Plant Physiology

Plant physiology:- Is the study of the function or physiology of plants fundamental processes such as photosynthesis and respiration.

Lab (1)

Preparation the solution

Solution:- is a mixture, typically consists of the dissolved material called the **solute** and the dissolving agent called the **solvent**

Ex:- sugar (solute) dissolved in water (solvent).

Type of solution (upon concentration):-

Molar solution:- an aqueous solution that contain 1 mole (gram-molecular weight) of solute in 1 liter of the solution.

Molarity(molar concentration): the number of moles of solute per liter of solution.

Normality:- a measure of concentration equal to the gram equivalent weight per liter of solution.

$$N = M \times \text{electron exchanged}$$

These solution complete to final volume of (1) liter.

$M = \frac{Wt}{M.wt} \times \frac{1000}{V}$	$N = \frac{Wt}{Eq.wt} \times \frac{1000}{V}$

m.wt : molecular weight

$$eq.wt = \frac{m.wt}{n}$$

v : volume (ml)

Equivalent weight: the weight of a compound that contains one equivalent of a proton (for acid) or one equivalent of an hydroxide (for base).

N= equivalent number

{ Hcl , NaoH } n = 1 , {$Ca(oh)_2$, H_2SO_4 } n = 2

{$Fe(oH)_3$, H_3PO_4 } n= 3

Nacl → n = 1

$Cacl_2$ → n = 2

$Fecl_3$ → n = 3

Percentage solution (%) :- based on percent and they are the easiest to calculate because they don't depend a knowledge of molecular weight.

Weighting sol. (w/w) :- prepared by dissolving a weight of solute in a weight of solvent.

Volumetric sol. (v/v) :- prepared by dissolving a volume of solute in a volume of solvent.

Weight-volumetric sol. (w/v) :- prepared by dissolving a weight of solute in a volume of solvent.

These solution complete to final volume of (100 ml) .

Dilution law :-

$$C_1 V_1 = C_2 V_2$$

C = concentration

V = volume

Million solution ….(ppm) part per million

(1/1000000) or (10^{-6}) ….this unite using for very tiny compounds (hormones, enzymes, gases, vitamins)

How to prepare a solution :-

$Wt = M \times M.wt \times \frac{V}{1000}$	$Wt = N \times eq.wt \times \frac{V}{1000}$

Examples :-

Q :- prepare a solution of Hcl & NaoH with concentration (2M)

(M.wt Hcl = 36.5) (M.wt NaoH = 40).

Q :- How to prepare Hcl a solution of $Ca(oH)_2$. the concentration (2N) . (M.wt = 111).

Q :- prepare a (2%) solution of methylene blue

-Weighting 2gm of methylene blue , adding a volume of distiller water , mix well then complete the volume to 100ml.

Q :- how to prepare a solution 10% of H_2SO_4 in water.

- Taken a 10ml of H_2SO_4 then adding a volume of distilled water to it, mix well then complete volume to 100ml.

Lab (2)

Acidity & Al Kalinty & Buffers

Plant cell or tissue of → 90% water

→ 10% chemical compounds carbohydrate, enzymes, salts, proteins

- ❖ All biochemical reaction occur within the plant cell uses the water present in the cell.

Pure water is the standard by which all other solution are compared because water is an ionic ally neutral solution.

Acids are molecules that release hydrogen ions (H^+) when dissolved in water. Acids increase the concentration of H^+ in a solution.

Base are molecules that remove H^+ from solution, Bases decrease the concentration of H^+ in a solution when the proportionately less. By general agreement, the scale(pH stands for the potential of hydrogen ions).

Buffers :- they are chemicals that absorb excess H^+ as the pH decreases (more acidity) or release H^+ as the pH increases (more Al kaline). Buffers minimize changes in pH.

- In most organisms, the pH is kept relatively constant by Buffers.
- Most biological fluids (e.g. milk, blood) contain buffers.

And in plant cell there are buffer fluid like:

Citric acid, oxalic acid, A ammonium hydroxide, carbonic acid.

