Acid and Base Concentrations

MyJoVE Corp,
2016

Material Proyectable

Preparation of 0.1 M NaOHExpand In the first part of the lab, you will use a 50% w/w solution of NaOH to prepare 500 mL of 0.1 M. The 50% w/w NaOH is indicative of its weight ratio. For example, if the instructor prepared 150 mL of the 50% w/w NaOH solution, then 150 g of NaOH was dissolved in 150 g of water, and the total weight of the solution is 300 g. To begin, put on the appropriate personal protective equipment, including gloves, chemical splash goggles, and a lab coat. Calculate the molarity of 50% w/w NaOH, which is M1 in the dilution formula. Note: The density of 50% w/w NaOH is 1.53 g/mL, and the molar mass of NaOH is 39.998 g /mole. Table 1. Preparation of 0.1 M NaOH from 50% w/w NaOH Density of 50% w/w stock solution 1.53 g /mL Molar massNaOH 39.998 g/mol Mass of NaOH in 50% w/w stock solution (mg) Total mass of 50% w/w stock solution Volume of 50% w/w stock solution (mL) Moles of NaOH in 50% w/w solution (mol) Molarity of 50% w/w stock solution (M1) Volume of 50% w/w solution needed (V1) Click Here to download Table 1 Use the dilution formula to determine the volume of 50% w/w NaOH needed to prepare 500 mL of 0.1 M NaOH. Label the 500 mL polyethylene bottle as '0.1 M NaOH'. Adjust the volume on a 1-mL pipette to the value calculated and use it to transfer the 50% w/w NaOH to the polyethylene bottle. Use a 100-mL graduated cylinder to measure the amount of water and pour it into the bottle containing the NaOH. Cap the bottle and invert it several times to mix the solution. Note: You will need 500 mL minus the calculated volume of NaOH. Standardization of 0.1 M NaOHExpand After you have prepared 0.1 M NaOH, determine its exact concentration, or standardize it, using the acid-base titration method. In this technique, a base like NaOH is slowly added to an acid like potassium hydrogen phthalate (KHP). The chemical reaction that takes place in the flask is a neutralization reaction. In this neutralization reaction, one mole of base neutralizes one mole of acid, resulting in salt and water. This reaction is performed in the presence of the indicator phenolphthalein, which is colorless at the start of the reaction when the pH is acidic. The indicator turns pink as soon as enough NaOH is added to the flask to make the pH basic. Label the three Erlenmeyer flasks as 'A', 'B', and 'C'. Weigh 0.5 - 0.7 g of KHP for each of the flasks and record the mass for each. Note: Try to measure the same mass of KHP for all three flasks. Table 2. Standardization of NaOH Molar massKHP = 204.23 g/mol Flask A Flask B Flask C Mass of KHP (g) Volumeinitial NaOH(mL) Volumefinal NaOH (mL) VolumeNaOH (mL) Moles of KHP Moles of NaOH Molarity of NaOH Average molarity Standard deviation Click Here to download Table 2 Add 50 mL of deionized water to each flask, and use a glass stirring rod to stir the solutions until they appear homogeneous. Add 2-3 drops of phenolphthalein to each of the three flasks. Set up the titration apparatus. Attach the burette clamp to the ring stand, and securely clamp the 50-mL glass burette to it. Make sure the valve of the burette is closed. Label a 400-mL beaker as 'waste' and place it under the burette. Rinse the burette by pouring about 5 mL of 0.1 M NaOH into the burette. Open the burette valve to allow the NaOH to flow into the beaker. Close the valve and fill the burette with slightly more than 50 mL of NaOH. Release any air bubbles present in the tip of the burette by opening and closing the burette valve. Record the starting volume of NaOH. Place flask A below the tip of the burette, and titrate the solution using 1 mL volumes of NaOH. Swirl the solution after each addition. Continue adding 1 mL volumes to the flask until the pink color persists. This is considered the endpoint. Record the volume of 0.1 M NaOH added to achieve the endpoint. Repeat the titration for flasks B and C. This data will be used to calculate the actual concentration of NaOH. Titration of phosphoric acidExpand In this experiment, we will determine two of the three pKa values for the triprotic acid, phosphoric acid, using acid-base titration. In this neutralization reaction, phosphoric acid reacts with NaOH to form water