

Name of Subject - Botany

Semester - B.Sc. II

Topic - Respiration (Plant Physiology)

Name of Author Prof. Aftab Alam, Dept. of Botany, A.N.D. College, Shahpur Patan.

Leaf No - 06

Respiration

Respiration is a Katabolic phase of metabolism. In it — complex organic compounds such as sugar, fat etc are broken down into simpler forms with accompanying energy release to the cell.

Respiration can be shown by the following summary reaction —



From above mentioned reaction it is clear that respiration includes —

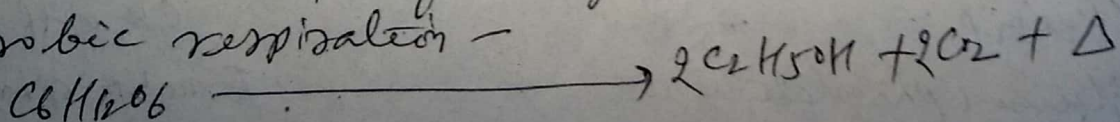
- (a) Intake of  $O_2$
- (b) Breakdown of complex organic compounds present inside the cell.
- (c) Release of Energy
- (d) Liberation of  $CO_2$  and water.

Types of Respiration : Respiration is of two types —

(A) Aerobic Respiration : - It occurs in the presence of — atmospheric oxygen. In it substrate is completely oxidised. The amount of energy release is quite considerable. The aerobic respiration can be shown by the above mentioned reaction.

(B) Anaerobic Respiration : - It occurs in the absence of  $O_2$ . In it substrate is not completely oxidised. The amount of energy released during anaerobic respiration is quite low in comparison to the amount of energy released during aerobic respiration.

The following are the equation of an- aerobic respiration —



# Mechanism of Respiration

Respiration includes two major steps —

- I. Glycolysis
- II. Krebs' cycle

## Glycolysis

It is initial step of the respiration. It is common in both aerobic as well as anaerobic respiration. It occurs in the cytoplasm of the cell.

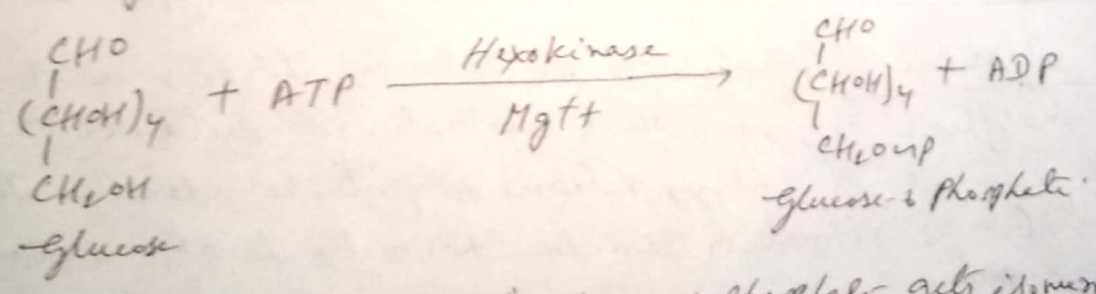
During glycolysis a molecule of glucose is broken down into two molecules of pyruvic acids. The details of glycolysis were made known by three German scientists: Embden, Meyerhof and Parnes. Thus in their honor glycolysis is also called EMP-pathway.

Glycolysis includes following steps —

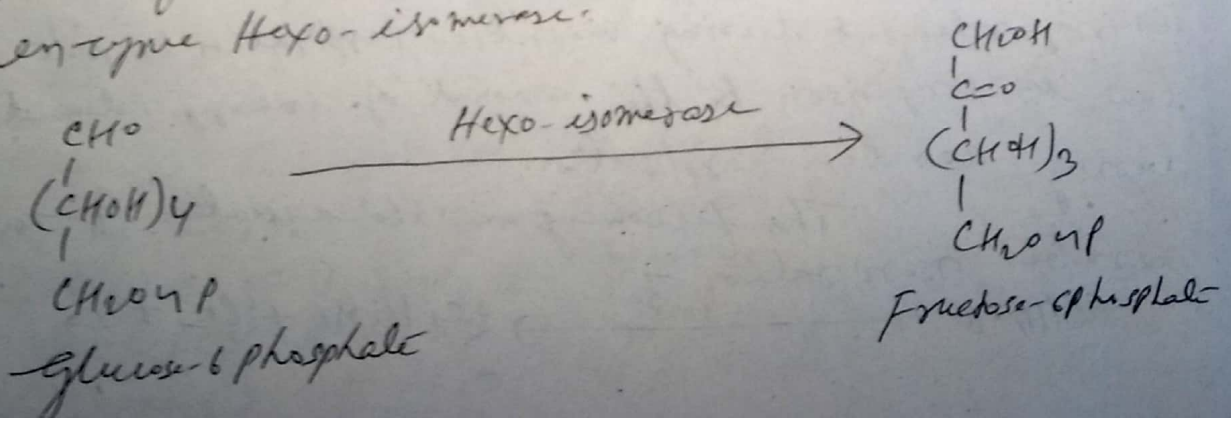
### (a) Transphosphorylation of Hexoses :-

