**Course Title: Medical Biochemistry II**

**RAD 2nd, Sec A**

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 **Max Marks: 50**

**Note: There are FIVE questions, each carry 10 marks with grand total of 50 marks.**

**ATTEMPT all questions.**

**Avoid copy paste material, as it may deduct your marks.**

**Q1. Explain the process of “ATP synthesis coupled with electron flow”**

**Answer:**

**ATP SYNTHESIS COUPLED WITH ELECTRON FLOW:**

*Electron transfer to O2 was found to be coupled to ATP synthesis from ADP + Pi in isolated mitochondria.*

. Atp would not be synthesized when only ADP and Pi are added in isolated mitochondria suspensions.

. O2 consumption, an indication of electron flow, was detected when a reductant is added, a accompanied by an increase of ATP synthesis.

. Both of O2 consumption and ATP synthesis were suppressed when inhibitors of respiratory chain was added.

. Atp synthesis depends on the occurrence of electron flow in mitochondria.

. O2 consumption was neither observed if ADP was not added to the suspension, although a reductant is provided!

. The O2 consumption was also not observed in the presence of inhibitors of ATP synthase.

. Electron flow also depends on ATP synthesis.

**Q2. Write the reactions that are catalyzed by the following enzymes.**

* + 1. **Acyl CoA dehydrogenase**

**Answer :**

Acyl-CoA dehydrogenase are a class of enzymes that function to catalyze the initial step in each cycle of fatty acid B-oxidation in the mitochondria of cell.

. This enzymes action represents the first step in fatty acid metabolism (the process of breaking long chains of fatty acids into acetyl-CoA molecules)

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* + 1. **Adenosine deaminase**

**Answer :**

Adenosine deaminase (also known as adenosine aminohydrolase, or ADA) is an enzyme involve in Purine metabolism.

. It is needed for the breakdown of adonesine from food and for the turnover of nucleic acid and tissue.

. Its primary function in human is development and maintenance of the immune system.

* + 1. **Nucleotidase**

**Answer :**

 A nucleotidase is a hydrolytic enzyme.

 That catalizes the hydrolysis of a nucleotide into

 Nucleoside and phosphate.

* + 1. **Gluconolactonase**

**Answer :**

In enzymology, a gluconolactonase is an enzyme that catalyzed the chemical reaction D-glucono-15-lactone+H2OD-gluconate. Thus,

. The two substrate of this enzyme are D-glucono-1,5-lactone and H2O. Where as it product is D-gluconate.

* + 1. **Enoyl-CoA hyhydratase**

**Answer :**

Enoyl-CoA hydrates or crotonase is an enzyme that hydrates the double bond between the second and third carbons on 2-trans/cis-enoyl-CoA;ECH is essential to metabolizing fatty acids in beta oxidation to produce both acetyl-CoA and energy in the form of ATP.

**Q3. Define nucleotide, nucleoside and differentiate between DNA and RNA.**

**Ans.**

* **Nucleotide:**
* **Defintion :**

Nucleotides are organic molecules consisting of a nucleoside and phosphate. They serve as monomeric units of the nucleic acid polymers deoxyribonucleic acid and ribonucleic acid, both of which are essential biomolecules with in all life forms on earth.

* **Nucleoside:**
* **Definition:**

Nucleoside are glycosylamines that can be thought of as nucleotides without a phosphate group. A nucleoside consists simply of a nucleobase and a five carbon sugar where as a nucleotide is composed of a nucleobase, a five carbon sugar, and one or more phosphate groups.

* **Difference B/w DNA and RNA:**

|  |  |
| --- | --- |
| DNA | RNA |
| DNA contains sugar deoxyribose.  | **RNA contains sugar ribose.**  |
| DNA is double stranded molecule.  | **RNA is a single stranded molecule.**  |
| DNA is stable under alkaline conditions.  | **RNA is not stable.**  |
| DNA is responsible for storing and transferring genetic information.  | **RNA directly codes for amino acids.**  |
| DNA uses the base adenine, thymine, cytosine and guanine.  | **RNA uses adenine, uracil, cytosine and guanine.**  |

**Q4. Why Dickens and Horecker’s Pathway is called HMP pathway. Enlist the enzymes used in PPP Pathway.**

**Answer :**

**Dickens and Horecker’s Pathway :**

. The Dickens and Horecker’s Pathway is also known as HMP (Hexose mono phosphate pathway) because this pathway is starting from a compound which is known as Glucose-6-phosphate.

. Glucose is 6-carbon molecule, Hexose.

. The group attached to the 6th carbon of glucose G-6-P which we called phosphate group.

. The group of phosphate attached to the 6th carbon of G-6-P is one in number, that's why it is called mono phosphate, and the mono phosphate group is attached to glucose 6th phosphate so it is called Hexose monophosphate.

