14 Respiration in Plants

Question: How many times decarboxylation occurs during each TCA cycle?

NEET 2023 Manipur

A Thrice

B Many

C Once

D Twice

Answer: D

Explanation
The tricarboxylic acid (TCA) cycle, also known as the citric acid cycle or Krebs cycle, involves the oxidative decarboxylation of malate to oxaloacetate and of isocitrate to alpha-ketoglutarate. However, the latter reaction is followed by another decarboxylation when alpha-ketoglutarate is converted to succinyl-CoA. So in total, there are two decarboxylation reactions per TCA cycle.

So, the correct answer is Option D : Twice.

Question: Fatty acids are connected with the respiratory pathway through :

A Acetyl CoA

B α-Ketoglutaric acid

C Dihydroxy acetone phosphate

D Pyruvic acid

Answer: A

Explanation

Yes, that's correct. Fatty acids are broken down through a process called beta-oxidation, which occurs in the mitochondria. During beta-oxidation, fatty acids are broken down two carbon atoms at a time, resulting in the formation of acetyl CoA. This acetyl CoA can then enter the Krebs cycle (also known as the citric acid cycle or TCA cycle) to be further oxidized, producing NADH and FADH2, which can be used in the electron transport chain to produce ATP, the cell's main form of energy.

Hence, fatty acids are connected with the respiratory pathway through Acetyl CoA. So, the correct answer is Option A : Acetyl CoA.

Question: Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A : ATP is used at two steps in glycolysis.

Reason R : First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1, 6-diphosphate.

In the light of the above statements, choose the correct answer from the options given below :

A Both A and R are true but R is NOT the correct explanation of A.

B A is true but R is false.

C A is false but R is true.

D Both A and R are true and R is the correct explanation of A.

Answer: D

Explanation

The process of glycolysis involves the breakdown of glucose into two molecules of pyruvate. This metabolic pathway is divided into two parts: the energy investment phase and the energy payoff phase.

In the energy investment phase, two molecules of ATP are indeed used. The first ATP is used to convert glucose into glucose-6-phosphate, and the second ATP is used to convert fructose-6-phosphate into fructose-1, 6-diphosphate. These steps are necessary to prepare the glucose molecule for the energy payoff phase, where ATP will be generated.

So, both Assertion A and Reason R are true, and Reason R correctly explains Assertion A.
Therefore, the answer is :

Option D : Both A and R are true and R is the correct explanation of A.

Question: Which of the following combinations is required for chemiosmosis?

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A Membrane, proton pump, proton gradient, NADP synthase

B Proton pump, electron gradient, ATP synthase

C Proton pump, electron gradient, NADP synthase

D Membrane, proton pump, proton gradient, ATP synthase

Answer: D

Explanation

Chemiosmosis is a process by which ATP (adenosine triphosphate) is produced in the cell. It relies on a concentration gradient of protons (H+ ions) across a membrane. The proton gradient is created by a proton pump. As protons flow back across the membrane, down their concentration gradient, they pass through a protein complex called ATP synthase, which uses the energy of the proton flow to produce ATP.

So, the correct answer is :

Option D : Membrane, proton pump, proton gradient, ATP synthase

Question: Match List I with List II:

	List I		List II
(A)	Oxidative decarboxylation	(I)	Citrate synthase
(B)	Glycolysis	(II)	Pyruvate dehydrogenase
(C)	Oxidative phosphorylation	(III)	Electron transport system
(D)	Tricarboxylic acid cycle	(IV)	EMP pathway

Choose the correct answer from the options given below :

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A – II, B – IV, C – I, D – III

B A – III, B – I, C – II, D – IV

C A – II, B – IV, C – III, D – I

D A – III, B – IV, C – II, D – I

Answer: C

Explanation

Pyruvate, which is formed by the glycolytic catabolism of carbohydrates in the cytosol, after it enters mitochondrial matrix undergoes oxidative decarboxylation by a complex set of reactions catalyzed by pyruvate dehydrogenase.

The scheme of glycolysis was given by Gustav Embden, Otto Meyrhof and J. Parnas, and is often referred to as the EMP pathway.

In electron transport system, the energy of oxidation-reduction is utilized for the production of proton gradient required for phosphorylation, thus, this process is also called oxidative phosphorylation.

The TCA (tricarboxylic acid cycle) starts with the condensation of acetyl group with oxaloacetic acid (OAA) and water to yield citric acid. The reaction is catalysed by the enzyme citrate synthase. Thus, option (C) is correct.

