NCERT TEXTBOOK QUESTIONS FROM SOLVED

1. Give the schematic representation of an overall view of Krebs' cycle.
Solution:

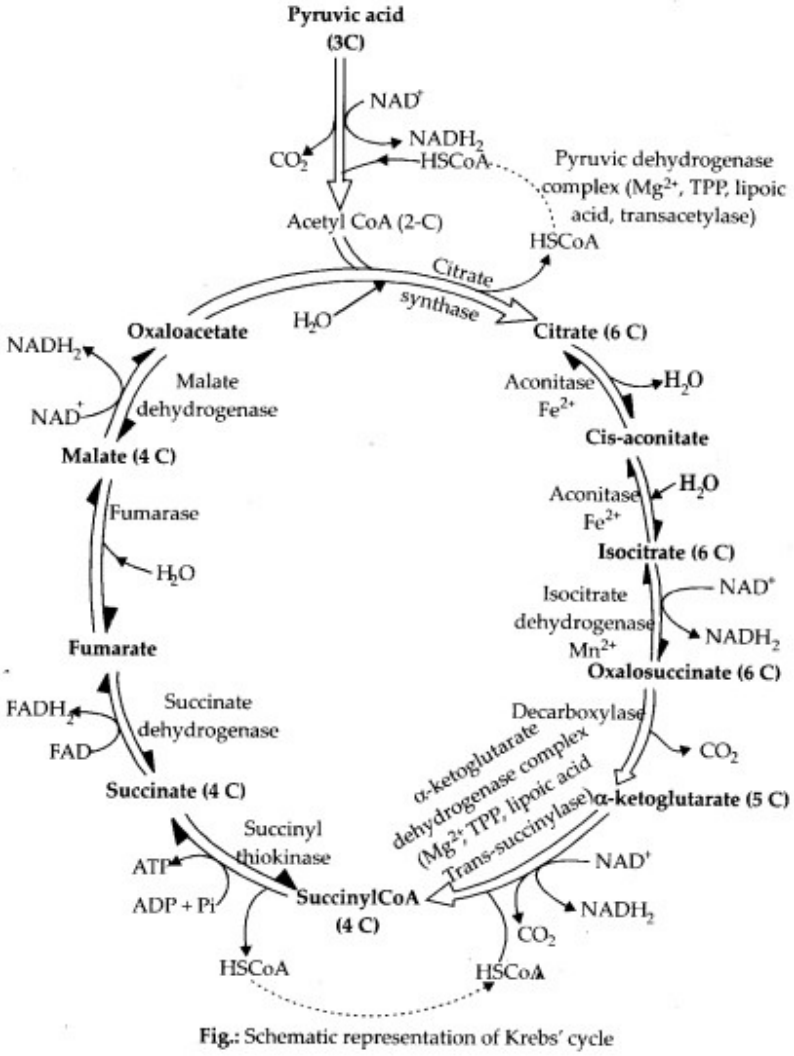


Fig.: Schematic representation of Krebs' cycle

2. Differentiate between
(a) Respiration and Combustion
(b) Glycolysis and Krebs' cycle
(c) Aerobic respiration and Fermentation
Solution:
(a) Differences between respiration and combustion are as follows :

	Respiration	Combustion
(i)	It occurs inside living cells.	It is a noncellular process.
(ii)	Respiration is a biochemical process.	Combustion is a physio-chemical process.
(iii)	Energy is released in stages as chemical bonds are broken in steps.	Energy is released in a single step as all chemical steps occur simultaneously.
(iv)	Most of the energy is trapped in ATP molecules.	ATP is not formed.
(v)	Oxidation occurs at the end of reaction (terminal oxidation) between reduced coenzymes and oxygen.	The substrate is directly oxidised in combustion.
(vi)	A number of intermediates are formed. They are used in the synthesis of different organic compounds	No intermediates are produced in combustion.
(vii)	A number of enzymes are required, one for each step or reaction.	Burning is a non-enzymatic process.
(viii)	Less than 50% energy is liberated in the form of heat energy. Light is rarely produced.	Energy is libreated in the form of both light and heat energy.
(ix)	Temperature is not allowed to rise.	Temperature becomes very high.

