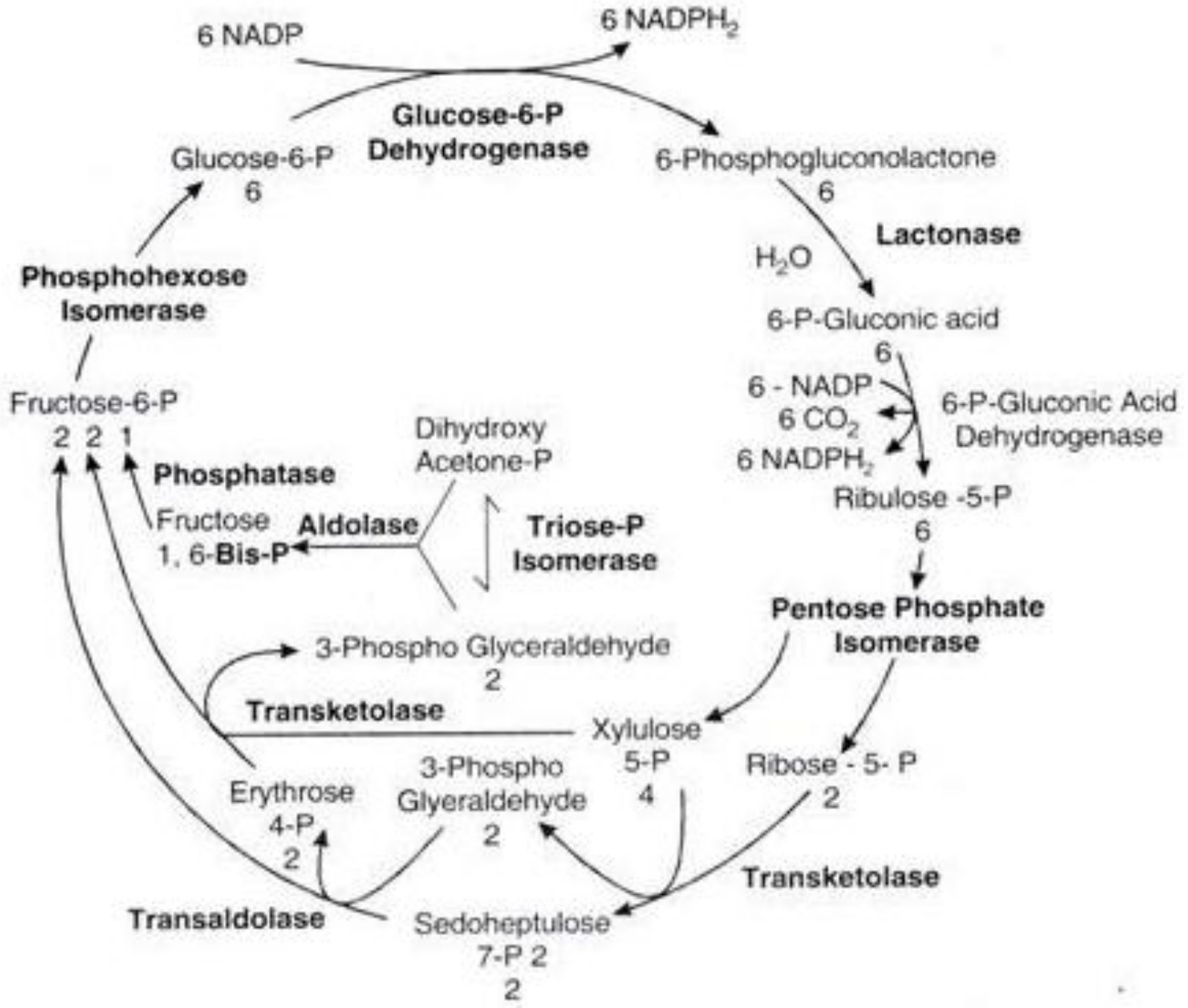
Pentose Phosphate Pathway

30.09.2020

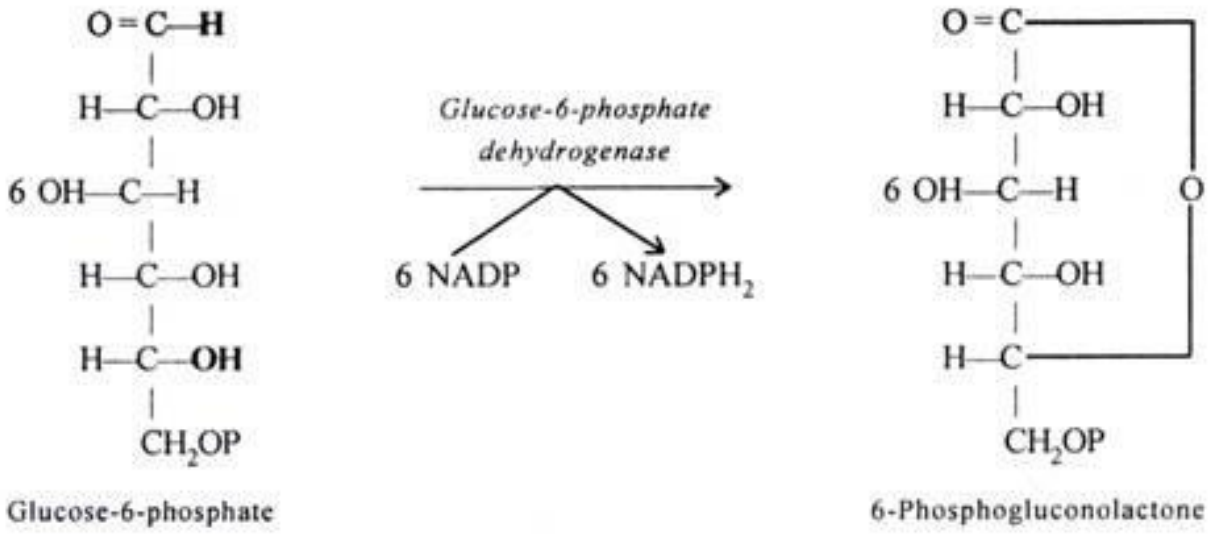
Introdution

- It involves the oxidation of Glucose-6-Phosphate to 6-Phosphogluconic acid which in turn is converted into pentose phosphates.
- In this pathway glucose-6-phosphate is directly oxidised without entering glycolysis, hence it is also known as Direct Oxidation Pathway or Hexose Monophosphate Shunt.


6 NADP
6 NADPH2
Glucose-6-P Dehydrogenase
Glucose-6-P
6
6-Phosphogluconolactone
6
Lactonase
H2O
Phosphohexose Isomerase
6-P-Gluconic acid
6
6 - NADP
6 CO2
6 NADPH2
6-P-Gluconic Acid Dehydrogenase
Fructose-6-P
2 2 1
Phosphatase
Dihydroxy Acetone-P
Fructose 1, 6-Bis-P
Aldolase
Triose-P Isomerase
Ribulose -5-P
6
Pentose Phosphate Isomerase
3-Phospho Glyceraldehyde
2
Transketolase
Xylulose 5-P
4
Ribose - 5- P
2
Erythrose 4-P
2
3-Phospho Glyeraldehyde
2
Transketolase
Transaldolase
Sedoheptulose 7-P 2
2

