

Answer on Question #57384 - Biology - Biochemistry

Question:

The number of ATP molecules formed from 8 molecules of H₂O due to noncyclic electron transport and subsequent photophosphorylation is ?

Assume that quinone cycle facilitates the transfer 4H⁺ to the lumen of thylakoid membrane for every two electrons passing through electron transport system and one ATP is formed for every 3H⁺ moving down the proton gradient by the mediation of F_o - F₁ ATPase.

Solution:

To calculate the ATP watch a detailed diagram of the Z-scheme of photosynthesis:

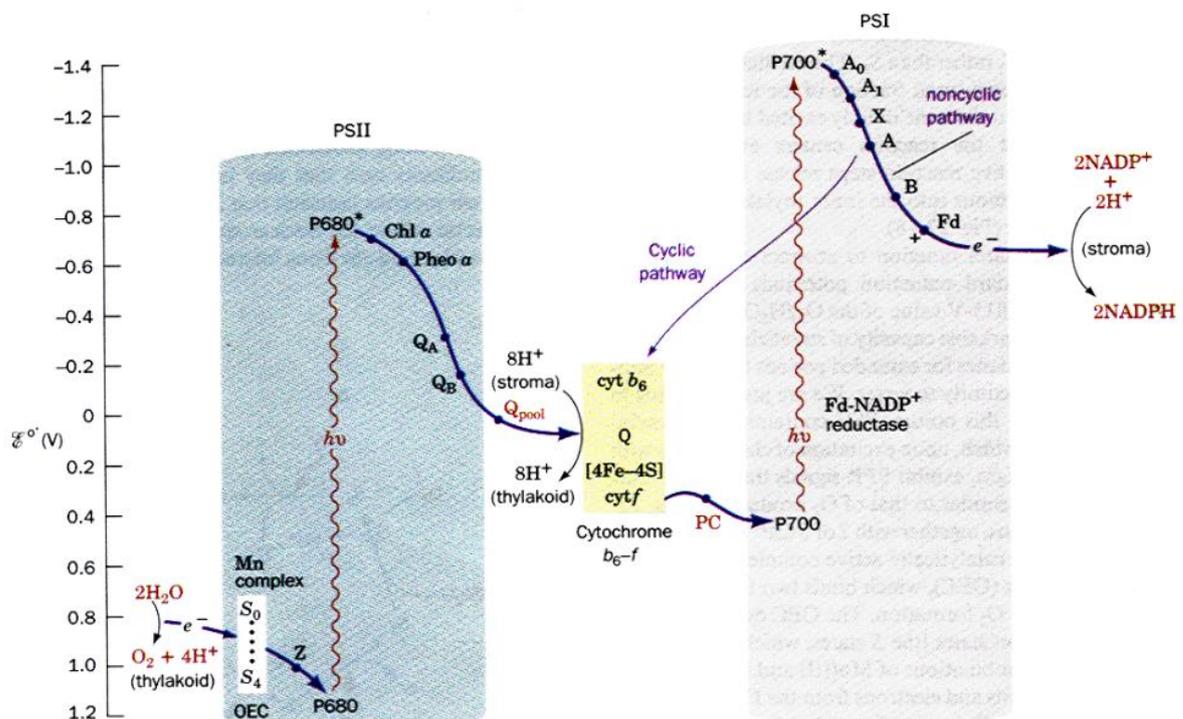


FIGURE 22-16. A detailed diagram of the Z-scheme of photosynthesis. Electrons ejected from P680 by the absorption of photons are replaced with electrons abstracted from H₂O by an Mn complex (OEC), thereby forming O₂ and four H⁺. Each ejected electron is passed through a chain of electron carriers to a pool of plastoquinone molecules (Q). The resulting plastoquinol, in turn, reduces the cytochrome *b₆f* particle (yellow box) that transfers electrons with the concomitant

translocation of protons into the thylakoid space. Cytochrome *b₆f* then transfers the electrons, via a poorly characterized pathway, to plastocyanin (PC). The plastocyanin regenerates photooxidized P700. The electron ejected from P700, through the intermediacy of a chain of electron carriers, reduces NADP⁺ to NADPH in noncyclic electron transport. Alternatively, the electron may be returned to the cytochrome *b₆f* complex in a cyclic process that translocates protons into the thylakoid space.

ATP productions in noncyclic pathways:

- 12H⁺ (4 from 2H₂O and 8 from 4PQH₂ in Cyt *b₆f*) are transported by one O₂ production, 12H⁺/O₂.
- 3H⁺ produce one ATP (~ 1 ATP/ 3H⁺), thus, 4ATP/O₂.

- Each NADPH produced has the free energy to produce 3ATP (we have 2NADPH).
- Thus if the NADPH oxidation is taken into account, **10ATP** can be produced (4ATP by proton gradient and 6ATP by 2NADPH oxidation).

So this is calculation for **2H₂O**: 4ATP (or 10 ATP if the NADPH oxidation is taken into account)

Now we can calculate ATP productions for **8H₂O**: 16ATP (or 40 ATP if the NADPH oxidation is taken into account)