Kevin Zhang Lab Report 5

Introduction

The goal of this lab is to find the equilibrium constant of a chemical equilibrium. This is achieved by changing the concentrations of reactants and measuring the change in concentrations of products.

Chemical Responsibility

Some of the chemicals in this lab are dangerous. Isopropyl alcohol is flammable and toxic when ingested. Glacial Acetic acid, Sulfuric Acid, and Sodium Hydroxide are toxic and corrosive.

Report Sheet

Volumes of NaOH

1. Step 1: 33.8 mL
2. Step 2: 1.4mL
3. Step 4: 17.9mL

Calculations

Step 1:

$$[\text{acetic acid}] = \frac{\text{Vol}_{\text{NaOH}} \times \frac{0.200 \text{ mol NaOH}}{1\text{L}}}{\text{volume}} = \frac{33.8mL \times \frac{1L}{1000mL} \times \frac{0.200mol}{1L}}{1mL \times \frac{1L}{1000mL}} = 6.76M$$

Step 4:

$$[\text{acetic acid}] = \frac{\text{Vol}_{\text{NaOH}} \times \frac{0.200 \text{ mol NaOH}}{1\text{L}}}{\text{total volume}} = \frac{(17.9mL - 1.4mL) \times \frac{1L}{1000mL} \times \frac{0.200mol}{1L}}{1mL \times \frac{1L}{1000mL}} = 3.30M$$

Table

Reaction	Acetic Acid	Isopropyl Alcohol	Isopropyl Acetate	Water
Initial	6.76	6.76	0	0
Change	-3.46	-3.46	+3.46	+3.46
Equilibrium	3.30	3.30	3.46	3.46

Equilibrium Constant

$$K_c = \frac{[CH_3COOC_3H_7][H_2O]}{[C_3H_7OH][CH_3COOH]} = \frac{3.46^2}{3.30^2} = 1.099$$

Sample Calculations

See above

Discussion of Results

Not entirely sure of these results, but what we ended up with is an equilibrium constant of ~1.099. The way this was done was by determining the initial concentration using step 1, in order to figure out how many moles of Acetic acid was in the original solution mixture. Then, we could apply the same logic after the allowing the reaction to progress for a week. That the equilibrium constant is 1.099 makes some sense, since the reaction is favorable, but only very slightly, and therefore would take a long time. This likely why step 4 needed to be performed a week later.

Post-Lab Questions

1. What is meant by a reversible reaction? A reversible reaction is one where the reactants can also act as products if there is too much product. The reaction balances between the reactant and product, so that there is not too much of either.
2. True or False: The numerical value of equilibrium constant changes only if temperature changes. True
3. Which component of the reaction mixture was titrated with sodium hydroxide? Acetic Acid
4. Why was it necessary to wrap the rubber stopper with saran wrap? Fumes from the reaction mixture could attack the rubber stopper
5. Why was it necessary to titrate a blank sample solution? The sulfuric acid also reacts with the sodium hydroxide. We did not want that to affect the computations.
6. List two advantages of using a buret for measuring reaction volumes as opposed to maybe a graduated cylinder
    1. The buret can be more easily used for measuring an unknown quantity of volume used. We didn't know how much NaOH was going to be consumed
    2. The buret can be controlled more precisely to slow or speed up. With a graduated cylinder, we only pour.
7. What is a catalyst and why was a catalyst used in this reaction? A catalyst is a substance that does directly affect the reaction, except to speed it up. With such a low equilibrium constant, the reaction would have progressed very slowly, which is why the catalyst was necessary.
8. When would you want to use a pipet instead of buret? A pipet is great when you need a very small volume. The pipet can hold up to 1-2mL (maybe more in some cases), but it would quickly get very tedious refilling and emptying for any larger volumes.

Conclusion

In conclusion, we can determine the equilibrium constant of a reaction by measuring the initial and final concentrations of the reactants and products in the reaction.