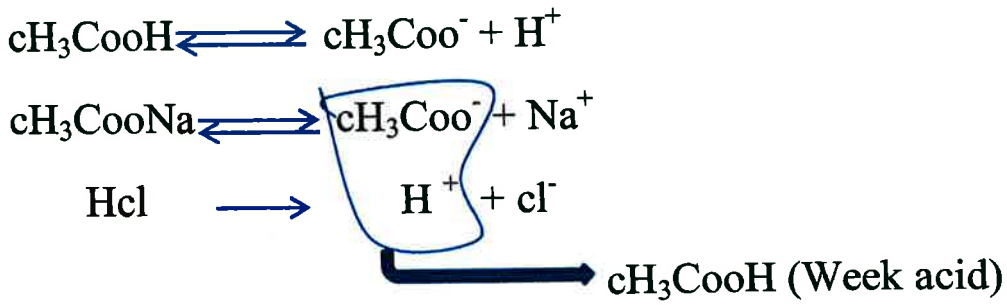
Maximum Buffer capacity :- is the quantity of strong acid or bases that must be added to change the pH of 1 liter solution by one pH unit.

Note :- buffer solution only can maintain the pH stable in some range (called buffer capacity) and the buffer capacity is affected by

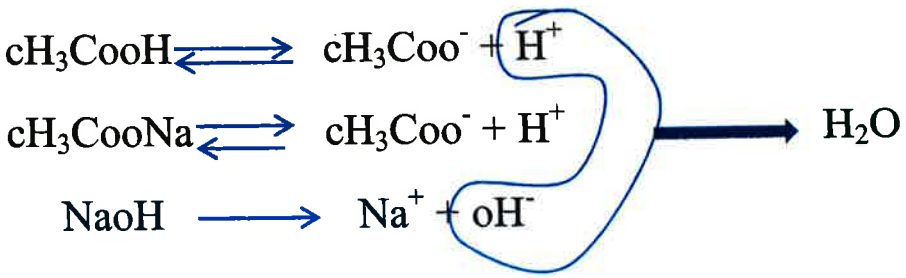
1- The concentration of the buffer component.
2- The quality of the buffer component.

❖ Mechanism of How buffer working:-

a) With strong acid



b) With strong base



Methods used to measure the pH:-

1. Litmus paper
2. pH – meter

Q:- three solution , three pH were 9, 5, 4.

After adding a chemical compound to them the pH changing as show in

A	B	C	
9	5	4	
7	8	4.1	after adding

- which of three solution is a buffer ?
- what the nature of the chemical compound that added ?

Lab (3)

Diffusion

The movement of ions or molecules from a region of high concentration to a region of low concentration.

This movement dependent , or due to the (kinetic energy)

Properties :-

1. Movement in one way direction from high pressure region to low pressure .
2. Does not require energy.
3. Diffusion stop when concentration on both sides equal.
4. Diffusion of one compound is independent to diffusion of other.
5. Molecules continue to move, but no change in net concentration.
6. Equilibrium is reached.

Facture affection diffusion:-

1. Size of particles .
2. Rate of diffusion as the concentration difference increase.
3. Temperature :- when temperature increased, the kinetic energy of particles increased , and the diffusion is increased.
4. The solubility:- the greater solubility of particles or molecules in the media the faster it will diffuse.
5. The rate of diffusion decrease when molecules must travel a longer distance in their search for equilibrium.

The importance of diffusion in plant life:-

1. It is an essential process in exchange of gases (O_2 and CO_2) during respiration and photosynthesis .
2. Up take of minerals is affected by diffusion.
3. It helps in removal of excess water by the process of transpiration.
4. Translocation of organic solutes also take place by diffusion means.
5. Fragrance of flowers spread in air by diffusion means attracts insects to pollination.

The diffusion in gases faster than in liquids, and in liquids faster than in solid

The diffusion of solid substances in solid medium, and in liquid medium.

Exp. 1.

2 dishes, containing agar.

First one we put potassium brameante (58 m.w). and the second one we put iodine potassium (204 m.w).

When comparing diffusion between the two above we see that potassium bramneant faster in diffusion , comparing with iodine potassium , because their weight less than other.