(b) Differences between glycolysis and Krebs' cycle are as follows:

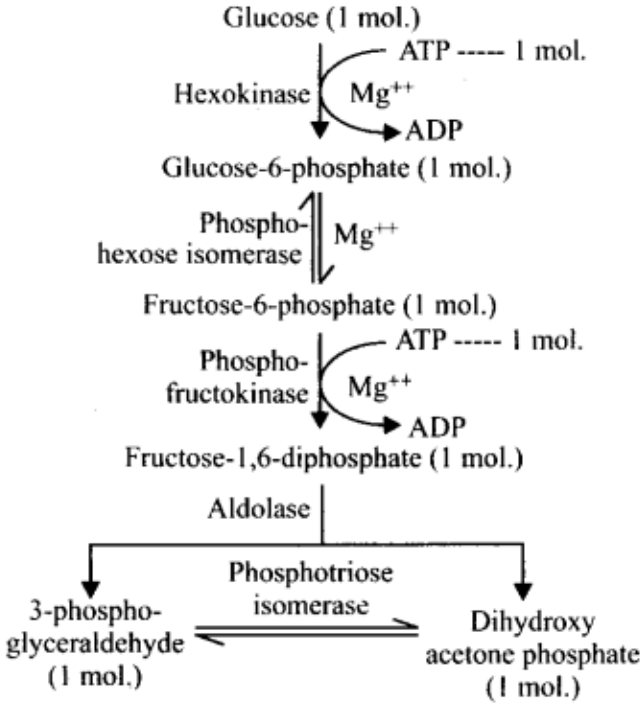
	Glycolysis	Krebs' cycle
(i)	It occurs inside the cytoplasm.	Krebs' cycle operates inside mitochondria.
(ii)	Glycolysis is the first step of respiration in which glucose is broken down to the level of pyruvate.	Krebs' cycle is the second step in respiration where an active acetyl group is broken down completely.
(iii)	The process is common to both aerobic and anaerobic modes of respiration.	It occurs only in aerobic respiration.
(iv)	It degrades a molecule of glucose into two molecules of an organic substance, pyruvate.	It degrades pyruvate completely into inorganic substances ($CO_2 + H_2O$).
(v)	Glycolysis consumes 2 ATP molecules for the initial phosphorylation of substrate molecule.	It does not consume ATP.
(vi)	In glycolysis, one glucose molecule liberates 4 ATP molecules through substrate level phosphorylation.	In Krebs' cycle, two acetyl residues liberate two ATP or GTP molecules through substrate level phosphorylation.
(vii)	Net gain is two molecules of NADH and two molecules of ATP for every molecule of glucose broken down.	Krebs' cycle produces six molecules of NADH, and 2 molecules of $FADH_2$ for every two molecules of acetyl CoA oxidised by it. Two molecules of NADH are liberated during conversion of two pyruvates to acetyl CoA.
(viii)	The net gain of energy is equal to 8 ATP.	The net gain of energy is equal to 24 molecules of ATP. Six molecules of ATP can be produced from $2NADH_2$ formed during dehydrogenation of two pyruvates.
(ix)	No carbon dioxide is evolved in glycolysis.	Carbon dioxide is evolved in Krebs' cycle.
(x)	Oxygen is not required for glycolysis.	Krebs' cycle uses oxygen as terminal oxidant.

(C) Differences between aerobic respiration and fermentation are as follows:

	Aerobic respiration	Fermentation
(i)	It uses oxygen for breaking the respiratory material into simpler substances.	Oxygen is not used in the breakdown of respiratory substrate.
(ii)	Respiratory material is completely oxidised.	Respiratory material is incompletely broken.
(iii)	The end products are inorganic.	At least one of the end products is organic. Inorganic substances may or may not be produced.
(iv)	Aerobic respiration is the normal mode of respiration of plants and animals.	It is the normal mode of respiration in some parasitic worms and microorganisms. In others, anaerobic respiration is a stop-gap arrangement.
(v)	Aerobic respiration consists of three steps –glycolysis, Krebs' cycle and terminal oxidation.	Anaerobic respiration or fermentation consists of two steps – glycolysis and incomplete breakdown of pyruvic acid.
(vi)	Every carbon atom of the food is oxidised and a large quantity of carbon dioxide is evolved.	Less quantity of carbon dioxide is evolved.
(vii)	Water is formed.	Water is usually not formed.
(viii)	686 kcal of energy are produced per gm mole of glucose.	Only 39-59 kcal of energy are formed per gm mole of glucose.
(ix)	It continues indefinitely.	It cannot continue indefinitely (except in some micro-organisms) because of the accumulation of poisonous compounds and less availability of energy per gm mole of food broken.

3. What are respiratory substrates? Name the most common respiratory substrate.
Solution: Respiratory substrates are those organic substances which are oxidised during respiration to liberate energy inside the living cells. The common respiratory substrates are carbohydrates, proteins, fats and organic acids. The most common respiratory substrate is glucose. It is a hexose monosaccharide.

