

TDC Part II
Paper I, Group B
Inorganic Chemistry



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TOPIC:- STANDARD SOLUTION

STANDARD SOLUTION

We know that a solution is made up of two components, one is solute and other is solvent. The component present in large amount is solvent while component present in small amount constitute solute. Here we will discuss about standard solutions. Solutions having known strength are known as standard solutions. There are different ways of expressing strength of a solution. These are in a form of molarity, molality, normality, percentage by weight or by volume, parts per million and formality. Molarity of a solution is defined as the number of moles of solute dissolved per litre of the solution. It is represented by M. Molality of a solution is defined as a number of moles of solute dissolved in thousand gram of a solvent. It is represented by m. Normality of a solution is defined as number of gram equivalent of the solute dissolved per litre of the solution. It is represented by N. The percentage by weight means mass of

solute dissolved in 100 gram of its solution. For example, 20% oxalic acid by weight means that in 100 g of solution of oxalic acid, there is 20 g of the acid. Parts per million can be written as ppm. It is defined as a number of milligrams of solute present in one litre of the solvent. Generally we express hardness in ppm. Therefore we can say that solution with known value of molarity, molality, normality, ppm, percentage by weight or by volume or formality is said to be standard solution. Standard solutions are prepared either by direct weighing of the substance or by standardization. Standardization is a process of making one solution standard by titrating it with another standard solution. On the basis of their preparation, standard solutions are classified as primary standard and secondary standard solutions.

Primary standard solutions:

Those solutions which are prepared by direct weighing of the substance are called primary

standard solutions and these substances are said to be primary standard substances or simply primary standards. For example, oxalic acid, ferrous ammonium sulphate, silver nitrate, potassium dichromate ($K_2Cr_2O_7$), succinic acid. There are certain conditions that a primary standard substance must possess. These are:

- It should be easily soluble in the desired solvent.
- It should not undergo decomposition in the solvent.
- It should be stable in air i.e. it remains unaffected.
- It must have large equivalent weight.
- On standing, there should be no change in its composition.
- Its availability should be in highly pure state.

As mentioned earlier that primary standard substance are obtained by direct weighing therefore in order to calculate the required weight for the preparation of the standard solution, we use a general formula: $w = NEV/1000$, where N is normality of the solution, E represent its equivalent weight and V represents the desired volume of the

solution in mL. Suppose we have to prepare N/10 oxalic acid solution in 500 mL of distilled water. As we know oxalic acid is a primary standard substance hence its standard solution is prepared by direct weighing. Keeping normality = 1/10, E = 63, V = 500 mL, in the above expression for calculating the weight, the weight obtained is 3.15 g. Then 3.15 g of oxalic acid is weighed using digital analytical balance transferred to 500 mL volumetric flask using a funnel. Small amount of distilled water say 50 ml is added into the volumetric flask. Allow the oxalic acid to dissolve. When oxalic acid get dissolve completely, further add distilled water up to the mark indicating that the solution prepared is 500 ml. The prepared solution in the volumetric flask is 500 mL, N/10 oxalic acid solution. In this way, primary standard solutions are prepared.

Secondary standard solutions:

These solutions are not prepared by direct weighing of the substance but are prepared by a

process known as standardization. The substance is called secondary standard substance or secondary standards. These substances do not fulfil the conditions that a primary standard substance possesses. For example, sodium hydroxide, potassium hydroxide, hydrochloric acid, sulphuric acid. In the process of standardization, an approximate weight of the secondary standard substance is dissolved in a volumetric flask of required volume and the exact amount of the solution is obtained by titrating it against another standard solution using some indicator. The process of standardization involves the concept of titration. The preparation of standard solution sodium hydroxide (NaOH) is discussed in section 1.11.