

Hexose Monophosphate shunt [HMP shunt]

OR

Pentose Phosphate Pathway

→ It takes place in the cytosol of cell membrane.

→ Tissues: adipose tissue, mammary gland, thyroid, erythrocytes (RBCs).

→ Activity of this pathway is very low in skeletal muscle.

→ very important pathway to generating NADPH

•• NADH → Regenerating ATP from ADP.

•• NADPH → used to synthesis of fatty acids, cholesterol, steroids.

→ converting hexoses into pentoses

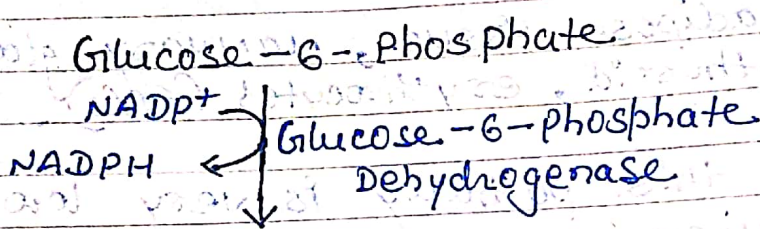
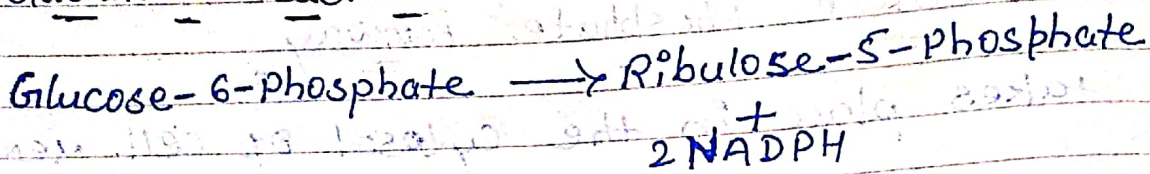
• Pentoses imp. substrate for DNA & RNA

Nucleotides

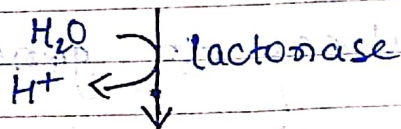
↓
Nitrogenous Bases
+
Phosphate
+
5c sugar.
(Ribose/Deoxyribose)