and the salt, sodium phosphate. Attach the drop counter to the ring stand, below the burette clamp. Secure the plastic burette so that its tip is just above the drop counter. Connect the drop counter to the data acquisition system, and make sure the two valves of the plastic burette are both in the closed position. Place the waste container below the burette and pour a few mL of 0.1 M NaOH into the burette. Open both valves to drain the NaOH into the waste beaker. Then close the valves. Fill the plastic burette with 25 mL of 0.1 M NaOH. Drain about 5 mL into the waste beaker-enough so that NaOH fills the burette tip. Make sure there are no air bubbles, then close the valves. Calibrate the drop counter. Replace the waste beaker beneath the burette with a 10-mL graduated cylinder. Then, open the bottom valve on the burette, while keeping the top valve closed. Turn on the data acquisition system and set it to 'drop counting mode'. Slowly open the top valve to very slowly release drops, ideally at one drop every 2 s. Allow the drops to empty from the burette until there is 9-10 mL of 0.1 M NaOH in the graduated cylinder. Close the bottom valve and leave the top valve as is. Read the volume of NaOH in the graduated cylinder to the first decimal place and enter this value in the data acquisition system. Record the value for 'drops/mL'. Then, discard the NaOH in the graduated cylinder into the aqueous waste beaker. Calibrate the pH sensor before starting the titration. Connect the pH sensor to the data acquisition system, then select 'Calibrate'. Rinse the bulb of the pH sensor with deionized water before inserting it into the pH 7 buffer. Leave the sensor submerged until the voltage stabilizes, then accept the measurement. Rinse the bulb with deionized water and insert it into the pH 10 buffer. Allow the voltage to stabilize, then accept the measurement. Rinse the bulb of the pH sensor again and slide it through the designated slot in the drop counter. Measure 40 mL of deionized water into a clean 100-mL beaker, then, transfer 1 mL of phosphoric acid into the beaker of water. Place the beaker on the stir plate under the drop counter. Carefully slide the pH sensor into the beaker. Add a stir bar to the beaker, and turn the stir setting onto high. Start collecting data on the acquisition device. Then, open the bottom valve on the burette. Note: The drop rate should be about 1 drop every 2 s. After the first drop is released, check to see data are being recorded. Continue the titration until the pH meter reads pH 12. Then, stop acquiring data and close the valve on the burette. Save your data on a flash drive. To clean up your workspace, check the pH of all waste solutions using pH paper. Neutralize all acidic aqueous waste with baking soda and all basic waste with citric acid. Add enough of either baking soda or citric acid to the solution until it stops bubbling. Flush all neutralized solutions down the sink with copious amounts of water. Wash all glassware. ResultsExpand In the first part of this lab, you standardized a solution of NaOH using KHP to determine its actual concentration. Now, let's see how close the standardized concentration is to the 0.1 M concentration that was prepared. Determine the number of moles of KHP that was added to each flask, and by extension, the moles of NaOH. Once the solution is neutralized, the molar quantities of KHP and NaOH are equal. Calculate the molarity of NaOH based on the total volume of NaOH that was added to each flask. The actual concentration is lower than the expected 0.1 molarity. This is because NaOH is hygroscopic, so it is difficult to weigh it accurately. Plot the results for the phosphoric acid titration (pH vs. Volume of NaOH). Phosphoric acid is a weak triprotic acid, meaning that it has the potential to provide three protons per molecule when it dissociates in aqueous solutions. Phosphoric acid has three pKa values, one for when each proton is dissociated. Look at the data. There are two sigmoidal curves, indicating two equivalence points. Each equivalence point corresponds to a dissociation constant, Ka, of phosphoric acid. Note: You stopped the experiment once the pH reached 12, so you only measured two of the three Ka values

