**Course Title: Medical Biochemistry II**

**RAD 2nd, Sec A**

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**Student ID: 16370**

**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.

**QUESTION NO: 01**

**Ans) ATP Synthesis:-**

ATP Synthesis move H+ ion that were pumped out of the matrix by electron transport chain back into the matrix. The energy from the influx of proton into the matrix is used to generate ATP by the phosphorylation (addition of phosphate) of ADP. The movement of ion across the selectively permeable and mitochondrial membrane and down their electrochemical gradient is called chemiosmosis.

**Important:-**

NADH generate more ATP and FADH2 for every NADH molecule that is oxidized 10H+ are pumped into the intermembrane phase . The yield about three ATP molecule. Because FADH2 enter the chain at later stage (complex 11) Only six H+ ion are transferred to the intermembrane space.

This account for about two ATP molecule.

**Electron transport chain:-**

* It is also called oxidative phosphorylation or respiratory chain
* It is a series of electron carries containing FAD .NAD and FMN enzyme Q and cytochrome ( b , c1,c,a+a3) collectively known as electron transport chain (ETC) .
* Electron transport chain passes on electron from NADH2 OR FADH2 to molecular oxygen Forming of molecule of water and generating energy, which is capture in the form of ATP,s.
* The metabolic intermediates of glucose and fatty acids donates electron to coenzyme i.e NAD and FAD and reduce them to NADH2 and FADH2 .
* These reduced coenzyme then donates a pair of electron to specialized Set of electron carriers collectively called electron transport chain and become oxidized thus reducing the next member of electron transport chain .
* ETC is therefore the best example of redox phenomena because the oxidation and reduction is taking place side by side.
* As electron passed down the ETC , they lose much of their free energy.
* Part of this energy is captured and store in the form of ATP and the rest is released as heat.
* ATP is produced by the phosphorylation of ADP with Pi. This phosphorylation is coupled with the oxidation and reduction member of the electron transport chain therefore this whole process known is **oxidative phosphorylation.**
* Each carriers of ETC can receive electron from electron donor and can subsequently donate electron to the next carrier of the chain ultimately to combine ½ molecule O2 and to form water.
* This requirement of oxygen make the electron transport chain , respiratory chain which account for greatest portion of the body's utilization oxygen.
  + Electron transport chain is present in the inner mitochondrial membrane
  + It is the common final pathway by which electron derived From different fuels of the body flow to oxygen
  + ETC and ATP Synthesis by oxidative phosphorylation proceed continuously in all cells of the body that contain mitochondria .

**Chemiosmosis:-**

Energy released in electron transport chain reaction captured by ATP synthase which is then used to make ATP a process called chemiosmosis

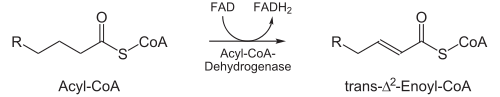
Chemiosmosis is a movement of ion across a semipermeable membrane, down there electrochemical gradient.

**QUESTION NO 02**

**ANS) ENZYME:-**

Enzyme are protein produced by the living cell , which are capable to catalyzes a chemical reaction in a living organism to yield specific product

1) **Reaction that is catalyzed by Acyl CoA dehydrogenase:-**

[](https://en.m.wikipedia.org/wiki/File:Beta-Oxidation1.svg)

**2) Reaction that is catalyzes by adenosine daeminase**

H2O NH3

Adenosine daeminase ---------------🡪 ionsine

HOH2C NH2

**3) Reaction that is catalyzes by nucleotidase**

the 5'nucleotidase enzyme catalysis the following chemical reaction

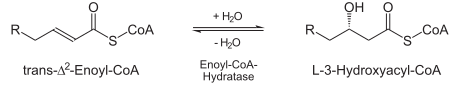
a 5'-nucleotide  + H2O ⇌ a nucleoside + phosphate

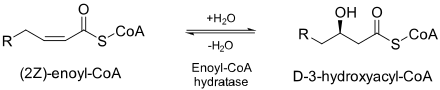
Ribose5-phosphte  + H2O ⇌ ribose + phosphate

**4) Reaction that is catalyzes by Gluconolactonase:-**

D-glucono-1,5-lactone + H2O = D-gluconate.