Question: Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of

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A Amylase

B Lipase

C Dinitrogenase

D Succinic dehydrogenase

Answer: D

Explanation

Melonate is a known inhibitor of the enzyme succinic dehydrogenase, which is involved in the citric acid cycle (also known as the Krebs cycle or TCA cycle), an essential metabolic pathway in many organisms, including bacteria.

By inhibiting succinic dehydrogenase, melonate can disrupt the normal metabolism of pathogenic bacteria and inhibit their growth.

So, the correct answer is :

Option D : Succinic dehydrogenase

2022

MCQ (Single Correct Answer)

Q.1. The number of time(s) decarboxylation of isocitrate occurs during single TCA cycle is

A Four

B One

C Two

D Three

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Ans. (C)

Explanation

During TCA cycle, 6-C compound isocitrate is converted into succinyl CoA, a 4-C compound by removing two CO_2 molecules.

The steps are as follows -

Q.2. What is the net gain of ATP when each molecule of glucose is converted to two molecules of pyruvic acid?

A Four

B Six

C Two

D Eight

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Ans. (C)

Explanation

During glycolysis, total 4 ATPs are produced from one glucose molecule with a net gain of 2 ATPs.

Q.3. What amount of energy is released from glucose during lactic acid fermentation?

A Approximately 15%

B More than 18%

C About 10%

D Less than 7%

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Ans. (D)

Explanation

Less than seven percent of the energy in glucose is released during lactic acid fermentation and not all of it is trapped as high energy bonds of ATP.

TOPIC 1
Glycolysis

01 Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalysed by **[NEET (National) 2019]**

(a) hexokinase
(b) enolase
(c) phosphofructokinase
(d) aldolase

Ans. *(a)*

Conversion of glucose to glucose-6-phosphate during glycolysis is catalysed by the enzyme hexokinase. During this step, glucose is phosphorylated to glucose-6-phosphate by ATP. It is the first step of activation phase of glycolysis.

02 Which of the following biomolecules is common to respiration-mediated breakdown of fats, carbohydrates and proteins? **[NEET 2016, Phase II]**

(a) Glucose-6-phosphate
(b) Fructose 1,6-bisphosphate
(c) Pyruvic acid
(d) Acetyl Co-A

Ans. *(d)*

Carbohydrates, fats and proteins, all can be used as a substrate in cellular respiration. All of them first get converted to acetyl Co-A to enter into Krebs' cycle of aerobic cellular respiration. Thus, it is the common factor of respiration entering Krebs' cycle after breakdown of carbohydrates, fats and proteins.

03 In glycolysis, during oxidation electrons are removed by **[CBSE AIPMT 2004]**

(a) ATP
(b) glyceraldehyde-3-phosphate
(c) NAD^+
(d) molecular oxygen

Ans. *(c)*

When 3-phosphoglyceraldehyde is converted into 1,3 diphosphoglyceric acid, two electrons and two protons are released which are utilised to convert NAD^+ to NADH and one H^+.

$NAD^+ + 2H^+ + 2e^- \rightarrow NADH + H^+$.

04 In animal cells, the first stage of glucose breakdown is **[CBSE AIPMT 1994]**

(a) Krebs' cycle
(b) glycolysis
(c) oxidative phosphorylation
(d) ETC

Ans. *(b)*

Glycolysis refers to the sequence of reactions by which glucose is degraded anaerobically into pyruvic acid inside cytoplasm. The net gain of molecules of ATP during glycolysis is 2.

05 End product of glycolysis is **[CBSE AIPMT 1990]**

(a) acetyl Co-A
(b) pyruvic acid
(c) glucose 1-phosphate
(d) fructose 1-phosphate

Ans. *(b)*

During glycolysis one molecule of glucose is broken down into two molecules of pyruvic acid in the cytoplasm. Glycolysis is the common path of aerobic and anaerobic respiration.

06 EMP can produce a total of **[CBSE AIPMT 1990]**

(a) 6 ATP (b) 8 ATP
(c) 24 ATP (d) 38 ATP

Ans. *(b)*

EMP (Embden-Meyerhof Paranas Pathway) refers to glycolysis, in which one molecule of glucose is broken down to two molecules of pyruvic acid. In this process there is a gain of 2NADH (2×3 ATP) and 2 ATP, i.e. total 8 ATP.

07 Incomplete oxidation of glucose into pyruvic acid with several intermediate steps is known as **[CBSE AIPMT 1988]**

(a) TCA-pathway (b) glycolysis
(c) HMS-pathway (d) Krebs' cycle

Ans. *(b)*

Glycolysis is the sequence of enzyme mediated reactions by which glucose is degraded anaerobically into pyruvic acid in cell cytoplasm. The net gain of molecules of ATP during glycolysis is two.

