

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.

- i. Acyl CoA dehydrogenase
- ii. Adenosine deaminase
- iii. Nucleotidase
- iv. Gluconolactonase
- v. 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.

(ANSWERS)

Answer # 1: Electron transport chain:

The electron transport chain is a series of protein complexes found in the inner membrane of the mitochondria. Electrons are passed from one membrane of the transport chain to another in a series of redox reactions.

ATP SYNTHESIS:

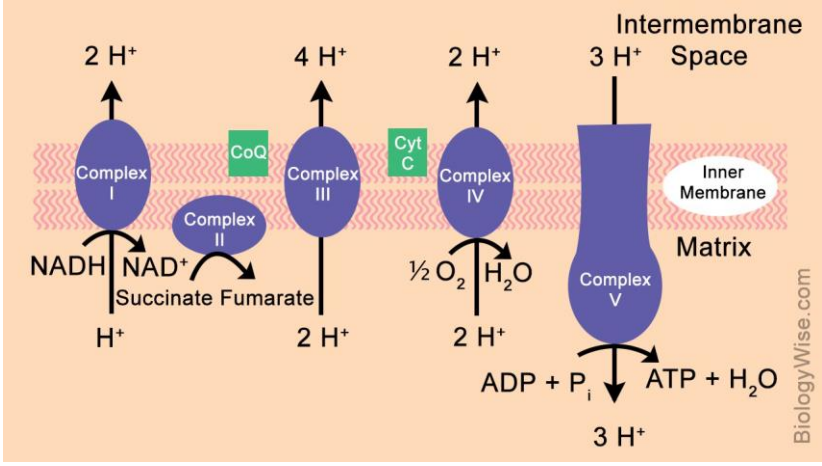
ATP synthesis moves H^+ ions that were pumped out of the matrix by the electron transport chain back into the matrix. The energy from the matrix is used to generate ATP by the phosphorylation (addition of phosphate) of ADP. The movement of ions across the selectively semipermeable mitochondrial membrane and down their gradient is called chemiosmosis.

Chemiosmosis:

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

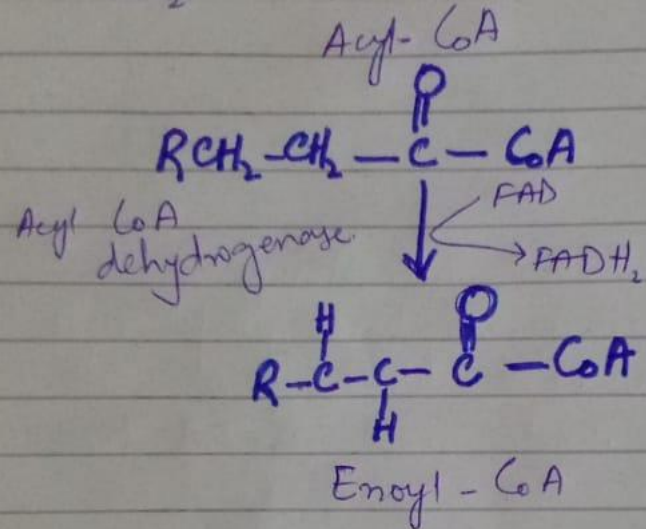
Oxidative phosphorylation:

Oxidative phosphorylation is made up of two closely connected processes: the electron transport chain and chemiosmosis. So both processes of electron transportation and ATP synthesis occur at the same time.



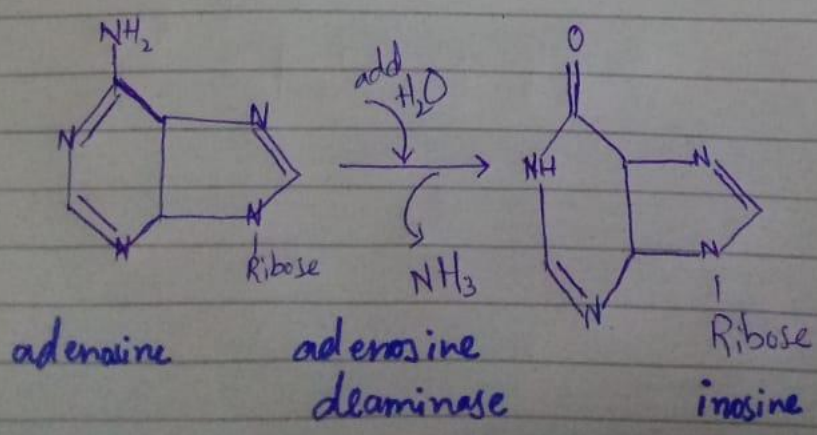
Answer #2:

i) Acyl CoA Dehydrogenase: Forms a double bond between the alpha & beta carbon atoms in the fatty chain. Produces one $FADH_2$.



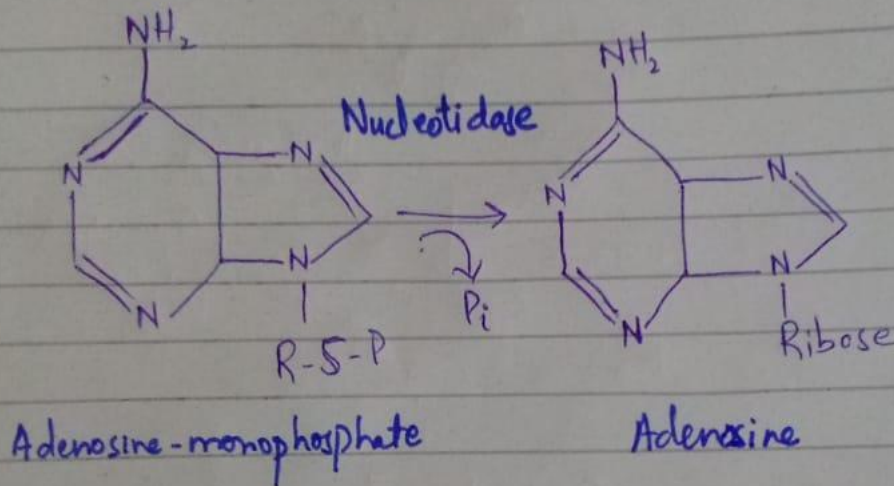
ii) Adenosine Deaminase:

Adenosine is converted into Inosine with the liberation of NH_3 (Ammonia) in the presence of adenosine deaminase enzyme.



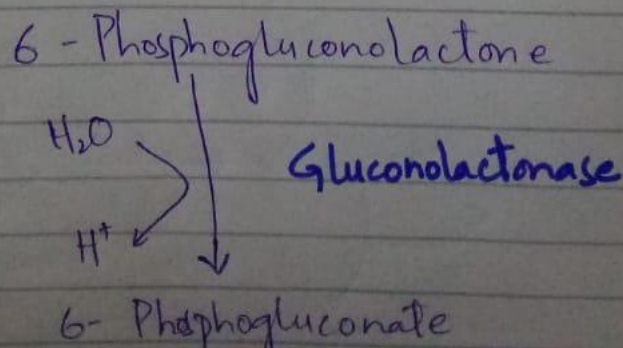
iii) Nucleotidase:

In the presence of nucleotidase enzyme Adenosine monophosphate is converted into Adenosine and inorganic phosphate.