5) Reaction that is catalyzes by enoyl CoA hydratase :-

[](https://en.m.wikipedia.org/wiki/File:Beta-Oxidation2.svg)

[](https://en.m.wikipedia.org/wiki/File:Enoyl-CoA_hydratase_reaction_cis.svg)

**QUESTION NO: 03**

Ans) **Nucleotide :-**

A nucleotide is the basic building block of nucleic acid. RNA and DNA are polymers made up of long chain of nucleotides.

A nucleotide contains.

* Pentose sugar
* Phosphate group
* Nitrogenous base.

There are two types of nitrogenous base

1. **Purins** :- purins are larger molecules double ring nitrogenous base. Example :- adenine, Guanine
2. **Pyramidines:-** pyramidines ate smaller molecule single ring nitrogenous base . Example : cytosin, thymine, uracil

**Nucleoside :-**

It is a nitrogenous base with sugar .

**Example:-**

* Adenine + sugar \_\_\_ adenosine
* Guanine + sugar \_\_\_ Guanosine
* Thymine + sugar \_\_\_ Thymidine
* Cytosin + sugar \_\_\_ cytidine
* Uracil + sugar \_\_\_ uridine

**Differentiate between RNA and DNA**

|  |  |
| --- | --- |
| **DNA** | **RNA** |
| DNA stand for deoxyribonucleic acid | RNA stand for ribonucleic acid |
| Chiefly found inside the nucleus | Found in cytoplasm |
| Double standard | Single standard |
| The sugar is deoxyribose | The sugar is ribose |
| Four nitrogenous base : A, G , T, C | Four nitrogenous base: A, G , C, U |

**QUESTION NO :- 4**

**Ans) HMP pathway:-**

The pentose phosphate pathway ( also called the hexose monophosphate pathway) is a metabolic pathway parallel to glyoclysis.

**Dickens and Horecker's pathway:-**

HMP pathway is also called Dickens and Horecker's pathway . Because Dickens and Horecker's is the name of scientist who discovers this pathway.

* HMP pathway generate NADPH and pentose (5 carbon sugar ) a precursor for the synthesis of nucleotides.

**Phases of HMP pathway:-**

* There are two distinct phases in the pathway
* The first is the oxidative phase which is irreversible
* Second is non- oxidative phase which is reversible
* In the first phase NADPH is generated
* While in the second phase synthesis 9f pentose sugar occur

**Occurrence :-**

HMP pathway mainly occur in cytoplasm of cell

1. **Oxidative phase:-**

Mainly occur in liver , adipose tissue , testes, ovary , RBC’S and lactating memory gland

1. **Non – oxidative phase:-**

Mainly occur in all tissues as in this phase pentose sugar is formed which is used in DNA and RNA synthesis .

**Enzymes involved in oxidative phase:-**

* Glucose 6-phosphate dehydrogenase
* 6- phosphogluconolactone hydrolase / gluconolactonase
* Phosphogluconate dehydrogenase

**Enzymes involved in non-oxidative phase:-**

* Isomerase **or** epimerase enzyme
* Transketolase. TPP
* Transaldolase enzyme
* Transketolase. TPP

**QUESTION NO 05**

**Carnitine shuttle:-**

The carnitine shuttle represents a mechanism by which long chain fatty-acids, which are impermeable to the mitochondrial membranes, and transported into the mitochondrial matrix for the purpose beta oxidation and energy production.

**Function:-**

• It is responsible for transferring of long chain fatty acids across the barrier of the inner mitochondrial membrane to gain access to the enzyme of beta oxidation.

• In living cells carnitine is required for the transport of fatty acids from the cytosol into the mitochondria during the breakdown of lipids (fats) for the generation of metabolic energy.

• It is widely available is a nutritional supplement.

**Beta oxidation of lipids:-**

**Definition:-**

Beta oxidation is the catabolic process by which fatty acid molecules are broken down to generate acetyl Co-A.

**Use of NADH2 and FADH2:-**

Acetyl Co-A enters the citric acid cycle while NADH and FADH2 produced in beta oxidation process is used in electron transport chain.

**Occurrence:-**

Beta oxidation of fatty acid occur in mitochondria.

**Substrate:-**

Free fatty acids, H2O.

**Products:-**

One acetyl CoA, one NADH, and one FADH2 for every removal of a two-carbon group from the fatty acid chain.

**Stages involved in beta oxidation:-**

Three stages are involved in beta oxidation of fatty acid;

• Activation of fatty acid occurring in the cytoplasm

• Transport of fatty acid into mitochondria

• Beta oxidation in the mitochondrial matrix

**FINISHED [[1]](#endnote-1)**

1. [↑](#endnote-ref-1)