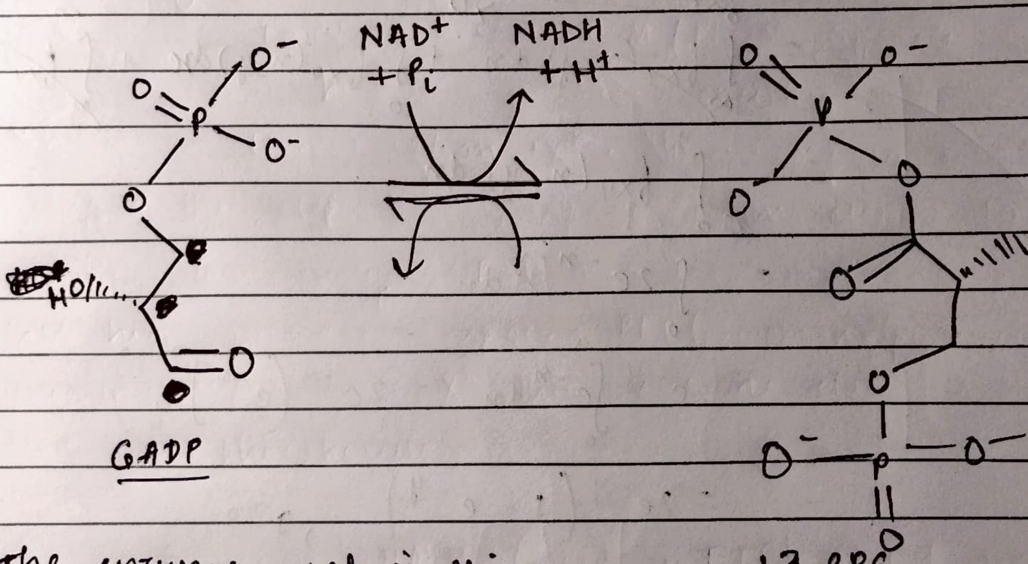
2023113019 : Raunak Seksaria

ITB A4

Glycolysis is a central metabolic pathway where glucose, a 6 carbon sugar, is broken down into 2 molecules of pyruvate, with energy being harvested in the form of ATP and NADH (later also used for energy production). Glycolysis is usually said to be broken down into a preparatory (energy investment) phase (Steps 1-5), ~~Steps 6-10~~ & a pay-off (energy recovery) phase (Steps 6-10). Steps 6-8 are thus, ~~this part of~~ the beginning of the energy recovery phase, & involve both the production of high-energy molecules, & the preparation of intermediates for ATP generation.

Steps 6 :

We note that by the time we reach step 6, the substrate is no longer glucose. At the beginning of step 6, we already have obtained GADP (D-Glyceraldehyde 3-phosphate).



