**Course Title: Medical Biochemistry II**

**DT 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”.

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

* + 1. Acyl CoA dehydrogenase
    2. Adenosine deaminase
    3. Nucleotidase
    4. Gluconolactonase
    5. Enoyl-CoA hydratase

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

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

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

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

Ans: “ATP SYNTHESIS COUPLED WITH ELECTRON FLOW”:

Electron transfer through the respiratory chain releases more than enough free energy to form ATP. Mitochondrial oxidative phosphorylation therefore poses no thermodynamic problem. However, one cannot deduce from thermodynamic considerations the chemical mechanism by which energy released in one exergonic reaction (the oxidation of NADH by O2) is channeled into a second, endergonic, reaction (the condensation of ADP and Pi). To describe the process of oxidative phosphorylation completely, we need to identify the physical and chemical changes that result from electron flow and cause ADP phosphorylation - the mechanism that couples oxidation with phosphorylation. .

**Importance of ATP synthase**

* Composed of 100,000 atoms
* The primary source of ATP in eukaryotic systems is the mitochondria (95%)
* ATP is generated by catalyzing the addition of a inorganic phosphate to adenosine diphosphate
* ATP is synthesized by enzymes in the mitochondria called ATP synthases

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

1. Acyl CoA dehydrogenase
2. Adenosine deaminase
3. Nucleotidase
4. Gluconolactonase
5. Enoyl-CoA hydratase

**Ans = Catalyzed reaction**

**Definition**

Catalysis is the process of increasing the rate of a chemical reaction by adding a substance known as a catalyst, which is not consumed in the catalyzed reaction and can continue to act repeatedly

**Ans : Enoyl-CoA hydrates (** Ech) catalyzes the second step in the psiologically important beta-oxidation pathway of fatty acid metabolism . this enzyme facilitatesthe synaddition of a water molecule across the double bond of a trans-2-enoyl-CoA thioester resulting in the formation of a betahydroxyacyl-Coa thioester .

1. **Adenosine deaminase**

**Adenosine** deaminase (ADE1) catalyzes the conversion of adenine to hypoxanthine and ammonia as shown in scheme 1 (1,2) ADE is part of the purine degradation pathway where hypoxanthine is subsequently oxidized to uric acid by xanthine oxidase via a xanthine intermediate

**Nucleotidase..**

Nucleotidase is a hydrolytic enzyme that catalyzes the hydrolysis of a nucleotide into a nucleoside and a phosphate . a nucleotide + H2o =a nucleotide + phosphate For example , it converts adenosine , and guanosine mono phosphate to guanosine .

**Gluconolactonase**

6 phosphogluconolactone is converted into 6 phosphogluconate in the presence of an enzyme knowen as 6-phosphogluconolactone hydrolase

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

**Ans: Nucleoside**

It is a nitrogenous with sugar

Example :-

Adenine + Sugar > Adenosine

Guanine + Sugar Guanosine

Thyrine + Sugar > Thynidine

Cybsine + Sugar Cytidine

Urail + Sugar uridine

Conservation of nucleotide to nucleoside:

In the passes of nucleotidase enzyme adenosine mono phosphate is converted into adenosine and inorganic phosphate .

**Nucleotide:-**

A nucleotide contain ;

* Pentose sugar
* Phosphate group
* Nitrogenious bases .

**Differentiate between DNA and RNA.**

* The DNA is a double-stranded molecule that has a long chain of nucleotides.
* **Definition:**

It is a long polymer**.** It has a deoxyribose and phosphate backbone having four distinct bases: thymine, adenine, cytosine, and guanine**.**

* **Location:**

It is located in the nucleus of a cell and in the

mitochondria.

* **Sugar portion:**

It has 2-deoxyribose.

* **Function:**

DNA is functional is the transmission of genetic information. It forms as a media for long-term storage.

* **Predominant Structure:**

**Propagation:**

DNA replicates on its own, it is self-replicating.