Preparation of 0.1 M NaOHExpand In the first part of the lab, you will use a 50% w/w solution of NaOH to prepare 500 mL of 0.1 M. The 50% w/w NaOH is indicative of its weight ratio. For example, if the instructor prepared 150 mL of the 50% w/w NaOH solution, then 150 g of NaOH was dissolved in 150 g of water, and the total weight of the solution is 300 g. To begin, put on the appropriate personal protective equipment, including gloves, chemical splash goggles, and a lab coat. Calculate the molarity of 50% w/w NaOH, which is M1 in the dilution formula. Note: The density of 50% w/w NaOH is 1.53 g/mL, and the molar mass of NaOH is 39.998 g /mole. Table 1. Preparation of 0.1 M NaOH from 50% w/w NaOH Density of 50% w/w stock solution 1.53 g /mL Molar massNaOH 39.998 g/mol Mass of NaOH in 50% w/w stock solution (mg) Total mass of 50% w/w stock solution Volume of 50% w/w stock solution (mL) Moles of NaOH in 50% w/w solution (mol) Molarity of 50% w/w stock solution (M1) Volume of 50% w/w solution needed (V1) Click Here to download Table 1

Use the dilution formula to determine the volume of 50% w/w NaOH needed to prepare 500 mL of 0.1 M NaOH. Label the 500 mL polyethylene bottle as '0.1 M NaOH'. Adjust the volume on a 1-mL pipette to the value calculated and use it to transfer the 50% w/w NaOH to the polyethylene bottle. Use a 100-mL graduated cylinder to measure the amount of water and pour it into the bottle containing the NaOH. Cap the bottle and invert it several times to mix the solution. Note: You will need 500 mL minus the calculated volume of NaOH. Standardization of 0.1 M NaOHExpand After you have prepared 0.1 M NaOH, determine its exact concentration, or standardize it, using the acid-base titration method. In this technique, a base like NaOH is slowly added to an acid like potassium hydrogen phthalate (KHP). The chemical reaction that takes place in the flask is a neutralization reaction. In this neutralization reaction, one mole of base neutralizes one mole of acid, resulting in salt and water. This reaction is performed in the presence of the indicator phenolphthalein, which is colorless at the start of the reaction when the pH is acidic. The indicator turns pink as soon as enough NaOH is added to the flask to make the pH basic. Label the three Erlenmeyer flasks as 'A', 'B', and 'C'. Weigh 0.5 - 0.7 g of KHP for each of the flasks and record the mass for each. Note: Try to measure the same mass of KHP for all three flasks. Table 2. Standardization of NaOH Molar massKHP = 204.23 g/mol Flask A Flask B Flask C Mass of KHP (g) Volumeinitial NaOH(mL) Volumefinal NaOH (mL) VolumeNaOH (mL) Moles of KHP Moles of NaOH Molarity of NaOH Average molarity Standard deviation Click Here to download Table 2 Add 50 mL of deionized water to each flask, and use a glass stirring rod to stir the solutions until they appear homogeneous. Add 2-3 drops of phenolphthalein to each of the three flasks. Set up the titration apparatus. Attach the burette clamp to the ring stand, and securely clamp the 50-mL glass burette to it. Make sure the valve of the burette is closed. Label a 400-mL beaker as 'waste' and place it under the burette. Rinse the burette by pouring about 5 mL of 0.1 M NaOH into the burette. Open the burette valve to allow the NaOH to flow into the beaker. Close the valve and fill the burette with slightly more than 50 mL of NaOH. Release any air bubbles present in the tip of the burette by opening and closing the burette valve. Record the starting volume of NaOH. Place flask A below the tip of the burette, and titrate the solution using 1 mL volumes of NaOH. Swirl the solution after each addition. Continue adding 1 mL volumes to the flask until the pink color persists. This is considered the endpoint. Record the volume of 0.1 M NaOH added to achieve the endpoint. Repeat the titration for flasks B and C. This data will be used to calculate the actual concentration of NaOH. Titration of phosphoric acidExpand In this experiment, we will determine two of the three pKa values for the triprotic acid, phosphoric acid, using acid-base titration. In this neutralization reaction, phosphoric acid reacts with NaOH to form water and the salt, sodium phosphate. Attach the drop counter to the ring stand, below the burette clamp. Secure the plastic burette so that its tip is just above the drop counter. Connect the drop counter to the data acquisition system, and make sure the two valves of the plastic burette are both in the closed position. Place the waste container