Analytical Chemistry
1st year

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Methods for the Expression of Concentration of Solutions

Solutions

- A solution is a special type of homogeneous mixture composed of two or more substances. In that mixture, a solute is a substance dissolved in another substance, known as a solvent.
- Aqueous solution is prepared by dissolving a solute (NaCl/NaOH/ HCl) in solvent water.
- We must understand the Concentration of solution

- The concentration of a solution is the quantity of solute present in a given quantity of solution.

Concentration

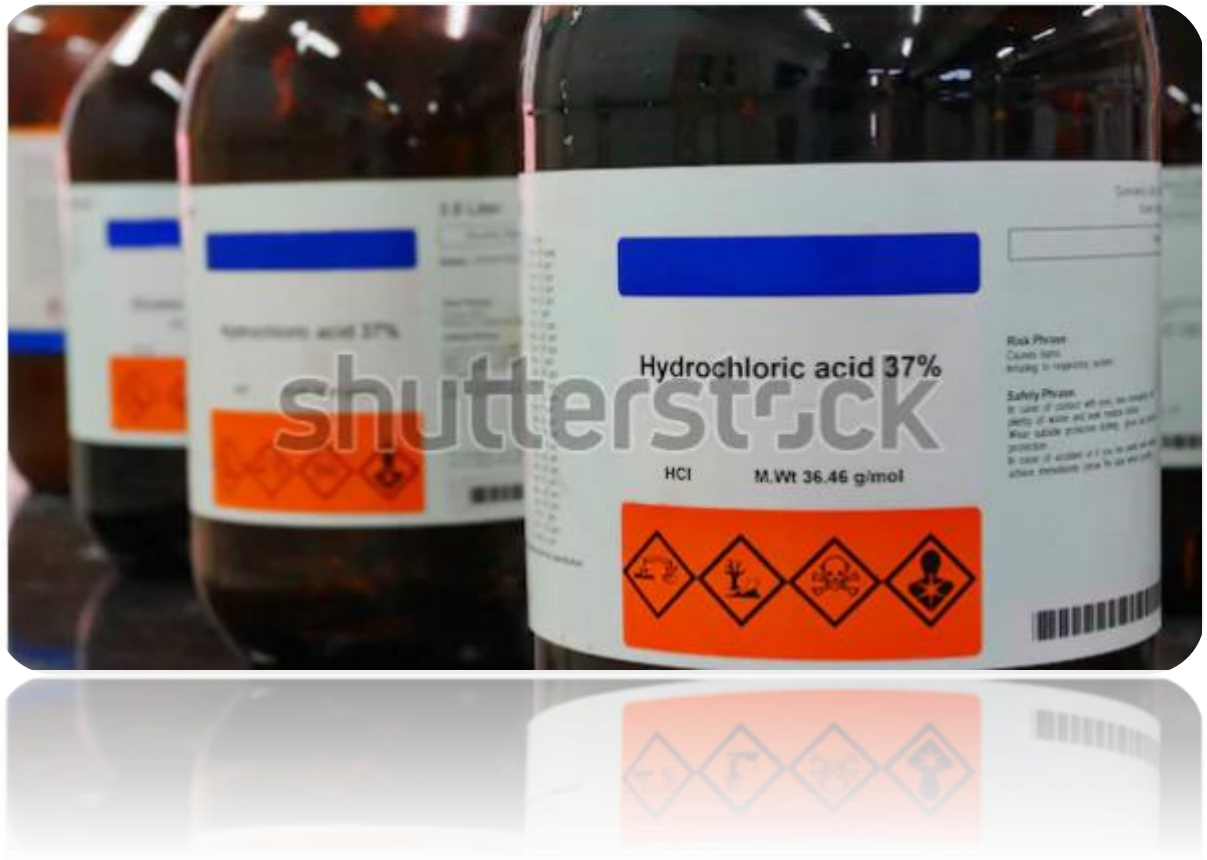
- The concentration of a solution is a measure of the amount of solute that is dissolved in the solvent.
- While concentrations can be used to describe any mixture, we will typically deal with binary mixtures (two components) that are aqueous solutions (solute is dissolved in water)
- There are a number of ways to define concentration but all of them have the same essential idea of expressing the amount of material (solute) that is dissolved in the mixture compared to the amount of solvent (water).

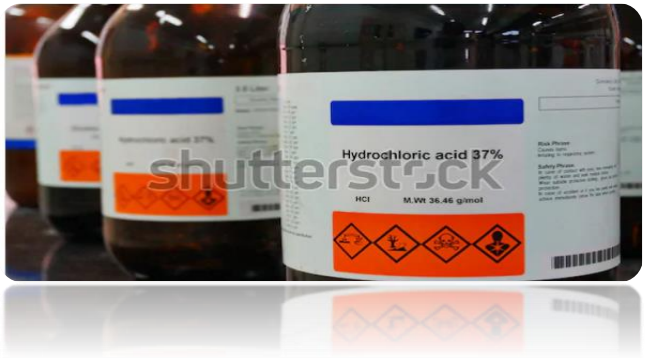
The Dilution

Dilution is the process of reducing the concentration of a solute in a solution. To dilute a solution means to add more solvent without the addition of more solute.

