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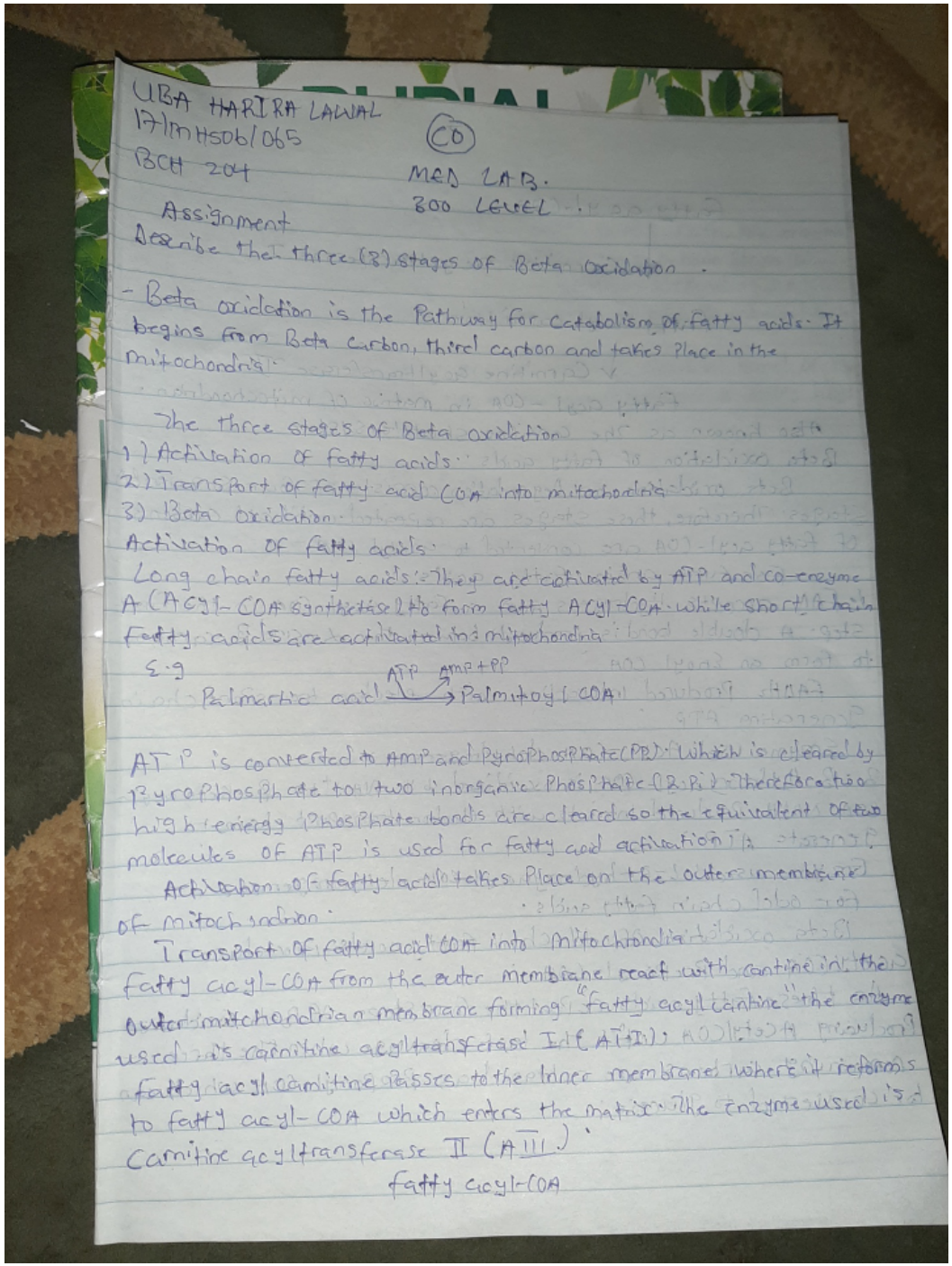

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Assignment
Describe the three (3) stages of Beta oxidation.

- Beta oxidation is the Pathway for catabolism of fatty acids. It begins from Beta carbon, third carbon and takes place in the mitochondria.

The three stages of Beta oxidation
1) Activation of fatty acids.
2) Transport of fatty acid CoA into mitochondria
3) Beta oxidation.

Activation of fatty acids:
Long chain fatty acids: They are activated by ATP and co-enzyme A (Acyl-CoA synthetase) to form fatty Acyl-CoA while short chain fatty acids are activated in mitochondria

E.g

Palmartic acid $\xrightarrow{ATP \quad AMP+PP}$ Palmitoyl-CoA

ATP is converted to AMP and PyroPhosPhate (PP) which is cleared by PyroPhosPhate to two inorganic PhosPhate (2Pi) therefore two high energy PhosPhate bonds are cleared so the equivalent of two molecules of ATP is used for fatty acid activation.

Activation of fatty acids takes Place on the outer membrane of mitochondrion.

Transport of fatty acid CoA into mitochondria
fatty acyl-CoA from the outer membrane react with cantine in the outer mitchondrian membrane forming "fatty acyl cantine" the enzyme used is cantine acyltransferase I (AT I), fatty acyl cantine passes to the inner membrane where it reforms to fatty acyl-CoA which enters the matrix. The enzyme used is Carnitine acyltransferase II (AT II).

fatty acyl-CoA

fatty acyl-COA

↓ Carnitine acyltransferase I

fatty acyl carnitine

↓ Carnitine acyltransferase II

fatty acyl-COA in matrix of mitochondrian.

Also known as the carnitine shuttle system.

Beta oxidation of fatty acids.

Beta oxidation or degredation consists of four sequent stages. Therefore, these stages are repeated until all carbons of fatty acyl-COA are converted to acetyl COA

For Even-chain fatty acids:

1. FAD accepts Hydrogens from a fatty acyl-COA in the first step. A double bond is produced between the α- and β-carbon to form an Enoyl COA

$FADH_2$ Produced interactive with electron transport chain generating ATP

Enzyme used: Acyl-COA dehydrogenase

2. β-Hydroxy acyl-COA is oxidized by NAD^+ to β-Keto acyl-COA NADH Produced interacts with electon transport chain to generate ATP

Enzyme used: L-3-hydroxyacyl-COA dehydrogenase.

For odd chain fatty acids:

Beta oxidation of odd-chain fatty acids Procedure:

Cetyl COA and Propionyl-COA

As these fatty acids repeat the four steps of Beta oxidation producing AcetylCOA until the last cleavage when the three remaining carbons are released as Proponyl-COA which can converted to glucose.

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For unsaturated fatty acids:

Beta oxidation of unsaturated fatty acids require enzyme in addition to the four that catalyze the repetitive steps of Beta-oxidation. The reaction Pathway differs depending on whether the double bond is at an even or odd-numbered carbon position.

So, the Beta-oxidation occurs until a double bond of the unsaturated fatty acid is near the carboxyl end of fatty acyl chain.

Overall reaction of Beta-oxidation:

C_n-acyl COA + FAD + NAD^+ + H_2O + COA → C_{n-2} acyl COA + $FADH_2$ + NADH + H + acetyl COA.