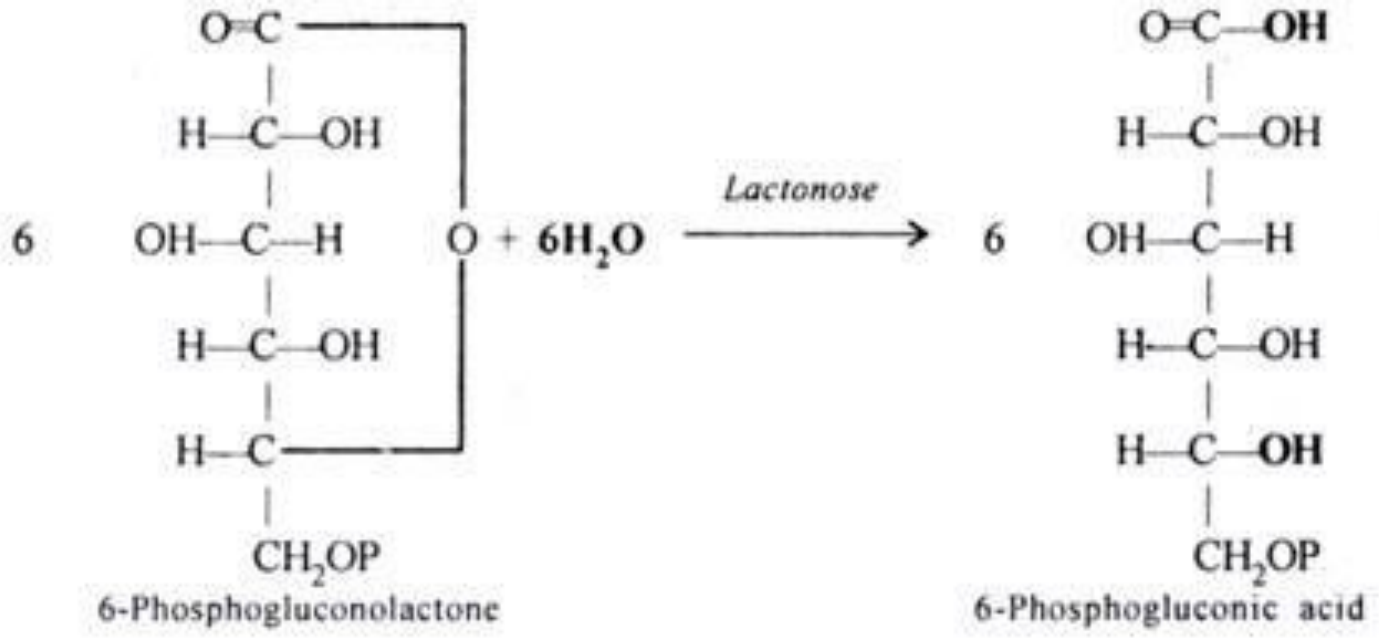
Reaction 1

- 6 molecules of glucose-6-phosphate in the presence of coenzyme NADP are converted (oxidised) into 6 molecules of 6-phosphogluconolactone by the enzyme glucose-6-phosphate dehydrogenase. 6 molecules of NADP are reduced in the reaction which is reversible.



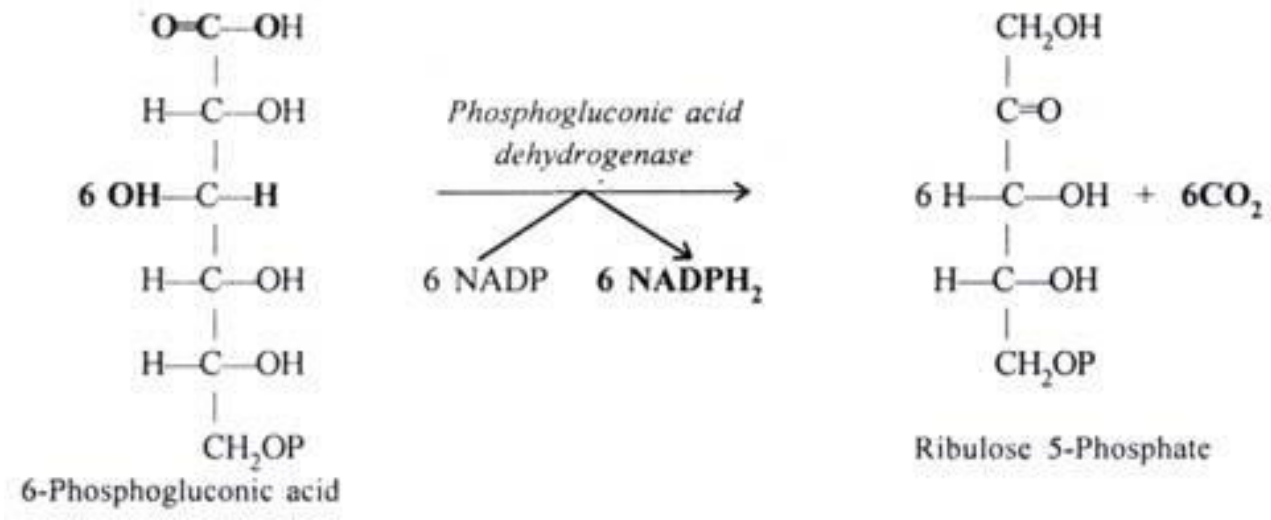
Reaction 2

- 6-Phosphogluconolactone is hydrolysed by the enzyme Lactonase to produced 6 molecule of 6-phosphogluconic acid.