TOPIC 2
Krebs Cycle and Electron Transport Chain

08 Which of the following statement is incorrect? **[NEET 2021]**

(a) During aerobic respiration, role of oxygen is limited to the terminal stage
(b) In ETC (Electron Transport Chain), one molecule of NADH + H^+ gives rise to 2 ATP molecules and one $FADH_2$ gives rise to 3 ATP molecules
(c) ATP is synthesised through complex V
(d) Oxidation-reduction reactions produce proton gradient in respiration

Ans. *(b)*

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

NADH and $FADH_2$ are two different types of electron donors. They differ in the ways they feed electron during electron transport chain. NADH feeds its electrons into the electron transport chain at the beginning (Complex I). $FADH_2$ feeds into the electron transport chain at Complex II (at a lower energy level down the chain). The high energy electrons from NADH have sufficient energy to result in 3 ATP whereas the lower energy electrons in $FADH_2$ have energy for 2 ATP production.

09 Pyruvate dehydrogenase activity during aerobic respiration requires **[NEET (Oct.) 2020]**

(a) calcium (b) iron
(c) cobalt (d) magnesium

Ans. *(d)*

Pyruvate dehydrogenase enzyme is involved in the conversion of pyruvate to acetyl Co-A, after the completion of glycolysis and before the start of Krebs' cycle. This enzyme is made up of decarboxylase, lipoic acid, transacetylase and Mg^{2+} ion. The reaction occur in following way

$$\text{Pyruvate} + NAD^+ + \text{Co-A} \xrightarrow[\text{dehydrogenase, } Mg^{2+}]{\text{Pyruvate}} \text{Acetyl Co-A} + NADH + H^+ + CO_2$$

In this reaction Mg^{2+} acts as a cofactor.

10 The number of substrate level phosphorylation in one turn of citric acid cycle is **[NEET (Sep.) 2020]**

(a) one (b) two (c) three (d) zero

Ans. *(a)*

The number of substrate level phosphorylation in one turn of citric acid cycle is 1. During Krebs' or citric acid cycle, succinyl-Co-A is acted upon by enzyme succinyl-Co-A synthetase to form succinate (a 4C compound). The reaction releases sufficient energy to form ATP (in plants) or GTP (in animals) by substrate-level phosphorylation. GTP can form ATP through a coupled reaction. Succinyl Co-A+GDP/ADP+H_3PO_4 synthetase. Succinyl Co-A Succinate +Co-A+GTP/ATP.

11 Where is respiratory Electron Transport System (ETS) located in plants? **[NEET (Odisha) 2019]**

(a) Mitochondrial matrix
(b) Outer mitochondrial membrane
(c) Inner mitochondrial membrane
(d) Intermembrane space

Ans. *(c)*

Respiratory Electron Transport System (ETS) in plants is located in inner mitochondrial membrane. It serves as the site of oxidative phosphorylation through the action of ATP synthase.

12 Which one of these statements is incorrect? **[NEET 2018]**

(a) Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms.
(b) Glycolysis occurs in cytosol
(c) Enzymes of TCA cycle are present in mitochondrial matrix
(d) Oxidative phosphorylation takes place in outer mitochondrial membrane

Ans. *(d)*

Oxidative phosphorylation is the process of ATP formation due to the transfer of electrons from NADH or $FADH_2$ to oxygen molecule (O_2) by a series of electron carriers. This process occurs in the inner mitochondrial membrane because of its less permeability, presence of ETC proteins and ATP synthase.

The rest three statements are correct.

13 What is the role of NAD^+ in cellular respiration? **[NEET 2018]**

(a) It is a nucleotide source of ATP synthesis
(b) It functions as an electron carrier
(c) It functions as an enzyme
(d) It is the final electron acceptor for anaerobic respiration

Ans. *(b)*

NAD^+ functions as an **electron carrier** in cellular respiration. NAD is an oxidising agent which accept electrons and then transfer them to the Electron Transport System (ETS). As a result, 3ATP molecules are formed.

14 Which statement is wrong for Krebs' cycle? **[NEET 2017]**

(a) There are three points in the cycle where NAD^+ is reduced to NADH + H^+
(b) There is one point in the cycle where FAD^+ is reduced to $FADH_2$
(c) During conversion of succinyl Co-A to succinic acid, a molecule of GTP is synthesised
(d) The cycle starts with condensation of acetyl group (acetyl Co-A) with pyruvic acid to yield citric acid

Ans. *(d)*

Option (d) is incorrect, which can be corrected as

Krebs' cycle starts with the condensation of acetyl group with oxaloacetic acid and water to yield citric acid.