→ Pathway has 3 stages

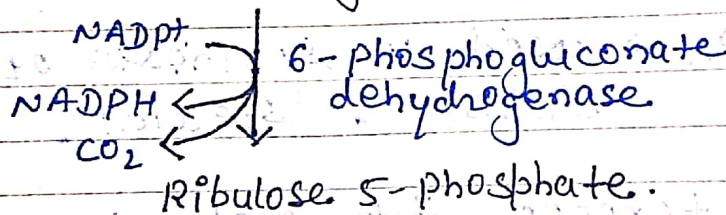
(i) oxidative reaction -



6-phosphogluconolactone

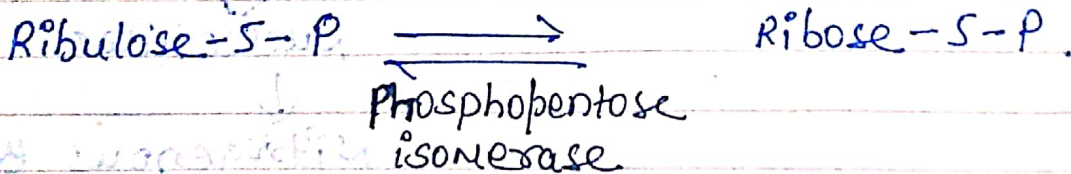


6-phosphogluconate

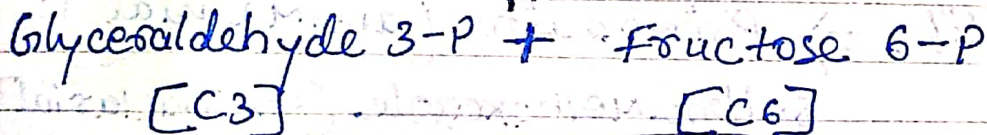
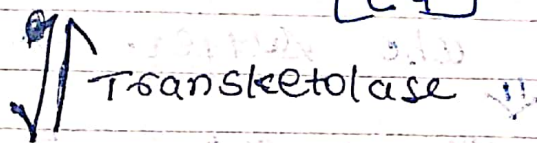
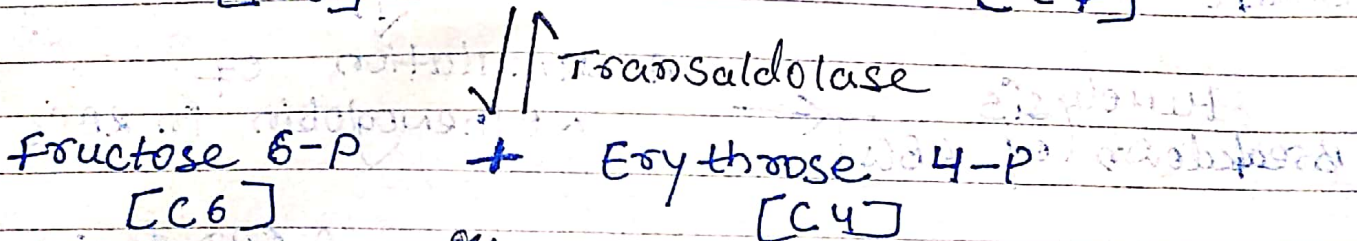
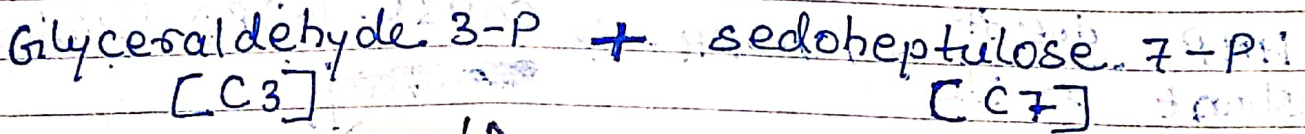
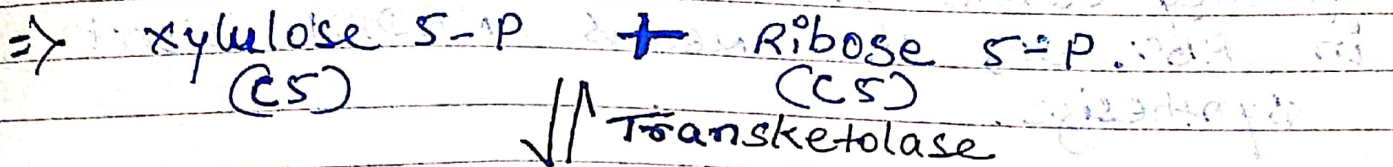
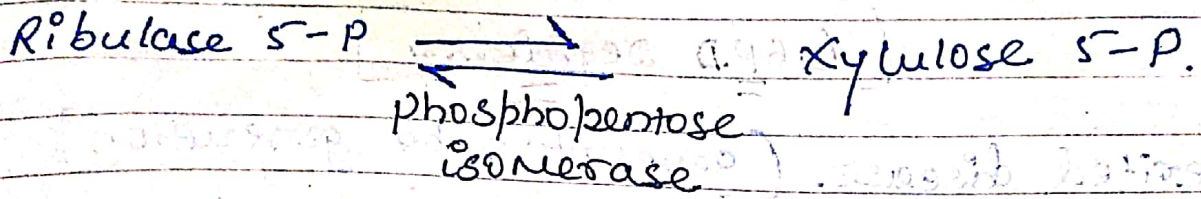


Ribulose 5-phosphate.

(ii) Isomerization of Ribulose-6-P. to Ribose-5-P.