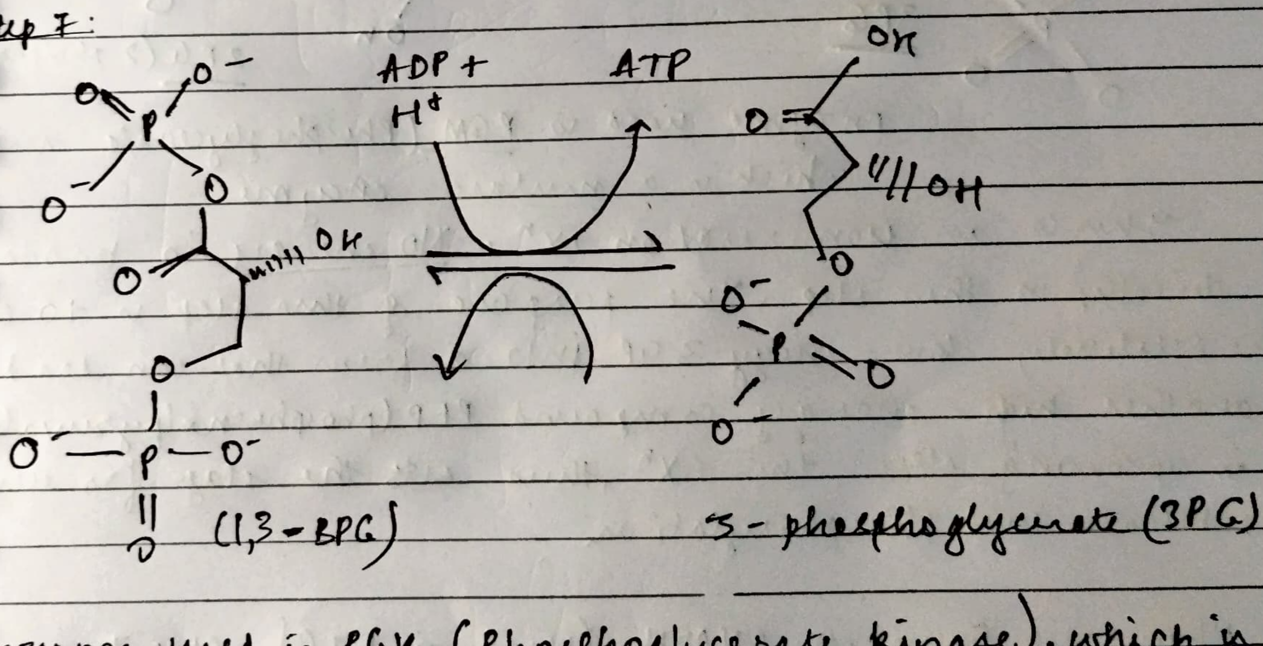
GADP

1,3 BPG
(D-1,3-Biphosphoglycerate)

The enzyme used in this conversion is GAPDH (an oxidoreductase) [Glyceraldehyde phosphate dehydrogenase]

The NADH produced in this step is an important molecule that will later be used in the Electron Transport Chain (ETC) during oxidative phosphorylation to generate ATP.
In addition to catalysed (by the enzyme) oxidation, GADPH also helps add an inorganic phosphate group (P_i) to GADP, resulting in the energy rich, high phosphoryl transfer potential containing 1,3 - BPG.
Also, since 1 glucose yields 2 GADP, thus, we get 2 NADH per glucose in step 6. We also note that arsenate $[AsO_4]^{3-}$, if present, {akin to P_i}, it may reduce & then hydrolyse to ~~Step 7~~ form the intermediate in the next step of the pathway, bypassing ATP production. It's called an uncoupler of glycolysis.

Step 7:

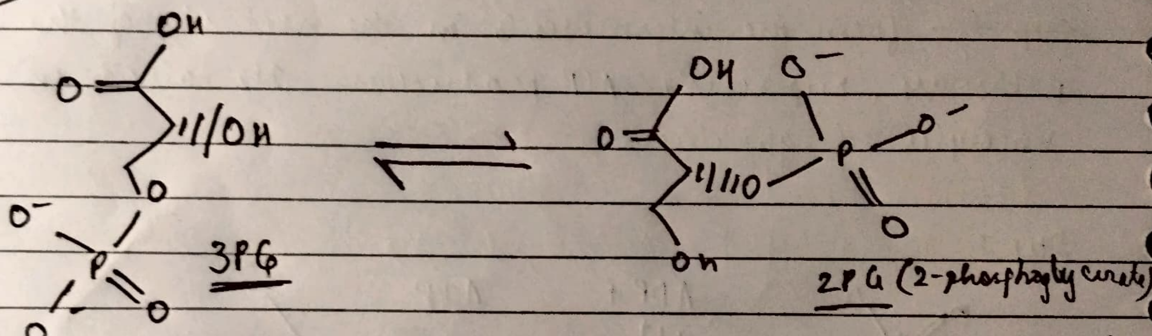


Enzyme used is PGK (Phosphoglycerate kinase), which is a transferase enzyme.
~~Directly comes~~ ∵ phosphate group (in ATP produced), comes directly from substrate, it's called as substrate-level phosphorylation, in contrast to oxidative phosphorylation, which requires oxidizing agent & a membrane-bound ATP synthase.

ADP actually exists as $ADPMg^-$, & ATP as $ATPMg^{2-}$, balancing charges. (Cofactors: Mg^{2+}). When the cell has plenty of ATP (and little ADP) the rx^n does not occur, thus the process becomes an imp. regulatory pt. in the pathway. Since we had 2 1,3-BPG molecules, 2 ATP is produced per molecule of glucose.

Hence, we have reached an energy-break even pt., because 2ATP was used up in the ~~energy~~ preparatory phase. (Steps 1-5).

Step 8:



3PG

2PG (2-phosphoglycerate)

Enzyme used is PGM (Phosphoglycerate mutase) which is a mutase enzyme

This is an isomerisation rx^n, NO energy is produced directly in this step. The purpose of this step is to convert the relatively low-energy 3GP into a form that can lead to another high-energy compound PEP (phosphoenolpyruvate) in upcoming steps. This rx^n, thus, sets the stage for second substrate level phosphorylation.

Thus, step 6 generates 2NADH (used in ETC), step 7 generates 2ATP (thus break-even energy point for glycolysis), Step 8 generates no energy but is a preparatory step.