below the burette and pour a few mL of 0.1 M NaOH into the burette. Open both valves to drain the NaOH into the waste beaker. Then close the valves. Fill the plastic burette with 25 mL of 0.1 M NaOH. Drain about 5 mL into the waste beaker-enough so that NaOH fills the burette tip. Make sure there are no air bubbles, then close the valves. Calibrate the drop counter. Replace the waste beaker beneath the burette with a 10-mL graduated cylinder. Then, open the bottom valve on the burette, while keeping the top valve closed. Turn on the data acquisition system and set it to 'drop counting mode'. Slowly open the top valve to very slowly release drops, ideally at one drop every 2 s. Allow the drops to empty from the burette until there is 9-10 mL of 0.1 M NaOH in the graduated cylinder. Close the bottom valve and leave the top valve as is. Read the volume of NaOH in the graduated cylinder to the first decimal place and enter this value in the data acquisition system. Record the value for 'drops/mL'. Then, discard the NaOH in the graduated cylinder into the aqueous waste beaker. Calibrate the pH sensor before starting the titration. Connect the pH sensor to the data acquisition system, then select 'Calibrate'. Rinse the bulb of the pH sensor with deionized water before inserting it into the pH 7 buffer. Leave the sensor submerged until the voltage stabilizes, then accept the measurement. Rinse the bulb with deionized water and insert it into the pH 10 buffer. Allow the voltage to stabilize, then accept the measurement. Rinse the bulb of the pH sensor again and slide it through the designated slot in the drop counter. Measure 40 mL of deionized water into a clean 100-mL beaker, then, transfer 1 mL of phosphoric acid into the beaker of water. Place the beaker on the stir plate under the drop counter. Carefully slide the pH sensor into the beaker. Add a stir bar to the beaker, and turn the stir setting onto high. Start collecting data on the acquisition device. Then, open the bottom valve on the burette. Note: The drop rate should be about 1 drop every 2 s. After the first drop is released, check to see data are being recorded. Continue the titration until the pH meter reads pH 12. Then, stop acquiring data and close the valve on the burette. Save your data on a flash drive. To clean up your workspace, check the pH of all waste solutions using pH paper. Neutralize all acidic aqueous waste with baking soda and all basic waste with citric acid. Add enough of either baking soda or citric acid to the solution until it stops bubbling. Flush all neutralized solutions down the sink with copious amounts of water. Wash all glassware. ResultsExpand In the first part of this lab, you standardized a solution of NaOH using KHP to determine its actual concentration. Now, let's see how close the standardized concentration is to the 0.1 M concentration that was prepared. Determine the number of moles of KHP that was added to each flask, and by extension, the moles of NaOH. Once the solution is neutralized, the molar quantities of KHP and NaOH are equal. Calculate the molarity of NaOH based on the total volume of NaOH that was added to each flask. The actual concentration is lower than the expected 0.1 molarity. This is because NaOH is hygroscopic, so it is difficult to weigh it accurately. Plot the results for the phosphoric acid titration (pH vs. Volume of NaOH). Phosphoric acid is a weak triprotic acid, meaning that it has the potential to provide three protons per molecule when it dissociates in aqueous solutions. Phosphoric acid has three pKa values, one for when each proton is dissociated. Look at the data. There are two sigmoidal curves, indicating two equivalence points. Each equivalence point corresponds to a dissociation constant, Ka, of phosphoric acid. Note: You stopped the experiment once the pH reached 12, so you only measured two of the three Ka values

https://rebiunoda.pro.baratznet.cloud:28443/OpacDiscovery/public/catalog/detail/b2FpOmNlbGVicmF0aW9uOmVzLmJhcmF0ei5yZW4vMjUxNzcwOTE

Título: Acid and Base Concentrations

Editorial: Cambridge, MA MyJoVE Corp 2016

Descripción física: 1 recurso electrónico (914 seg.) son., col

Mención de serie: JOVE Science Education Lab Chem

Nota general: Tít. sacado de la página de descripción del recurso

Audiencia: Para estudiantes universitarios, graduados y profesionales

Detalles del sistema: Forma de acceso: World Wide Web

Baratz Innovación Documental

- Gran Vía, 59 28013 Madrid
- (+34) 91 456 03 60
- informa@baratz.es