During this step transfer of phosphate radical occurs from ATP to glucose and Fructose phosphate.

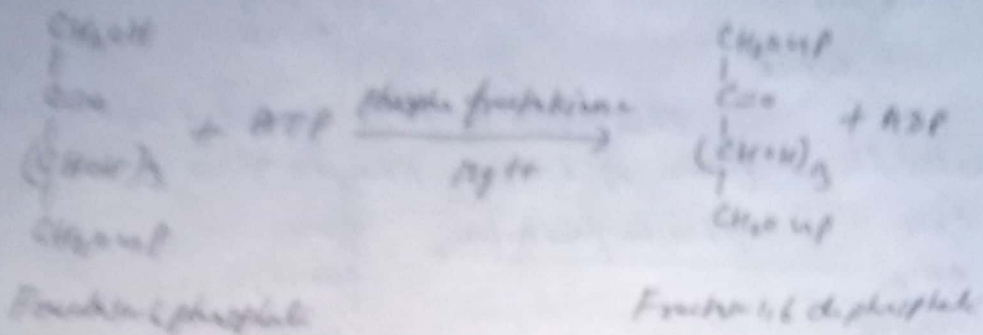
Firstly a molecule of glucose reacts with a molecule of ATP in the presence of enzyme Hexo-kinase and Mg<sup>++</sup> to form glucose-6 phosphate.



Thereafter this glucose-6 phosphate gets isomerised into fructose-6 phosphate by the influence of enzyme Hexo-isomerase.



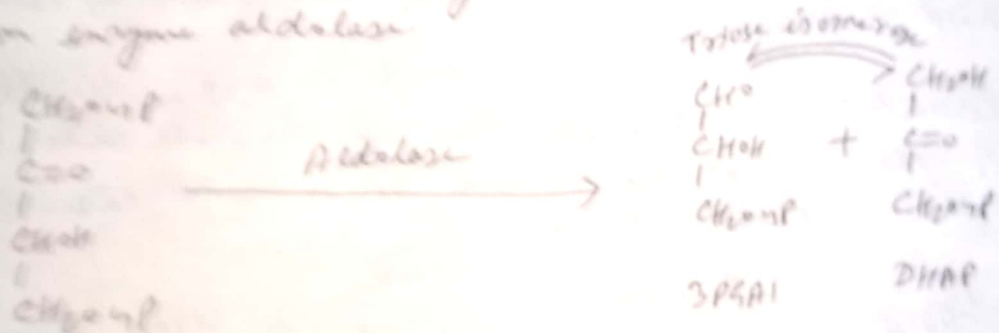
Then Fructose 1 phosphate reacts with another molecule of ATP in the presence of enzyme phosphofructokinase  $\rightarrow$  Fructose 1,6 diphosphate.



### ⑤ Splitting of Hexose . .

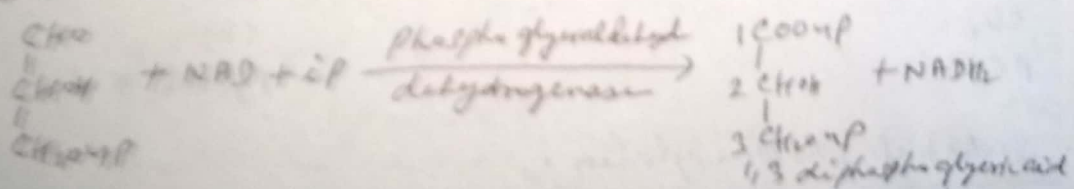
Now Fructose 1,6 diphosphate is split into two three carbon compounds: 3PGA and dihydroxy acetone phosphate. These two compounds are interconvertible in the presence of enzyme triose isomerase.

The splitting of hexose is catalysed by an enzyme aldolase.