(iii) Linkage of PP pathway to Glycolysis



control of Pathway

Note: If cell need Ribose 6-P then they take Glyceraldehyde 3-P & Fructose 6-P then do ~~the~~ reversible to form Ribose 6-P.

If cell need NADPH then after form Glyceraldehyde 3-P & Fructose 6-P cycle enters in glycolysis.

Glucose 6-phosphate dehydrogenase deficiency

G6PD deficiency

⇒ Inherited disease (generation by generation)

⇒ Deficiency occurs in all cell but more severe in RBC. So, that means NADPH doesn't synthesize.

HMP doesn't provide → NADPH → ~~cause~~ cause G6PD deficiency

↓
Accumulation of methemoglobin in RBCs
← Hemolysis (breakdown of RBCs)

⇒ Those patient who suffer from G6PD deficiency

↓
some drugs like ⇒ Primaquine (antimalarial)
[oxidant nature] Sulphamethoxazole (Antibacterial)
Acetanilid (Antipyretic)

Glycogen Metabolic Pathways

• Glycogen is a polymer of glucose residues linked by alpha-(1,4)- & alpha-(1,6) - glycosidic bond.

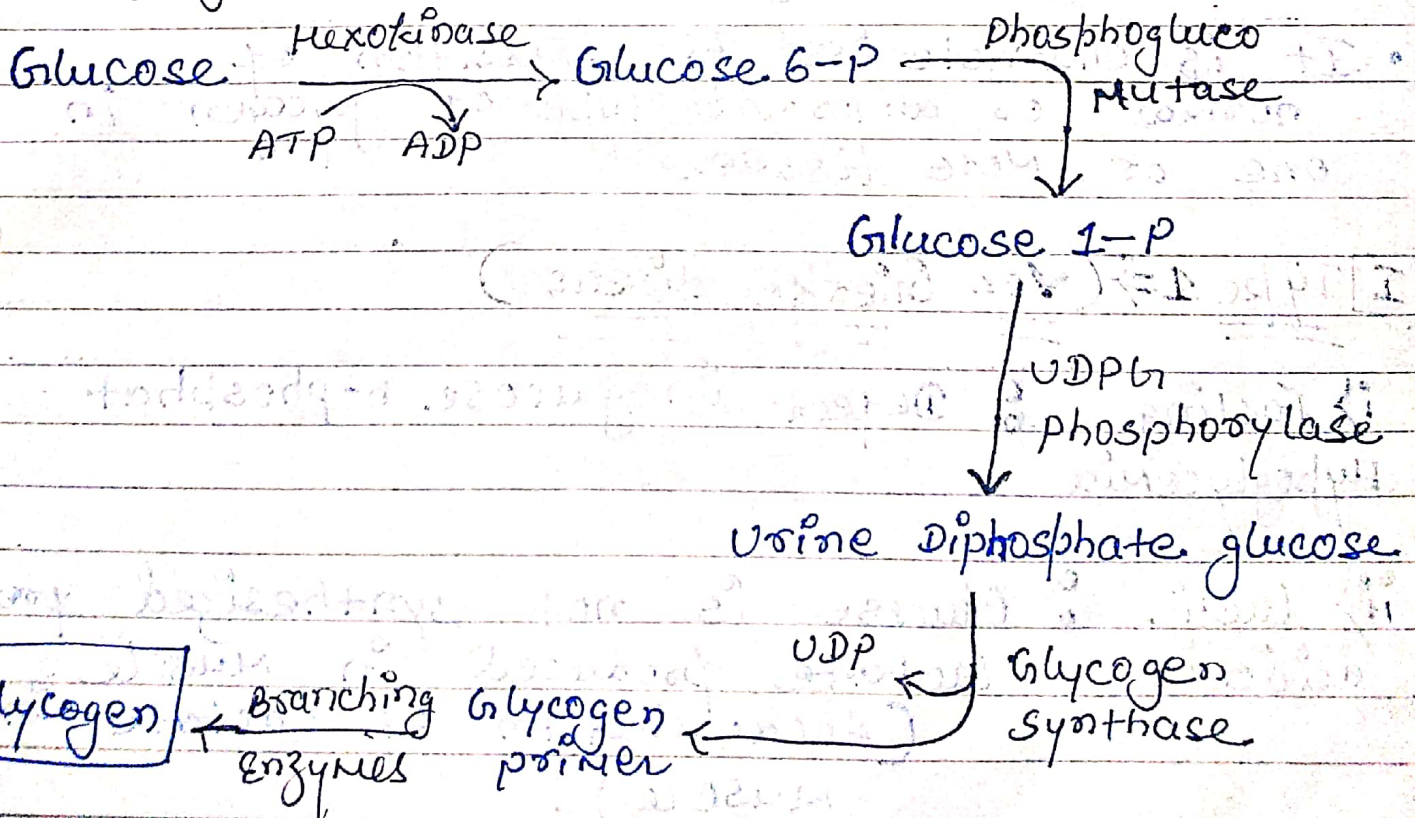
• Glycogen is the storage form of glucose in liver and muscle.

