8. Describe the process of Glycolysis.

9. What are the regulations of glycolysis?

Glycolysis is the major pathway for the utilization of glucose and is found in the cytosol of cells. Glycolysis converts one molecular glucose into two molecules of pyruvate. 2ATP molecules are needed for early reaction in the glycolytic pathway but 4 ATPs are generated later. Glycolysis has a dual role. The first is to generate ATP and second is to produce intermediate products that are used in different biosynthetic pathway. As an example acetyl-CoA is the intermediate product of glycolysis are used in fatty acid synthesis. The overall reaction of glycolysis is—

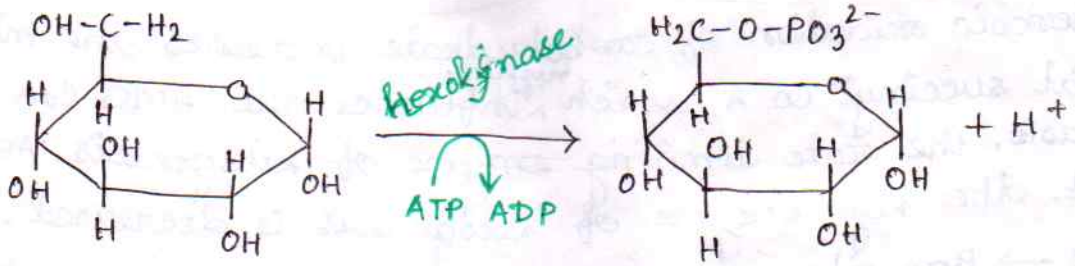
$$Glucose + 2ADP + 2NAD^+ + 2Pi \rightarrow 2\,Pyruvate + 2ATP + 2NADH + 2H^+ + 2H_2O$$

The individual steps in glycolysis are give in below —

Step-I

Glucose is the precursor of glycolysis is phospho related by ATP to form glucose-6-phosphate and ADP. This is an irreversible reaction catalysed by the enzyme hexokinase.

$$Glucose + ATP \xrightarrow{hexokinase} Glucose\text{-}6\text{-}phosphate + ADP + H^+$$



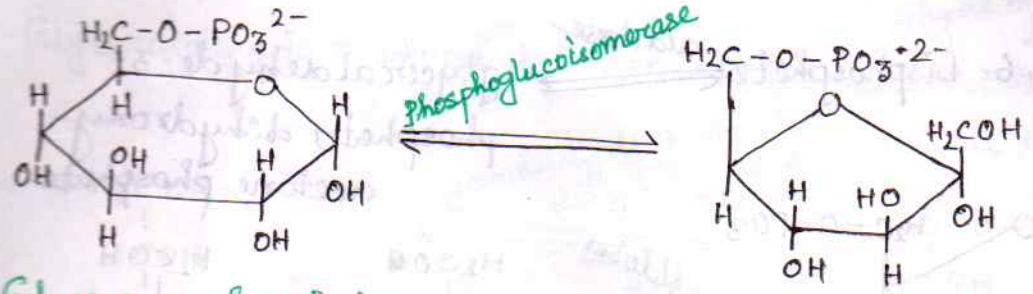
Glucose

Glucose-6-phosphate

Step II

Glucose 6-phosphate is now converted to Fructose 6-phosphate. It is a transfer of an aldoes to ketose. The enzyme used in this step is phospho-gluco-isomerase.

Glucose 6-phosphate $\xrightleftharpoons{\text{Phosphoglucoisomerase}}$ Fructose-6-phosphate



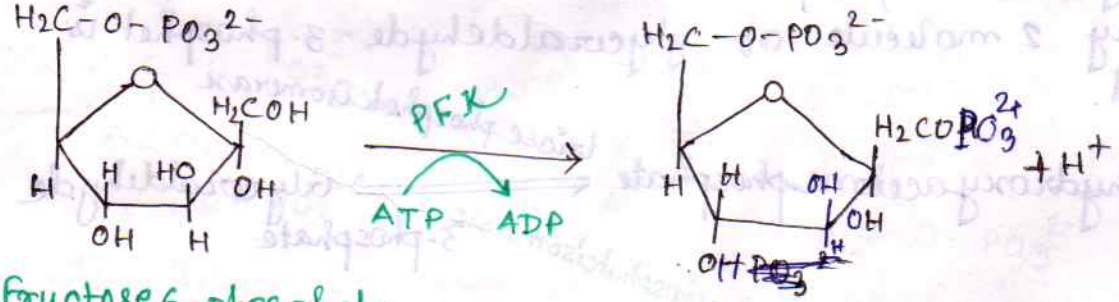
Glucose-6-phosphate

Fructose 6-phosphate

Step III

In this step Fructose 6-phosphate is phosphorelated by ATP to form Fructose-1,6-bisphosphate and ADP. This step is catalysed by the enzyme phosphofructokinase (PFK). This is an irreversible step of glycolysis and consider as the rate limiting step of this pathway.

