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4th lecture analytical Chemistry 25/1/2021

# Methods for the Expression of Concentration of Solutions

- 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.

# Percent Concentration

amount of a solute present in per 100 part of solution

1.   Weight percent (w/w%)
     It is defined as numbers of grams of a solute present in 100grams of solution of preparation

Expressed as (w/w%) = weight of solute (g)/ weight of solution (g) X100%

Example:  10% w/w NaCl  is 10 NaCl for every 100g of solution

5% Iodine ointment is 5gm present for every 100g of ointment

# Volume percent (v/v%)

1. Is defined as the volume of a solute in ml dissolved in 100ml of solution as liquid

2. Expressed as (v/v %) = volume of solute (ml)/ volume of solution(ml) X100%

3. Used when solution is made by mixing two liquids

4. For example 70% ethanol is prepared by dissolving 70ml of ethanol in 100ml of solution

# weight/volume percent (w/v%)

- Is defined as the amount of a solute in grams present in 100ml of solution as liquid of preparation

- Expressed as (w/v %) = weight of solute g/ volume of solution ml X100%

- Example: 0.9% w/v NaCl saline solution is prepared by dissolving 0.9g in 100ml saline solution

➢ Concentration = quantity of solute/ quantity of preparation

- weight/volume percent (w/v %) = weight of solute g/ volume of solution  ml X100

- Example: A formula for antifungal shampoo contains (2% w/v) ketoconazole. How many grams of ketoconazole would be needed to prepare 25 liters?

- Concentration = 2% (w/v) = 2g/100ml

- Quantity of preparation = 25L X 1000ml/1L = 25,000ml

- Concentration = quantity of solute/ quantity of preparation

- 2g/100ml = X/ 25,000= **500g**

# Parts per million (ppm)

- Parts per million (ppm) represents the number of parts of solute in $10^6$

- ppm = $\dfrac{parts\ of\ solute}{10^6\ parts\ of\ prepartion}$

- (weight in -volume )ppm = $\dfrac{grams\ of\ solute}{ml\ of\ 10^6\ parts\ of\ solution}$

- (weight in –weight)ppm = $\dfrac{grams\ of\ solute}{g\ of\ 10^6\ parts\ of\ solution}$

- (volume-in volume) = $\dfrac{ml\ of\ solute}{ml\ of\ 10^6\ parts\ of\ solution}$

- Parts per million (ppm) represents the number of parts of solute in $10^6$ of solution
- This unit is used to express very small amount of solute
- Example: Prepare 1000ppm solution of NaOH

1 ppm = 1mg per liter of solution

1000ppm= 1000mg

1000mg =1gram

1gram = 1000ppm

Now weigh 1gram of NaOH and dissolve it on 1litter of solvent to prepare 1 liter of 1000ppm NaOH

Example: By using 1000ppm NaOH:

- Prepare 10ppm in 500ml, 6ppm in 250ml, 2 ppm in 100ml solutions of NaOH

- $C_1V_1 = C_2V_2$

- 1000ppm X $V_1$= 10ppm X 500 = 5ml $V_1$

- $C_1V_1 = C_2V_2$

- 1000ppm X $V_1$= 6ppm X 250ml = 1.5ml $V_1$

- $C_1V_1 = C_2V_2$

- 1000ppm X $V_1$= 2ppm X 100ml = 0.2ml $V_1$

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- Example: If 14 L of cough syrup are found to contain 0.01ml of eucalyptus oil, what is the concentration of eucalyptus oil in ppm?

- $\dfrac{1000ml}{1L} = \dfrac{Xml}{14L} = \dfrac{1000ml\ X\ 14L}{1L} =$ 14000ml

- $\dfrac{0.01}{14000ml} = \dfrac{yml\ of\ solute}{1000,000\ ml\ of\ prepartion}$

- $y = \dfrac{0.01ml\ X 1000,000ml}{14000} =$ 0.71ml of eucalyptus oil (0.71ppm)

- Calculate the concentration of (diclofenac sodium) in ppm if a sample of Voltaren gel weighing 10g contains 0.00006 parts of (diclofenac sodium).

- $$\frac{0.00006g}{10g} = \frac{y \; g \; of \; solute}{1000,000 \; g} = \frac{0.00006g \; X \; 1000,000g}{10g} = 6g \; ppm$$

# parts per billion (ppb)

- Parts per billion (ppb) represents the number of parts of solute in $10^9$

- ppb $= \dfrac{parts\ of\ solute}{10^9 \text{ parts of prepartion}}$

- (weight in -volume )ppb $= \dfrac{grams\ of\ solute}{\text{ml of } 10^9 \text{ parts of solution}}$

- (weight in –weight)ppb $= \dfrac{grams\ of\ solute}{\text{g of } 10^9 \text{ parts of solution}}$

- (volume-in volume)ppb $= \dfrac{ml\ of\ solute}{\text{ml of } 10^9 \text{ parts of solution}}$

# parts per billion (ppb)

- A sample of **anti-allergic** syrup contains 0.34ppb of tranilast as an active ingredient, how many grams of tranilast will be used to prepare 110L of anti-allergic syrup ?

- $\dfrac{1000ml}{1L} = \dfrac{Xml}{110L} = \dfrac{1000ml\ X\ 110L}{1L} = 110.000ml$

- $\dfrac{0.34g}{1000,000.000ml} = \dfrac{y\ g\ of\ solute}{110.000\ ml\ of\ prepartion}$

- $y = \dfrac{0.34g\ X110.000ml}{1000.000.000ml} = 0.000037g$ of tranilast ($3.7\ x\ 10^{-5}$ g)

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Thank you