Glycogen Metabolic Pathway

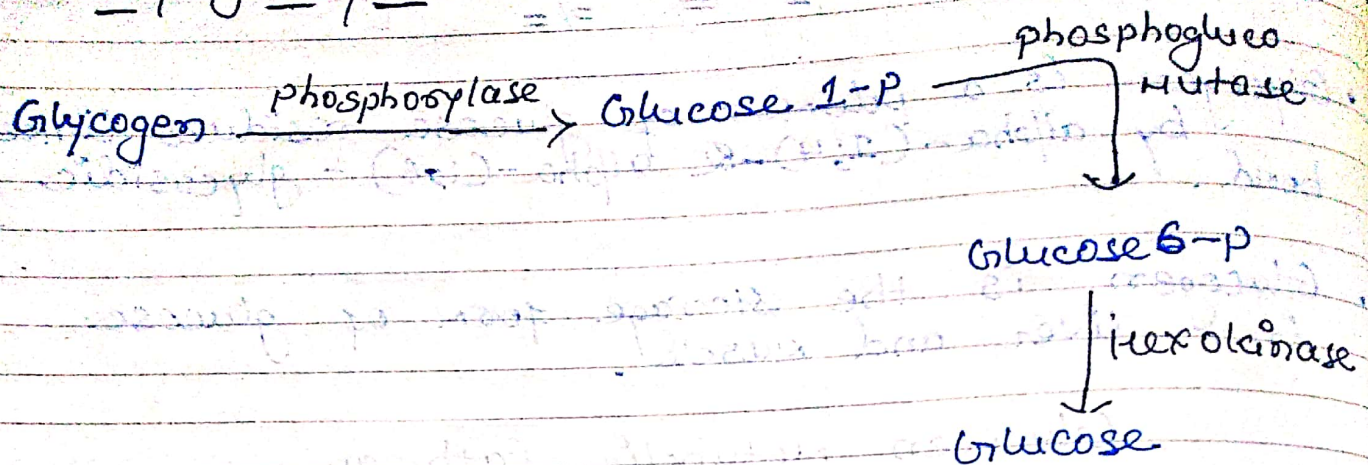
Glycogenesis
[Synthesis of glycogen from glucose]

Glycogenolysis
[Breakdown of glycogen into glucose]

* Glycogenesis:



→ glycogenolysis



Glycogen storage disease

• Those problems occurs during glycogenesis (during synthesis) & during glycogenolysis (during breakdown) collectively refer to as glycogen storage disease.

• It is characterised by deposition of normal or abnormal type of glycogen in one or more tissue.

