NEET Important Questions with Solutions from Respiration in Plants

Q.1. In anaerobic respiration

A) Carbon dioxide is taken in.

B) Oxygen is taken in.

C) Oxygen is given out.

D) Carbon dioxide is given out.

Answer: Carbon dioxide is given out.

Solution: Anaerobic respiration is that respiration in which oxygen is not required as it does not serve as the final electron acceptor, while in aerobic respiration oxygen, is the final electron acceptor, which ultimately gets converted to water molecules. The cellular respiration process starts with glycolysis which takes place independent of oxygen. The end product of the glycolytic pathway, i.e., pyruvate, gets converted either into lactic acid or ethanol. If the ethanol is formed, it is called as fermentation. In both processes, carbon dioxide is released as a by-product. Anaerobic respiration occurs in the muscle cells during the period of hard exercise.

Q.2. Site of glycolysis in a prokaryotic cell is

A) mesosome

B) cytosol

C) cell membrane

D) nucleoid

Answer: cytosol

Solution: **Glycolysis/EMP pathway:**
(1) **Discovery:** It was given by Embden, Meyerhof, and Parnas in 1930. It is the first stage of the breakdown of glucose in the cell.
(2) **Definition:** Glycolysis (Gr. glycos= sweet/ sugar; lysis= breaking) is a stepped process by which one molecule of glucose (6C) breaks into two molecules of pyruvic acid (3C).
(3) **Site of occurrence:** Glycolysis takes place in the cytosol and does not utilise oxygen. Thus, it is an anaerobic pathway. In fact, it occurs in both aerobic and anaerobic respiration.

Steps of glycolysis: Glycolysis consists of 10 steps, divided into 2 phases, preparatory phase, and pay-off phase. Each step is catalyzed by a specific enzyme. Most of the reactions are reversible.
Preparatory phase: In this phase, 2 molecules of ATP are utilised.

Pay-off phase: In this phase, energy is released in the form of ATP, and $NADH_2$ is formed.

Q.3. Terminal oxidation of one molecule of NADH gives:

A) 3 ATP molecules

B) 12 ATP molecules

C) 2 ATP molecules

D) 1 ATP molecule

Answer: 3 ATP molecules

Solution: Electrons are transferred from NADH/$FADH_2$ to O_2 through a series of electron carriers present on the inner mitochondrial membrane (in eukaryotes).

The pathway through which the electron passes from one carrier to another is called the electron transport system (ETS). The process of electron transfer begins with a hydride ion removed from NADH and is converted into 2 electrons and a proton. Most of the electron carriers involved are grouped into 4 respiratory enzymes complexes. The final electron acceptor is oxygen.

When the electrons pass from complex I to IV in the electron transport chain, they are coupled to complex V i.e., ATP synthase for the production of ATP from ADP and inorganic phosphate.

Oxidation of one molecule of NADH gives 3 molecules of ATP and one molecule of $FADH_2$ produces 2 molecules of ATP.

Q.4. During oxidative phosphorylation, the net gain of ATP is

A) 48

B) 38

C) 34

D) 30

Answer: 34

Solution: 34 molecules of ATP (30 through NADH and 4 through $FADH_2$) are obtained as a result of oxidative phosphorylation.

Glycolysis yields 6 ATP, 6 ATP from link reaction and from Krebs cycle 22 ATP are generated through oxidative phosphorylation.

Rest 4 molecules are obtained as a result of direct phosphorylation.

Q.5. How many NADPH molecules are formed in a single turn of the Krebs cycle?

A) 4

B) Zero

C) 3

D) 8

Answer: Zero

Solution: 3 molecules of NADH2 and 1 molecule of FADH2 are formed by two turns in Kreb's cycle but by one turn, zero number of NADPH2 are formed. Krebs cycle is a second phase of aerobic respiration during which acetyl CoA condenses with OAA to form citrate which undergoes oxidative decarboxylation.

Q.6. The respiratory quotient during cellular respiration would depend on the

A) Nature of enzymes involved.

B) Nature of the substrate.

C) Amount of carbon dioxide released.

D) Amount of oxygen utilized.

Answer: Nature of the substrate.

Solution: RQ is the ratio of the volume of carbon dioxide released to the volume of oxygen taken in respiration. It depends on the nature of the substrate, which is oxidised. For carbohydrates RQ is one, for fats and proteins less than one but more than one for organic acids, etc.

Q.7. Chemiosmotic theory of ATP synthesis in the chloroplasts and mitochondria is based on?

A) Membrane potential

B) Accumulation of Na ions

C) Accumulation of K ions

D) Proton gradient

Answer: Proton gradient

Solution: Chemiosmotic theory was developed by Peter Michelle. It performs in both chloroplast and mitochondria. During electron transport system, ATP formation takes place by the Chemiosmotic hypothesis.