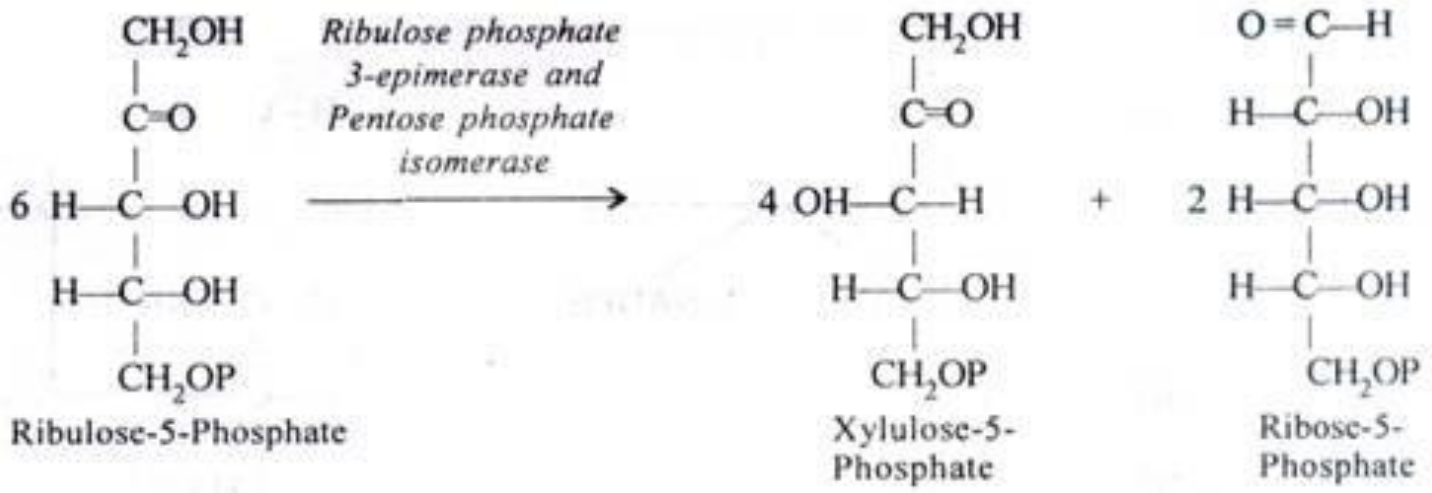
Reaction 3

- 6-Phosphogluconic acid is oxidatively decarboxylated by the enzyme 6-Phosphogluconic acid dehydrogenase.
- 6 molecules of NADP are reduced, 6 molecules of CO_2 are released and 6 mols, of Ribulose-5-Phosphate are produced



