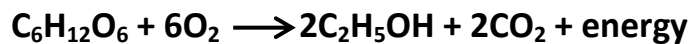## The Respiration:

- The light energy which is captured in a few bold chemical steps and stored up in the form of carbohydrates in photosynthesis, is used by the plant for all its further growth and metabolism, by thousands of chemical reactions (oxidative catabolism). The exergonic energy obtained from the sugars in respiration.
- Changes associated with the respiratory process:-
  1. An adsorption of (O_2) gas.
  2. Oxidation of materials within the cell.
  3. Release of energy, in the form of (ATP) molecules and heat.
  4. Many intermediate compounds are formed; some of them play an important role in the life of the cell.
  5. The end products are (CO_2 + H_2O).
  6. This losing results a reduction in the dry weight of the plant.

Although than the other compounds like starch, lipids, proteins, organic acids can be used as respiratory substances, but the sugars (glucose) can regards an essential substance for the process as shown by this equation:

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + energy$$

- Aerobic and anaerobic respiration:-
  1. Aerobic respiration: it's a respiration in presence of oxygen, it's known in plants, animals, fungi ...etc.
  2. Anaerobic respiration: it occur in many organisms which able to break down carbohydrates to (CO_2 + some other substances like; alcohol, lactic acid or others) with utilizing molecular of oxygen. This process may be also called fermentation (التخمر) or Glycolysis (التحلل السكري):

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 2C_2H_5OH + 2CO_2 + energy$$

Respiratory quotient (R.Q):
It's the molar ratio of (CO_2) evolved to (O_2) absorbed in respiration, this value according on the oxygen quantity in the nutrient substances which used in the respiration.
Thus the (R.Q) value differs according to the carbohydrates, lipids, proteins, or other substances.
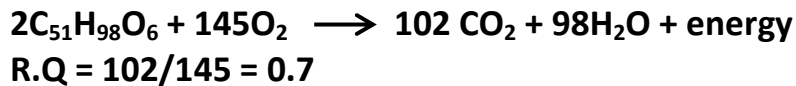
Carbohydrate substances
The ratio is (1) when the substances is glucose or other hexose sugars and completely oxidizes to (CO2 + H2O), as in this equation:

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 2C_2H_5OH + 2CO_2 + energy$$
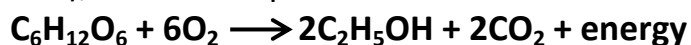
$$CO2/O2 = R.Q \qquad 6/6 = 1$$

Fats substances:

Fats are compounds which are relatively poor in oxygen compared to carbohydrates and thus would require more oxygen to oxidize them. Thus a fat would give:

$$2C_{51}H_{98}O_6 + 145O_2 \longrightarrow 102\ CO_2 + 98H_2O + energy$$
$$R.Q = 102/145 = 0.7$$

Protein substances:

These compounds also contain oxygen less than the carbohydrates. Utilization of protein occurs only in tissues that have been completely depleted of carbohydrates and fats, like starved leaves (kept in the dark). R.Q of protein is less than (1) also.

Organic compounds:

Other compounds which are produced from amino acids after hydrolysis of proteins, are relatively richer in (O_2) compared to carbohydrates or fats and so that require less oxygen to oxidize a molecule, the R.Q value is (u) to oxalic acid where the oxidation completed.

$$COOH\text{-}COOH + O_2 \longrightarrow CO_2 + 2H_2O + energy$$
$$R.Q = CO_2/O = 4/1 = 4$$
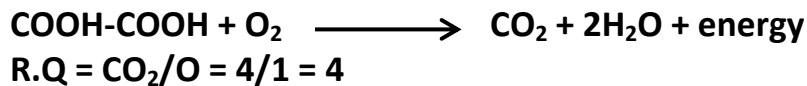
Factors affecting the respiration:
1. Temperature
2. O2 concentration of the atmosphere
3. CO2 concentration
4. Substrate concentration
5. Water content in tissues.
6. Light.
7. Protoplasmic conditions
8. Inorganic salts
9. Injury and the effects of mechanical stimulation.

Rates of respiration:

The rate of respiration measured either as absorption of (O2) or release of (CO2) or decrease in dry weight. The value is greatest in the young roots and stems or the germinating seeds, and least in the dormant seeds and spores.