Chemiosmotic hypothesis works due to proton gradient because ATP synthesizing enzyme becomes active only in the influence of proton gradient.

In mitochondria, a proton gradient is generated in intermembrane space while in chloroplast proton gradient is generated inside the lumen of the thylakoid.

Q.8. The energy-releasing metabolic process in which substrate is oxidised without an external electron acceptor is called?

A) Glycolysis

B) Fermentation

C) Aerobic respiration

D) Photorespiration

Answer: Fermentation

Solution: The metabolic process which is responsible for energy production, without the need of the substrate to get oxidised by an external electron acceptor is known as fermentation. It is seen in anaerobic respiration.
Glycolysis, aerobic respiration, photorespiration are processes which require the substrate to get oxidised. They need an external electron acceptor to produce energy.

Q.9. Total number of ATP molecules formed (net gain) during the process of aerobic respiration is

A) 42

B) 14

C) 30

D) 38

Answer: 38

Solution: Aerobic respiration is the type of respiration which occurs in the presence of oxygen. The steps involved in aerobic respiration are glycolysis, Kreb's cycle and electron transfer chain reaction. The amount of energy which is produced by the complete oxidation of a single molecule of glucose in muscle cells and nerve cells is 36 molecules of ATP. It can be calculated as follows:
10 $NADH_2$ produce 30 ATP, 2 $FADH_2$ produce 4 ATP. 4 molecules of ATP are produced during the substrate-level phosphorylation which occurs during glycolysis. This leads to the production of total 38 molecules of ATP. Out of these, 2 ATP molecules are spent in transporting $NADH_2$ molecules to the mitochondria, which gives a net gain of 36 molecules of ATP.
In aerobic prokaryotic organisms and the cells of heart, liver and kidney, 38 molecules of ATP are produced from one molecule of glucose.

Q.10. In the TCA cycle, $FADH_2$ is formed during

A) conversion of succinyl Co-A to succinate.

B) conversion of citrate to cis-aconitate.

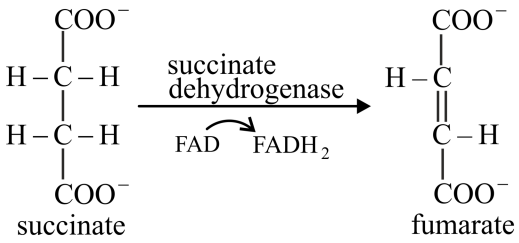
C) conversion of succinate to fumarate.

D) conversion of fumarate to malate.

Answer: conversion of succinate to fumarate.

Solution: In the citric acid cycle, $FADH_2$ is formed during the sixth step where dehydration results in the conversion of succinate to fumarate. In this step, two hydrogen atoms are transferred to FAD which produces $FADH_2$.

So, the correct answer is option 3.



Q.11. During which stage in the complete oxidation of glucose, highest number of ATP molecules are formed from ADP?

A) Glycolysis

B) Krebs cycle

C) Conversion of pyruvic acid to acetyl Co-A

D) Electron transport chain

Answer: Electron transport chain

Solution: The electron transport chain is a series of four protein complexes that couple redox reactions which creates an electrochemical gradient that leads to the creation of ATP in a complete system named oxidative phosphorylation. ATP molecules from ADP are generated maximum in the electron transport chain.

Q.12. Cytochromes are found in:

A) Matrix of mitochondria

B) Outer wall of mitochondria

C) Cristae of mitochondria

D) Lysosomes

Answer: Cristae of mitochondria

Solution: Cytochromes are the iron-containing electron acceptors, which are present on the inner mitochondrial membrane, called cristae, helpful in ETS. They are miniature biochemical factories where foodstuff is oxidised to CO_2 and H_2O.

Q.13. Which enzyme catalyzes the link reaction?

A) Pyruvate carboxylase

B) Malate dehydrogenase

C) Pyruvate dehydrogenase

D) Acetyl CoA dehydrogenase

Answer: Pyruvate dehydrogenase

Solution: The pyruvate molecule enters the mitochondrial matrix where it is converted to acetyl-CoA by a reaction known as oxidative decarboxylation in presence of oxidizing agent NAD^+. The enzyme responsible for this reaction is pyruvate dehydrogenase and the cofactor is Mg^{++}.

Q.14. Inner mitochondrial membrane possesses enzymes

A) ATPase, succinic dehydrogenase cytochrome oxidase.

B) Malate dehydrogenase, citrate synthetase

C) Diphosphokinase and cyclase

D) citrate synthetase

Answer: ATPase, succinic dehydrogenase cytochrome oxidase.

Solution: The main outcome of aerobic respiration is cellular energy or ATP. This process is divided into two main components, one occurring in the cytoplasm, called Glycolysis, and the other inside the mitochondria, called Kreb's cycle. The mitochondria are well equipped for the biochemical process.