During conversion of succinic acid to fumaric acid FAD^+ is reduced to $FADH_2$. During conversion of pyruvic acid to acetyl Co-A, isocitrate to oxalosuccinic acid and α-ketoglutaric acid to succinyl Co-A NAD^+ is reduced to NADPH+H^+.

15 Oxidative phosphorylation is **[NEET 2016, Phase II]**

(a) formation of ATP by transfer of phosphate group from a substrate to ADP
(b) oxidation of phosphate group in ATP
(c) addition of phosphate group to ATP
(d) formation of ATP by energy released from electrons removed during substrate oxidation

Ans. *(a)*

Oxidative phosphorylation is the process of formation of ATP from ADP and inorganic phosphate (P_i) in the presence of oxygen. It occurs mainly in the Electron Transport Chain (ETC) of cellular respiration.

16 Which of the metabolites is common to respiration mediated breakdown of fats, carbohydrates and proteins? **[NEET 2013]**

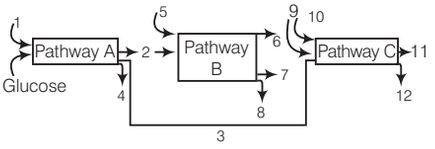
(a) Glucose-6-phosphate
(b) Fructose 1, 6-bisphosphate
(c) Pyruvic acid
(d) Acetyl Co-A

Ans. *(d)*

Acetyl Co-A is common to respiration mediated breakdown of fats, carbohydrates and proteins.

Glucose and fructose are phosphorylated to give rise to glucose-6-phosphate by the activity of the enzyme hexokinase.
Glucose-6-phosphate is then converted into fructose-6-phosphate and further to fructose 1-6-bisphosphate. Pyruvic acid is the end product of glycolysis.

17 The three boxes in this diagram represent the three major biosynthetic pathways in aerobic respiration. Arrows represent net reactants or products **[NEET 2013]**



Arrows numbered 4, 8 and 12 can all be

(a) NADH (b) ATP

(c) H_2O (d) FAD^+ or $FADH_2$

Ans. *(b)*

Pathway *A* is glycolysis, pathway *B* is the Krebs' cycle and pathway *C* is oxidative phosphorylation

Arrow 1 — ADP or NAD^+

Arrow 2 — Pyruvate

Arrow 3 — NADH

Arrow 4 — ATP

Arrow 5 — ADP, NAD^+ or FAD

Arrow 6 and 7 — $FADH_2$ and NADH (either one can be 6 or 7)

Arrow 8 — ATP or CO_2

Arrow 9 and 10 — O_2 and ADP (either one can be 9 or 10)

Arrow 11 and 12 — H_2O and ATP (either onecan be 11 or 12)

18 Aerobic respiratory pathway is appropriately termed **[CBSE AIPMT 2009]**

(a) catabolic (b) parabolic

(c) amphibolic (d) anabolic

Ans. *(c)*

An amphibolic pathway is a biochemical pathway that serves both anabolic and catabolic processes. An important example of an amphibolic pathway is the Krebs' cycle, which involves both the catabolism of carbohydrates and fatty acid and the synthesis of anabolic precursors for amino acid synthesis, *eg*, α-ketogluturate and oxalo acetate.

19 The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that Adenosine Triphosphate (ATP) is formed because **[CBSE AIPMT 2008]**

(a) high energy bonds are formed in mitochondrial proteins

(b) ADP is pumped out of the matrix into the intermembrane space

(c) a proton gradient forms across the inner membrane

(d) there is a change in the permeability of the inner mitochondrial membrane toward Adenosine Diphosphate (ADP)

Ans. *(c)*

The production of ATP with the help of energy liberated during oxidation of reduced coenzymes and terminal oxidation is called oxidative phosphorylation. Peter Mitchell (1961) gave a hypothesis known as chemiosmotic hypothesis for ATP synthesis. According to this when electrons flow from dual proton, electron carrier to a non-hydrogen carrier the H^+ are released and expelled into the intermembrane space and thus creates a proton gradient with higher concentration of H^+ in the inter membranous space than the matrix. Due to the proton motive force the protons flow back and energy liberated during this back flow of protons activate ATPase present in F_1 head to synthesize ATP.

20 The overall goal of glycolysis, Krebs' cycle and the electron transport system is the formation of **[CBSE AIPMT 2007]**

(a) ATP in small stepwise units

(b) ATP in one large oxidation reaction

(c) sugars

(d) nucleic acids

Ans. *(a)*

Glycolysis, Krebs' cycle and electron transport system are meant for ATP synthesis in different steps. ATP is the energy currency of cell.