- Mconc X Vconc = Mdil x Vdil or M1 X V1 = M2 x V2
- Prepare a diluted solution of NaCl 0.2M in 250ml by using the 4M solution
- 4M X Vconc = 0.2M X 250ml = 12.5ml Vconc
- Describe how concentrated HCl solution with 12M can be used to prepare 0.5M diluted solution in 1000ml?
- Mconc X Vconc = Mdil X Vdil
- 12M X Vconc = 0.5M X 1000ml = 42 ml Vconc

The Dilution





- Calculate the Molarity of the concentrated HCl solution with specific gravity 1.17 g/ml, the w/w% is 35% then prepare a diluted solution 0.2M in 250ml
- M = Specific gravity X w/w% /100X 1000/M.wt
- M = 1.17 g/ml X 35%X 1000/M.wt
- M = 1.17 g/ml X (35/100 = 0.35)X 1000/36.4 mol =11.2
- Dilution?
- M1V1 = M2 V2 == 11.2 X V2= 0.2 X 250ml = 4.5ml V1 need to prepare diluted 0.2M in 250ml

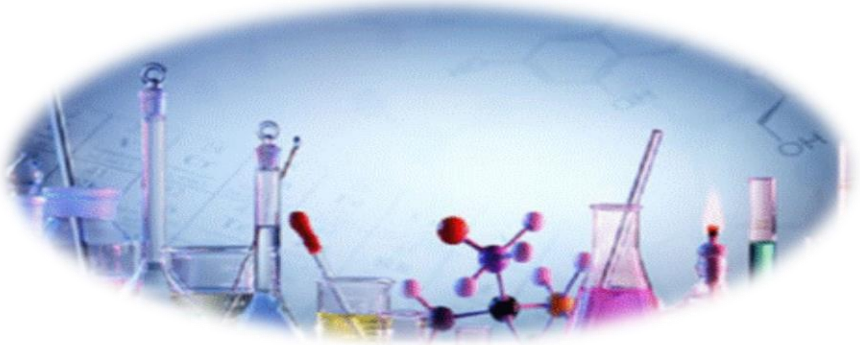
- Use the concentrated nitric acid HNO3 (specific gravity is 1.41, w/w% 70%) to prepare a diluted solution with 0.85M in 500ml?

- M = Specific gravity X w/w% /100X 1000/M.wt
- M = 1.41 g/ml X 70%X 1000/M.wt
- M = 1.41 g/ml X (70/100 = 0.70)X 1000/63.01=15.7
- Dilution?
- M1V1 = M2 V2
- 15.7 X V1= 0.85 X 500ml = 27.1ml V1 need to prepare diluted 0.85 in 500ml

- How to prepare a diluted H_2SO_4 solution of 0.6M in 1000 ml using the concentrated H_2SO_4 solution (specific gravity 1.83, 100 w/w%)?
- M = Specific gravity X w/w% /100X 1000/M.wt
- M = 1.83 g/ml X 100%X 1000/M.wt
- M = 1.83 g/ml X (100/100 = 1)X 1000/98=18.7
- Dilution?
- M1 X V1 = M2 V2 =
- 18.7 X V1= 0.6 X 1000ml = 32.1ml V1 of Conc H_2SO_4 need to prepare diluted 0.6 in 1000ml

- Concentration is an expression of how much solute is dissolved in a solvent in a chemical solution.
- There are multiple units of concentration. Which unit you use depends on how you intend to use the chemical solution.

Molality



- Molality (m) is the number of moles of solute per kilogram of solvent
- m = number of moles of solute/ Kilogram of solvent
- Example: What is the molality of a solution of 20 g NaOH in 500 g water?
- Find number of moles of solute = Wt of solute (NaOH)/ M.wt NaOH=

Number of moles = 20g/ 40mol/g=0.5mol

Find the solvent in Kg = 500 g water x 1 kg / 1000 g = 0.50 kg water

- m = number of moles of solute/ Kilogram of solvent

m= 0.5mol / 0.50 kg = 1m

Molality

- Example: What is the molality of a solution of 18 g $CaCl_2$ in 450 g water?
- m = number of moles of solute/ Kilogram of solvent
- Find number of moles of solute = Wt of solute ($CaCl_2$)/ M.wt $CaCl_2$ =

Number of moles = 18g/ 75.5mol/g=0.24mol

Find the solvent in Kg = 450 g water x 1 kg / 1000 g = 0.450 kg water

- m = number of moles of solute/ Kilogram of solvent

m= 0.24mol / 0.45 kg = 0.53m

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Thank you