The mitochondrion is a double-membraned cell organelle. In the inner membrane of the mitochondria respiratory chain enzymes are located ATP synthase, the enzyme is embedded, Succinate dehydrogenase is a part respiratory-complex II is present.

Q.15. In Kreb's cycle, the conversion of oxalosuccinate into $\alpha-$ ketoglutarate involves _____ reaction.

A) Oxidation

B) Reduction

C) Hydration

D) Decarboxylation

Answer: Decarboxylation

Solution: During Kreb's cycle, the oxalosuccinic acid loses a molecule of CO_2 (decarboxylation) and as a result, α-ketoglutaric acid (5-carbon compound) is produced (one carbon atom has been removed in the form of CO_2). In the presence of CoA, NAD+ and enzyme dehydrogenase, α-ketoglutaric acid is converted into Succinyl CoA (4-carbon) and one carbon is lost in the form of CO_2. NAD+ is reduced to NADH.

Q.16. Fermentation is

A) anaerobic respiration

B) aerobic oxidation of carbohydrate

C) complete oxidation of carbohydrate

D) none of the above

Answer: anaerobic respiration

Solution: Fermentation is a type of cellular respiration found in plants and some unicellular microorganisms, which does not require oxygen, i.e., anaerobic respiration, and that results in the production of ethanol from glucose and release of small amount of energy.

Q.17. During starvation, RQ value will be

A) O

B) less than unity

C) more than unity

D) unity

Answer: less than unity

Solution: The respiratory quotient (RQ) of respiration is the ratio of volume of carbon dioxide liberated during respiration to the volume of oxygen absorbed or consumed to evolve that amount of CO_2. Depending on the respiratory substrate, there are four possibilities of this RQ value, like

1. The RQ is 1, when glucose is respired.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$

$\frac{6CO_2}{6O_2} = 1$

2. The RQ is less than 1 and is nearly 0.71 when a triglyceralide is respired and is nearly 0.7 to 0.9 when protein is respired.

$C_{57}H_{104}O_2\left(Fat\right) + 80\ O_2 \rightarrow 57\ CO_2 + 52\ H_2O$

$\frac{57CO_2}{80O_2} = 0.71$

3. The RQ is more than 1 when some organic acid is respired.

$2C_2H_2O_4\left(Oxalic\ acid\right) + O_2 \rightarrow 4\ CO_2 + 2\ H_2O$

$\frac{4CO_2}{1O_2} = 4$

4. The RQ is infinity when anaerobic respiration is taking place.

During starvation, the carbohydrate is not available and thus fat and proteins are respired. This makes the RQ fall below 1.

Q.18. Which of the following shows the higher rate of respiration?

A) Collenchyma

B) Leaf

C) Dry seeds

D) Germinating seeds

Answer: Germinating seeds

Solution: The germinating seeds are the most active cells with a high rate of respiration and release a huge amount of carbon dioxide when compared to the plant that has already grown. A new plantlet requires more oxygen and energy during its initial growth.

Hence, during germination imbibition takes place, the rate of respiration will become very high and releases a very high amount of energy. Around 30 to 40% of energy is converted into ATP and utilised by the plant for its growth and the rest is evolved in the form of heat.

Q.19. Match the following and choose the correct option from those given below:

	Column I		Column II
A.	Molecular oxygen	I.	α -Ketoglutaric acid
B.	Electron acceptor	II.	Hydrogen acceptor
C.	Pyruvate dehydrogenase	III.	Cytochrome c
D.	Decarboxylation	IV.	Acetyl CoA

A) A-(ii), B-(iii),C-(iv),D-(i)

B) A-(iii), B-(iv),C-(ii),D-(i)

C) A-(ii), B-(i),C-(iii),D-(iv)

D) A-(iv), B-(iii),C-(i),D-(ii)

Answer: A-(ii), B-(iii),C-(iv),D-(i)

Solution: In ETC, oxygen is the final electron and hydrogen ion acceptor. They combine to form water. Cytochrome c is an electron acceptor, and is localized in between mitochondrial membranes. Pyruvate dehydrogenase enzyme helps in the formation of acetyl CoA from pyruvate. α- Ketoglutaric acid is an intermediate of the Krebs cycle. It gets converted into succinyl- CoA by loosing one CO_2 molecule. α-keto glutarate is formed as a result of decarboxylation of isocitrate.

Q.20. Final electron acceptor in ETS is-

A) H_2O

B) O_2

C) $cyt\ a_3$

D) $cyt\ a$

Answer: O_2

Solution: $NADH\ and\ FADH_2$ produced at the end of the Kreb's cycle undergo oxidation resulting in the release of electrons that are transferred through complexes involving cytochromes in the inner membrane of mitochondria and synthesising ATP in the process. The process ends when 2 electrons, two hydrogen ions and half O_2combine to form a water molecule. Hence, oxygen acts as a terminal electron acceptor.