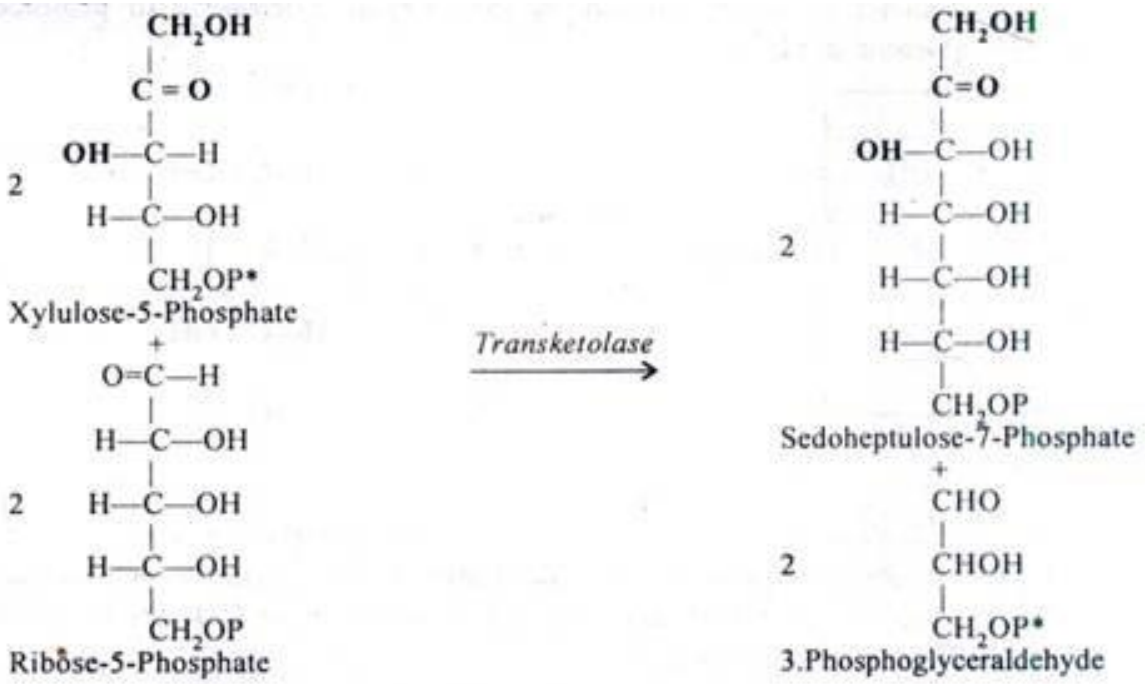
Reaction 4

- 6 mols. of Ribulose-5-Phosphate isomerise into 4 mols. of Xylulose-5-Phosphate and 2 mols. of Ribose-5-Phosphate in the presence of Ribulose phosphate-3-epimerase and Pentose phosphate isomerase respectively



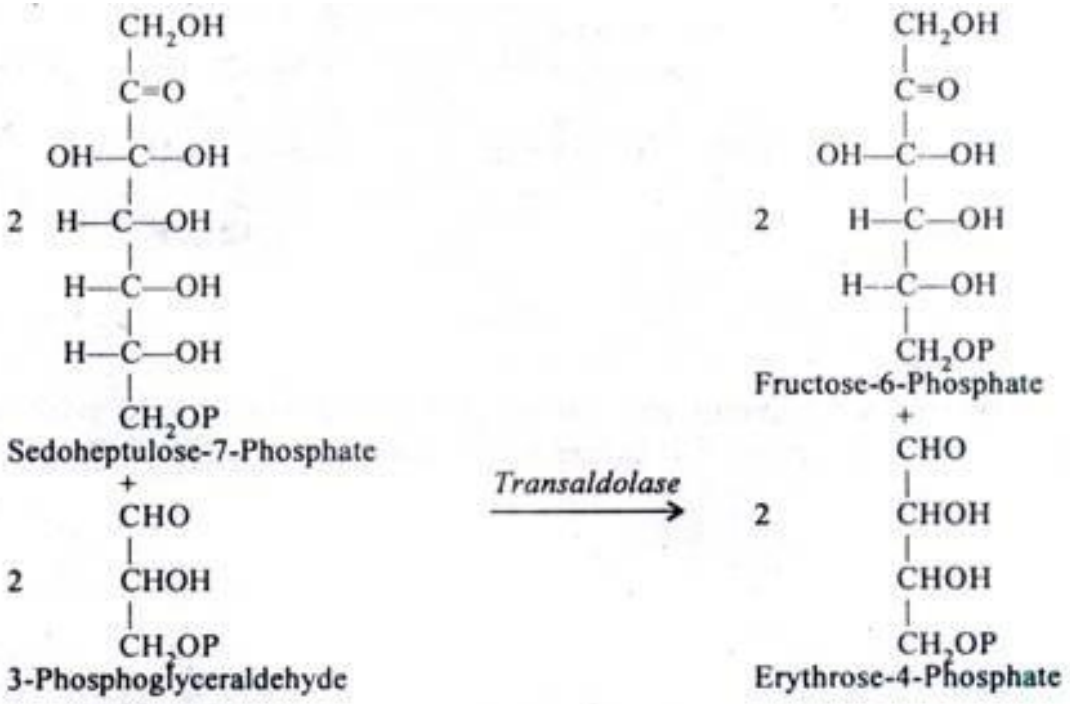
Reaction 5

- 2 mols. of xylulose-5-Phosphate and 2 mols. of Ribose-5-phosphate combine in the presence of Transketolase to form 2 mols. of Sedoheptulose-7-Phosphate and 2 mols. of 3-Phosphoglyceraldehyde.



