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Section **A**

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Paper **biochemistry**

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Q 1.

Ans.

Dickens shunt - a secondary pathway for the oxidation of d-glucose (not occurring in skeletal muscle), generating reducing power in the cytoplasm outside the mitochondria and synthesizing pentoses and a few other sugars. Synonym(s): pentose phosphate pathway; Warburg-Lipmann-Dickens-Horecker shunt.

The HMP shunt is parallel to the glycolysis pathway and takes place in the cytoplasm. A 6-carbon sugar, glucose, may enter the glycolytic pathway or enter the alternative HMP shunt depending on the cell's individual needs at the time. Once the glucose enters the HMP shunt, it undergoes a series of reactions, broken down into the oxidative(irreversible) and non-oxidative phases (reversible). The oxidative phase is responsible for converting the intermediate glucose-6-phosphate to 6-phosphogluconate, using the glucose-6-phosphate dehydrogenase (G6PD) enzyme. The by-product of this reaction is the important molecule NADPH. 6-phosphogluconate then converts into ribulose-5-phosphate, and NADPH gets produced again as a by-produc

The non-oxidative phase : the HMP shunt involves the conversion of ribulose-5-phosphate to ribose-5-phosphate (R-5-P) through a series of independent reactions. It is important to note that no NADPH molecules get created in this part of the HMP shunt. R-5-P in this reaction can be returned to the glycolytic pathway as fructose-6-phosphate. This step requires the transketolase enzyme with the presence of the thiamine co-factor. Thiamine also participates in a plethora of other metabolic reactions throughout the body. It is used by enzyme alpha-ketoglutarate in the Krebs cycle, for the enzyme pyruvate dehydrogenase as well as branch-chained ketoacid dehydrogenase.[3]

The HMP shunt pathway is under the regulation of the demands of NADPH in the respective tissue. The rate-limiting enzyme is G6PD and has allosteric inhibition directed by the presence of NADPH and allosteric activation via the presence of NADP+. Consequently, the activity of G6PD activity also increases in a fed state with a high carbohydrate diet, and conversely, decreases in a starving or

Q 2.

Ans.

Enzyme involved in glycolysis.

Step 1: Hexokinase

Step 2: Phosphoglucose Isomerase

Step 3: Phosphofructokinase

Step 4: Aldolase

Step 5: Triose phosphate isomerase

Step 6: Glyceraldehyde-3-phosphate Dehydrogenase

Step 7: Phosphoglycerate Kinase

Step 8: Phosphoglycerate Mutase

Step 9: Enolase

Step 10: Ryruvate Kinase

Step 1: Hexokinase : The first step in glycolysis is the conversion of glucose into glucose-6- phosphate. The enzyme that catalyses this reaction is hexokinase.

Step 2: **Phosphoglucose Isomerase:** The second reaction of glycolysis is the rearrangement of glucose 6-phosphate (G6P) fructose 6-phosphate (F6P) by glucose phosphate isomerase (Phosphoglucose Isomerase)

Step 3: **Phosphofructokinase:** Phosphofructokinase, with magnesium as a cofactor, changes fructose 6-phosphate into fructo bisphosphate.

Step 4: **Aldolase:**The enzyme Aldolase splits fructose 1, 6-bisphosphate into two sugars that are isomers of each other These two sugars age dihydroxyacetone phosphate (DHAP) and glyceraldehyde 3-phosphate (GAP)

Step 5: **Triose phosphate isomerase:** The enzyme triose phosphate isomerase rapidly inter- converts the toolecules dihydroxyacetone phosphate (DHAP) and glyceraldehyde 3-phosphate (GAP), Glyceraldehyde phosphate is removed / used in next step of Glycolysis.

Step 6: **Glyceraldehyde-3-phosphate Dehydrogenase:** Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) dehydrogenates and adds an inorganic phosphate to glyceraldehyde 3-phosphate, producing 1.3-bisphosphoglycerate.

Step 7: **Phosphoglycerate Kinase:** Phosphoglycerate kinase transfers a phosphate group from 1,3-bisphosphoglycerate to ADP to form ATP and 3-phosphoglycerate.

Step 8: **Phosphoglycerate Mutase:** The enzyme phosphoglycerate mutase relocates the P from 3-phosphoglycerate from the 3rd carbon to the 2nd carbon to form 2-phosphoglycerate.

Step 9: **Enolase:** The enzyme enolase removes a molecule of water from 2-phosphoglycerate to form phospho enol ruguvie acid (PEP).

Step 10: **Pyruvate Kinase:** The enzyme pyruvate kinase transfers a P from phosphoenolpyruvate (PEP) to ADP to form pyruvic acid and ATP

Q 3.