The unit $\longrightarrow$ **Mg/ mg plant tissue/hr.**

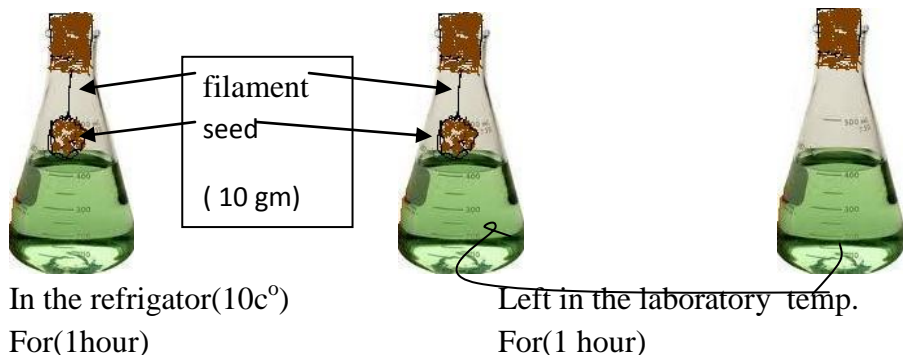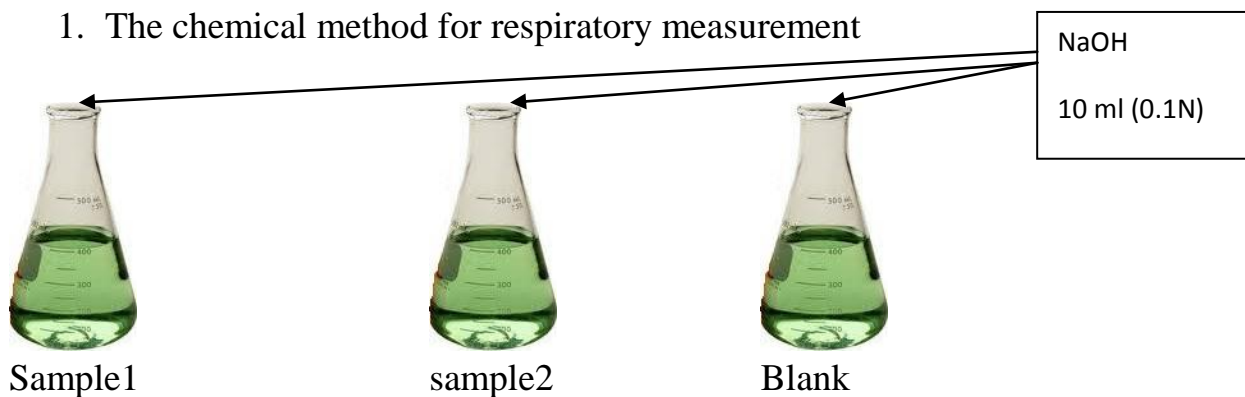- Mechanism of respiration:

Include three essential stages:
1. Glycolysis   in cytoplasm
2. Kreps cycle   in mitochondria
3. Electron transport system   in mitochondria

Methods of respiratory measurement:
1. Polarigraphic oxygen meter method.
2. Manometric method.
3. Chemical method.

Practice part:

1. The chemical method for respiratory measurement

NaOH

10 ml (0.1N)

Sample1   sample2   Blank

filament

seed

(10 gm)

In the refrigator(10c^o)   Left in the laboratory temp.
For(1hour)   For(1 hour)

2. Then adding (1 drop) of ph.ph (o.5%) indicator for each sample and the blank (color be pink)
3. Titration with (0.1N) Hcl (until the color disappear , colorless)

Hcl 0.1N

Hcl ml losses with each sample= ?

1sample   2 sample   blank
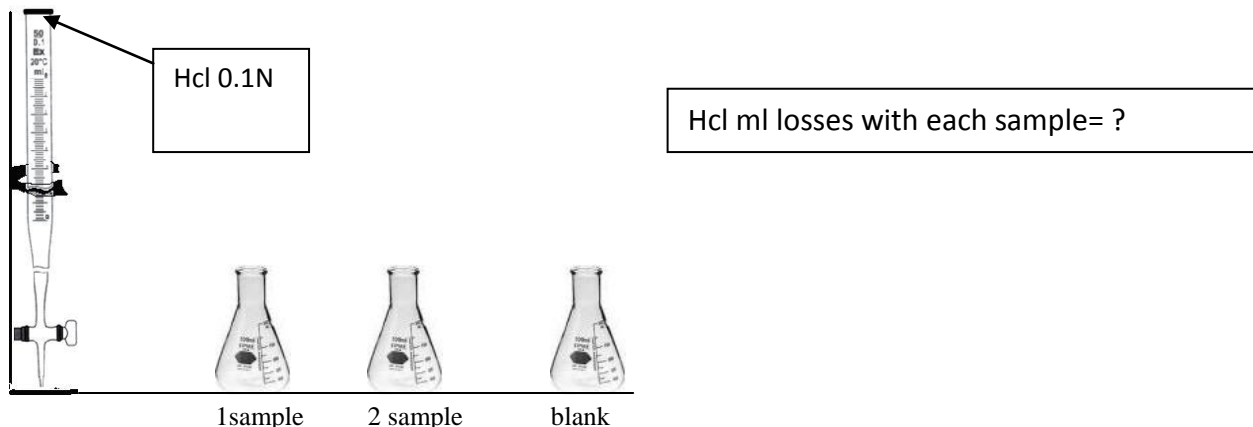
4. Put the upper value of (Hcl) in this equation :

R.r(Mg/mg tissue plant/hr)=(Blank- Sample)*0.1*1000/wt. of seed

6.What is the result for each sample? Do you know why?