Exp. 2 .

2 tubes, contain water.

First one we put potassium bramneant and second one we put ioden potassium.

When comparing diffusion between the two above, we see that potassium bramneant diffuses faster than iodine potassium, because its weight is less.

Lab (4)

Plasmolysis

The process in which cells lose water in a hypertonic solution , causing the cell to shrink due to diffusion of water out of the cell.

Type of solution regarding to the concentration of solutes

1. Hypertonic
2. Isotonic
3. Hypotonic

Types of plasmolysis:-

1. Incipient plasmolysis :- the stage of plasmolysis at which the first sign of shrinkage of cell contents from cell wall becomes delectable . it take place if the cell is putted in isotonic (approximately) solution and the water will continue to move inside and outside the cell.
2. Evident plasmolysis :- stage when the cell wall has reached its limit of contraction and cytoplasm has detached from cell wall attaining spherical shape. This type of plasmolysis happens when the cell is putted in hypertonic solution leading the water inside the cell to get out to the surrounding solution.

تجربة القطرة الساقطة :-

Experiment of (falling drop) grad kg rove.

1- Prepare 2 solution , hypertonic and hypotonic
2- Prepare 3 tubes , hypertonic , isotonic (distill water) , hypotonic.
3- Prepare a piece of onion or potato add one piece in each tube for 5-10 min., and add a drop of methylene blue stain to each tube.
4- Prepare anther 3 tubes like in 2 (group B)
5- Taken a drop from each tube of group A, then add it on each tube of group B.
6- See the movement or diffuse of each drop in the solution.

Lab (5)

Permeability

- Transmission the particles through the membranes.
- This phenomena for membranes, not for substances.
- There for there are 3 kites of membranes.

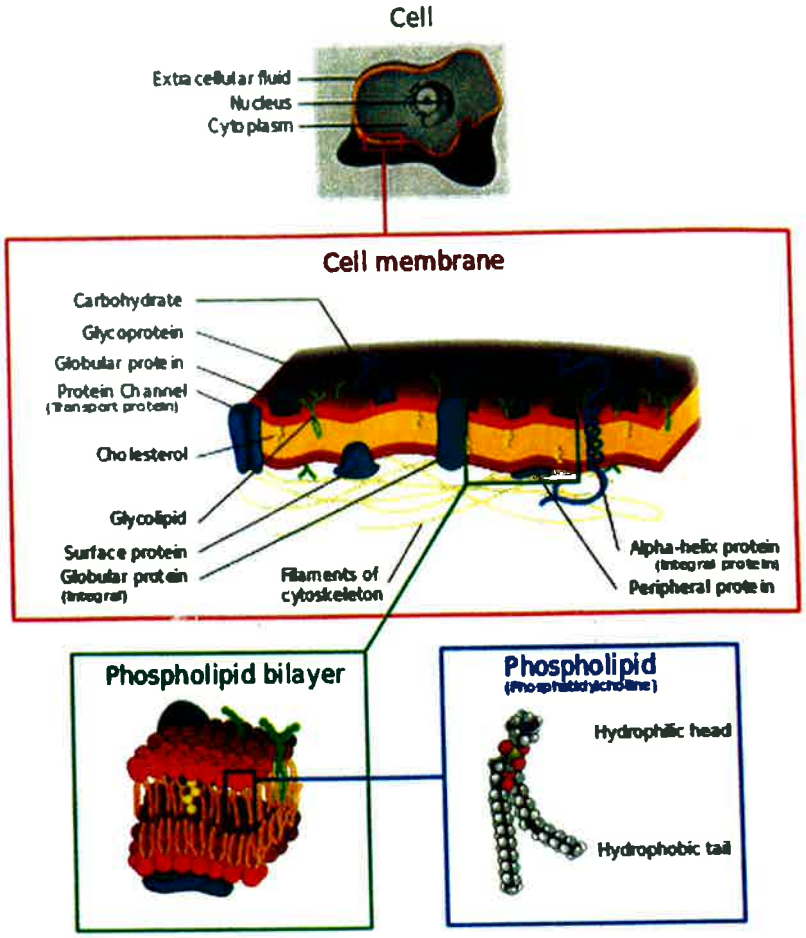
1- Impermeable membranes :- these membranes dose not allowed all particles for passing or transmission through it. Like (cuteness, supercne ,) these covered by waxy layer.

