**PREPARING CHEMICAL SOLUTIONS AND DILUTION**

**1. OBJECTIVE AND IMPORTANCE OF EXPERIMENT**

Lab experiments often require preparation of chemical solutions in their procedure. We look at preparation of these chemical solutions by weight/volume (w/v) and by weight/weight (w/w). Also, in environmental chemistry, results of the analysis of samples are expressed in two basic ways (weight/volume (w/v) and weight/weight (w/w)).

Basic terms;

**Solute** - The substance which dissolves in a solution

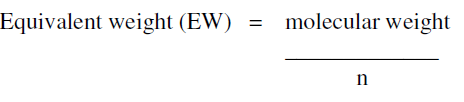
**Solution** - A mixture of two or more pure substances. In a solution one pure substance is dissolved in another pure substance homogenously. For example, in a sugar and water solution, the solution has the same concentration throughout, ie. it is homogenous.

**Molarity** - The most common unit of solution concentration is molarity (M). The molarity of a solution is defined as the number of moles of solute per one liter of solution. Note that the unit of volume for molarity is liters, not milliliters or some other unit.



**Normality** - A concentration unit (N);defined as the number of equivalents of solute per liter of solution. (e.g., 1M H2SO4 = 2N H2SO4) **Normality** rather than aqueous solutions of acids and bases molarity.





**Saturated Solution -** A solution that contains the maximum amount of a particular solute that will dissolve at that temperature.

* 1. **EXPERIMENTAL PROCEDURE**

***Materials and Equipment***

* Volumetric Flask
* Beaker
* Analytical balance
* Pipette
* Graduated Cylinder
* Stirring rod (magnet)
* Stirrer
* H2SO4
* NaCl
* KCl
* NaOH

***Procedure***

1. **Using percentage by weight (w/v)**

A 10% NaCl solution has ten grams of sodium chloride dissolved in 100 ml of solution.

Weigh **10g** of sodium chloride. Pour it into a volumetric flask containing about **80ml** of water. Once the sodium chloride has dissolved completely (swirl the flask gently if necessary), add water to bring the volume up to the final **100 ml.**

1. **Using percentage by weight/weight (w/w)**

Describe how you would prepare 30 g of a 20 percent (w/w) solution of KCl in water.

The weight of potassium chloride required is 20% of the total weight of the solution, or 0.2 × (30 g) = 6.0 g of KCl. The remainder of the solution (30 – 6 = 24) g consists of water. Thus you would dissolve 6.0 g of KCl in 24 g of water.

1. **Molar Solutions**

500 mL of approximately 0.20 M NaOH using solid NaOH

Since the concentration is known to two significant figures the mass of NaOH and the volume of solution do not need to be measured exactly. The desired mass of NaOH is

0.20molNaOHL×40.0gNaOHmolNaOH×0.50L=4.0g

To prepare the solution, place 4.0 grams of NaOH, weighed to the nearest tenth of a gram, in a bottle or beaker and add approximately 500 mL of water.

1. **Using percentage by volume/volume (v/v)**

2 L of 4% v/v acetic acid using concentrated glacial acetic acid (99.8% w/w acetic acid).

The concentration of this solution is only approximate so it is not necessary to measure the volumes exactly, nor is it necessary to account for the fact that glacial acetic acid is slightly less than 100% w/w acetic acid (it is approximately 99.8% w/w). The necessary volume of glacial acetic acid is

4mLCH3COOH100mL×2000mL=80mLCH3COOH

To prepare the solution, use a graduated cylinder to transfer 80 mL of glacial acetic acid to a container that holds approximately 2 L and add sufficient water to bring the solution to the desired volume.

1. **Normality Solutions**

Prepare 500 mL of 1 N H2SO4. (96%w/w sulfuric acid).

d= 1.84 kg/L, MA=98 gr/mole

M=1.84\*0.96/98=18 M N=18\*2=36 N

N1\*V1=N2\*V2

1\*500=36\*V2

V2=13.8 ml add water to bring the volume up to the final **500 ml.**

1. **Preparing Solutions by Dilution**

Solutions are often prepared by diluting a more concentrated stock solution. A known volume of the stock solution is transferred to a new container and brought to a new volume. Since the total amount of solute is the same before and after **dilution**, we know that

Co×Vo=Cd×Vd

where *C*o is the stock solution’s concentration, *V*o is the volume of stock solution being diluted, *C*d is the dilute solution’s concentration, and *V*d is the volume of the dilute solution. Again, the type of glassware used to measure *V*o and *V*d depends on how exact the solution’s concentration must be known.

A laboratory procedure calls for 250 mL of an approximately 0.10 M solution of NH3. Describe how you would prepare this solution using a stock solution of concentrated NH3 (14.8 M).

14.8M×Vo=0.10M×0.25L14.8M×Vo=0.10M×0.25L

and solving for *V*o gives 1.69 × 10-3 liters, or 1.7 mL. Since we are making a solution that is approximately 0.10 M NH3 we can use a graduated cylinder to measure the 1.7 mL of concentrated NH3, transfer the NH3 to a beaker, and add sufficient water to give a total volume of approximately 250 mL.