P.G. Sem II CC-7 Unit-2

sub-unit: 2.3

By Dr. Sunil Kumar Mandal
Assoc Prof. & Head
P.G. Dept. of Zoo.
M.U.

Glycogenolysis

Introduction → Glycogen is the storage form of food or energy in animals. It is a stored form of homoglycans having molecular weight of several millions found in animal tissues, particularly, liver and muscles. It is also called animal amylopectin because like amylopectin, it is branched chain polysaccharide of α-D-glucopyranose unit linked by 1→4 glucoside bonds forming linear chain and 1→6 glucoside bonds present at branched points at intervals of 12-18 glucose unit. Because of more frequent branching, glycogen is more compact than amylopectin. Due to aromatic carbon present in glucoside bonds, glycogen is a non-reducing sugar and give red colour with iodine solution. It is the process of breakdown of glycogen to release energy. Process of glycogenolysis is accomplished in five enzymatic steps as follows —

1. **phosphorolytic cleavage by glycogen phosphorylase** — Glycogen is degraded through phosphorolytic cleavages by the enzyme glycogen phosphorylase using phosphate. The glucose residues from the free ends of glycogen are released as glucose-1-Phosphate by cleavage of α 1, 4, glycoside bonds.

Removal of glucose residues by the phosphorolytic cleavages continues till four glucose residues from the branch point (i.e. α-1,6-glycosidic bond) remain on this chain. The enzyme stops to cleave α-1,4-glycosidic bond any further till next enzyme comes to act. Glycogen molecule, degraded to the extent where no further phosphorolytic removal is possible, is called limit dextrin. ΔG of this phosphorolytic cleavage is +3.1 KJ per mole. But the intracellular concentration of phosphate is 100 time the concentration of glucose-1-P04. This makes the ΔG' of this reaction to −6 KJ per mol. Furthermore, the enzyme releases glucose as a phosphorylated compound (Gl-1-P) without using ATP.

2. Transfer of a trisaccharide piece from the branch point – Further degradation of glycogen is possible only after another enzyme, a debranching enzyme, comes to act. This debranching enzyme is in fact two enzyme. First to act is α-1-4-glucan transferase, which removes a trisaccharide piece away from the branch point and transfers it to the adjacent linear chain, by linking Carbon-1 of the first glucose of trisaccharide to the Carbon-4 of the glucose of the linear chain by forming an α-1,4-glycosidic bond. In this

NOTES 4 PRO

Krebs Cycle

P.G. Sem II CC-7 Unit 2 - Subunit 2.3

Glycogenolysis

The process of formation of glycogen from glucose or other saccharide sources is called Glycogenolysis.

