Name:……………………………………

Date:……………………………………..

3. PREPARATION OF A STANDARD SOLUTIONS

Objectives

To overview the most important concentration units and their use to calculate the mass of solid necessary to prepare a standard solution. To practice the preparation of standard solutions.

Pre-lab Exercise:

Calculate the amount of solid necessary to prepare the solution!

Volume of solution to be prepared (V): ....

Concentration (c): ....

Formula of salt from which solution is prepared: ....

Amount of the salt to be used for preparing the solution: $n = c \times V =$

The molar mass of the crystalline salt: $M =$

The mass of solid to be weighed: $m = n \times M =$

Preparation of a standard solution from crystalline salt

Date: ....

Experiment Outline

The instructors will tell you the identity and concentration of the salt your solution should contain. Calculate the amount of solid necessary and prepare the solution by the proper method already demonstrated.

1. Based on the demonstration, list the most important steps of preparing a **solution** in a volumetric flask starting form a solid salt

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2. Preparation of a solution

- Weighing data (mass of the solid actually weighted):

- Steps of the solution preparation:

- Calculation of the **accurate** concentration of the solution (it can only be calculated after measuring the accurate weight of the solid used):

The mass of the solid weighed: m =

The molar mass of the crystalline salt: M =

Amount of the salt used for preparing the solution: $n = m/M$=

Concentration of the solution: $c = n/V$ =

4. DENSITY MEASUREMENTS

Objectives

To introduce the density-measuring devices used in a chemical laboratory. To determine the density of the prepared solution and calculate the weight-percent composition based on the density.

Pre-lab Assignment

Find some background information about the following topics in a general chemistry textbook and read it: **density measurement**

Pre-lab Exercises

1. What methods are known for measuring density? List them in the order of their accuracy!

2. Estimate whether the density of the following objects is larger or smaller than the density of water.

a.) a wooden cube of 1×1×1 m: ....,
b.) your body ....,
c.) a piece of limestone: ....,
d.) wood chips: ....,
e.) a small lead ball: ....

3. The density of water at room temperature is almost exactly 1 g/cm^3. A chemist wants to determine the density of water by measuring a 25-cm^3 sample. What precision (how many significant figures) should be quoted in the result if the following measuring devices are used

a/ an analytical balance and a 25 ml single-volume pipette: ....,
b/ a standard laboratory balance and a single-volume pipette: ....,
c/ an analytical balance and a measuring cylinder: ....,
d/ a standard laboratory balance and a measuring cylinder: ....
e/ an analytical balance and a pycnometer: ....

4. The density of a solid is determined by first weighing a piece on an analytical balance (41.7523 g). The volume of the same piece is measured (21.3 cm^3) in a measuring cylinder through the volume of displaced liquid. Give the density of the solid to the appropriate number of significant figures.

5. The density of solid **A** is 2.70 g/cm^3, that of solid **B** is 3.87 g/cm^3. A 1.00 g piece of each solid is placed into a measuring cylinder containing 5.00 cm^3 water. Which piece displaces more water? What is the difference between the displaced volumes of water (in cm^3)?

Density measurement using a pycnometer

Experiment Outline

1. Determination of the volume of the pycnometer

- Select a suitable pycnometer, make sure it is dry and weigh it on an analytical balance together with all its accessories (m_1). Record the temperature reading if the pycnometer has a built-in thermometer, otherwise record the laboratory temperature.
- remove the pycnometer from the balance room and fill it with distilled water with special care to avoid the formation of bubbles. Insert the thermometer or stopper into the pycnometer. If your pycnometer has a marked capillary ending, the level of water should rise above the mark. Drain excess water with filter paper or a dry piece of cloth from the outside of pycnometer and (if needed) from the top of the stopper or thermometer. Make sure that the outer surface of the pycnometer is dry.
- If your pycnometer has a marked capillary ending, drain the water from this capillary using a narrow piece of filter paper until the level of water reaches the mark. Handle the pycnometer very carefully and avoid holding it in your hands for periods longer than absolutely necessary because your hands are warmer than the pycnometer and heat may corrupt the measurement.
- Weigh the filled pycnometer (m_2), and record the temperature reading. If your pycnometer does not have a separate thermometer, measure the temperature of water separately after the measurement. If your pycnometer has a marked open-end capillary it may be difficult to weigh it consistently because evaporation of the relatively volatile solvent causes the mass to decrease in time. This phenomenon often poses a difficulty with water or aqueous solution. The best way to deal with this problem is to set the level of water a little above the mark, place the pycnometer on the balance, and record the mass when the level of water is exactly at the mark.
- Calculate the volume of the pycnometer after finding (and possibly interpolating) the density of water (ρ_w) at the measured temperature:

$$\text{volume of the pycnometer: } V = (m_2 - m_1) / \rho_w$$

2. Measurement of the mass of the solution in the pycnometer

Rinse the pycnometer with a small amount of your solution three times, fill it carefully with the solution in the same way you used for filling it with water. Make sure the outer surface is dry and weigh the pycnometer (m_3).

$$\text{mass of the solution} = m_3 - m_1$$

3. Calculation of the density of the solution

The density is calculated by dividing the mass of the solution by the volume of the pycnometer:

$$\rho = (m_3 - m_1) / V$$

4. Calculation of the weight percent composition of the solution

- The weight percent composition can be calculated from the concentration (obtained from the mass of solute and volume of solution) and density of the solution.

Density measurement using a pycnometer

Date: ....

1. Measurement of the density of the solution

The name of the salt from which the solution was prepared: ....

The exact concentration of the solution: ....

Weighing data:

Mass of the dry pycnometer (m_1) ....g

Mass of the pycnometer filled with water (m_2) ....g

Mass of the water in the pycnometer (m_w=m_2-m_1) ....g

Temperature of water:..............ºC, density of water (ρ_w):................g/cm^3

(from the table, given to four significant digits)

Mass of the pycnometer filled with the sample (m_3) ....g

Temperature of the sample:..............ºC

Calculate the volume of the pycnometer

$V = (m_2 – m_1)/\rho_w$ = ...g/..................g/cm^3 = ...cm^3

Calculate the density of the sample:

$\rho = (m_3 - m_1)/V$ = ...g/.................cm^3 = ... g/cm^3.

2. Determination of the weight percent composition of the solution

Calculate the mass of 100.00 cm^3 sample using the measured density (see above)

$m_{solution} = V \cdot \rho$ = ... g

Calculate the mass of solute (dissolved salt without crystallization water) in this solution

m_{salt} = ... g

Calculate the weight percent composition of the solution:

$\frac{m_{salt}}{m_{solution}} \times 100 =$ = ... %(m/m).