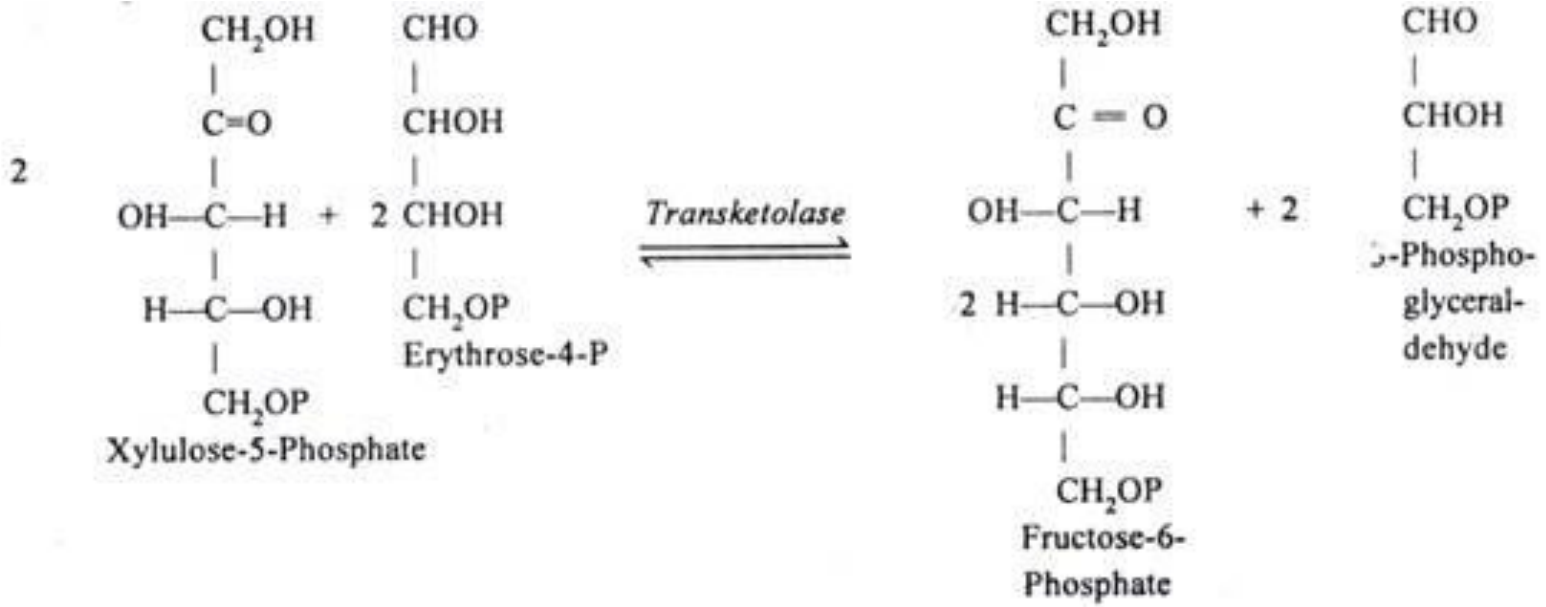
Reaction 6

- 2 mols. of Sedoheptulose-7-Phosphate and 2 mols. of 3-Phosphoglyceraldehyde combine in the presence of Transaldolase to form 2 mols. of Fructose-6-Phosphate and 2 mols. of Erythrose-4-Phosphate (4-carbon atoms sugar)



