Laboratory Mathematics

Sorry In Advance

Lab Math Concepts

- Conversions
- Molecular Weight and Concentration
    - Normality, Equivalence
- % solutions
- Dilutions
- Specific gravity

Conversions

Dimensional Analysis

Conversion Factors

- How do we use them?
  - Eg. 80 mm is how many inches? (conversion factor is 1" = 2.54 cm)
  - This process is repeatable and defined

Dimensional Analysis

- By using fundamental qualities and their relationships (***conversion factors***) we can do most problems involving conversions
  - E.g. Calculate the molarity of 8.00 g of NaCl in 125 mL of water

$1.094\ M$

Molecular Weight and Concentration

Moles/Molarity and Equivalents/Normality

Molecular Weights and Concentrations

Molarity

- Moles per liter of solution
  - A mole of substance is 1 x gram molecular weight (gmw)
  - 23 g of sodium in 1 L in 1 M
  - 40 g of calcium in 1 L is 1 M

Normality

- Equivalents per liter of solution
  - An equivalent is gmw / valence (measure of reactive potential)
  - 23 g of sodium in 1 L is 1 N
  - 40 g of calcium in 1 L is 2 N
    - 40 gmw / 2+ charge = EqWt = 20g

Equivalent weight

- What is the equivalent weight of H_3PO_4? How about mEq wt?
  - Molar weight? (3 x 1) + 31 + (16 x 4) = 98 g / mol

$$\frac{98g\ H_3PO_4}{1\ \cancel{mol\ H_3PO_4}} \times \frac{1\ \cancel{mol\ H_3PO_4}}{3\ Eq\ H_3PO_4} =$$

=32.7 mg/ mEq

Normality

- It’s just another step: 350 g NaCl in 1.5 L of water is what normality?
- Do you miss working out molarity? You can do that first if you’d prefer:

% Solutions

Or an antiquated way to write concentrations

% Solutions

- % (W/W)- The number of grams of substance in 100 g of solution
  - Eg: 10% Li_2CO_3 solution is 10g Li_2CO_3 in 100 g of mixture
- % (V/V)- The number of mL in a total volume of 100 mL
  - Eg: 10% HCl solution is 10 mL HCl in 100 mL of solution
- % (W/V)- the number of g of substance in a solution of 100 mL volume
  - 10% NaCl solution is 10g of NaCl in 100 mL of solution

Dilutions

Creating solutions of lower concentration

Dilutions

- Expressed relative to total
  - 1:2
  - ½
- Others may express as sample to diluent
  - 1:1
  - 1/1

Both of these
are X 2 dilutions
(D2 in chem)

Dilutions

- Combining sample and diluent allows us to use the following equation:

  $$V_1C_1=V_2C_2$$

- Example: 100 μL of serum is combined with 400 μL of saline. What dilution have we made?
  - Part / Total → 100 μL / 500 μL → 1/5
- What is our dilution factor?
  - x5

Dilutions Application

- We can only measure so high, but some people are sicker than that, imagine… what nerve!?
- Analyzer can measure lipase 3-300 U/L
  - Returns result of: 5000 > Linearty – INVALID RESULT
- What dilution should we make?
  - 1/11 will give us ~450 U/L still too high
  - 1/101 will give us ~45 U/L, that works, but is large and introduces a lot of possible error
  - 1/21 will give us 238 U/L PERFECT

Dilution Application

- Making a 1/21 aka D21 aka x21
- Choose a good total volume (protip: a multiple of 21)
- 210μL is good for the fixed volume pipettes we have
  - If only 1/21st of our dilution is patient sample that is 10μL
  - The rest (200μL) is diluent
  - 10μL patient + 200 μL diluent = 210μL
- Dilution = 1/21
- Answer returned as 247 U/L
  - 247 U/L x 21 = 5187 U/L

Specific Gravity

Density by another name

Specific Gravity

- Measure of density
- A ratio of masses, represents 1 mL of given liquid solution (i.e. urine) in relation to 1 mL of H_2O
- Urine typically has S.G. 1.005-1.030
  - Assuming we have urine with SG of 1.015
    - 1 mL of that urine has a mass of 1.015 g