* **RNA:**

**Definition:**

Is a polymer with a ribose and phosphate backbone with four varying bases: uracil, cytosine, adenine, and guanine.

**Location:**

It is found in the cytoplasm, nucleus, and in the ribosome.

**Sugar portion:**

It has Ribose.

**Function:**

RNA is functional is the transmission of the genetic code that is necessary for the protein creation from the nucleus to the ribosome.

**Predominant Structure:**

The RNA is a single-stranded molecule which has a shorter chain of nucleotides

**Q=4**

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

**Ans:**

**ENZYMES**

Glucose -6-phosphate dehydrogenase is the rate –controlling enzyme of this pathway . it is allosterically stimulated by NADP+and strongly inhibited by NADPH An ANDPH- utilizing pathway froms NADPH+ which stimulates glucose -6-phosphate dehydrogenase to produce more NADPH. This step is also inhibited by acetyl CoA .

* The pentose phosphate pathway (also called the boxes monophosphate pathway ) is a metabolic pathway parallel to glycolysis.
* This pathway is also called dickens and horeckoer’s pathway .
* It generates NADPH and pentos (5-carbon sugar ) a precursor for the synthesis of nucleotides .

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

**Ans: Stages involved in beta oxidation**

Three stges involved in beta oxidation of fatty acid .

* Activation of fatty acids occouring in the cytoplasm .
* Transport of fatty acids into mitochondria
* 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 acid
* -CoA is formed.
* The ATP is converted to AMP and pyrophosphate.
* AMP will attached to with fatty acid and and will convertad into fatty acyl adenylate .
* While the pyrophosphate is cleaved by pyrophosphate to two inorganic phosphate (2 pi) which will help in the production of ATP if required anywhere .
* In next step the fatty acyl adenylate will react with Coenzyme A in the presence of fatty acyl CoA aynthetase enzyme .
* From fatty acyl adenylate the AMP group will removed and CoA will attach form fatty acyl CoA an activated form of fatty acid .

1. **Trasportation of fatty acyl-CoA from cytoplasm to Mitochondria**

* Fatty acyl-CoA from the cytosol react with carnitine in the outer mitochondrial membrane forming fatty acyl carnitine . The enzyme used is carnitine acyl transfers 1 (CAT) .
* Fatty acyl carnitine easily passes from the inner membrane to mitochondria matrix where it re-forms to fatty acyl –CoA . the enzyme used is cartinine acyl transfers 2 .
* Inside the mitochondria the fatty cyl- CoA undergoes beta-oxidation .

1. **Beta –Oxidation of activated fatty acids**

B-oxidation (in which all reaction involves the beta corbon of a fatty acyl –CoA) will occur in 4 steps . these steps are repeated until all the carbons of fatty acyl-CoA are converted to acetyle-CoA **. The four steps are :**

1. Dehydrgenation
2. Hydration
3. Dehydrogenation
4. Cleavage

**Dehydrogenation**

FAD+ accept hydrogens fro a fetty acyl-CoA in the first step . A double bond is produced in the a – and b-carbon 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.

**Hydration**

H2O will adds across double bond and B-hydroxile acyl-CoA is formed in the presence of Enoyl-CoA hydrates.

**Dehydrogenation**

B-hydroxyl acyl-CoA is oxidized by NAD+ to a B-keto acyl-CoAin the presence of B-hydroxyl acyl-CoA dehydrogenase . The NADH that is produced interact with the electron transport chain generating ATP.

**Cleavage**

The bond between the alpha and beta carbons of the B-keto acyl –CoA is cleavage by a thiolase enzyme that require coenzyme A . Acetly-CoA is produse from the two carbons at the carboxyle end of the original fatty acyl-CoA and the remaining carbon from a fatty acyl-CoA that is two carbons shorter than the original .

The shortened fatty acyl-CoA repeats these four steps .Repetition continue until all the crbons of the original fatty acyl-CoA are converted to acety-CoA.