**Student Name**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Le Chatelier’s Principle**

**Instructions**

This task is a report on several small experiments related to equilibrium systems. The focus is on aspects of reversible reactions and the use of Le Chatelier’s principle.

Students will complete all experimentation and record all results. The experiments could be spaced over a period of a week.

Students will then be given one hour to answer the questions set in this report. The report will comprise all experimental results and responses to set questions.

**Laboratory coats and safety glasses are to be worn during all experiments.**

**Aim**: To investigate three different equilibrium systems.

**Materials**

0.5 M CoCl2 solution

NaCl saturated solution

HCl(c) \*\*handle with care\*\*

0.2 M K2Cr2O4 solution

1.0 M H2SO4

1.0 M NaOH

0.02 M Fe(NO3)3

0.05 M KSCN solution

**Part A**

Iron ions and thiocyanate ions can react together according to the reaction

Fe3+(aq) + SCN-(aq) ⇄ FeSCN2+(aq)

bright red

Procedure

1. Add 2 mL of iron solution to a test-tube.

2. Add 2 mL of thiocyanate solution.

3. Add water to nearly fill the test-tube.

4. Shake gently.

5. Split this solution evenly between three test-tubes.

6. To the first add a few more drops of iron solution. Observe.

7. To the second add a few drops of thiocyanate solution. Observe

8. To the third add water slowly and observe the red intensity change.

**Part B**

Cobalt chloride can form an equilibrium with chloride ions

Co2+(aq) + 4Cl-(aq) ⇄ CoCl42-(aq)

pink blue

**Procedure**

1. Add 5 mL of CoCl2 solution to a test tube.

2. Add 4 mL of saturated sodium chloride solution.

3. Heat the test-tube until a colour change occurs.

4. Sit in a test-tube rack to cool.

============================================================

5. Add 5 mL of CoCl2 to another test tube.

6. Ask your teacher to add 5 mL of concentrated HCl in the fume cupboard ####care###

7. Record the colour change.

8. Add water to double the volume – check the colour change after stirring.

**Part C**

Bromocresol green is an indicator. It is a weak acid. The equation for its reaction in water is

HIn(aq) + H2O(l) ⇄ H3O+(aq) + In-(aq)

where HIn is used to represent bromocresol green as a weak acid.

**Procedure**

1. Add 10 mL of water to a test-tube

2. Add 6 drops of bromocresol green and 5 drops of NaOH.

3. Add oxalic acid until a colour change occurs.

4. See if you can get the solution to change back to previous colour.

5. Reverse the last colour change.

Appropriate recording of observations 2 marks

**34**

**Questions**

**Part A**

**1 a**. Explain the colour change when you added Fe3+.

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 **b**. What has happened to the value of *K*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **c**. How does the final concentration of Fe3+ compare to the concentration before the

 addition?

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1+ 1 + 1 = 3 marks

**2**. Explain your colour change when you added SCN-

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1 mark

**3**. Your answers to Q.1 and 2. prove we are dealing with a reversible reaction. Explain how.

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2 marks

**4**. When you add a small amount of water to this equilibrium mixture, the red colour drops

 rapidly in intensity. Give two reasons for this.

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2 marks

**Part B**

Co2+(aq) + 4Cl-(aq) ⇄ CoCl42-(aq)

pink blue

**5**. Is this reaction exothermic or endothermic? Explain your answer carefully.

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3 marks

**6. a**. Explain the colour change when you added the HCl in step 6?

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 **b**. What happens to the value of *K* as you add HCl? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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 **c**. Explain why the addition of water causes the colour change that it does.

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 **d**. Will water have the same impact on any reversible reaction that is occurring in

 solution? Explain your answer.

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1 + 1 + 2 + 2 = 6 marks

**7. a**. Write an expression for *K* for this reaction.

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 **b**. The CoCl2 solution was very dilute and the HCl solution was very concentrated.

 Calculate the value of *K* if the concentrations at equilibrium are

 [Co2+] = 0.10 M [Cl-] = 4.6 M and [CoCl42-] = 0.080 M

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 **c**. If you repeat this experiment in one month’s time, will you get the same value of K?

 Explain your answer.

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1 + 2 + 1 = 4 marks

**Part C**

HIn(aq) + H2O(l) ⇄ H3O+(aq) + In-(aq)

**8**. **a**. Bromocresol green is an example of an indicator. What chemical properties does an

 indicator require?

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 **b**. Would you expect all indicators to change colour at the same point of the experiment?

 Explain your answer.

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2 + 2 = 4 marks

**9**. **a**. Explain the colour change when you added sodium hydroxide.

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 **b**. What happens to the value of *K* after you have added potassium hydroxide?

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  **c**. How does the concentration of H3O+ ions after the sodium hydroxide is added

 compare to what it was before the sodium hydroxide is added? Explain your answer.

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1 + 1+ 2 = 4 marks

**10. a**. Explain your colour change when you added oxalic acid.

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 **b**. You were able to make the colour of the solution alternate between the two possible

 colours. What is the colour of an indicator actually indicating?

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2+ 1 = 3 marks

**11**. An equilibrium exists between N2O4 and NO2. The equation for the reaction is

 N2O4(g) ⇋ 2NO2(g)

 *colourless brown*

 An equilibrium mixture of the above gases is allowed to form. The volume of the reactor

 is then halved. How will the final colour of the mixture compare to what it was before the

 volume was halved? Explain your answer.

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2 marks

**END OF TASK BOOK**