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1) Describe the three (3) stages of beta oxidation. (Show pathways where necessary)

**First Stage: *β- oxidation pathway;*** in this stage, the fatty acids undergo oxidative removal of successive two-carbon units in the form of acetyl-CoA, starting from the carboxyl end of the fatty acyl chain. For example, the C-16 fatty acid palmitic acid (palmitate at pH 7) undergoes 7 passes through this oxidative sequence, in each pass losing two carbons as acetyl-CoA. At the end of seven cycles, the last two carbons of palmitate (originally C-15 and C-16) are left as acetyl-CoA. The overall result is the conversion of 16-carbon chain of palmitate to 8 two-carbon acetyl-CoA molecules.

**Second Stage:** ***Citric acid cycle;*** In this stage of fatty acid oxidation, the acetyl residues of acetyl-CoA are oxidized to CO2 via the citric acid cycle, which also takes place in the mitochondrial matrix. Acetyl-CoA derived from fatty acid oxidation, thus, enters a final common pathway of oxidation along with acetyl-CoA derived from glucose via glycolysis and pyruvate oxidation.

**Third Stage:** ***Mitochondrial respiratory Chain;*** The first two stages of fatty acid oxidation produce the electron carriers, NADH and FADH2, which in the third stage donate electrons to the mitochondrial respiratory chain, through which electrons are carried to oxygen. Coupled to this flow of electrons is the phosphorylation of ADP to ATP. Thus, energy released by fatty acid oxidation is conserved as ATP