Experiment 19, The Principle of le Chatelier

Name ____ Per ___

Purpose: To shift the equilibrium of the following reactions using le Chatelier's Principle, *When a system at equilibrium is stressed, it will shift in the direction that absorbs the stress.* We can stress an equilibrium by changing temperature, pressure, or concentration of the reactants or products. Here are the reactions for Part I:

$$2\ H^{+} + 2\ CrO_4^{-2} \longleftrightarrow Cr_2O_7^{-2} + H_2O$$

yellow .... orange

and

$$2\ OH^{-} + Cr_2O_7^{-2} \longleftrightarrow 2\ CrO_4^{-2} + H_2O$$

orange .... yellow

Procedure:

Part I:

a. Obtain 5.0 ml of 0.1 M K_2CrO_4 and 5.0 ml of 0.1 M $K_2Cr_2O_7$ in separate 13 X 150 mm test tubes. These will serve sources of the aqueous ions, CrO_4^{-2} and $Cr_2O_7^{-2}$. *Do NOT chuck them!* Record the color of each solution.

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b. Place 10 drops of each solution from **Step a** into separate test tubes. Add, a drop at a time, some 1 M NaOH solution alternately to each solution until a color change is noted in one of the tubes. Record the colors and retain these tubes for Step e.

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c. Place 10 drops of each stock solution from **Step a** above into separate test tubes. Add, a drop at a time, some 1 M HCl solution alternately to each solution until a color change is noted in one of the tubes. Record the colors and retain these tubes for Step d.

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d. Add 1 M NaOH, drop by drop, to one of the tubes obtained in **Step c** until a change is noted.

e. Add 1 M HCl drop by drop, to one of the tubes obtained in **Step b** until a change is noted.

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Questions for Part I:

1a. What can you conclude about the reaction, **$2\ CrO_4^{-2}$ ---> $Cr_2O_7^{-2}$** , and its dependence on hydrogen ions, **H^+**, as noted in **Step c** and **Step e**?

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1b. Balance the equation by adding the proper number of **H^+** ions and **H_2O** molecules to the appropriate side of the equation.

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2a. What can you conclude about the reverse reaction, **$Cr_2O_7^{-2}$ ---> $2\ CrO_4^{-2}$** , and its dependence on hydroxide ions, **OH^-**, as noted in **Step b** and **Step d**?

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2b. Balance the equation by adding the proper number of **OH^+** ions and **H_2O** molecules to the appropriate side of the equation.

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Part II: The equilibrium of Solid Barium Chromate, $BaCrO_4$, with a Saturated Solutions of its Ions:

a. Place 10 drops of 0.1 M K_2CrO_4 in a test tube. Add 2 drops of 1 M NaOH. Add, a drop at a time, 0.1 M $Ba(NO_3)_2$, until a change is noted. Record the result. Retain this test tube for **Step c**.

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b. Place 10 drops of 0.1 M $K_2Cr_2O_7$ in a tube. Add 2 drops of 1 M HCl then 10 drops of 0.1 M $Ba(NO_3)_2$. Record the result and retain this tube for **Step d**.

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Record your conclusion about the relative solubilities of $BaCrO_4$ and $BaCr_2O_7$ from your observations in **Step a** and **Step b**.

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c. To the tube from **Step a** add, drop by drop, 1 M HCl until a change is noted. Record your observations.

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d. To the tube from **Step b** add, drop by drop, 1 M NaOH until a change is noted. Record your observation.

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e. Suggest a way to reverse the changes and reactions you observed in **Step c**. Do the same for Step d. Try these experiments.

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f. Place 10 drops of 0.1M $K_2Cr_2O_7$ in a tube and 10 drops of K_2CrO_4 in another tube. Add 5 drops of 0.1 M $Ba(NO_3)_2$ to each. Note the result.

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Questions for Part II:

1. Use the equations you balanced above to explain the results you obtained in Steps c, d, e of **Part II**.

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2. Make a statement summarizing your results with the chromate ion- dichromate ion equilibrium which includes the application of the Principle of le Chatelier.

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Write a critique for this lab.