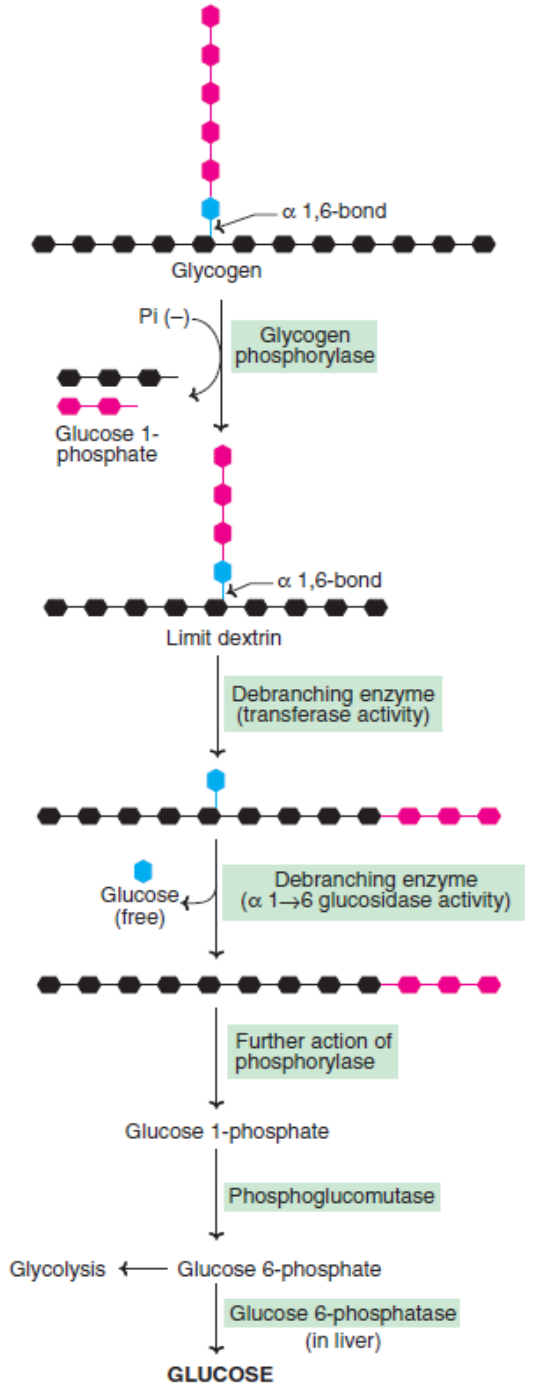
GLYCOGENOLYSIS

- The **degradation of stored glycogen** in liver and muscle constitutes glycogenolysis.
- The pathways for the synthesis and degradation of glycogen are not reversible.
- An independent set of enzymes present in the cytosol carry out glycogenolysis.
- Glycogen is degraded by breaking alpha-1,4- and alpha-1,6-glycosidic bonds



1. **Action of glycogen phosphorylase :**

- The alpha- 1,4-glycosidic bonds (from the non-reducing ends) are cleaved sequentially by the enzyme glycogen phosphorylase to yield glucose 1-phosphate.
- This process—called **phosphorolysis**—continues until four glucose residues remain on either side of branching point (alpha-1,6- glycosidic link).
- The glycogen so formed is known as **limit dextrin** which cannot be further degraded by phosphorylase.
- Glycogen phosphorylase possesses a molecule of pyridoxal phosphate, covalently bound to the enzyme.

2. Action of debranching enzyme :

- The branches of glycogen are cleaved by two enzyme activities present on a single polypeptide called **debranching enzyme,** hence it is a **bifunctional enzyme.**
- Glycosyl 4 : 4 transferase activity removes a fragment of three or four glucose residues attached at a branch and transfers them to another chain.
- Here, one alpha-1,4-bond is cleaved and the same alpha-1,4 bond is made, but the places are different.
- Amylo alpha-1,6-glucosidase breaks the alpha-1,6 bond at the branch with a single glucose residue and **releases a free glucose.**
- The remaining molecule of glycogen is again available for the action of phosphorylase and debranching enzyme to repeat the reactions stated in 1 and 2.

3. Formation of glucose 6-phosphate and glucose :

- Through the combined action of glycogen phosphorylase and debranching enzyme, glucose 1-phosphate and free glucose in a ratio of 8 : 1 are produced.
- Glucose 1-phosphate is converted to glucose 6-phosphate by the enzyme phosphoglucomutase.
- The fate of glucose 6-phosphate depends on the tissue.
- The liver, kidney and intestine contain the enzyme **glucose 6-phosphatase** that cleaves glucose 6-phosphate to glucose.
- This enzyme is absent in muscle and brain, hence free glucose cannot be produced from glucose 6-phosphate in these tissues.
- Therefore, liver is the major glycogen storage organ to provide glucose into the circulation to be utilized by various tissues.
- In the peripheral tissues, glucose 6-phosphate produced by glycogenolysis will be used for glycolysis.
- It may be noted that though glucose 6-phosphatase is absent in muscle, some amount of free glucose (8-10% of glycogen) is produced in glycogenolysis due to the action of debranching enzyme (alpha-1,6-glucosidase activity).

Regulation glycogenolysis