Biochemical Calculations

312 BCH

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Reference: Biochemical calculations by Irwin H. Segel.

Midterm dates

- 1st Midterm:
  - 5th week, Monday 4th of February (28 Jumad’a I).
  - Time 12-1 pm.
- 2nd Midterm:
  - 10th week, Monday 11th of March (4 Rajab)
  - Time 12-1 pm.

Marks distribution

- Midterm 1: 15 marks (15%)
- Midterm 2: 20 marks (20%)
- Lab: 25 marks (25%)
- Final exam: 40 marks (40%)

Objective of this lecture

1) To be familiar with the names and type of glassware used in the labs.
2) To know how to calculate the molarity and normality of solutions

Glassware

Bottles

Wide neck, amber, bottles; can be used for a wide range of light sensitive liquid or solid storage.

Reagent bottles

Narrow neck bottles; can be used for a wide range of liquid storage, media preparation and sampling applications.

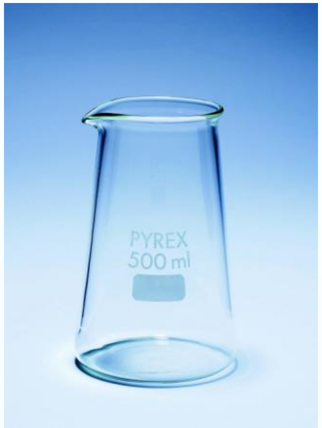
Glassware continued

Media-lab bottles

Wash bottles

Glassware continued

Beakers

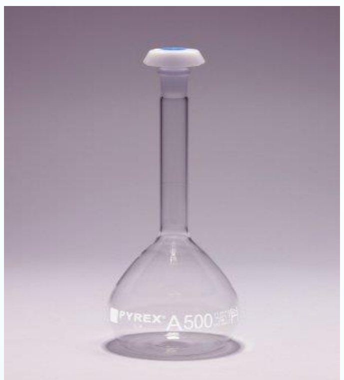


Conical shape beakers; ideally used for titrations and mixing application, these conical shape beakers are a cross between a standard beaker and conical flask.

Griffin beaker; is great for general laboratory use.

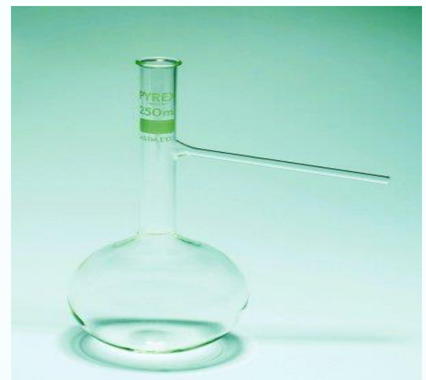
Glassware continued

Flasks



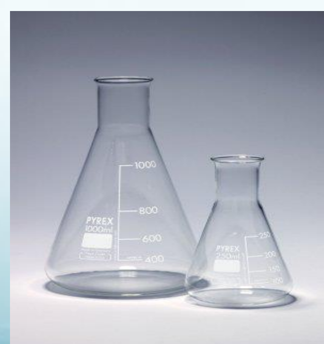
Volumetric flasks; are precision measuring instruments.

Boiling flasks



Distillation flasks

Cell culture flasks



Erlenmeyer Conical flasks

Glassware continued

Volumetric ware

Burette

Burette clamp

Cylinder

Mixing cylinder

Glassware continued

Test tubes

Test tubes

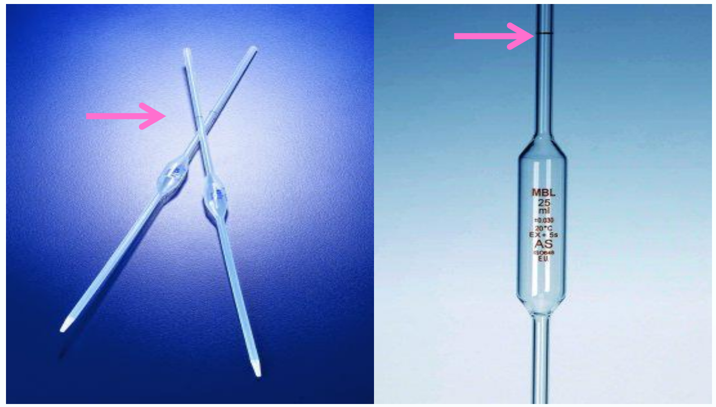
Test tubes with ground socket joint.