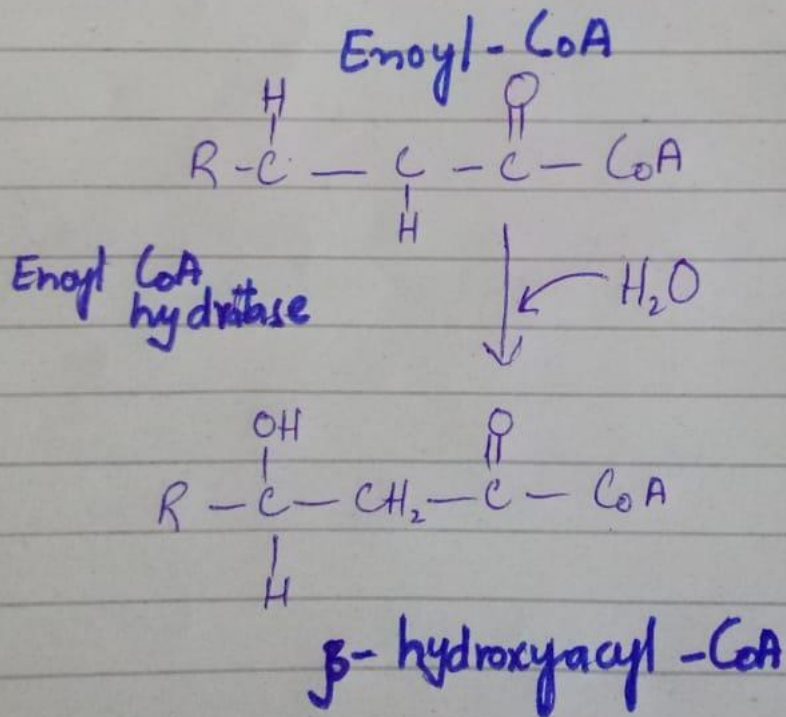
iv) Gluconolactonase:

6-Phosphogluconolactone is converted into 6-Phosphogluconate in the presence of an enzyme known as 6-Phosphogluconolactone hydrolase / gluconolactonase.



v) Enoyl-CoA hydratase:

Incorporates a water molecules into the fatty acid chain, thereby breaking the double bond between the alpha and Beta Carbon atoms.



Answer # 3:

NUCLEOTIDE:

The nucleotide is made up of three parts, a phosphate group, a 5-carbon sugar , and a nitrogenous base.

Two types of nitrogenous base

- I. **Purines:** examples; adenine and guanine
- II. **Pyrimidines:** examples; cytosine, thymine and uracil.

NUCLEOSIDE:

It is a nitrogenous base with sugar

Example; Adenine + sugar = Adenosine

Guanine + sugar = Guanosine

DNA:

- DNA stands for deoxyribonucleic acid
- Found inside the nucleus
- It is double stranded
- The sugar is deoxyribose
- Have four nitrogenous bases (adenine, guanine, thymine and cytosine)

RNA:

- RNA stands for ribonucleic acid
- Found in cytoplasm
- It is single stranded
- The sugar is ribose
- Have four nitrogenous bases (adenine, guanine, cytosine and uracil)

Answer # 4:

HMP Pathway:

The pentose phosphate pathway also called hexose monophosphate pathway is a metabolic pathway parallel to glycolysis. This pathway is also called **Dickens and horecker's** pathway.

Two phases in this pathway; first one is oxidative phase, which is irreversible and **NADPH** is generated in this phase. Second one is non-oxidative phase, which is reversible and synthesis of **pentose sugar** occur in this phase.

Enzymes involved in oxidative phase:

- Glucose-6-phosphate dehydrogenase (G6PDH)
- 6-phosphogluconolactone hydrolase (PGLS)/Gluconolactonase
- 6-phosphogluconate dehydrogenase (PGD)

Enzymes involved in non-oxidative phase:

- Ribulose-5-phosphate 3-epimerase **OR** ribulose-5-phosphate isomerase
- Transketoase
- Transaldolase
- Again transketolase

Answer # 5:

Function of carnitine shuttle system:

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

Beta-oxidation:

It is referred as “beta oxidation” because the beta carbon of the fatty acid undergoes oxidation.

Occurrence: in mitochondria

Substrates: fatty acid and 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

1. Activation of fatty acids occurring in the cytoplasm
2. Transport of fatty acyl-CoA from cytoplasm to mitochondria
3. Beta-oxidation of activated fatty acids in the mitochondrial matrix

Beta oxidation (in which all reactions involve the beta-carbon of a fatty acyl-CoA) will occur in four steps. These steps are repeated until all the carbons of fatty acyl-CoA are converted to acetyl-CoA. These **steps** are

- i. Dehydrogenation
- ii. Hydration
- iii. Dehydrogenation
- iv. Cleavage

Fatty acid beta oxidation is the major process by which fatty acids are oxidized, by sequential removal of two-carbon units from the acyl chain, providing a major source of ATP.

THE END

