CHAPTER

12

RESPIRATION IN PLANTS

CLASS 11TH

NCERT EXERCISE AND SOLUTIONS - BIOLOGY

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Q. 1. Differentiate between

(a) Respiration and Combustion
(b) Glycolysis and Krebs' cycle
(c) Aerobic respiration and Fermentation

ANSWER:-

(a) Respiration and Combustion

Respiration	Combustion
It is a biochemical process.	It is a physicochemical process.
The temperature remains low.	The temperature increases significantly.
Takes place in living cells.	It is a non-cellular process.
Energy is stored as ATP.	ATP is not involved in the combustion process.

(b) Glycolysis and Krebs' cycle

Glycolysis	Krebs' cycle
The initial step in respiration.	The second step in respiration.
Occurs in the cytoplasm.	Occurs in the mitochondria.
Takes place both aerobically and anaerobically.	Occurs only aerobically.
Two ATPs are used.	No ATPs are used.
The net gain is 8 ATPs.	The net gain is 24 ATPs.
It is a linear pathway.	It is a cyclic pathway.

(c) Aerobic respiration and Fermentation

Aerobic respiration	Fermentation
Involves gas exchange.	Does not involve gas exchange.
Oxygen is required for the process.	Oxygen is absent during the process.
Respiratory substrates are fully oxidized.	Respiratory substrates are only partially oxidized.
The end products are inorganic.	At least one product is organic.

Q. 2. What are respiratory substrates? Name the most common respiratory substrate.

ANSWER:-

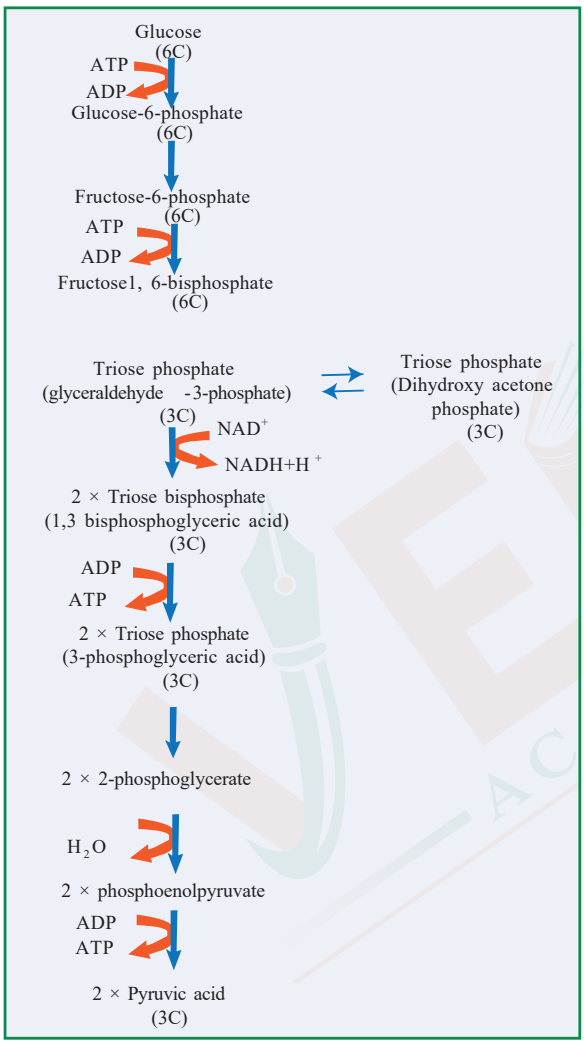
Respiratory substrates are organic compounds that are oxidized during respiration to release energy

within living cells. The most common respiratory substrates include carbohydrates, proteins, fats, and organic acids.