Culture Tubes

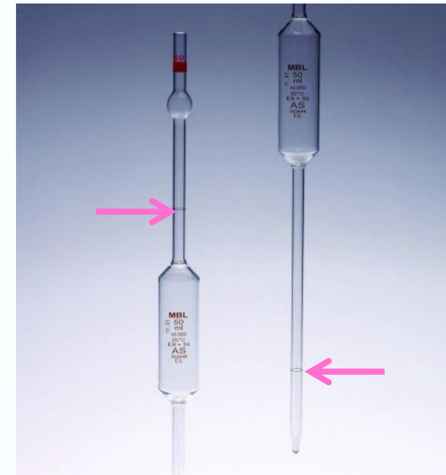
Centrifuge Tubes

Glassware continued

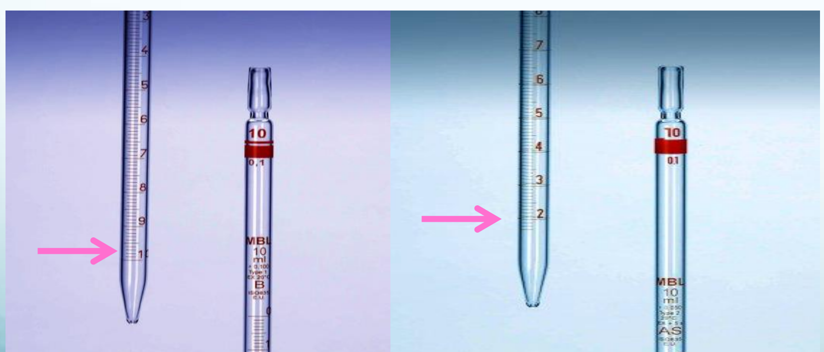
Pipettes



One mark pipette



Two mark pipette
with safety bulb at
top.



Type 1 Type 2

Graduated pipettes

Pasteur Pipettes

Glassware continued

Funnels

Filter funnels

Dropping & Separating Funnels

Buchner Funnels

Lab equipment

Petri dishes

Evaporating dishes

Vial Racks

pH meter

Balance

Ring Stand

Test Tube Clamp

Test Tube Rack

Lab equipment continued

Plates

Micropipettes

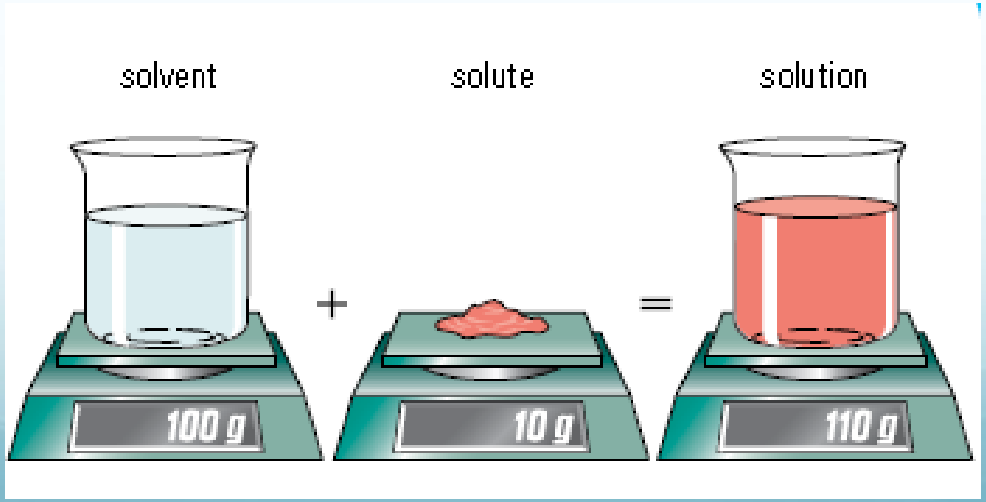
Multichannel micropipettes

Tips

Eppendorf tubes

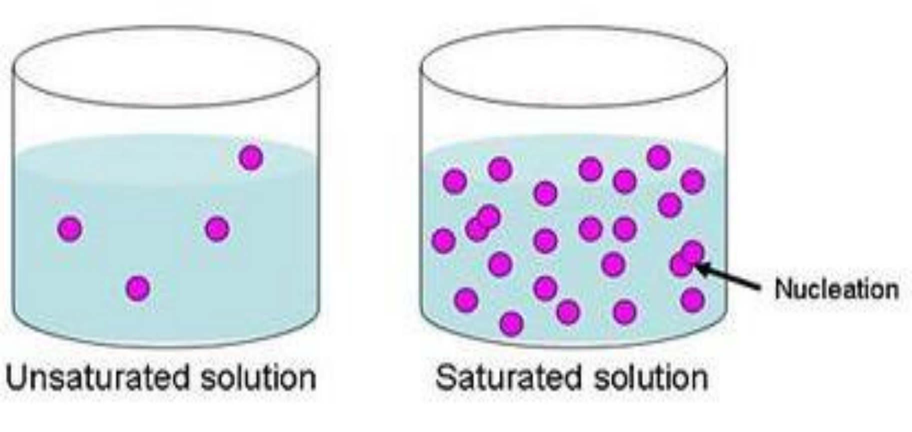
Solution Composition

- A solute is the substance being dissolved.
- A solvent is the liquid in which the solute is dissolved.
- A solute is dissolved in a solvent.
- An aqueous solution has water as solvent.