21 All enzymes of TCA cycle are located in the mitochondrial matrix except one which is located in inner mitochondrial membranes in eukaryotes and in cytosol in prokaryotes. This enzyme is **[CBSE AIPMT 2007]**

(a) lactate dehydrogenase

(b) isocitrate dehydrogenase

(c) malate dehydrogenase

(d) succinate dehydrogenase

Ans. *(d)*

Succinate dehydrogenase enzyme is present on inner membrane of mitochondria and catalyses the oxidation of succinate to fumarate.

22 During which stage, in the complete oxidation of glucose are the greatest number of ATP molecules formed from ADP **[CBSE AIPMT 2005]**

(a) glycolysis (b) Krebs' cycle

(c) conversion of pyruvic acid to acetyl Co-A

(d) electron transport chain

Ans. *(d)*

The last step of aerobic respiration is the oxidation2 of reduced coenzymes, i.e., $NADH_2$ and $FADH_2$ by molecular oxygen through FAD, ubiquinone, cyt.-*b*, cyt.-*c*, cyt-c_1, cyt.-*a* and cyt.-a_3. By oxidation of 1 molecule of $NADH_2$, 3 ATP molecules are produced and by oxidation of 1 molecule of $FADH_2$ 2ATP molecules are Produced.

In glycolysis 2 ATP molecules are produced from ADP.

Further $2NADH_2$ produced, give $2 \times 3 = 6$ ATP, on oxidative phosphorylation. Similarly in Krebs' cycle 2 ATP molecules are produced. So the greatest number of ATP molecules are produced in the electron transport chain.

23 Chemiosmotic theory of ATP synthesis in the chloroplast and mitochondria is based on **[CBSE AIPMT 2005]**

(a) membrane potential

(b) accumulation of Na^+ ions

(c) accumulation of K^+ ions

(d) proton gradient

Ans. *(d)*

Chemiosmotic hypothesis for oxidative phosphorylation (ATP synthesis) was proposed by **Peter Mitchell** in 1961, for this he was awarded Nobel Prize in 1978. This theory is based on proton gradient.

24 Which one of the following concerns photophosphorylation? **[CBSE AIPMT 2003]**

(a) AMP + inorganic $PO_4 \xrightarrow{\text{Light energy}}$ ATP

(b) ADP + AMP $\xrightarrow{\text{Light energy}}$ ATP

(c) ADP + inorganic $PO_4 \xrightarrow{\text{Light energy}}$ ATP

(d) ADP + inorganic $PO_4 \longrightarrow$ ATP

Ans. *(c)*

Phosphorylation refers to the process in which ATP is made when energy is used to bind another phosphate to ADP. Photophosphorylation reactions are part of both respiration and photosynthesis.

25 In which one of the following do the two names refer to one and the same thing? **[CBSE AIPMT 2003]**

(a) Tricarboxylic acid cycle and urea cycle
(b) Krebs' cycle and Calvin cycle
(c) Tricarboxylic acid cycle and citric acid cycle
(d) Citric acid cycle and Calvin cycle

Ans. *(c)*

Tricarboxylic acid cycle is also known as citric acid cycle. This is an aerobic process, that takes place in the matrix of mitochondria. Kreb that discovered this cycle in 1937. So, this is also known as Krebs' cycle.

26 The mechanism of ATP formation both in chloroplast and mitochondria is explained by **[CBSE AIPMT 1997]**

(a) relay pump theory of Godlewski
(b) Munch's pressure/mass flow model
(c) chemiosmotic theory of Mitchell
(d) Cholondy-Went's model

Ans. *(c)*

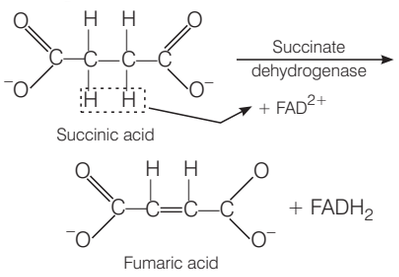
In chemiosmotic- coupling hypothesis, outward pumping of protons across the inner chloroplast or mitochondrial membrane results in accumulation of protons between outer membrane and inner membrane. A proton gradient is thus established. As protons now flow back passively down the gradient, the proton motive force is utilised to synthesise ATP.