Fructose 6-phosphate + ATP $\xrightarrow{\text{PFK}}$ Fructose 1,6-bisphosphate + ADP + H^+



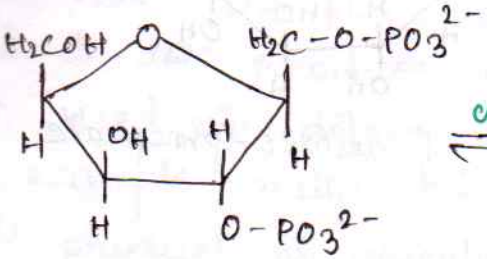
Fructose 6-phosphate

Fructose 1,6-bisphosphate

Step IV

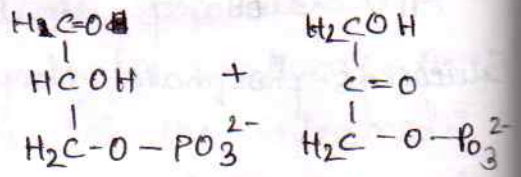
In this stage, aldolase can split Fructose 1,6-bisphosphate into glyceraldehyde 3- phosphate and dihydroxy acetone phosphate. This enzyme splits a six carbon molecule to 2, three carbon molecule

Fructose 1, 6- bisphosphate $\xrightleftharpoons{\text{aldolase}}$ glyceraldehyde-3-phosphate + dihydroxy acetone phosphate



Fructose 1,6-bisphosphate

Aldolase



Glyceraldehyde 3-phosphate.

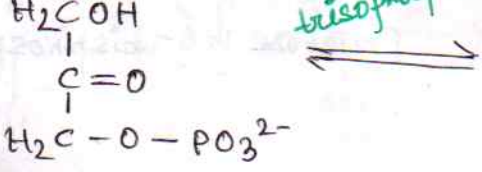
Dihydroxy acetone phosphate

Step-V

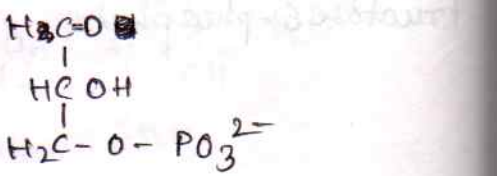
Among the 2. three carbon molecule glyceraldehyde 3-phosphate is only used in glycolysis process. The another molecule dihydroxy acetone phosphate is converted to previous 1 by the enzyme triosephosphateisomerase. To continue the pathway 2 molecule of glyceraldehyde-3-phosphet is used.

Dihydroxyacetonephosphate $\xrightleftharpoons{\text{triose phosphate isomerase}}$ Glyceraldehyde 3-phosphate

triosephosphateisomerase



Dihydroxy acetone phosphate

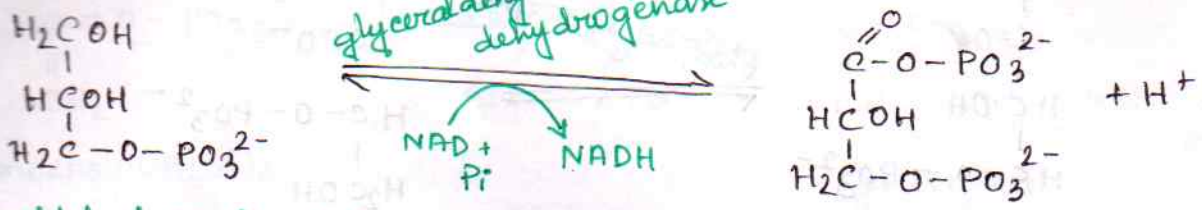


Glyceraldehyde-3-phosphate

Step VI

By the help of the enzyme glyceraldehyde 3-phosphate dehydrogenase, Glyceraldehyde 3-phosphate is converted to 1,3-biphosphoglycerate. In this step, one NADH and H^+ ion is produced.

Glyceraldehyde 3-phosphate + NAD + Pi $\xrightleftharpoons{\text{glyceraldehyde 3-phosphate dehydrogenase}}$ 1,3 biphospho glycerate + NADH + H^+



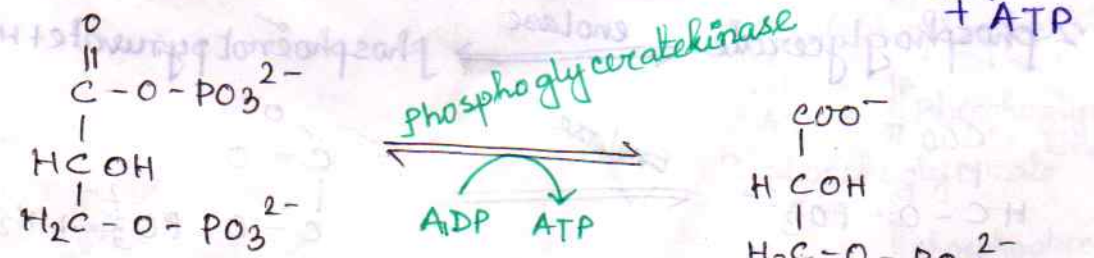
Glyceraldehyde 3-phosphate

1, 3- BPG

Step VII

Phosphoglycerate kinase catalysed 1,3-BPG into 3-phospho glycerate. In this step 1 ATP is produced from ADP.

