Name:……

Date:……..

6. ACID-BASE TITRATIONS

Objectives

To determine the precise concentration of a base solution by acid-base titration after diluting it from a more concentrated standard solution.

Pre-lab Assignment

Find some background information about the following topics in a general chemistry textbook and read it.

- the principles of acid-base titrations in general
- the working principles of acid-base indicators

Pre-lab Exercises

1. List the safety rules concerning concentrated bases and their dilution:

2. 500.00 cm^3 ~0.04 mol/dm^3 NaOH solution needs to be prepared by the dilution of a concentrated NaOH solution (50 weight%, density: 1.53 g/cm^3). What is the volume (in cm^3) of the concentrated solution needed?

The amount of substance in the NaOH solution to be prepared:

c = 0.02 mol/dm^3,

V = 500 cm^3 = 0.500 dm^3

n(NaOH) = $c \times V$ = ……. mol

The mass of this amount:

M(NaOH) =

m(NaOH) = $n \times M$(NaOH) = ……. g

100 g of the concentrated solution contains 50 g NaOH.

Calculate the mass of the concentrated solution that contains the necessary amount of NaOH:

m(concentrated solution) =……. g

The volume of this solution:

$$V = \frac{m}{\rho} = \frac{\text{g}}{\frac{\text{g}}{\text{cm}^3}} = \text{……. cm}^3$$

What volume would you measure if you had only a 5 cm^3 graduated pipette with 0.1 cm^3 graduation marks as the best piece of volumetric equipment for this purpose?

6.1. Preparation of a standard solution of sodium hydroxide

Experiment Outline (Reading)

Objective:

Preparation of 100.0 cm^3 NaOH solution of a the required concentration by diluting a concentrated solution of sodium hydroxide (50 weight%, $\rho = 1.53$ g/cm^3).

Procedure:

Calculate the volume of concentrated solution necessary in cm^3 using the known weight% and the density.

Put about 50 cm^3 of distilled water into a beaker and add the amount of concentrated NaOH solution necessary using a small, plastic measuring cylinder. (**Never use a pipette for measuring concentrated base solutions.**) **Be careful and avoid pouring drops of this concentrated solution onto anything.** Mix the liquids in the beaker and then pour it quantitatively into a 100 cm^3 volumetric flask. Rinse the beaker several times with small amounts of distilled water into the volumetric flask then fill up the flask to the mark. Shake the solution well until the solution becomes entirely homogeneous. Store the homogeneous solution in another flask, and label it. Do not store the solution without a cap and open to the atmosphere.

6.2. Determination of the concentration of the standard sodium hydroxide solution

Pre-lab Exercises

1. 10.00 cm^3 0.183 mol/dm^3 HCl solution is exactly neutralized by 9.85 cm^3 unknown NaOH solution. What is the concentration of the NaOH solution? Give the result to a reasonable precision.

2. Check the transition pH interval of the acid-base indicators used in the following experiment in a textbook or other suitable book.

phenolphthalein: ..... methylred: .....

Determination of the concentration of the standard sodium hydroxide solution

Date: .....

Experiment Outline

Dilute the prepared standard solution tenfold: measure 10.0 cm^3 standard solution with a single-volume pipette into a 100 cm^3 volumetric flask, fill up with water to the mark and shake the solution until it is entirely homogeneous.

Use the 10.0 cm^3 single-volume pipette to measure 10.00 cm^3 of the provided standard hydrochloric acid solution with known concentration (**record its concentration in your lab manual**) into 3 separate titration flasks or beakers. Dilute the solution to a final volume of 30-40 cm^3 with distilled water and add two or three drops of methylred indicator solution. Fill the burette with the NaOH solution prepared. Titrate the first sample with constant stirring quickly until the indicator shows approximately the transition color. This will give an approximate value for the equivalent volume (V'). The second and third titrations should be done more carefully. The titrating solution can be added quickly until V = V'−0.5 cm^3 reached. The final increments should be added slowly, drop by drop until the exact transition color of the indicator is reached.

Calculate the average of the titrations (exclude the first, if you find the volume inaccurate!) and determine the precise concentration of the standard NaOH solution.

Preparation of the dilute solution:

10.00 cm^3 of the previously prepared standard solution is diluted to 100.0 cm^3 and carefully homogenized.

Titration of the dilute NaOH solution

volume of the titrated hydrochloric acid solution: ..... cm^3

concentration of the titrated hydrochloric acid solution: ..... mol/dm^3

volume of the NaOH solution added until transition color is reached:

measurement 1 (approximate) ..... cm^3

measurement 2 ..... cm^3

measurement 3 ..... cm^3

average: ..... cm^3

Calculation of the <u>precise</u> concentration of the diluted NaOH solution:

The <u>precise</u> concentration of the diluted NaOH solution: ..... mol/dm^3

The <u>precise</u> concentration of the original (more concentrated) standard NaOH solution:

..... mol/dm^3

Remarks (compare the intended and the actual concentration of your standard NaOH solution)