27 In Krebs' cycle FAD participates as electron acceptor during the conversion of **[CBSE AIPMT 1997]**

(a) succinyl Co-A to succinic acid
(b) α-ketoglutarate to succinyl Co-A
(c) succinic acid to fumaric acid
(d) fumaric acid to malic acid

Ans. *(c)*

Electrons and H-ions during oxidation of succinic acid to fumaric acid, are taken up by FAD which gets reduced to $FADH_2$.



28 Oxidative phosphorylation involves simultaneous oxidation and phosphorylation to finally form **[CBSE AIPMT 1996]**

(a) pyruvate (b) NADP
(c) DPN (d) ATP

Ans. *(d)*

In oxidative phosphorylation ATP is formed as the electrons are transferred from NADH or $FADH_2$ to O_2 by a series of electron carriers, located in the inner membrane of mitochondria.

29 Krebs' cycle occurs in **[CBSE AIPMT 1996]**

(a) mitochondria
(b) cytoplasm
(c) chloroplast
(d) ribosomes

Ans. *(a)*

Krebs' cycle occurs inside the matrix of mitochondria. The cycle is also named as **citric acid cylce** or **tricarboxylic acid cycle.** It includes stepwise oxidative and cyclic degradation of activated acetate derived from pyruvic acid.

30 Which of the following is essential for conversion of pyruvic acid into acetyl Co-A? **[CBSE AIPMT 1995]**

(a) LAA (b) NAD^+
(c) TPP (d) All of these

Ans. *(d)*

The oxidative decarboxylation of pyruvate into acetyl Co-A involves the presence of atleast five essential co-factors and an enzyme complex. The co-factors involved are Mg ions, Thiamine Pyrophosphate (TPP), NAD^+, Coenzyme-A (Co-A) and lipoic acid.

31 ATP is injected in cyanide poisoning because it is **[CBSE AIPMT 1994]**

(a) necessary for cellular functions
(b) necessary for $Na^+ - K^+$ pump
(c) $Na^+ - K^+$ pump operates at the cell membranes
(d) ATP breaks down cyanide

Ans. *(a)*

Cyanide is a deadly poison. It stops respiration by inhibiting electron flow from cyt.-*b* to*cyt.*-c_1. ATP is the energy currency of cell is injected in cyanide poisoning because, it is necessary for cellular functions.

32 Out of 38 ATP molecules produced per glucose, 32 ATP molecules are formed from NADH / $FADH_2$ in **[CBSE AIPMT 1993]**

(a) respiratory chain
(b) Krebs' cycle
(c) oxidative decarboxylation
(d) EMP

Ans. *(a)*

Respiratory chain helps in forming 32 ATP molecules from NADH/$FADH_2$ molecules. In which Oxidative phosphorylation is the synthesis of energy rich ATP molecules with the help of energy liberated during oxidation of reduced coenzymes ($NADH_2$, $FADH_2$). produced in glycolysis and Krebs' cycle. A total of 10$NADH_2$ and 2$FADH_2$ molecules are formed in aerobic respiration. They help in formation of 32 or 34ATP molecules.

33 End product of citric acid/Krebs' cycle is **[CBSE AIPMT 1993]**

(a) citric acid (b) lactic acid
(c) pyruvic acid (d) $CO_2 + H_2O$

Ans. *(d)*

Krebs' cycle or citric acid cycle that takes place in the matrix of mitochondrion begins by linking acetyl Co-A to oxaloacetic acid forming citric acid. In the presence of various enzymes, cycle continues through the formation of various intermediates and release of CO_2 and H_2O as end-products.

34 Link between glycolysis, Krebs' cycle and β-oxidation of fatty acid or carbohydrate and fat metabolism is **[CBSE AIPMT 1992, 90]**

(a) oxaloacetic acid (b) succinic acid
(c) citric acid (d) acetyl Co-A

Ans. *(d)*

The pyruvic acid synthesised from glycolysis enters into mitochondria and undergoes oxidative decarboxylation to produce CO_2 and $NADH_2$.

The product combines with coenzyme-A to form acetyl Co-A. It is the connecting link between glycolysis, Krebs' cycle and fat oxidation.

35 Oxidative phosphorylation is production of **[CBSE AIPMT 1992]**

(a) ATP in photosynthesis
(b) NADPH in photosynthesis
(c) ATP in respiration
(d) NADH in respiration

Ans. *(c)*

Oxidative phosphorylation is the synthesis of ATP from ADP and inorganic phosphate which occurs with the help of energy obtained from oxidation of reduced coenzymes formed in cellular respiration.

