

STUDENTS' WORKSHEET

CHEMICAL EQUILIBRIUM
(concentration factor)



Group's Name:

Class:

Structured
Inquiry
Worksheet

Students Worksheet Instructions

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This student worksheet aims to train students' conceptual understanding and inquiry abilities on the material of factors that influence the direction of chemical equilibrium shifts. Students' scientific inquiry ability can be understood as their capacity to recognize and analyze problem situations and to find solutions by engaging in processes such as asking questions, planning and conducting investigations, collecting data, thinking critically and logically about the relationship between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments (National Research Council [NRC], 1996).

Students' Inquiry Abilities by Kao and Wu (2008) practiced in this Worksheet are:

1. Questioning
Asking and identifying questions
2. Experimenting
Identifying variables and planning experimental procedures
3. Analyzing
Identifying relevant data and transforming data
4. Explaining
Making a claim and using evidence

Work Instructions

1. Read each question in this Worksheet carefully.
2. Work on this Worksheet by discussing with your friend next to you.
3. Write your answer in the answer column provided.
4. Ask the teacher if you have difficulty or are unclear in working on the Worksheet

Core Competencies

- 3.9 Analyze the factors that influence the shift in the direction of equilibrium and their application in industry
- 4.9 Design, conduct, conclude and present the results of experiments on factors that influence the shift in the direction of equilibrium

Basic Competencies

- 3.9.1 Students are able to analyze the influence of concentration factors on shifts in the direction of chemical equilibrium based on experiment in the Worksheet
- 3.9.2 Students are able to apply chemical equilibrium in industry based on experiment in the Worksheet
- 4.9.1 Students are able to conclude the results of the discussion of concentration factors that affect shifts in the direction of chemical equilibrium
- 4.9.2 Students are able to communicate the results of the discussion regarding concentration factors that affect shifts in the direction of chemical equilibrium

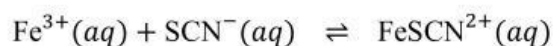
Learning Goals

- 3.9.1.1 Based on the experiment in the Worksheet, students are able to determine the experimental variables of the concentration factors that affect the shift in the direction of chemical equilibrium correctly.
- 3.9.1.2 Based on the experiment in the Worksheet, students are able to determine the formulation of the problem of the concentration factors that affect the shift in the direction of chemical equilibrium correctly
- 3.9.1.3 Based on the tools and materials that have been presented, students are able to design experimental procedures for concentration factors that affect the shift in the direction of chemical equilibrium correctly.
- 3.9.1.4 Based on the experimental procedures that have been created, students are able to analyze experiments on concentration factors that affect shifts in the direction of chemical equilibrium correctly
- 4.9.1.1 Through group discussions, students are able to conclude concentration factors that affect shifts in the direction of chemical equilibrium well
- 4.9.2.1 Through group discussions, students are able to communicate the results of discussions regarding concentration factors that affect shifts in the direction of chemical equilibrium well

Experiment



In this experiment, you will study a reversible reaction between iron (III) ions (Fe^{3+}) and thiocyanate ions (SCN^-). The chemical equilibrium reaction is:



A solution of FeSCN^{2+} is prepared in test tube (A). Different solutions are added to separate test tubes containing the same FeSCN^{2+} solution, and you will observe changes in the color of the solution:

- **In test tube (B):** KSCN are added to the solution.
- **In test tube (C):** FeCl_3 are added to the solution.
- **In test tube (D):** NaH_2PO_4 is added to the solution.

1.

What is the most appropriate research question for the above experiment?

- A. How does the addition of different substances affect the color of the solution?
- B. What is the effect of temperature on the FeSCN^{2+} solution?
- C. How much of each substance is required to completely react with FeSCN ?
- D. Which substance produces the darkest red color in the solution?
- E. How long does it take for FeSCN^{2+} to decompose completely in water?

Answer:

2.

Identify the variables in the experiment!

- What should remain constant (control variable):
- What will you change (Manipulated variable):
- What will you measure or observe (Responding variable):

3.

Write the experimental procedure based on the experiment above. Your procedure should include:

- The steps you will follow to conduct the experiment
- The way you will describe any color changes in the appearance of the solutions.

Answer:

4.

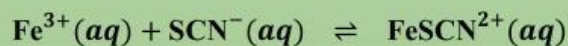
Write down your observations!

Answer:

Test Tube	Initial Solution	Color of Initial Solution	Solution Added	Color of solution added	Color Change (from → to)
B					
C					
D					

5.

Write your observation in this summary table!



Left   Right

Answer:

Test Tube	Solution Added	Color Change (from → to)	Direction of Shift (right/ left)
B			
C			
D			

6.

Based on the experimental data above, explain why these results occurred in the test tube B, C, and D!

Answer:

Test Tube B:

The color has changed because adding, which increased the concentration of, so the equilibrium shifted to, causing the color to change from..... to

Test Tube C:

The color has changed because adding, which increased the concentration of, so the equilibrium shifted to, causing the color to change from..... to

Test Tube D:

The color has changed because adding, which increased the concentration of, so the equilibrium shifted to, causing the color to change from..... to

7.

Based on the observed experiment, write a conclusion by generalizing the relationship between the observed changes and Le Chatelier's Principle!

Answer:

The color has changed because

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This shows that according to **Le Chatelier's Principle**,

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