[I] Type 1 ⇒ (Von Gierke disease)

i) Fasting Hypoglycemia : Defect in glucose 6-phosphat

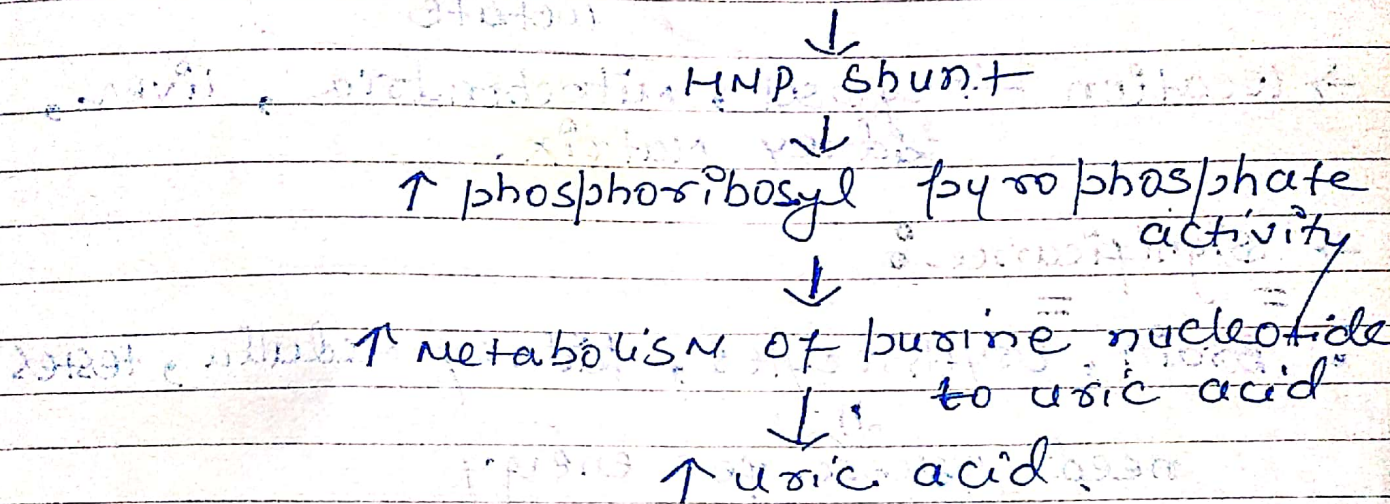
ii) Lactic acidemia : Glucose is not synthesized from lactate produced in muscle (Accumulation of lactate in muscle).

iii) Hyperlipidemia

- ↑ (inc.) plasma, free fatty acids & ketone bodies.

iv) Hyperuricemia

- Accumulation of Glucose 6-phosphate



(II) Type 2 (Pompe's disease)

- Accumulation of glycogen in lysosomes due to deficiency of lysosomal (1,4- or 1,6-glycosidase enzymes are not available to breakdown).

- ↓
- Heart enlargement
 - Muscle weakness

Gluconeogenesis

- Synthesis of glucose from non-carbohydrate compounds.

- Non-carbohydrate compounds \Rightarrow

Pyruvate.
Amino acids
Proteins
Fatty acids
Lactate

\rightarrow location \rightarrow Cytosol, mitochondria, liver, kidney matrix.

\rightarrow Significance

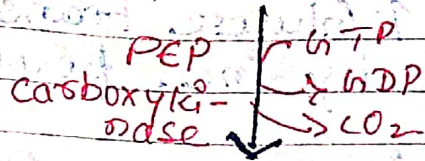
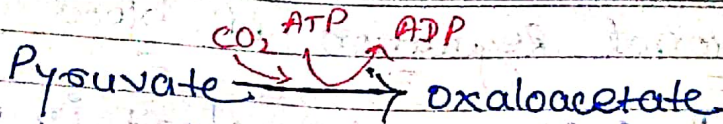
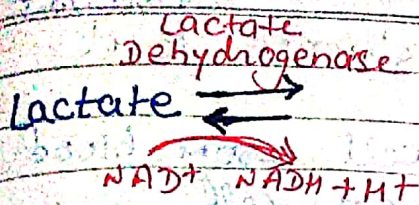
• Brain, Erythrocytes, kidney medulla, testes
 \Downarrow
need glucose for energy

• Glucose is the only source that supplies energy to the skeletal muscle (Anaerobic condition).