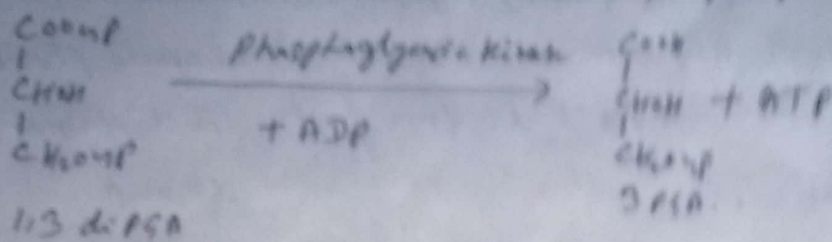
### ⑥ Oxidation of P3A (Phosphoglyceraldehyde) -

This form P3A is now oxidised into 1,3 diphosphoglyceric acid (1,3 dPGA) by losing a molecule of hydrogen. This reaction takes place in presence of enzyme phosphoglyceraldehyde dehydrogenase, NAD &  $\text{P}_i$  (inorganic phosphate).

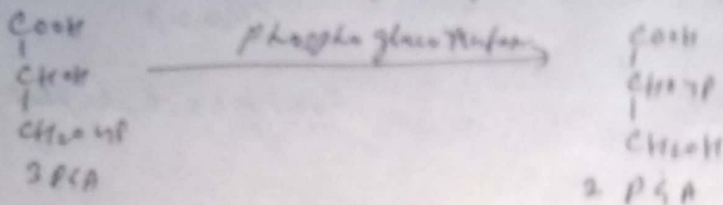


Thereafter this 1,3 diphosphoglyceric acid loses one of its two phosphate radicals from carbon no. 1. by the influence of enzyme phosphoglyceric Kinase and  $\text{Mg}^{++}$  from 3 P3A. Here ATP functions as phosphate acceptor. By accepting phosphate the ADP is directly converted into ATP.

This phenomenon is called substrate phosphorylation.



This 3PGA is then converted into 2PGA under the influence of enzyme phosphogluco mutase.

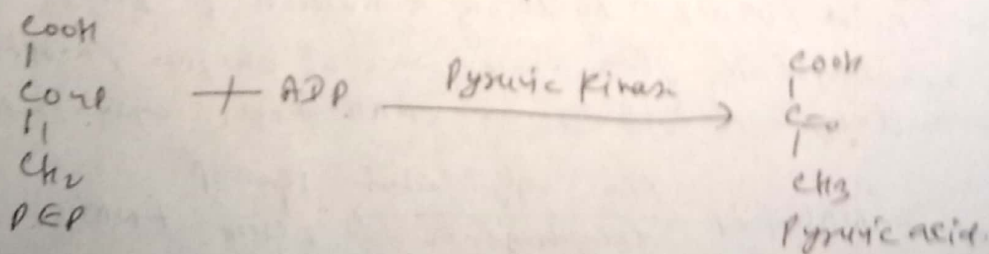
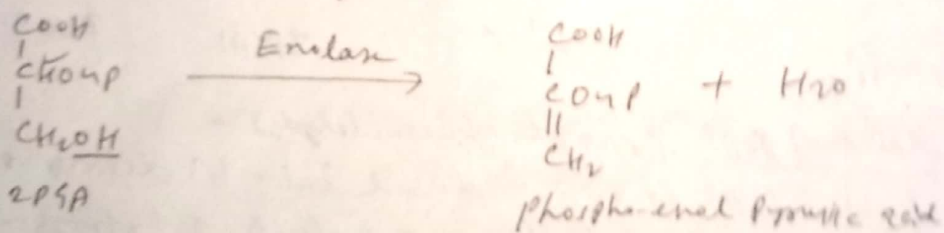


d) Formation of Pyruvic acid

First 2PGA molecule loses a molecule of water under the influence of enzyme enolase P Mg<sup>++</sup> to form phospho-enol pyruvic acid.

There after this phospho-enol pyruvic acid loses its phosphate radical to ADP under the influence of enzyme pyruvic kinase P Mg<sup>++</sup>. Thus ultimately pyruvic acid is formed.

Here also a molecule of ADP is directly converted into ATP by accepting phosphate radical of phospho-enol pyruvic acid. It is also a case of substrate phosphorylation.



Substrate phosphorylation.

The formation of ATP with the help of ADP and it without going to electron transport chain is called substrate phosphorylation. During glycolysis there are two stages where there is direct formation of ATP with the help of ADP + P<sub>i</sub>.

Step I - At 1,3 diphosphoglyceric acid (1,3 diPGA)

Step II - At phospho-enol pyruvic acid (PEP)

# Summary of Glycolysis