Q.21. Which is the common pathway for both aerobic and anaerobic respiration?

A) EMP pathway

B) Kreb's cycle

C) HMP pathway

D) Oxidative phosphorylation

Answer: EMP pathway

Solution: The term glycolysis has originated from the Greek words 'glycos' for sugar and 'lysis' for splitting. The scheme of glycolysis was given by Gustav Embden, Otto Meyerhof, and J. Parnas and is often referred to as the EMP pathway. In anaerobic organisms, it is the only process in respiration. Glycolysis occurs in the cytoplasm of the cell and is present in all living organisms. In this process, glucose undergoes partial oxidation to form two molecules of pyruvic acid.

Q.22. Select the correct statements.
(i) Between temperature range $0-25^{\circ}\mathrm{C}$, rate of respiration doubles for every $10^{\circ}\mathrm{C}$ rise in temperature.
(ii) Cytochromes are iron-porphyrin compounds
(iii) Respiratory rate of wounded or injured plant parts generally decreases

A) (i) and (ii)

B) (ii) and (iii)

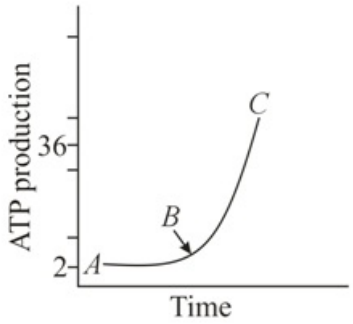
C) (i) and (iii)

D) (i), (ii) and (iii)

Answer: (i) and (ii)

Solution: Respiration is the metabolic process during which organic compounds, like glucose, break down into simpler substances and liberate carbon dioxide and ATP. The compounds like fats, proteins, carbohydrates, or organic acids are oxidized during the process. The rate of respiration increases with an increase in temperature from 0°C to 30°C. The respiration rate doubles for every 10°C rise in temperature, thus the temperature coefficient (Q10) for respiration is 2. At very high temperatures such as 50°C or more, the rate of respiration decreases due to enzymatic denaturation. So, at optimum temperature, the rate of respiration shows an initial increase for a short duration but later declines. Cytochromes are redox-active proteins containing a heme group, with a central Fe atom surrounded by a porphyrin ring. They are involved in the electron transport chain and redox catalysis, Wounding or injuring the plant increases the rate of respiration. It is probably due to the formation of growth hormone, traumatic acid, which increases the meristematic activity, resulting in callus formation.

Q.23. The graph below shows glucose utilization by animal cells under different growth conditions. What does the markings A, B and C indicates in the graph?



A) A - Anaerobic respiration

B - Introduction of O_2 to culture medium

C - Aerobic respiration

B) A - Aerobic respiration

B - Introduction of O_2 to culture medium

C - Anaerobic respiration

C) A - Anaerobic respiration

B - Supply of organic triphosphate

C - Aerobic respiration

D) A - Aerobic respiration

B - Introduction of CO to culture medium

C - Anaerobic respiration

Answer: A - Anaerobic respiration

B - Introduction of O_2 to culture medium

C - Aerobic respiration

Solution: A - Anaerobic respiration

B - Introduction of O_2 to culture medium

C - Aerobic respiration

Aerobic respiration is the process of producing cellular energy involving oxygen. Cells break down food in the mitochondria in a long, multistep process that produces roughly 36 ATP. Aerobic respiration is the process of breaking down the food that comes into a cell using oxygen to help power that process.

Q.24. Select the incorrect statement.

A) Outer membrane of mitochondria is permeable to monomers of carbohydrates, fats and proteins.

B) The outer limiting membrane of mitochondria maintains its permeability due to cation ion channels.

C) Inner membrane of mitochondria is convoluted with infoldings.

D) Mitochondria matrix contains single circular DNA molecule and ribosomes.

Answer: The outer limiting membrane of mitochondria maintains its permeability due to cation ion channels.

Solution: The outer membrane is the outer limiting membrane of the mitochondria. It is highly permeable to all low molecular weight solutes. The movement of these solutes is under the control of voltage-gated anion channels also called VDAC.

Q.25. What is the effect on the rate of respiration when the amount of CO_2 increases?

A) Respiration will increase

B) Unchanged

C) Respiration will decrease

D) Firstly increase and finally decrease

Answer: Respiration will decrease

Solution: Respiration involves breakdown of glucose molecule to form carbon dioxide and energy. Aerobic respiration occurs in the presence of oxygen whereas anaerobic respiration does not require the presence of oxygen. When carbon dioxide concentration is high, the rate of respiration decreases. The increase in carbon dioxide concentration and no oxygen presence has an adverse effect on the rate of aerobic respiration.

Practice more on Respiration in Plants