Question #61107, Chemistry, Other

Write short notes on the following:

a) Convention in biochemical energetic
b) Mechanism of muscle contraction
c) Regulation of glycogen metabolism

Answer:

a) Convention in biochemical energetic.
By convention, we indicate the storage of free energy with a plus sign. In biochemical processes free energy is stored in Adenosine triphosphate (ATP) - a small but surprising molecule used in cells as a coenzyme often called the "molecular unit of currency" of intracellular energy transfer. The ATP is the molecule that carries energy to the place where the energy is needed. When ATP breaks into ADP + Pi, (Adenosine diphosphate) the breakdown of the last covalent link of phosphate (a simple -P04), liberates a lot of energy that is used as energy in the reaction where is needed.

b) Mechanism of muscle contraction. Muscle contraction is the activation of tension-generating sites within muscle fibers. It can be described based on two variables: length and tension. During muscle contraction, the laterally projecting heads (cross bridges) of the thick myosin myofilaments come in contact with the thin actin myofilaments and rotate on them. This pulls the thin myofilaments towards the middle of the sarcomere past the thick myofilaments. The Z lines come closer together and the sarcomere becomes shorter. Length of the A band remains constant. Myofilaments stay the same length. Free end of actin myofilaments move closer to the centre of the sarcomere, bringing Z lines closer together. I bands shorten and H zone narrows. A similar action in all the sarcomeres results in shortening of the entire myofibril, and thereby of the whole fibre and the whole muscle. A contracted muscle becomes shorter and thicker and its volume remains the same.

c) Regulation of glycogen metabolism.
The allosteric regulatory effects exercised by glucose-6-phosphate, ATP and AMP on glycogen phosphorylase and glycogen synthase make good physiological sense. Depletion of ATP is an excellent reason to release glucose from the store in order to make some more. On the other hand, glucose-6-phosphate will be plentiful when glucose itself is abundant, and therefore signals an opportunity for replenishing the glycogen stores (Figure 1).

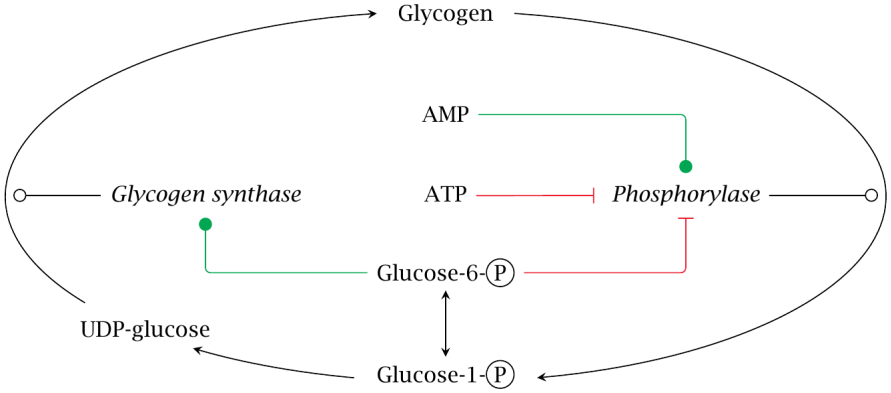

Figure 1 - Allosteric regulation of glycogen synthase and phosphorylase

Hormonal control of glycogen metabolism (Figure 2) is similar to that of gluconeogenesis. The activated kinase directly phosphorylates glycogen synthase, which inactivates that enzyme. Protein kinase A indirectly stimulates glycogen breakdown by phosphorylation of a dedicated regulatory enzyme, phosphorylase kinase, which in turn phosphorylates glycogen phosphorylase.

Note that glycogen synthase and phosphorylase respond in opposite ways to phosphorylation: The synthase is inactivated, whereas the phosphorylase is activated.

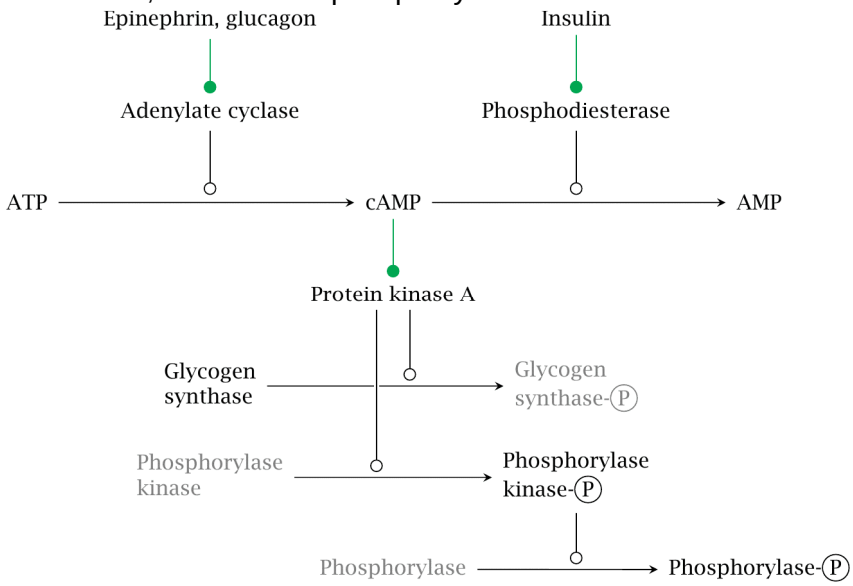

Figure 2 - Hormonal control of glycogen metabolism