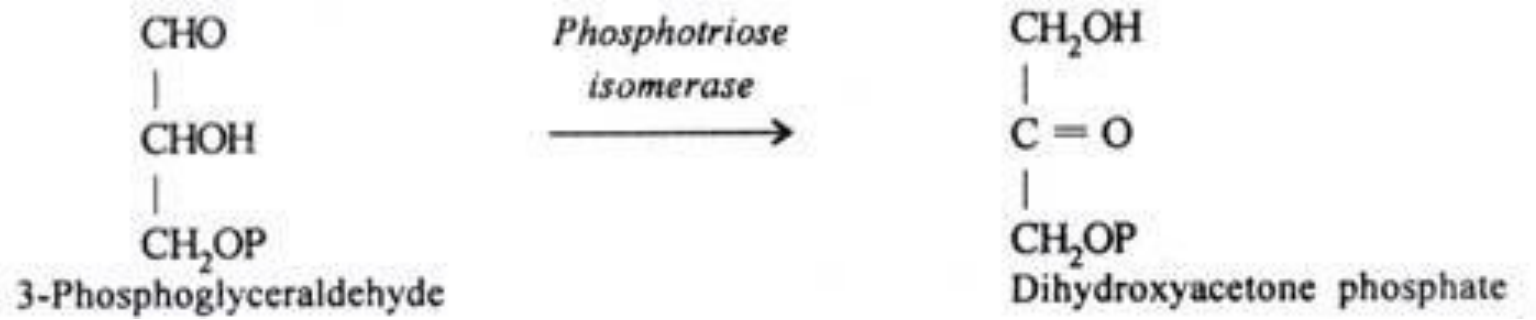
Reaction 7

- 2 mols. of Erythose-4-Phosphate react with remaining two mols. of xylulose-5-Phosphate (see reaction No. 4 and 5) in the presence of Transketolase to form 2 mols. of Fructose- 6-Phosphate and 2 mols of 3-Phosphoglyceraldehyde



