**Solutions**

A solution is a **homogeneous mixture**. One substance is dissolved into another. The substance that is dissolved is called the **solute**, while the one that does the dissolving is called the **solvent**. The most common solvent on earth is water. Water is very polar and has attractions to many other substances. Solutions may involve solids, liquids or gases. There are two main types of solutes:

**Electrolytes** – substances that dissolve and increase the conductivity of water.

**Nonelectrolytes** – substances that dissolve but do not change the conductivity.

Electrolytes behave the way they do because they are ionic. Ionic compounds when put into water are split apart into a positive cation and negative anion. Each of these ions are attracted to the oppositely charged side of the polar water molecule. This is called dissociation. This process can be written in an equation showing the dissolving process. These are **equations of dissociation**: eg Mg(NO3)2 (s) 🡺 Mg+2 (aq) + 2 NO3-1(aq)

There are only four main types of pure substances: metals, nonmetals, molecular compounds, and ionic compounds. Each has unique behaviours when put into water.

When a substance does dissolve, one property of the solution is described by comparing the amount of solute to the amount of solvent. This is the **concentration** of the solution. The following are the more common methods of determining concentration.

Percent by volume or percent by mass:

C= Vsolute x 100 C = m solute x 100

Vsolution Vsolution

8% V/V (ml/ml) 8% m/v (g/ml)

Parts per million (or billion) is a method commonly used for solutions with low concentrations.

ppm = x or Cppm = msolute mg

1000000 V solution msolution kg

In chemistry, the most common method of calculating concentration is a ratio comparing the moles of solute to the volume of the solution in litres. This is molarity with units of mol/L also referred to as molar. The formula used is C = n/v . There is also a mass to mole calculation that must first be completed.

The concentration of solutes can be calculated, but when an electrolyte is placed in solution, the concentration of the resulting ions is often different. The equation of dissociation can be used to predict the concentration of each individual ion.

e.g. Mg(NO3)2 (s) 🡺 Mg+2 (aq) + 2 NO3-1(aq)

In fact the total concentration of solutes is the sum of all ion concentrations.

0.21 mol/L + 0.42 mol/L = 0.63 mol/ L.

**Preparation of a solution:**

Show all calculations in determining the mass of the solute. Measure the mass of the solute using balance. Place the solute into a volumetric flask and then add water to the line. The solution is a **standard** solution when its properties are accurately known. If a large volume of the solution is produced so that more than one sample could be used the initial solution is called a **stock** solution. A stock solution is also used as the initial material in a **dilution**. Dilutions are carried out because the concentration of the sample needed is so small that it would be impossible to weigh out such small amounts of solute. It is far more accurate to produce a more concentrated solution and then take a small sample and dilute it. When doing a dilution, a pipet is used to take a sample of a more concentrated solution and then it is placed in a volumetric flask. Water is added to the required level, and the result is an accurately diluted solution. During a dilution the volume always increases and the concentration always decreases proportionally.

Moles before dilution = moles after dilution

n=CV C*i*V*i* = C*f*V*f*

Solubility is a measure of how well a solute will dissolve. Solubility may be calculated as the concentration of a **saturated** solution. (The maximum concentration at a specific temperature.) A solubility table can be used to identify, generally, how soluble a solute is. Every substance has quite a unique solubility. The state of a substance can greatly affect its solubility. Gases will dissolve at lower temperatures. Most solids will dissolve at higher temperatures.

When a saturated solution is produced and more solute is added, it appears that no further dissolving takes place. This is not true. Although the solution appears to be static, it is actually dynamic, or constantly changing. All solutions having solutes dissolved will reach a point where the rate of the forward (dissolving) process is balanced with the reverse (recrystallization) process. This is when the dissolving process is at **equilibrium**.

When a solute will dissolve continuously without reaching a saturation point, this is usually a liquid, it is **miscible**. Liquids that do not dissolve at all are **immiscible**.