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

Sub-unit: 2.3

Glycogenolysis

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Introduction → Glycogen is the storage form of food or energy in animals. It is a stored form of homoglycans having molecular weight of several million 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 glucosidic bonds present at branched points at intervals of 12-18 glucose units. Because of more frequent branching, glycogen is more compact than amylopectin. Due to anomeric carbon present in glucosidic bonds, glycogen is a non-reducing sugar and gives 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-PO4 by cleavage of α 1,4, glycosidic bonds.

Removal of glucose residue by the phosphorolytic cleavage 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 that 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 times the concentration of glucose-1-Poy. This makes the ΔG of this reaction to −6 KJ per mol. Furthermore, the enzyme releases glucose as a phosphorylated compound (G-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

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

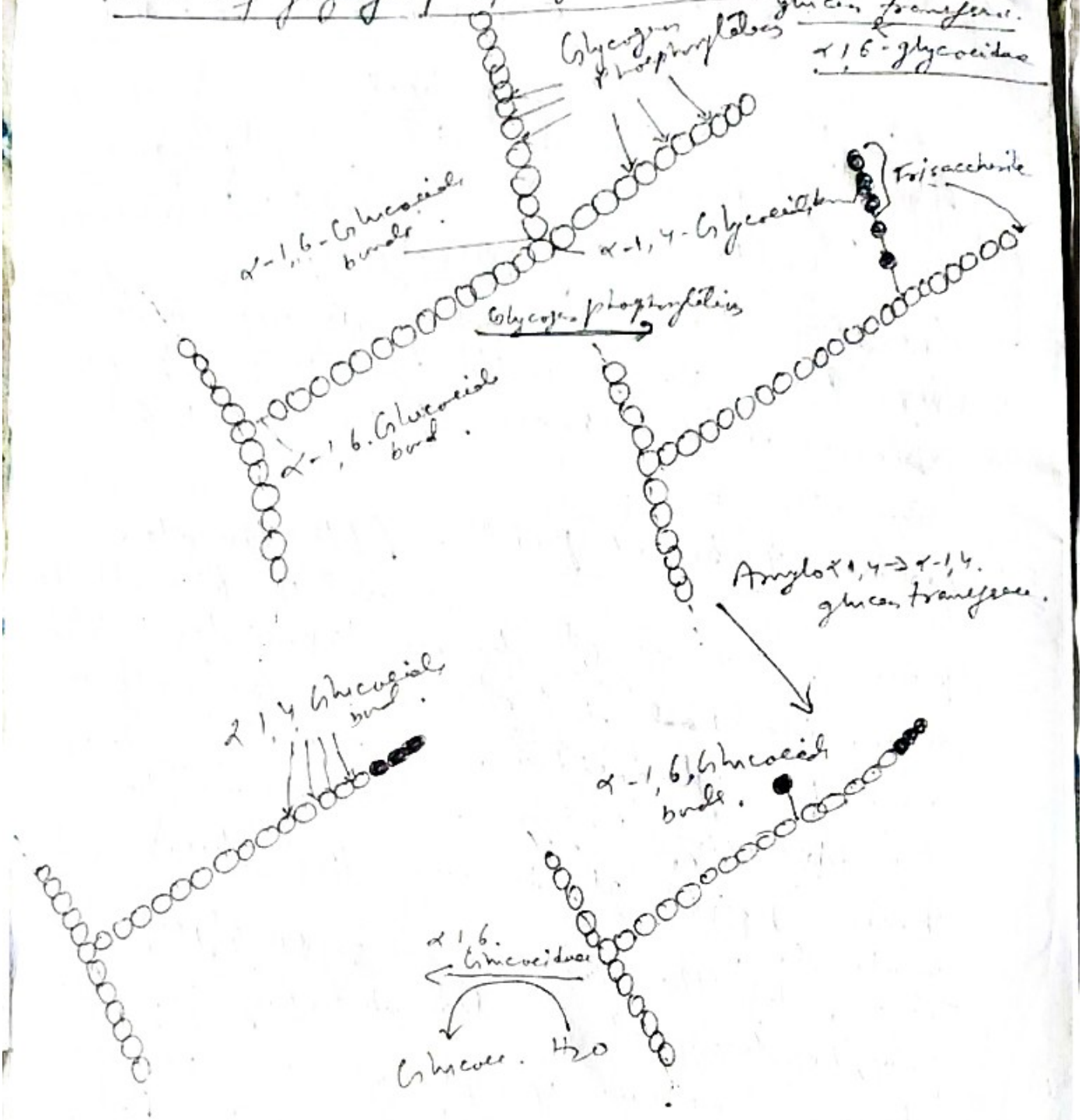
3. Removal of branch point — After the above removal of trisaccharide piece, the single glucose linked by α-1,6-glycosidic bond is exposed to the action of amylo 1,6-glucosidase, the second enzyme of the debranching enzyme. This removes the branch-point glucose as a free glucose molecule.

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

4. Conversion of glucose-1-Poy into glucose-6-Poy — Glucose-1-Poy formed above are converted to glucose-6-Poy by the enzyme phosphoglucomutase as in glycogenesis.

This conversion involves formation of glucose-1-6-diPoy 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 transfered to the carbon-6 of glucose-1-P, forming glucose 1,6. diphosphate. However, the enzyme gets dephosphorylated immediately