Q. 3. Give the schematic representation of glycolysis?

ANSWER:-

The schematic representation of glycolysis is as follows:



Q. 4. What are the main steps in aerobic respiration? Where does it take place?

ANSWER:-

The key stages of aerobic respiration are as follows:

- **Glycolysis:** This occurs in the cytoplasm (cytosol), where glucose is broken down into pyruvic acid.
- **Oxidative Decarboxylation:** Pyruvic acid is converted into acetyl coenzyme-A within the mitochondrial matrix.
- **TCA (Krebs Cycle):** This takes place in the mitochondrial matrix, where pyruvic acid is oxidized to release the energy stored in these molecules, which is used to produce ATP.

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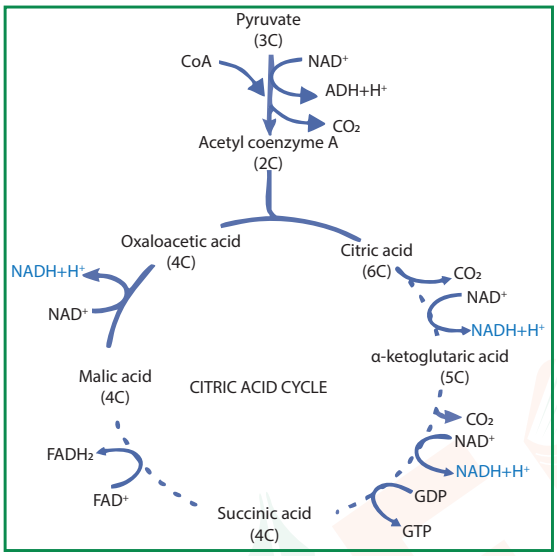
- **Electron Transport Chain:** Occurs in the mitochondrial membrane and involves the ATP synthase complex to generate ATP.

Q. 5. Give the schematic representation of an overall view of Krebs' cycle.

ANSWER:-

The schematic representation of an overall view of Krebs' cycle is as follows:



Q. 6. Explain ETS.

ANSWER:-

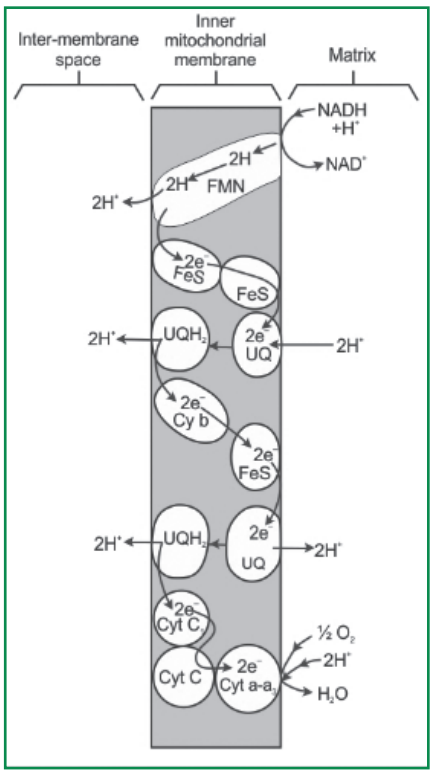
The electron transport system (ETS) is located in the inner mitochondrial membrane and plays a crucial role in releasing and utilizing the energy stored in NADH+H+ and $FADH_2$. NADH+H+, produced during the citric acid cycle and glycolysis, is oxidized by NADH dehydrogenase (Complex I).

The resulting electrons are transferred to ubiquinone via FMN. Similarly, $FADH_2$, generated during the citric acid cycle, is also passed to ubiquinone.

From ubiquinone, electrons are received by Complex III, or cytochrome bc1, which then transfers them to cytochrome c, a mobile carrier between Complex III and cytochrome c oxidase (Complex IV), which contains cytochrome a and a_3 with copper centres.

As electrons are transferred between complexes, additional processes occur, such as ATP production from ADP and inorganic phosphate, facilitated by ATP synthase (Complex V).

The amount of ATP generated depends on the molecule being oxidized. For every NADH molecule oxidized, 3 ATP molecules



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are produced, while the oxidation of one $FADH_2$ molecule yields 2 ATP molecules.