36 Terminal cytochrome of respiratory chain which donates electrons to oxygen is **[CBSE AIPMT 1992]**

(a) cyt-*b* (b) cyt-*c*
(c) cyt-a_1 (d) cyt-a_3

Ans. *(d)*

The ETS system contains various electron carriers such as cytochromes. The correct sequence of electron carrier/acceptor in ATP synthesis is cyt-*b*, cyt-c_1, cyt-*c*, cyt *(a and cyt-*a_3*)*. Cyt-a_3 is the terminal cytochrome, it possess two copper centers, which help in transfer of electron to oxygen.

37 $NADP^+$ is reduced to NADPH in **[CBSE AIPMT 1988]**

(a) HMP (b) Calvin cycle
(c) glycolysis (d) EMP

Ans. *(a)*

Pentose Phosphate Pathway (PPP) or Hexose Monophosphate Shunt (HMP) or phosphogluconate pathway occurs in the cytosol of mammalian cells. It involves oxidation of glucose to CO_2 and water through a series of reactions in which NADP is reduced to NADPH. Complete breakdown of one molecule of glucose forms 12 NADPH equal to 36 ATP molecules.

TOPIC 3

Respiratory Quotient and Respiratory Balance Sheet

38 Respiratory Quotient (RQ) value of tripalmitin is **[NEET (National) 2019]**

(a) 0.7 (b) 0.07
(c) 0.09 (d) 0.9

Ans. *(a)*

The RQ value of tripalmitin is 0.7. It can be calculated as follows

Respiratory Quotient (RQ)

$$= \frac{\text{Amount of } CO_2 \text{ released}}{\text{Amount of } O_2 \text{ Consumed}}$$

$$2\,(C_{51}H_{98}O_6) + 145\ O_2 \rightarrow 102CO_2 + 98\,H_2O$$

Tripalmitin

$$RQ = \frac{102\ CO_2}{1450\ O_2} = 0.7$$

It is to note that RQ of common fats is usually less than 1 under aerobic conditions.

39 How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy available in the high energy phosphate bond of one mole of ATP is 12 kcal? **[CBSE AIPMT 2006]**

(a) 30 (b) 57 (c) 1 (d) 2

Ans. *(b)*

One mole of ATP liberates 12 kcal of energy. so 686 kcal will be liberated by 686 / 12 = 57.1 ATP molecules.

40 How many ATP molecules are produced by aerobic oxidation of one molecule of glucose? **[CBSE AIPMT 2002]**

(a) 2 (b) 4 (c) 38 (d) 34

Ans. *(c)*

A total of 38 molecules of ATP are produced during aerobic respiration of one molecule of glucose

Summary of ATP synthesis

8 ATP from glycolysis.

6 ATP from acetyl Co-A.

24 ATP from Krebs' cycle.

Total = 38 ATP from aerobic oxidation of one molecule of glucose.

41 Net gain of ATP molecules during aerobic respiration is **[CBSE AIPMT 1999]**

(a) 36 molecules (b) 38 molecules
(c) 40 molecules (d) 48 molecules

Ans. *(b)*

During aerobic respiration, 38 ATP molecules are gained. If specifically aerobic respiration in eukaryote is asked, then the answer would be 36 ATP because 2 ATP molecules are produced by $FADH_2$ which accepts the H^+ from 2 NADH molecules produced in glycolysis.

42 Respiratory quotient (RQ) for fatty acid is **[CBSE AIPMT 1995]**

(a) > 1 (b) < 1
(c) 1 (d) 0

Ans. *(b)*

Respiratory Quotient (RQ)

$$= \frac{\text{Volume of } CO_2 \text{ formed}}{\text{Volume of } O_2 \text{ utilised}}$$

In fats, large amount of O_2 is used to combine with H_2, so output of CO_2 is less and RQ is only 0.70, i.e., less than unity.

43 Respiratory substrate yielding maximum number of ATP molecule is **[CBSE AIPMT 1994]**

(a) ketogenic amino acids (b) glucose
(c) amylose (d) glycogen

Ans. *(b)*

Respiratory substrate yielding maximum number of ATP molecules is glucose. One glucose molecule on aerobic respiration yields 36 ATP molecules.

44 Maximum amount of energy/ATP is liberated on oxidation of **[CBSE AIPMT 1994]**

(a) fats (b) proteins
(c) starch (d) vitamins

Ans. *(a)*

Fats or lipids are second to carbohydrates as a source of energy. By weight, each gram mol of fat yields about 9.3 kcal of energy, i.e. more than double of that yielded by glucose.

45 Apparatus to measure rate of respiration and RQ is **[CBSE AIPMT 1992]**

(a) auxanometer (b) potometer
(c) respirometer (d) manometer

Ans. *(c)*

Respirometer is an instrument used to measure the rate of respiration and also Respiratory Quotient (RQ). The most common respirometer is Ganong's respirometer.

