IMPORTANT QUESTIONS CLASS – 11 BIOLOGY CHAPTER -12 RESPIRATION IN PLANTS

Question 1.
Why does anaerobic respiration produce less energy than aerobic respiration?

Answer:
Because it does not involve the use of molecular oxygen. Food is not completely oxidized to CO_2 and waste. So a lot of energy is still retained with the food. Less energy is produced on anaerobic respiration. It yields only about 5% of the energy available in glucose. Then it is a wasteful process or respiration. In anaerobic respiration, yeast metabolizes glucose to ethanol and CO_2 without any use of molecular oxygen.

Question 2.
Explain the effects of temperature on the rate of respiration.

Answer:
Respiration is reduced at very high (above 50°c) and very low (near freezing temp.) temperatures. This is because enzymes can work best between 30°c – 40°c and get inactivated at very high and very' low tempera¬tures.

Question 3.
How does the exchange of respiratory gases occur in plants?

Answer:
The gaseous exchange takes place through

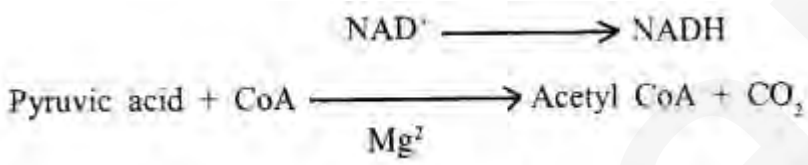
1. General body surface
2. Lenticels.
3. Stomata present in leaves and young stems. Oxygen becomes transported from cell to cell by diffusion.

Question 17.
Explain RQ significance.
Answer:
RQ value for carbohydrates is 1. It is less than one if proteins are being burnt and more than one if fats are being burnt. So RQ values are important in identifying the kind of substrate used in respiration.

Question 4.
Describe in detail the aerobic oxidation of pyruvic acid.

Answer:
Pyruvic acid generated in the crystal is transported to mitochondria and initiates the second phase of respiration. Before pyruvic acid enters the Kreb's cycle, one of its three carbon atoms is oxidized to carbon dioxide in the reaction called oxidative decarboxylation.

Pyruvate is first decarboxylated and then oxidized by the enzyme pyruvate dehydrogenase. The combination of the remaining two-carbon acetate unit is readily accepted by a sulfur-containing compound coenzyme A to form acetyl COA. During the process, NAD is reduced to NADH. This process is represented as.



During this process, two molecules of NADH are produced, and thus, it results in a net gain of 6ATP molecules.

(2 NADH + 3 = 6 ATP). 2 molecules of pyruvic acid produced during glycolysis,

Question 5.
Describe the net gain of ATP during respiration.

Answer:
There is a gain of 36 ATP molecules during aerobic respiration of one molecule of glucose. The detail is given in the table.

In most eukaryotic cells, 2 molecules of ATP are required for transporting the NADH produced in glycolysis into mitochondrial for further oxidation. Hence, the net gain of ATP is 36 molecules.

Table ATP molecules produced during respiration.

Stage of Respiration	Source	Number of ATP molecules produced
Glycolysis	Direct	2
	2-molecules of NADH (One molecule of NADH field 3 molecules of ATP)	6
Pyruvic acid to acetyl CoA citric acid cycle	2 molecules of NADP	6
	6NADH	18
	2FADH (FADH produces only 2 molecules of ATP)	4
Total field of ATP Molecules	Direct	2
		38

Question 6.
Define the following:

(a) Respiration
Answer:
Respiration: It is defined as the phenomenon of the release of energy by oxidation of various organic molecules, for cellular use is known as respiration.

(b) Respiratory substrate
Answer:
Respiratory substrate: The compounds that are oxidized during the process of respiration are called respiratory substrates.

(c) Respiratory quotient
Answer:
Respiratory quotient: During respiration oxygen is used and CO_2 is released. The ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration is called respiratory quotient (RQ).

(d) Anaerobic respiration
Answer:
Anaerobic respiration: The type of respiration, in which the carbohydrate is incompletely oxidized into some carbonic compounds in absence of oxygen, is called Anaerobic respiration.

(e) Aerobic respiration

Answer:

Aerobic respiration: It is that process of respiration which leads to complete oxidation of organic compound in the presence of oxygen.

This type of respiration is common in higher organisms.

(f) Fermentation.

Answer:

Fermentation: In anaerobic respiration yeasts metabolize glucose to ethanol and CO_2 without any use of molecular oxygen. This process is called fermentation in yeasts.

Question 7.

