Preparation of solutions

The purpose

To understand how to prepare a solution, and the calculations related with preparation process.

Introduction

Solution: is a homogeneous mixture, consisting of an one phase system with more than one component (or species). The phase may be solid, liquid or gas. Aqueous solution is a solution where water is the solvent.

solution = solute + solvent

examples of solutions

Solution phase	example
Solution of gas in gas	Air
Solution of gas in liquid	NH_3 in water
Solution of gas in solid	H_2 dissolved in pd
Solution of liquid in gas	aerosol
Solution of liquid in liquid	Acid in water
Solution of liquid in solid	Mercury in copper
Solution of solid in gas	smoke
Solution of solid in liquid	Sugar in water
Solution of solid in solid	Copper amalgam

A. Preparation of Liquid - Liquid Solutions

General method for preparation of diluted acid solution

The normality of concentrated acid can be calculated from the information written on the bottle (percentage % w/w , specific gravity , equivalent weight) according to the equation:-

$$N = \frac{\% \times Sp.gr \times 1000}{eq.wt}$$

To calculate the volume of conc. acid that should be taken (diluted) to prepare a specific volume of diluted acid in the selected normality we have to use the equation below:

$$\underset{\text{of conc. acid}}{N_1 \times V_1} = \underset{\text{of dilute acid}}{N_2 \times V_2}$$

Notes

1.Dilution is usually carried out by a factor of ten exactly.

2.Density and Specific Gravity

Density = mass/volume (The units are usually grams/mL).

Specific Gravity = (mass of substance)/(mass of equal volume water)

= (Density of substance)/Density of water)

Note that the temperature must be specified for specific gravity. Specific gravity is a unitless ratio (i.e., it doesn't matter what the units are so long the same units are used for the substance and water). Specific gravity is more often used in commerce and commercial reagent labeling than density

Procedure

Transfer (x) mL of concentrated acid into volumetric flask (x) mL using cylinder or pipette, complete to the mark with distilled water and mix well.

Preparation of Approximately 0.1 N Hydrochloric acid

For HCl

%= 37%

Sp.gr=1.18

eq.wt=36.5

So that

$$N_{HCl} = \frac{0.37 \times 1.188 \times 1000}{36.5} = 12N$$

To calculate the volume of conc. HCl that should be taken to prepare (250) mL of (0.1) N HCl

$$12N \times V_1 = 0.1N \times 250\ mL$$

So

V_1 = 2.08 mL should be diluted with distilled water in 250 mL volumetric flask to obtain 0.1N HCl.

B. Preparation of Solid - Liquid Solutions

We can expressed the concentration of solution prepared by dissolving a specific amount of solid substance in a specific volume of solution, in two ways formal concentration, and normal concentration.

$$formality = \frac{no.of\ fw}{1 liter of\ solution} \qquad normality = \frac{no.of\ equivalents}{1 liter of\ solution}$$

To calculate the weight need to prepare any one of these concentration in specific volume of solvent we use the equations:

$$Weight = \frac{fw \times F \times v(mL)}{1000}$$ For formal concentration

$$Weight = \frac{eq.wt \times N \times v(mL)}{1000}$$ For normal concentration

Procedure

Dissolve (x) gm of solid substance into a small beaker with distilled water and transfer the solution after dissolution into the volumetric flask (x) mL , washing the beaker many times and adding the washing into the volumetric flask for quantitative transferring of the solution, complete to the mark and mix well.

Preparation of 0.1 F Sodium Chloride

NaCl
fw= 58.4
F = 0.1F
v (mL)= 250 mL

The weight need is $Weight = \frac{58.4 \times 0.1 \times 250}{1000} = 1.46g$

So that to prepare 250 mL of 0.1 F NaCl we have to dissolve of 1.46g of NaCl in 250 mL distilled water.