2- Selective membranes :- it allows for some particles passes through, and dose not allows other particles for passing. That depend on the size and mass of these particles, the solubility of particles in the membrane(like cell membrane).

3- Complete permeability membrane :- allows for all particles passing through (like cell wall) and (dead membrane).

Permeability through membranes depends on :-

1. size and mass of particles.
2. Solubility of solutes in membranes .



Factors affecting permeability :-

A. Physical factors :-

1. **Size and mass** :- the greater in mass and size of partied, it will be less permeable.
2. **Heat** :- → freezing
   → Boiling
   → Heating

Freezing :- particles more permeable. Because in freezing water molecules become crystals with rho phis edges, or (ice needle) and these will fraction the cell membrane , also the inter spaces will be bigger, allowing all particles to pass.

Boiling :- in boiling water, particles more permeable because high temperature damage the membrane (deforming the proteins) .

Heating :- heating increases the kinetic energy of particles and increased their permeability.

B. Chemical factors :-

1. Acids , Bases and salts :- strong acids and bases will change the (pH) so the cell membrane damage or being more homogenizing , and also strong acids deforming the proteins in membrane. There for the interspaces will be bigger and more wildly , allowing the particles to pass.
2. Organic solvents :- these substances, effect on phospholipids in cell membrane (dissolve it), so the membrane convert to a complete permeable , and allows for all particles to pass through.

Transpiration

Lab (6)

Out excess water from plant body as water vapor through the holes that present on the surface of the leaf called (stomata)

High percent of water absorbed from soil will be lost by transpiration.

This process is necessary for :-

1- Absorption more of ions and nutrient from soil.
2- Rebalance the pressure of overload water inside the plant tissues, by get rid of over load water inside plant.

Types of transpiration :-

1- Stomata:- losing 90% of water vapor through stomata.
2- Cuticular :- losing 5% -10% of water vapor through epidermis and cuticle.
3- Lenticular :- losing 2-5% of water vapor through lancets of periderm in xylem.

Factories affecting transpiration :-

1- Light :- in day light, plant need water for photosynthesis and other bio reaction , so the loss of water is decreased through transpiration (inverse relationship).
2- Humidity :- high humidity in atmosphere (high percentage of water vapor), that will press on the stomata, and decreases loss of water through transpiration vapor from leaves.
3- Air movement (winds):- fast winds will increase evaporation on the surfaces of leaves, and that will

increase losing of water vapor from stomata (increasing transpiration).

4- Temperature :- in high temperature region (desert) plant need all the water and maintains of water inside tissue for survive, so the losing of water decreased.

5- Water containing :- high percent of water inside tissue, causing a high losing of water, for rebalance that pressure of water inside tissue. (increasing transpiration).

6- Atmospheric pressure :- high pressure (in high region) that will press on the stomata and that decrease of losing water vapor from leave (less transmination).

Guttation :- outer excess of water from plant as a drop (liquid form), through a special holes called (hydrathodes) in the end of xylem tissue, the adages of leaves for some plant (tomato, turimp). This case obtain transpiration decreased in unusual circumstance, and a high percent of water collected inside plant tissue, so the plant exiting water by guttation.

