Name: _____

Le Chatelier's Soda Lab

Background

The reaction to be observed during the lab is the reversible reaction:

$$CO_{2(g)} + H_2O \leftrightarrows H_2CO_{3(aq)} + \text{heat}$$

When universal indicator is added to the system, a distinct difference in color can be observed; depending on the direction equilibrium is shifted.

$$CO_{2(g)} + H_2O \leftrightarrows H_2CO_{3(aq)} + \text{heat}$$
(green ↔ yellow green ↔ yellow ↔ orange ↔ red)

Le Chatelier's principle states that when stress is added to a system at equilibrium, the equilibrium will shift in such a way as to relieve that stress. You will be investigating the effects of changing pressure, temperature, and concentration on the equilibrium of the above reaction. Throughout this lab, the color of your solution will indicate the direction of the equilibrium shift.

Problem

How does a change in pressure, temperature, or concentration affect the equilibrium of a reversible reaction?

Materials

- 1 liter of club soda
- Small beaker (100-150ml)
- Hot plate
- Universal indicator
- Dry ice
- 100ml graduated cylinder

Safety

- Always wear safety goggles when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.
- Wear gloves. The dry ice is extremely cold and can cause frostbite if directly touched with skin. Only maneuver the dry ice with proper handling equipment.
- Students should wear proper safety gear during chemistry demonstrations. Safety goggles and lab apron are required.

Procedure A

1. Your teacher will demonstrate this procedure.
2. Obtain an unopened container of club soda. Observe the liquid inside:

3. Is liquid inside is under a large or small amount of pressure? Record your answer below:

4. As the container is opened, observe the amount of bubbling. Write your observation below:

5. When the container is opened, does the pressure increase or decrease?

6. Which direction does the reaction shift when the container is opened?

Procedure B

1. Pour about 50ml of the club soda into a small beaker.
2. Add 30-40 drops of universal indicator to your club soda.
3. What is the color of the solution right now?

4. Place the beaker on a hot plate and heat it for approximately 3 to 5 minutes. What do you observe?

5. Which direction does the reaction shift when the temperature is raised?

Procedure C

1. Remove your beaker from the hot plate.
2. Add a piece of dry ice (frozen CO_2) to the beaker. What happens immediately?

3. Allow the dry ice to bubble through the solution until no further color change is noticed. What color is the final solution?

4. As it bubbles through solution, the dry ice increases the concentration of what substance in the solution?

5. Which direction has the equilibrium shifted?

Conclusion

Write a short paragraph summarizing how a change in pressure, temperature, and concentration will affect a shift in equilibrium.