**. List of enzymes used in PPP Pathway :**

**. Oxidation phase :**

i. Glucose-6-phosphate dehydrogenase

ii. Gluconolactonase

iii. 6-phosphogluconate dehydrogenase

**. Non. Oxidation phase :**

i. Epimarase

ii. Isomerase

iii. Trans ketolase

iv. Trans Aldolase

**Q5. What is the function of carnitine shuttle system? Write down the stages and steps involved in Beta oxidation of Lipids.**

**Answer :**

**Carnitine shuttle system :**

The carnitine shuttle is responsible for transferring long-chain fatty acids across barrier of the inner mitochondrial membrane to gain access to the enzymes of beta-oxidation.

**Function of carnitine shuttle system :**

. The oxidation of fatty acids is an important source of energy for ATP production in mitochondria through the entry of acetyl-CoA into the kreb's cycle.

. Fatty acids are oxidized inside the mitochondrial matrix but the fatty acids to be oxidized come from the cytosol. Fatty acids are activated in the cytosol by esterification with coenzyme A to form acyl-CoA.

. Activated medium chain fatty acids freely diffuse into mitochondria to be oxidized but long long chain fatty acids do not diffuse into mitochondria so they must be transported in.

. The transport of long chain fatty acids into mitochondria for oxidation is accomplished by the carnitine palmitoyltransferase. CPTI exchanges carnitine for the CoA attached to the long chain fatty acids to form a fatty acid carnitine conjugate.

. The fatty acid carnitine is transported into the matrix by a transporter protein in the inner mitochondrial membrane.

. Once the fatty acid carnitine is inside the matrix, CPTII exchanges CoA for carnitine to produce fatty acid-CoA again, ready to enter fatty acid oxidation in the matrix to produce energy. The free carnitine is transported back out to renew the cytoplasmic pool of carnitine and allow the transfer process to continue.

**Stages and steps involved in Beta oxidation of Lipids :**

**Stages involved in beta oxidation :**

Three stages involved in beta oxidation of fatty acid.

1. Activation of fatty acids occurring in the cytoplasm.

2. Transport of fatty acids into mitochondria.

3. Beta-oxidation in the mitochondrial matrix.

**1. Activation of fatty acids :**

. In the cytoplasm of the cell, long-chain fatty acids are activated by ATP and coenzyme A, and fatty acyl-CoA is formed.

. The ATP is converted to AMP and pyrophosphate.

. AMP will attached with fatty acid and will convert into fatty acyl adenylate.

. In next step fatty acyl adenylate will react with coenzyme A in the presence of fatty acyl CoA synthetase enzyme.

. From fatty acyl adenylate the AMP group will removed and CoA will attach to form fatty acyl CoA, an activated form of fatty acid.

**2. Transport of fatty acids into mitochondria :**

. Fatty acyl-CoA from the cytosol reacts with carnitine in the outer mitochondrial membrane, forming fatty acyl carnitine. The enzyme used in carnitine acyl transferase I.

. Fatty acyl carnitine easily passes from the inner membrane to mitochondrial matrix, where it re-forms to fatty acyl-CoA the enzyme used is carnitine acyl transferase II.

. Inside the mitochondria, the fatty acyl CoA undergoes beta-oxidation.

**3. Beta-oxidation in the mitochondrial matrix :**

. Beta oxidation in which all reactions involve the beta carbon of a fatty acyl CoA will occur.

**STEPS OF BETA OXIDATION :**

There are four steps of beta oxidation. These steps are repeated until all the carbons of fatty acyl-CoA are converted to acetyl-CoA. The four steps are;

1.Dehydrogenation

2.Hydration

3 Oxidation

4. Cleavage

**1.Dehydrogenation :**

FAD+ accept hydrogens from a fatty acyl-CoA in the first step. A double bond is produced between the alpha and beta carbons, and an Enoyl-CoA is formed in the presence of acyl-CoA dehydrogenase.

The FADH2 that is produced interacts with the electron transport chain, generating ATP.

**2.Hydration :**

H2O will adds across the double bond, and a beta hydroxyl acyl-CoA is formed in the presence of Enoyl-CoA hydratase.

**3 Oxidation :**

Beta hydroxyl acyl-CoA is oxidized by NAD+ to a beta keto acyl-CoA in the presence of beta hydroxyl acyl-CoA dehydrogenase. The NADH that is produced interacts with the electron transport chain, generating ATP.

**4. Cleavage :**

The bond between the alpha and beta carbons of the beta keto acyl-CoA is cleaved by a Thiolase enzymes that requires coenzyme A. Acetyl-CoA is produced from the two carbons at the carboxyl end of the original fatty acyl-CoA, and the remaining carbons from a fatty acyl-CoA that is two carbons shorter than the original.

. The shortened fatty acyl-CoA repeats these four steps. Repetitions continue until all the carbons of the original fatty acyl-CoA are converted to acetyl-CoA.