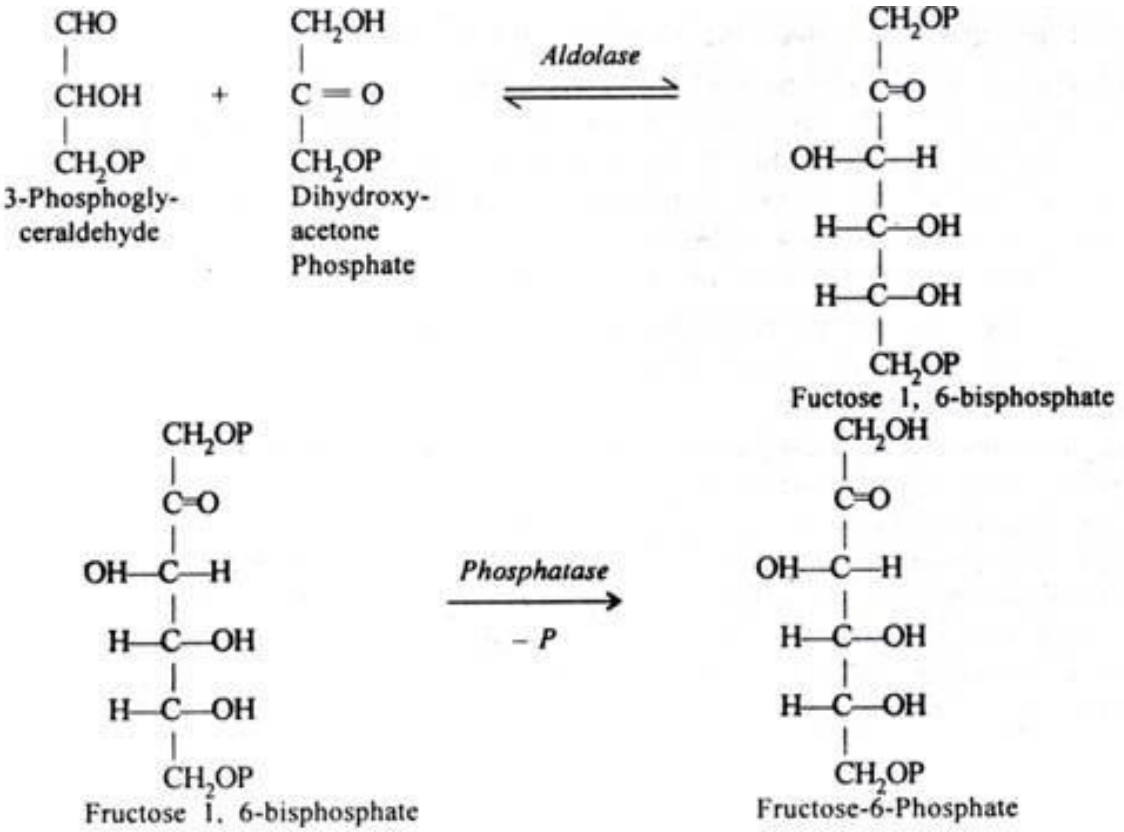
Reaction 8

- One mol. of 3-phosphoglyceraldehyde isomerises into dihydroxyacetone phosphate. The enzyme is Phosphotriose isomerase



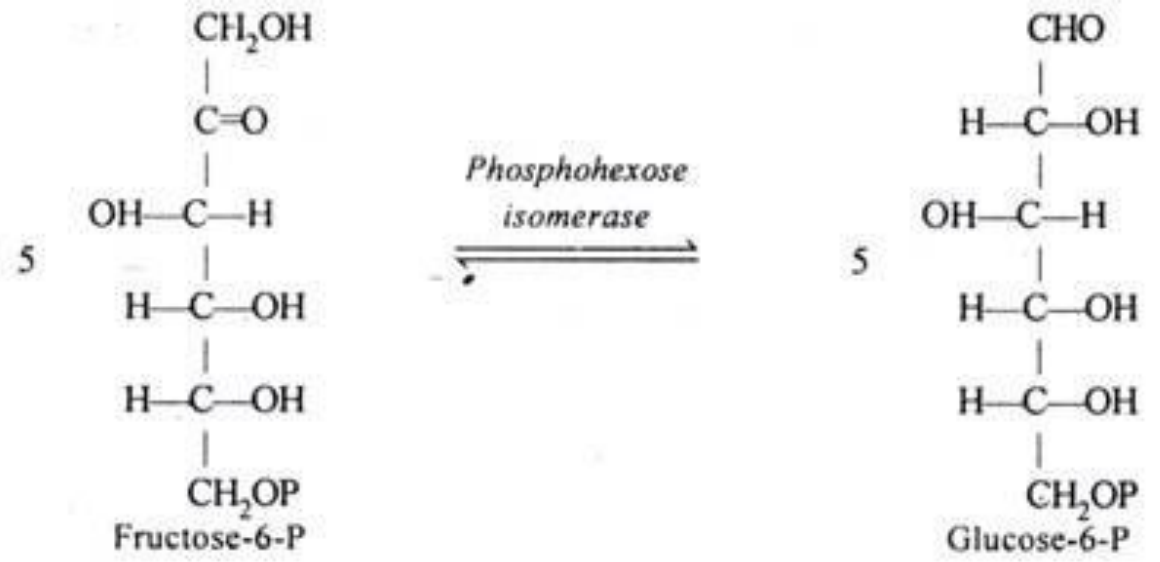
Reaction 9

- Remaining one mole, of 3-Phosphoglyceraldehyde unites with Dihydroxyacetone phosphate in presence of Aldolase to form one mol. of Fructose 1, 6-bisphosphate. The latter, in the presence of Phosphatase forms one mol. of Fructose 6-Phosphate



Reaction 10

- 5 molecules of Fructose-6-phosphate produced in reactions 6, 7 and 9, isomerise into 5 mols. of Glucose-6-Phosphate in presence of Phosphohexose isomerase.



Summary

- 6 mols. of Glucose-6-P which enter into this pathway after oxidation produce 6 mols. of CO_2 (Reaction No. 3. CO_2 comes from C-No. 1 of the glucose molecule) and 12 mols. of reduced coenzymes $NADPH_2$ (reaction 1 and 3) while 5 mols of Glucose-6-Phosphate are regenerated (Reaction No. 10).
- 6 (Glucose-6-P) + 12 $NADP^+$ → 5 (Glucose-6-P) + 12 (NADPH + H^+) + 6 CO_2
- In other words one mol. of Glucose-6-P after oxidation produces 6-mols. of CO_2 and 12 (NADPH + H^+) molecules.
- All the enzymes of pentose phosphate pathway are present in cytosol.