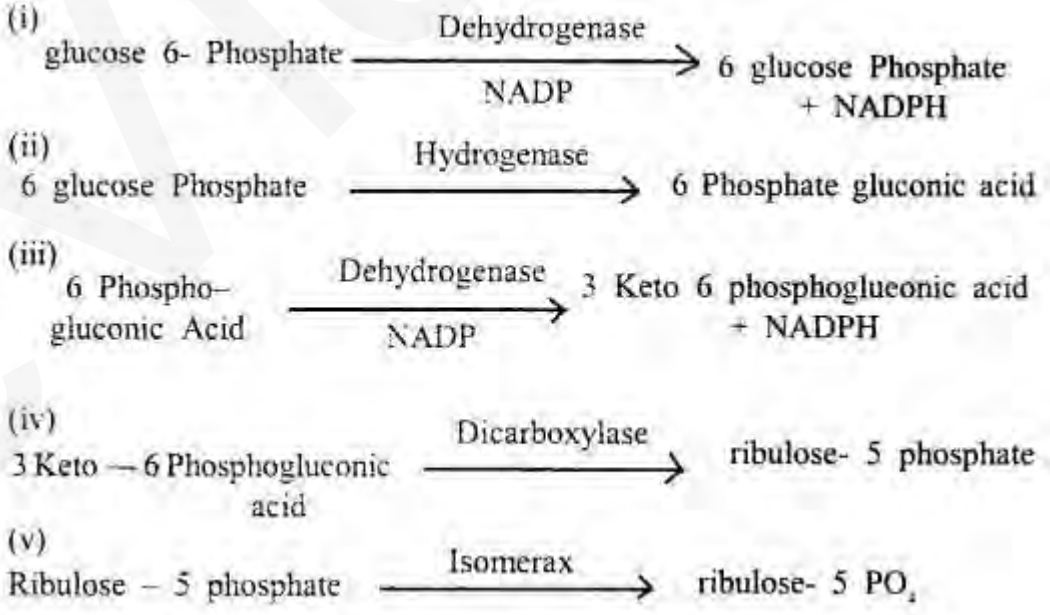
Describe the pentose phosphate pathway.

Answer:

Sometimes oxidation of glucose takes place by another pathway, which is called the pentose phosphate pathway (PPP). In the pentose pathway, glucose-6 phosphate (6C) produced during the early stages of glycolysis or the photosynthates produced during photosynthesis are oxidized to give rise to 6-phosphogluconate. This reaction takes place in the enzyme glucose 6phosphale dehydrogenase and generates NAD PH.

The 6-phosphoglucose molecules are further oxidized by the enzyme 6-phosphogluconate dehydrogenase. As a result of this, one molecule of each ribose-5 phosphate, carbon dioxide, and NADPH is produced, which in turn undergoes many changes to produce glycolytic intermediate. These reactions take place in the cytoplasm.

(From glycolysis)



Question 8.
Calculate the efficiency of respiration in the living system.

Answer:
During aerobic respiration, O_2 is consumed and CO_2 is released. The ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration is called respiratory quotient (RQ) or respiratory ratio.

$$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ consumed}}$$

The RQ (respiratory quotient) depends upon the respiratory substrate. When a carbohydrate is used as a substrate.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{Energy}$$

$$RQ = \frac{6CO_2}{6O_2} = 1.0$$

$C_6H_{12}O_6 – 2C_2H_5OH + 2CO + \text{Energy (247 K.J)}$ on complete oxidation. RQ will be

The total energy yield from 38 ATP molecules comes to 1298 kJ. The energy released by one molecule of glucose on complete oxidation is 2870 kJ. Thus, the efficiency is 45%. Much of the energy generated during respiration is released in the form of heat.

Question 9.
Illustrate the mechanism of the electron transport system.

Answer:
The glucose molecule is completely oxidized by the end of the citric acid cycle. But the energy is not released unless NADH and FADH are oxidized through the electron transport system. Here oxidation means the removal of electrons from it.

The metabolic pathway through which the electron passes from one carrier to another is called the electron transport system (ETS) and it is operative in the inner mitochondrial membrane. Electrons from NADH produced in the mitochondrial matrix are oxidized by an NADH dehydrogenase (Complex I) and electrons are then transferred to ubiquinone.

The ubiquinone located within the inner membrane also receives reducing equivalents via FADH, which is generated during the oxidation of succinate, through the activity of the enzyme, succinate dehydrogenase (complex II). The reduced ubiquinone is then oxidized with the transfer of electrons to the cytochrome complex (Complex III).

Cytochrome is a small protein attached to the outer surface of the inner membrane and acts as a mobile carrier for the transfer of electrons between complex III and complex IV.

(Complex IV) is cytochrome.

When the electrons pass from one carrier to another via complex 1 to IV in the electron transfer chain, they are coupled to ATP synthase (Complex V) for the production of ATP from ADP and inorganic phosphate. Oxidation of one molecule of NADH gives rise to 3 molecules of ATP, while that of one molecule of FADH, produces 2 molecules of ATP.

The electrons are earned by the cytochromes and recombine with their protons before the final stage when the hydrogen atom is accepted by oxygen to form water. Oxygen acts as the final hydrogen acceptor. The whole process by which oxygen allows the production of ATP by phosphorylation of ADP is called oxidative phosphorylation.