Aqueous Solution

- The majority of reactions occur in solutions.
- There are several ways to express the concentration of a substance in a solution based on:
  - The volume
  - The weight
  - Degree of saturation



Concentration based on volume

- Here the concentrations are based on the amount of dissolved solute per unit volume

- ***The calculations depending on volume include***:
  - Molarity (M)
  - Normality (N)
  - Activity (a)
  - Weight/Volume percent (w/v %)
  - Volume/volume percent (v/v%)
  - Milligram percent (mg %)
  - Osmolarity (osm)

1- Molarity

- Is the number of moles of solute per liter of solution

$$M = \frac{\text{No. of moles}}{\text{Volume of solution in L}}$$

- No. of moles = Wt_g /MWT (molecular weight)
- 1 mole contains Avogadro's number of molecules per liter (6.023×10^{23}).
- Molar concentrations are usually given in square brackets
  - Example: [H+] = molarity of hydrogen ion

    [NaOH] = molarity of Sodium Hydroxide

Molarity cont'd

- Examples:
  - A solution of NaCL had 0.8 moles of solute in 2 liters of solution. What is its molarity?

$$M = \frac{\text{no. of moles}}{\text{volume of solution in L}}$$

$$M = \frac{0.8}{2}$$

M = 0.4 molar

Molarity cont'ed

- **Examples:** How many grams of solid NaOH are required to prepared 500 ml of 0.04 M solution?

$$M = \frac{\text{no. of moles}}{\text{volume of solution in L}}$$

$$500 \text{ ml} = 500 \div 1000 = 0.5 \text{ L}$$

$$\text{no. of moles} = 0.04 \times 0.5$$

$$\text{no. of moles} = 0.02 \text{ mole}$$

$$\text{no. of moles} = \frac{\text{weight in gram}}{\text{molecular weight (MWT)}}$$

Molarity cont'ed

MWT of NaOH = 23 = 16 + 1 = 40

Wt in grams = no. of moles × MWT

wt in grams = 0.02 × 40

wt in grams = 0.8 grams

2- Normality

- Is the number of equivalents of solute per liter of solution

$$N = \frac{\text{no. of equivalents}}{\text{volume of solution in L}}$$

$$\text{no. of equivalents} = \frac{\text{weight in gram}}{\text{Equivalent weight (EW)}}$$

$$\text{equivalent weight} = \frac{\text{MWT}}{n}$$

n = is the number of replaceable hydrogen (H^+ in acids)or hydroxyl ions (OH^- in bases) per molecule

Normality cont'd

n = is the number of electrons gained or lost per molecule (in oxidizing or reducing agents)

$$N = \frac{\text{no. of equivalents}}{\text{volume of solution in L}}$$

$$N = \frac{\text{weight in gram}}{\text{Equivalent weight}} \;/\; \text{volume of solution in L}$$

$$N = \frac{\text{weight in gram}}{\text{MWT / n}} \;/\; \text{volume of solution in L}$$

Normality cont'd

$$N = \frac{\text{weight in gram} \times n}{\text{MWT}} / \text{volume of solution in L}$$

$$M = \frac{\text{no. of moles}}{\text{volume of solution in L}}$$

$$M = \frac{\text{weight in gram}}{\text{MWT}} / \text{volume of solution in L}$$

➡ $N = n \times M$

- For example: A 0.01 M solution of H_2SO_4 is 0.02 N

Normality cont'd

- **Example:** What is the normality of H_2SO_4 solution that contains 24.5 g of solute in a total volume of 100 ml?
- $N = n \times M$
- $n = 2$
- M = No. of moles / $V_{(L)}$
- 100 ml = 100 ÷ 1000 = 0.1L
- No. of moles = Wt_g /MWT
- MWT of $H_2SO_4 = 2 + 32 + (16 \times 4) = 98g$

Normality cont'ed

- No. of moles = 24.5/ 98
- No. of moles = 0.25 mole
- M = No. of moles / $V_{(L)}$
- M = 0.25/0.1 = 2.5 molar
- $N = n \times M$
- $N = 2 \times 2.5 = 5$ normal

Normality cont'ed

Another way to solve it:

- Normality (N) = No. of equivalents / $V_{(L)}$
- No. of equivalents = Wt_g of solute / equivalents weight (EW)
- EW= MWT of solute / n
- MWT of H_2SO_4 = 2 + 32 + (16 × 4) = 98 g
- EW= 98 / 2 = 49
- No. of equivalents = Wt_g of solute / equivalents weight (EW)
- = 24.5 g / 49 = 0.5 eq
- Normality (N) = No. of equivalents / $V_{(L)}$

=0.5 / 0.1 = 5 Normal