Because we did not stir the solution enough so there was still a little bit of light purple |

**Note:**

* The equilibrium equation of the reaction: H + H2O ⇌ H3O+ + MV−.
* Chemical reaction that changes color when base and acid solutions are added:
* When adding HCL acid solution to methyl solution, the solution turns light blue, adding NaOH solution turns purple-pink and adding HCL will turn the solution into light blue.
* The methyl solution has a light purple color through observation.

**3. EQUILIBRIA OF PRECIPITATION REACTIONS**

| Equilibrium System: **Ca2+(aq) + C2O42−(aq)** ⇌ **CaC2O4(s)** | | | |
| --- | --- | --- | --- |
| **Addition** | **Predicted outcome** | **Observation** | **Discussion** |
| Test tube 1:  0.1 M Na2C2O4 | opaque | milky white | When Na2C2O4 was added, it reacted with CaCl2 to form solid powder CaC2O4 which had white precipitate (Figure 17). Besides, the system shifted to the right.  CaCl2 + Na2C2O4 → CaC2O4 + 2NaCl  Na2C2O4 → 2Na + C2O42-  C2O42- + Ca2+ → CaC2O4 |
| Test tube 2:  + 0.1 M H2C2O4 | opaque | opaque | When H2C2O4 was added, it reacted with CaCl2 to form CaC2O4 and HCl. Besides, H2C2O4 dissociated partially.  H2C2O4 (aq) ↔ H+ (aq)+C2O42-(aq)  Moreover, the concentration of C2O42-increased and the system shifted to the right. Then the solution had white precipitate again and lighter white than tube 1 |
| Test tube 2:  + 6 M HCl | clear | opaque | When HCl was added, H+ reacted with C2O42- to form H2C2O4. Thus, the [C2O42-] was decreased and the system shifted to the left. Then the solution changed from white precipitate to colorless |
| Test tube 2:  + 6 M NH4OH | clear | opaque | When NH4OH was added, OH- reacted with Ca2+ form white precipitate Ca(OH)2 (Figure 20). Then, [Ca2+] was decreased and the sytem shifted to the left. Besides, gas released was NH3 |

**Note:**

* H2C2O4 is a weak acid so it will dissociate partially. CaC2O4 is formed slowly because of slow formation of C2O4.
* On the addition of HCl, H+ increases. Therefore, the equilibrium will shift to the left (backward reaction) to reduce the amount of H+. As a result, less precipitate forms. The reaction will move to the right to establish the equilibrium.
* According to Le Chatelier’s Principle, as C2O42- increases, the reaction will move to the right and reduce C2O42-, which also forms more CaC2O4. Therefore, the solution appears a white precipitate.

**4. TEMPERATURE EFFECTS ON EQUILIBRIA**

| Equilibrium System: **[Co(H2O)6]2+(aq) + 4Cl−(aq)** ⇌  **[CoCl4]2−(aq) + 6H2O(l)** | | | |
| --- | --- | --- | --- |
| **Description of conditions** | **Predicted outcome** | **Observation** | **Discussion** |
| Nothing changed  (control) | Purple-violet | light violet | The color of [Co(H2O)6]2+ is pink and the color of [CoCl4]2- is blue. Thus, the color of solution is purple (Figure 21) at an equilibrium state. |
| Hot water bath | Blue | blue | When the solution was put into hot water bath, the temperature increased. Thus, the system shifted to the right to reduce temperature. This made the solution turned to blue color |
| Ice-water bath | Purple-violet | pink | When the solution was put into ice water bath, the temperature decreased. Thus, the system shifted to the left to increase temperature. This made the solution turned to pink color |

**Note:**

* The equilibrium of the reaction: [Co(H2O)6]2+ + 4Cl− ⇌ [CoCl4]2− + 6H2O
* The color of [Co(H2O)6]2+ is pink while the color of [CoCl4]2− is blue.
* The color of the solution change according to the temperature:
* As the temperature increases, the solution turns blue
* As the temperature decreases, the solution turn pink

**Part 4. Conclusions :**

In conclusion, if a reaction is in equilibrium And we put any stresses in it, this will force the reaction to shift itself to be in equilibrium state again. This could be noticed by the physical changes of the reaction like change in color or shape.

END.