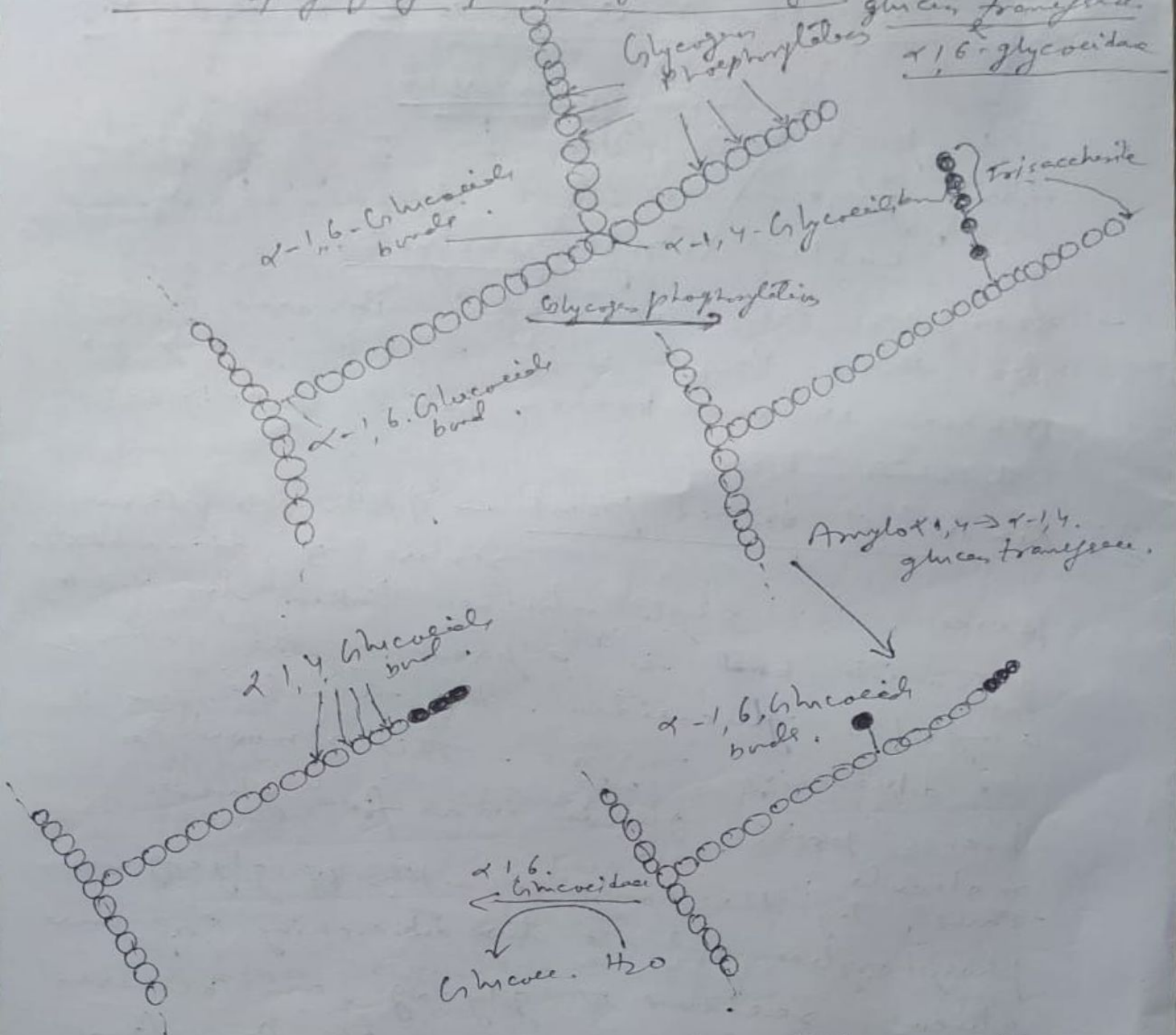
→ transfer the linear chain increases in length by three glucose unit but leaving only one glucose on the branch point of α-1-6-glycosidic bond.

3. Removal of branch point – After the above removal of trisaccharide piece, the single glucose linked by α-1,6-glycosidic bond is exposed to the action of amylo 1,6-glucosidase, the second enzyme of the debranching enzyme. This removes the branch-point glucose as a free glucose molecule.

Thus, by the combined action of glycogen phosphorylase and the two debranching enzymes glucose residues of glycogen are removed largely as glucose-1-Po4 with few free glucose molecules.

4. Conversion of glucose-1-Po4 into glucose-6-Po4 – Glucose-1-Po4 formed above are converted to glucose-6-Po4 by the enzyme phosphoglucomutase as in glycogenesis. This conversion involves formation of glucose-1,6-diPo4 as an intermediate compound.

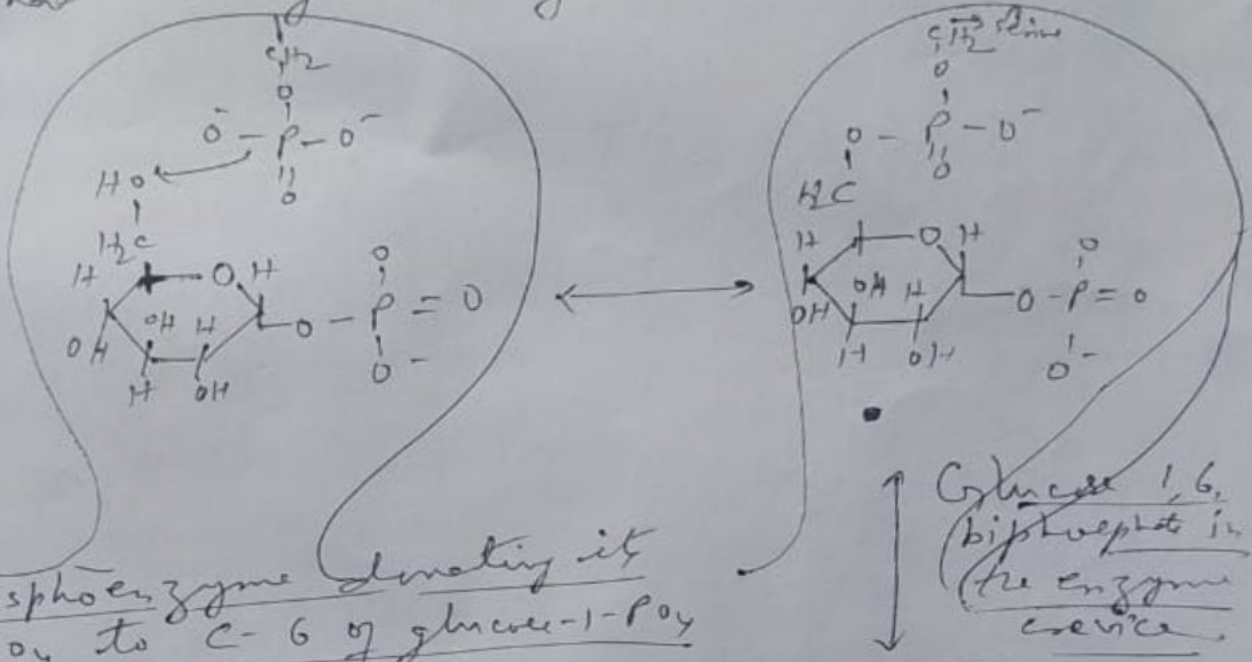
Action of glycogen phosphorylase. amylo (α-1,4→1,4 glucan transferase & α1,6-glycosidase