Note: There are two routes by which hydrogen from the substrate molecule passes. In route 1.3 ATP molecules are formed for every pair of hydrogen atoms. In route 2, only 2ATP molecules are formed from one pair of hydrogen atoms.
Oxygen acts as the final hydrogen acceptor and forms water.
NAD = nicotinamide adenine dinucleotide.
MN = flavin mononucleotide,
FAD = flavin adenine dinucleotide.
ETC produces 32 ATP molecules per glucose molecule and is the major source of cell energy.

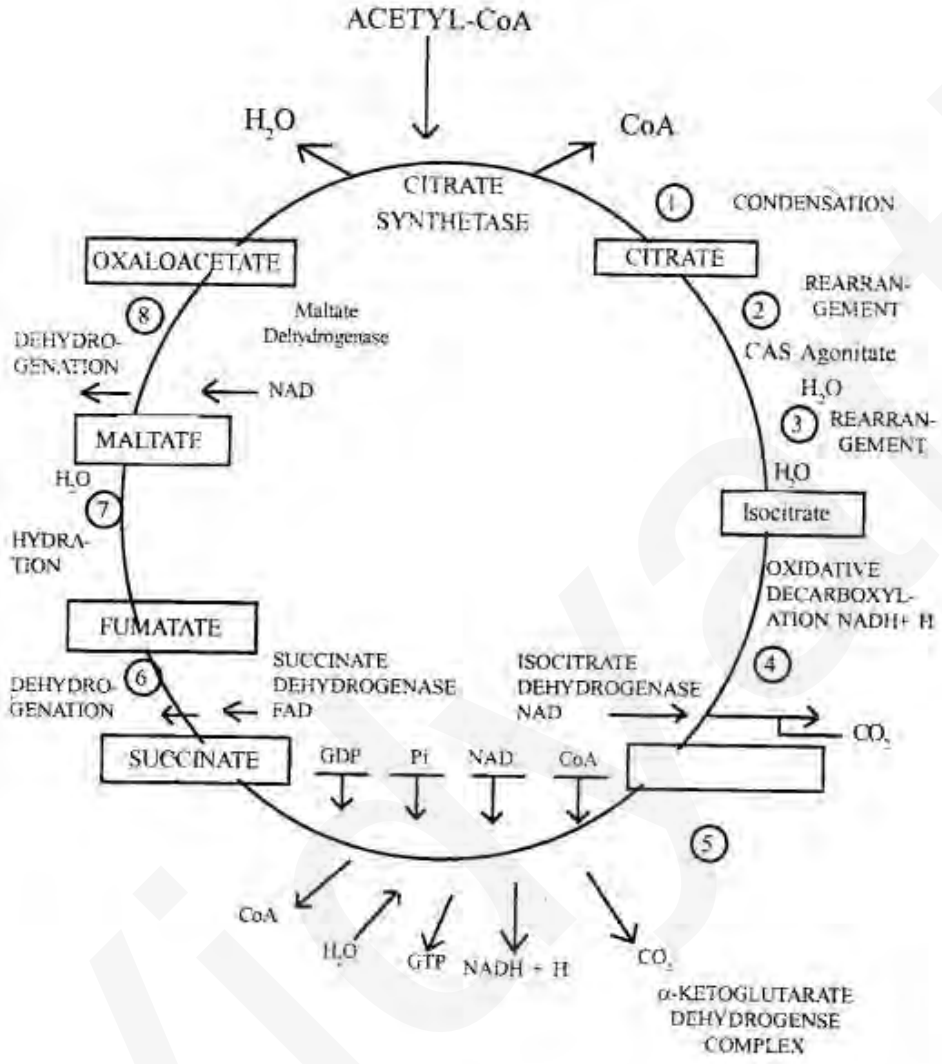
Electron Transport Chain.

Question 10.
Describe the process and role of the citric acid cycle in living organisms.

Answer:
In the process of respiration, the carbohydrates are converted into pyruvic acid through a series of enzymatic reactions. These reactions are known as glycolysis and take place in the cytosol. The pyruvic acid thus formed enters in mitochondria where O_2 and necessary enzymes are available; the pyruvic acid is finally converted into CO_2 and H_2O. This reaction series is known as Krebs Cycle or Citric acid cycle or Tricarboxylic acid (TCA) cycle.

During this cycle, 3 molecules of NAD and one molecule of FAD (Flavin Adenine Dinucleotide) are reduced to produce NADH and FADH respectively. NADH and FADH, so produced during the citric acid cycle are linked with the electron transport system and produce ATP by oxidative phosphorylation, The summary equation for this phase of respiration may therefore be written as follows:

$$\text{Pyruvic acid} + 4\,NAD^{+} + FAD + 2H_2O + ADP + Pi \xrightarrow[\text{Matrix}]{\text{Mitochondria}} 3CO_2 + 4NADH + 4H^{+} + FADH_2 + ATP$$



Kreb's cycle. It follows glycolytic reactions shown in and pyruvate oxidation.

It involves two processes

1. removal of hydrogen and
2. the breaking off of carbon dioxide units one by one.