4. Give the schematic representation of glycolysis.
Solution:



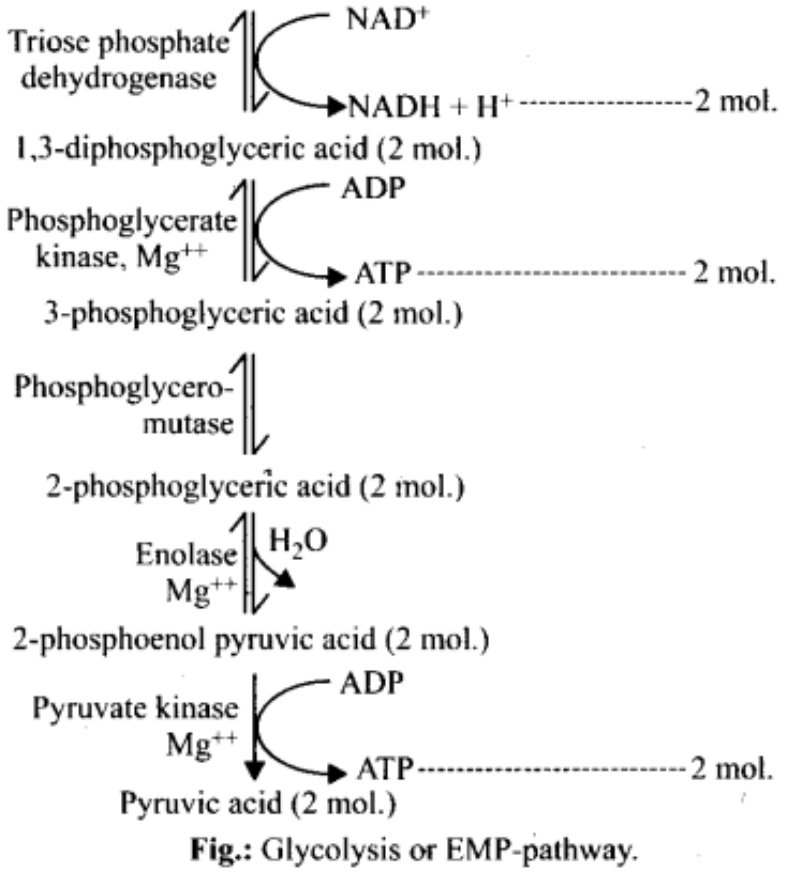


Fig.: Glycolysis or EMP-pathway.

5. Explain ETS.

Solution: An electron transport chain or system (ETS) is a series of coenzymes and cytochromes that take part in the passage of electrons from

a chemical to its ultimate acceptor. Reduced coenzymes participate in electron transport chain. Electron transport takes place on cristae of mitochondria [oxysomes (F_0 - F_1 , particles) found on the inner surface of the membrane of mitochondria]. NADH formed in glycolysis and citric acid cycle are oxidised by NADH dehydrogenase (complex I) and the electrons are transferred to ubiquinone. Ubiquinone also receives reducing equivalents via $FADH_2$ through the activity of succinate dehydrogenase (complex II). The reduced ubiquinone is then oxidised by transfer of electrons of cytochrome c via cytochrome Fc, complex (complex III). Cytochrome c acts as a mobile carrier between complex III and complex IV. Complex IV refers to cytochrome c oxidase complex containing cytochromes a and $a_3$and two copper centres. When the electrons are shunted over the carriers via complex I to IV in the electron transport chain, they are coupled to ATP synthetase (complex V) for the formation of ATP from ADP and Pi. Oxygen functions as the terminal acceptor of electrons and is reduced to water along with the hydrogen atoms. Reduced coenzymes (coenzyme I, II and FAD) do not combine directly with the molecular O_2. Only their hydrogen or electrons are transferred through various substances and finally reach O_2. The substances useful for the transfer of electron are called electron carriers. Only electrons are transferred through cytochromes (Cyt F_1 Cyt c, C_2, a, a_3) and finally reach molecular O_2. Both cytochrome a and a_3 form a system called cytochrome oxidase. Copper is also present in Cyt a_3 in addition to iron. The molecular oxygen that has accepted electrons now receives the protons that were liberated into the surrounding medium to give rise to a molecule of water. The liberated energy is utilised for the synthesis of ATP from ADP and Pi.

6. What are the main steps in aerobic respiration? Where does it

take place?
Solution: Aerobic respiration is an enzymatically controlled release of energy in a stepwise catabolic process of complete oxidation of organic food into carbon dioxide and water with oxygen acting as terminal oxidant. It occurs by two methods, common pathway and pentose phosphate pathway. Common pathway is known so because its first step, called glycolysis, is common to both aerobic and anaerobic modes of respiration. The common pathway of aerobic respiration consists of three steps - glycolysis, Krebs' cycle and terminal oxidation. Aerobic respiration takes place within mitochondria. The final product of glycolysis, pyruvate is transported from the cytoplasm into the mitochondria.

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