Pigments isolation and spectrum of absorption

Lab (7)

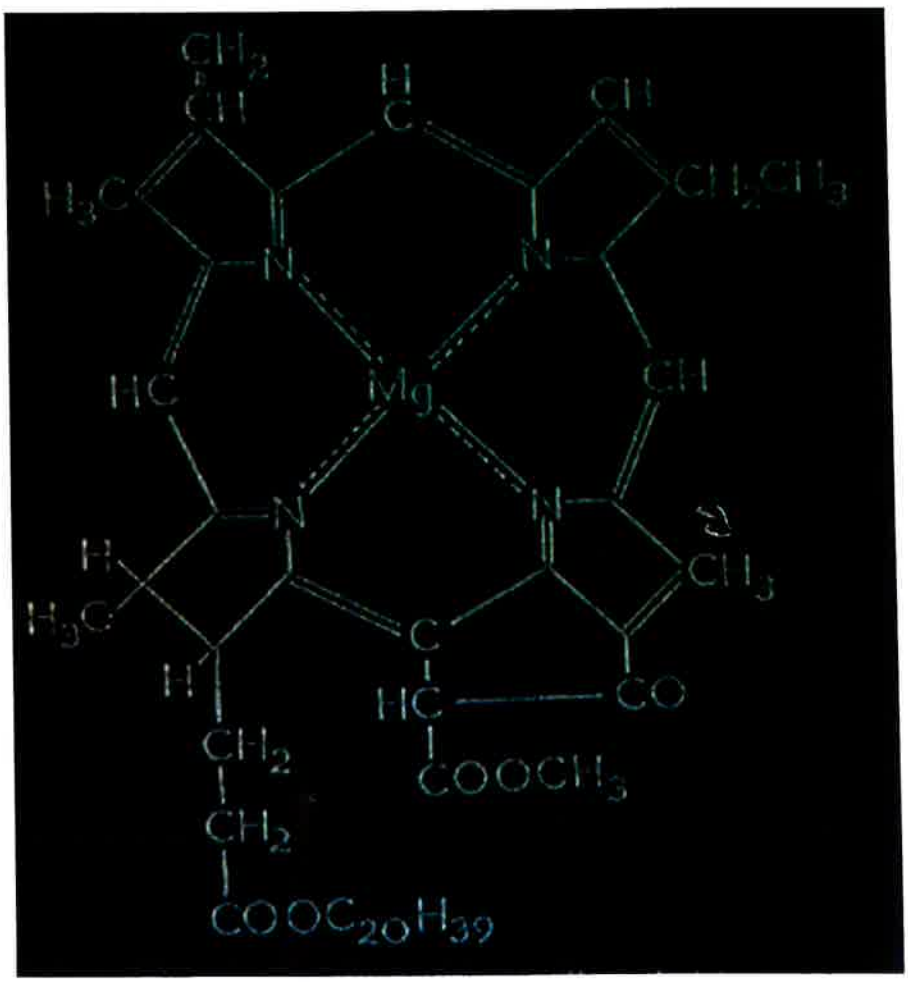
In plant there are two type of pigments :-

1- Essential pigments :- which is chlorophyll necessary for photosynthesis. We can called a (**green stain**), there are some types of chlorophyll in plant (**a** , **b**, **c**)

Chlorophyll a :- blue-green color. Existed in autotrophic organisms (except photosynthetic bacteria).

$C_{55}H_{72}O_5N_4Mg$

Chlorophyll b :- yellow-green color. Existed in high plant and green algae. $C_{55}H_{70}O_6N_4Mg$.



2- Assistance pigment :-

a- **Carotenes** :- yellow-orange (α , β , lycopene) $C_{40}H_{56}O$

b- **Xanthophyll** :- red-orange (lutein, violoxen, zeaxanthin, neoxan) $C_{40}H_{56}O_2$.

Isolation of pigment :-

1- Take a leaf of (chard or lettuce) put it in porcelain bowl.
2- Add 10 ml of acetone (80%).
3- Squash the leaf well for 3 min.
4- After the pigments exiting from leaf, filtered the extract by layers of gauze.
5- Complete the extract to 100 ml, by acetone.
6- Then measured the extract by spectrophotometer and record the (O.D) (Optical Density) using acetone as a control.
   Wave length (645, 663)
7- Take some extract, put it in beaker or cylinder, and put a strips of filter paper (arrow shape), waiting for 10 min and record what you see.

Spectrophotometer :- equipment for measuring the (O.D) for solutions. Depended on absorption and transmition.

Absorption :- the light or (wave length) that absorbed by sample.

Transmition :- the light or (wave length) that pass through the sample.

This above depended on color of sample and turbidity.