Ans. DIGESTION AND ABSORPTION OF CARBOHYDRATES. The digestion of carbohydrates begins in the mouth. The salivary enzyme amylase begins the breakdown of food starches into maltose, a disaccharide. As the food travels through the esophagus to the stomach, no significant digestion of carbohydrates takes place. The esoophagus produces by digestive enzymes but does produce mucous for lubrication. The acidic environment in the stomach stops the action of the amylase enzyme. The next step of carbohydrate digestion takes place in the duodenum. The food from the stomach enters the duodenum and mixes with the digestive secretion from the pancreas, liver, and gallbladder. Pancreatie juices also contain amylase, which continues the breakdown of starch and glycogen into maltose, a disaccharide. ... The disaccharides are broken down into monosaccharides by enzymes called maltases, sucrases, and lactases, which are present in the small intestinal wall. ... Matase breaks down maltose into glucose. Other disaccharides, such as sucrose and lactose are broken down by succrase and lactase, respectively. Sucrase breaks down sucrose (or "table sugar") into glucose and fructose, and lactase breaks down lactose into glucose and galactose. ... The monosaccharides (glucose) thus produced are absorbed and then can be used in metabolic pathways to produce energy. The monosaccharides are transported into the bloodstream to be transported to the different cells in the body.

Q 4.

Ans. Q4 **Step 1**: **Condensation of acetyl CoA with oxaloacetate**

first step of the citric acid cycle is the joining of the four-carbon compound oxaloacetate (OAA) and a two-carbon compound acetyl CoA.

The oxaloacetate reacts with the acetyl group of the acetyl CoA and water, resulting in the formation of a six-carbon compound citric acid, CoA.

Step 2: **Isomerization of citrate into isocitrate**

Now, for further metabolism, citrate is converted into isocitrate through the formation of intermediate cis-aconitase.

This reaction is a reversible reaction catalyzed by the enzyme (aconitase).

This reaction takes place by a two-step process where the first step involves dehydration of citrate to cis-aconitase, followed by the second step involving rehydration of cis-aconitase into isocitrate.

Step 3: **Oxidative decarboxylations of isocitrate**

The third step of the citric acid cycle is the first of the four oxidation-reduction reactions in this cycle.

Isocitrate is oxidatively decarboxylated to form a five-carbon compound, α-ketoglutarate catalyzed by the enzyme isocitrate dehydrogenase.

This reaction, like the second reaction, is a two-step reaction.

In the first step, isocitrate is dehydrogenated to oxalosuccinate while the second step involves the decarboxylation of oxalosuccinate to α-ketoglutarate.

Step 4: **Oxidative decarboxylation of α-ketoglutarate**

This step is another one of the oxidation-reduction reactions where α-ketoglutarate is oxidatively decarboxylated to form a four-carbon compound, succinyl-CoA, and CO2.

The reaction irreversible and catalyzed by the enzyme complex α-ketoglutarate dehydrogenase found in the mitochondrial space.

Step 5: **Conversion of succinyl-CoA into succinate**

In the next step, succinyl-CoA undergoes an energy-conserving reaction in which succinyl-CoA is cleaved to form succinate.

This reaction is accompanied by phosphorylation of guanosine diphosphate (GDP) to guanosine triphosphate (GTP).

Step 6: **Dehydration of succinate to fumarate**

Here, the succinate formed from succinyl-CoA is dehydrogenated to fumarate catalyzed by the enzyme complex succinate dehydrogenase found in the intramitochondrial space.

This is the only dehydrogenation step in the citric acid cycle in which NAD+ doesn't participate.

Instead, another high-energy electron carrier, flavin adenine dinucleotide (FAD) acts as the hydrogen acceptor resulting in the formation of FADH2.

Step 7: **Hydration of fumarate to malate**

The fumarate is reversibly hydrated to form L-malate in the presence of the enzyme fumarate hydratase.

As it is a reversible reaction, the formation of L-malate involves hydration, whereas the formation of fumarate involves dehydration.

Step 8: **Dehydrogenation of L-malate to oxaloacetate**

The last step of the citric acid cycle is also an oxidation-reduction reaction where L-malate is dehydrogenated to oxaloacetate in the presence of L-malate dehydrogenase, which is present in the mitochondrial matrix.

This is a reversible reaction involving oxidation of L-malate and reduction of NAD+ into NADH.

Oxaloacetate thus formed, allows the repetition of the cycle and NADH formed participate and the oxidative phosphorylation

This reaction completes the cycle.

Q 5.

Ans. The main difference between Fats and Oils is that, fats are usually derived from animals, whereas oils are usually derived from plants. ... The other difference is fats tend to be solids at room temperature; on the other hand, oils tend to be liquid at room temperature.

Solid fats and oils provide the same number of calories per gram. However, oils are generally better for your health than solid fats because they contain less saturated fats and/or trans fats. Foods containing partially hydrogenated vegetable oils usually contain trans fats.

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