1,3-BPG + ADP $\xrightleftharpoons{\text{phosphoglycerate kinase}}$ 3-phosphoglycerate + ATP



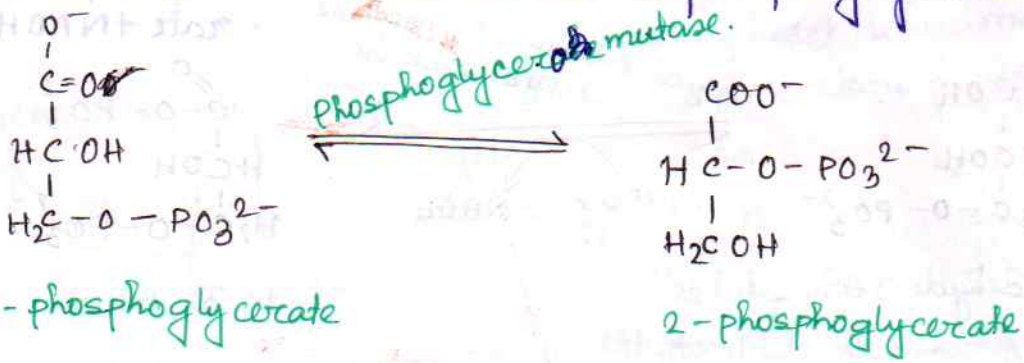
1,3-BPG

3-Phosphoglycerate

Step VIII

3-phosphoglycerate is now converted into 2-phospho glycerate by the help of the enzyme phosphoglycero - mutase. This reaction is a movement of the phos- -phate group from 3-carbon to 2-carbon.

3-phosphoglycerate $\xrightleftharpoons{\text{phosphoglycerate mutase}}$ 2-phosphoglycerate



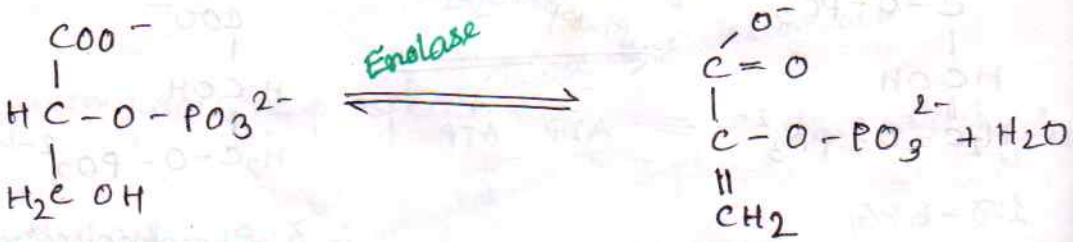
3-phosphoglycerate

2-phosphoglycerate

Step IX

In this step 2-phospho glycerate is converted to phosphoenol pyruvate by the enzyme enolase. One molecule of H_2O is produced in this step.

2-phosphoglycerate $\xrightleftharpoons{\text{enolase}}$ phosphoenolpyruvate + H_2O



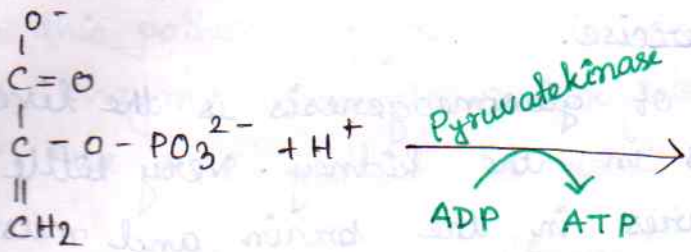
2-phosphoglycerate

Phosphoenolpyruvate

Step - X

In the last step of this pathway pyruvate kinase transfer phosphoenol pyruvate to pyruvate. In this step one ATP is produced and it is an irreversible reaction.

Phosphoenolpyruvate + ADP + H^+ —Pyruvatekinase→ Pyruvate + ATP



Phosphoenolpyruvate — Pyruvate

Glucose
ATP / ADP — hexokynase
Glucose 6 - phosphate
phosphoglucoisomerase
Fructose 6 - phosphate
ATP / ADP — phosphofructokinase
Fructose 1, 6 - bisphosphate
aldolase
Dihydroxy acetone phosphate ⇌ Glyceraldehyde 3 - phosphate
triosephosphateisomerase
NAD+Pi / NADH+H+ — glyceraldehyde 3-phosphate dehydrogenase
1, 3 - bisphosphoglycerate
ADP / ATP — phosphoglycerate kinase
3 - phosphoglycerate
phosphoglycerate mutase
2 - phosphoglycerate
H_2O — enolase
phosphoenol pyruvate
ADP / ATP — Pyruvatekinase
Pyruvate

Phosphotriosisomerase

Fig:- Pathway of glycolysis.