Q. 7. Distinguish between the following:

(a) Aerobic respiration and Anaerobic respiration
(b) Glycolysis and Fermentation
(c) Glycolysis and Citric acid Cycle

ANSWER:-

(a) Aerobic respiration and Anaerobic respiration

Aerobic respiration	Anaerobic respiration
Takes place in the presence of oxygen.	Occurs without the presence of oxygen.
Involves the complete breakdown of respiratory substances.	Involves the partial breakdown of respiratory substances.
The end products are carbon dioxide and water.	The end products are carbon dioxide and ethanol.
Requires the exchange of gases.	Does not involve the exchange of gases.

(b) Glycolysis and Fermentation

Glycolysis	Fermentation
It is the initial step in aerobic respiration and occurs in both aerobic and anaerobic respiration.	It is an anaerobic process that does not require oxygen.
It results in the production of pyruvic acid.	It produces lactic acid and ethanol.
It generates two molecules of NADH for each glucose molecule.	It utilizes NADH produced during glycolysis.
It produces two ATP molecules per glucose molecule.	It does not generate ATP.

(c) Glycolysis and Citric acid Cycle

Glycolysis	Citric acid Cycle
Takes place in the cytoplasm.	Takes place within the mitochondria.
Follows a linear pathway.	Follows a cyclic pathway.
Glucose is converted into pyruvate.	The acetyl group is fully broken down.
Yields a net gain of 8 ATP molecules.	Yields a net gain of 24 ATP molecules.

Q. 8. What are the assumptions made during the calculation of net gain of ATP?

ANSWER:-

The following assumptions are considered when calculating the net ATP gain:

- Each NADH produced within the mitochondria generates 3 ATP molecules during oxidation.
- NADH formed during glycolysis transfers its reducing power to the mitochondria via a shuttle system.
- The oxidation of $FADH_2$ produces 2 ATP molecules within the mitochondria.
- In the malate-aspartate shuttle (found in the heart, liver, and kidneys), 3 ATP molecules are

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formed, whereas the glycerol phosphate shuttle (present in muscles and nerve cells) yields 2 ATP molecules.

Q. 9. Discuss "The respiratory pathway is an amphibolic pathway."

ANSWER:-

Organic compounds like fats, carbohydrates, and proteins release energy when broken down in the respiratory pathway, a process categorized as catabolic. Alongside its catabolic role, the respiratory process also functions as an anabolic pathway, synthesizing various metabolic and secondary products. This dual functionality, involving both breakdown and synthesis, classifies the respiratory pathway as an amphibolic pathway.

Q. 10. Define RQ. What is its value for fats?

ANSWER:-

The respiratory quotient (RQ), also known as the respiratory ratio, is defined as the ratio of the volume of carbon dioxide (CO_2) evolved to the volume of oxygen (O_2) consumed during respiration.

$$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of Oxygen consumed}}$$

When the respiratory substrate is fat or protein, the RQ is less than 1.

$$2(C_{11}H_{98}O_6)+145\ O_2 \longrightarrow 102CO_2+98H_2O+\text{energy}$$

$$\text{RQ of fat} = \frac{102\ CO_2}{145\ O_2} = 0.7$$

Q. 11. What is oxidative phosphorylation?

ANSWER:-

Oxidative phosphorylation refers to the process of converting ADP into ATP through the electron transport system. This phosphorylation occurs in the inner mitochondrial membrane via the ATP synthase complex when hydrogen protons pass through it. The energy required for phosphorylation is obtained from oxidation-reduction reactions during respiration, making this process known as oxidative phosphorylation.

Q. 12. What is the significance of step-wise release of energy in respiration?

ANSWER:-

During respiration, a single glucose molecule is broken down into carbon dioxide and water, accompanied by the production of ATP molecules. If the energy were released all at once, a significant portion would be lost as heat. To enable the synthesis of new compounds, the cell must efficiently utilize this energy. Therefore, the stepwise release of energy during respiration ensures optimal energy conservation.

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