1. Co(H2O)62+(aq) + 4 Cl-(aq) <=> CoCl42-(aq) + 6 H2O(l)

    Pink **Blue**

The Co(H2O)62+complex is pink, and the CoCl42-complex is blue.

This reaction is endothermic. The equilibrium mixture colour is Pink

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Change | Imposed change | | Prediction using LCP | | [Co(H2O)62] | | | [Cl-] | | [CoCl42-] | | Amount of H2O | | Colour change |
| Adding  HCl |  | |  | |  | | |  | |  | |  | |  |
| Explanation using Collision theory: | | | | | | | | | | | | | | |
| Adding  CoCl42- | |  | |  | |  |  | |  | |  | |  | |
| Explanation using Collision theory: | | | | | | | | | | | | | | |
| Adding  AgNO3 aq | |  | |  | |  |  | |  | |  | |  | |
| Explanation using Collision theory: | | | | | | | | | | | | | | |

Draw the Graph of the following changes.

Concentration-Time Graph

**Chemical Concepts Demonstrated:**Equilibrium constants relative to temperature, color changes in transition metal complexes, LeChatelier's principle

|  |  |
| --- | --- |
| **Demonstration:**  Co(H2O)62+ is formed by dissolving CoCl2\*H2O in water.   1. The first sample of the solution is heated to boiling. 2. The first sample now contains a hot CoCl42- solution. AgNO3 is added to produce Co(H2O)62+ again. A second sample is used as a reference. 3. HCl is added to a third sample at room temperature. | http://chemed.chem.purdue.edu/demos/demosheets/graphics/cobalt.gif |

**Observations:**  
    When the solution is heated to boiling, it turns from pink to blue.   This blue solution shifts back to pink as the AgNO3is added.  When HCl is added to a pink solution, it turns blue.

**Explanations (including important chemical equation):**

    The following equilibrium is observed:

    Co(H2O)62+(aq) + 4 Cl-(aq) <=> CoCl42-(aq) + 6 H2O(g)

    The Co(H2O)62+complex is pink, and the CoCl42-complex is blue.

    This reaction is endothermic as written, so adding heat causes the equilibrium constant to shift to the right.  This, correspondingly, makes the solution blue.

    When the AgNO3is added, Cl-is removed from solution.  This shifts the equation back to the left, and the solution turns pink again.

     When HCl is added, there is more Cl-in solution, so the equilibrium is shifted to the right, and the solution turns blue.

    All of the above effects are variations of LeChatelier's principle.

1. Consider the following system at equilibrium at a constant temperature:

|  |  |  |
| --- | --- | --- |
| Fe3+(aq) + SCN-(aq) (colourless) | http://www.ausetute.com.au/images/eqlarrow.gif | FeSCN2+(aq) (red) |

Answer the following-

### (a) Increasing the Concentration of a SCN- (at Constant Temperature)

(b) Removing FeSCN2+ (at Constant Temperature)

(c) adding NaOH aq

(d) Adding K2CO3 aq

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Change | Imposed change | Prediction using LCP | [Fe3+ ] | [SCN- ] | [FeSCN2+ ] | Colour change |
|  |  |  |  |  |  |  |
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| --- | --- | --- |
| 2NO2(g) (red-brown) | http://www.ausetute.com.au/images/eqlarrow.gif | N2O4(g) (colourless) |

Consider the following gaseous system at equilibrium:

### (a) Reducing the Volume of the Reaction Vessel (at constant temperature)

### (b) Increasing the Volume of the Reaction Vessel (at constant temperature)

### (c) Increasing the Concentration of a Gaseous Reactant (at Constant Temperature and Volume)

### (d) Decreasing the Concentration of a Gaseous Reactant (at Constant Temperature and Volume)

### (e) Increasing the partial pressure of a Product (at Constant Temperature and Volume)

### (d) Addition of an Inert Gas (at Constant Temperature and Volume)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Change | Imposed change | Prediction using LCP/Shift in equlb/reaction favoured | [R] | [P] | Colour change |
|  |  |  |  |  |  |
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