Phosphoglucomutase is a polypeptide of 561 amino acids. Its active site basically is a deep-crevice possesses a phosphate linked to -OH of Serine. This phosphate of the enzyme is donated to the carbon-6 of glucose-1-Pi forming glucose 1,6. diphosphate. However, the enzyme gets rephosphorylated immediately

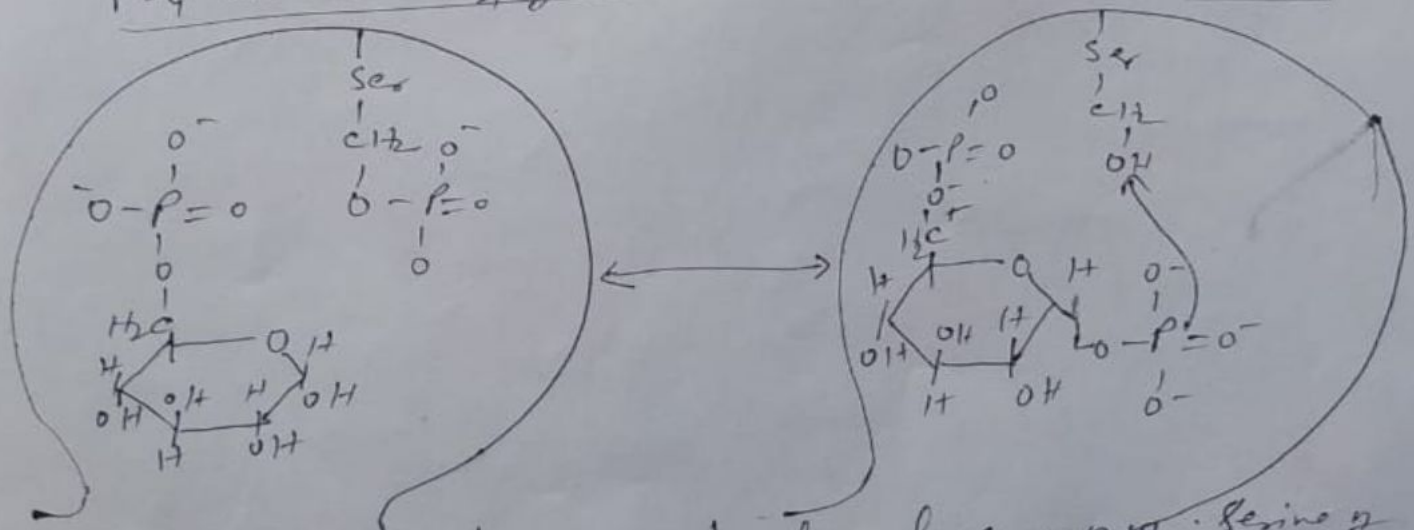
by picking up phosphate from Carbon-1 of glucose 1,6-diphosphate, which is thus released as glucose-6-Poy. All these changes are reversible.

5. Hydrolysis of glucose-6-Phosphate → Glucose-6-Phosphate is finally hydrolyzed to free glucose and phosphate by the enzyme glucose-6-phosphatase. This reaction is similar to that in gluconeogenesis.



Phosphoenzyme donating its Poy to C-6 of glucose-1-Poy

Glucose 1,6, biphosphate in the enzyme cavity.



Phosphoenzyme and glucose 6, Poy are set free.

hydroxyl group of Serine of enzyme picks Poy from C-1 of glucose-1,6,diPoy.

Conversion of glucose-1-Poy to glucose-6-Poy by Phosphoglucomutase