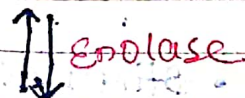
• In fasting condition \rightarrow gluconeogenesis is a process to form glucose which fulfil the basic requirements of body.

• Tissue accumulate lactate, glycerol

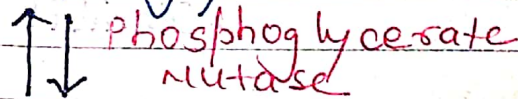
\downarrow
clear from blood by gluconeogenesis.



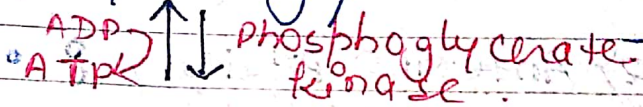
Phosphoenolpyruvate [PEP]



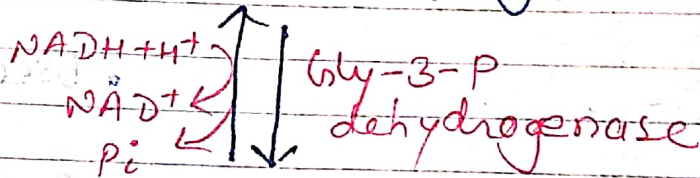
2-phosphoglycerate



3-phosphoglycerate

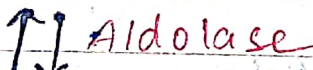
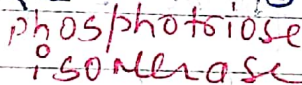


1,3-bisphosphoglycerate

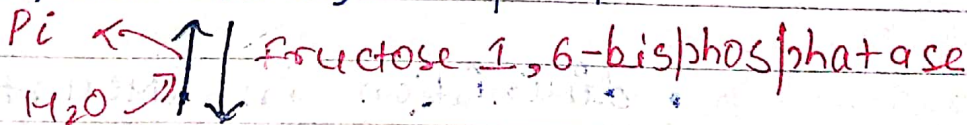


Dihydroxyacetone phosphate

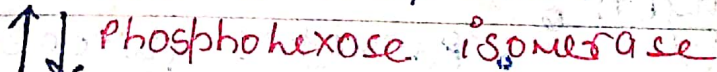
Glyceraldehyde 3-phosphate



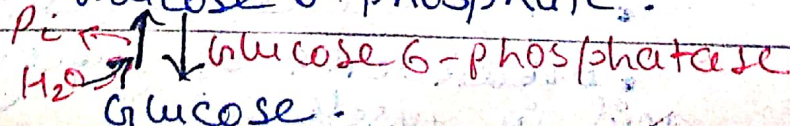
Fructose 1,6-bisphosphate



Fructose-6-phosphate



Glucose 6-phosphate



Glucose

E.T.C. \Rightarrow metabolic pathway air chain.

• transport one compound to another compound
• release of energy ATP form & the O_2 is converted into H_2O

Hormonal Regulation of blood glucose level

1) Insulin \circ \uparrow Glucose transport in cell from blood by inc. permeability of cell.

- inc. glycogen formⁿ in liver & muscles

- conversion of glucose into fat

- stimulate protein synthesis.

- Inhibit ketoneogenesis.

- \downarrow gluconeogenesis & \uparrow glycolysis

2) Anterior Pituitary \circ • Hyperglycemia
Hormones (GH)

- Inhibition of insulin.

- breakdown of muscle proteins.

- \uparrow mobilizatⁿ of fat in form of free fatty acid from adipose tissue.

3) Epinephrine \circ • \uparrow blood sugar & lactate

- Diminish the uptake of glucose by cell.

- diminution in amount of Insulin

4) Glucagon \circ

- Promotes glycogenolysis in liver

- \uparrow gluconeogenesis

- breakdown of glycogen to lactic acid in muscle.