46 When one glucose molecule is completely oxidised, it changes **[CBSE AIPMT 1992]**

(a) 36 ADP molecules into 36 ATP molecules
(b) 38 ADP molecules into 38 ATP molecules
(c) 30 ADP molecules into 30 ATP molecules
(d) 32 ADP molecules into 32 ATP molecules

Ans. *(b)*

In aerobic respiration or biological oxidation of one glucose molecule, 38

ADP molecules change into 38 ATP molecules, where donor phosphate is inorganic phosphate. ATP molecules are the energy currency of the cell, i.e. the common immediate source of energy in cellular activity.

47 Which one of the following statements about cytochrome 450 is wrong? **[CBSE AIPMT 1999]**

(a) It contains iron
(b) It is a coloured cell
(c) It has an important role in metabolism
(d) It is an enzyme involved in oxidation reactions

Ans. ***(b)***

Cytochrome is not a coloured cell, instead this is a respiratory pigment-mixture of iron and protein which are electron acceptors.

Cytochrome are membrane bound hemeproteins contains heme groups and are primarily responsible for the generation of ATP *via* electron transport.

48 RQ is **[CBSE AIPMT 1988]**

(a) C/N (b) N/C (c) CO_2/O_2 (d) O_2/CO_2

Ans. ***(c)***

Respiratory Quotient (RQ) is the ratio of volume of CO_2 evolved to the volume of oxygen consumed per unit time per unit weight. Therefore, RQ = CO_2/O_2.

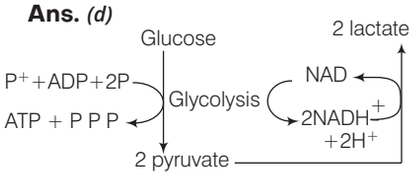
It is useful in knowing the type of respiration, major transformations and respiratory substrate.

TOPIC 4
Fermentation

49 In which one of the following processes CO_2 is not released? **[CBSE AIPMT 2014]**

(a) Aerobic respiration in plants
(b) Aerobic respiration in animals
(c) Alcoholic fermentation
(d) Lactate fermentation

Ans. ***(d)***



Lactic acid fermentation is process by which glucose, fructose and sucrose are converted into energy and the metabolite lactate. It is an anaerobic fermentation reaction that occurs in some bacteria and animal cells and allows glycolysis to continue by ensuring that NADH is returned to its oxidised state (NAD^+).

50 The energy-releasing metabolic process in which substrate is oxidised without an external electron acceptor is called **[CBSE AIPMT 2010, 08]**

(a) glycolysis
(b) fermentation
(c) aerobic respiration
(d) photorespiration

Ans. ***(b)***

Fermentation takes place in the lack of oxygen (when the electron transport chain is unusable) and becomes the cell's primary means of ATP (energy) production. It turns NADH and pyruvate in the glycolysis into NAD^+ and various small molecules depending on the type of fermentation. In the presence of O_2, NADH and pyruvate are used to generate ATP in respiration. It is called oxidative respiration.

51 In alcoholic fermentation **[CBSE AIPMT 2003]**

(a) oxygen is the electron acceptor
(b) triose phosphate is the electron donor while acetaldehyde is the electron acceptor
(c) triose phosphate is the electron donor while pyruvic acid is the electron acceptor
(d) there is no electron donor

Ans. ***(b)***

In alcoholic fermentation,

(a) NADH (formed during conversion of triose-3 phosphate to 3 phosphoglycerate) is oxidised to NAD^+
(b) electrons are accepted by acetaldehyde formed by decarboxylation of pyruvate.

52 Fermentation is anaerobic production of **[CBSE AIPMT 1996]**

(a) Protein and acetic acid
(b) alcohol, lactic acid or similar compounds
(c) ethers and acetones
(d) alcohol and lipoproteins

Ans. ***(b)***

Fermentation is defined as anaerobic break down of carbohydrates and other organic compounds to form aldehyde, alcohol and organic acids (lactic acid) with the help of microorganisms or their enzymes.

53 Fermentation products of yeast are **[CBSE AIPMT 1994]**

(a) $H_2O + CO_2$
(b) methyl alcohol $+CO_2$
(c) methyl alcohol $+H_2O$
(d) ethyl alcohol $+ CO_2$

Ans. ***(d)***

Yeast cells undergo alcoholic fermentation in which glucose is first converted into pyruvic acid. In the presence of pyruvic decarboxylase, it is changed into acetaldehyde. Alcohol dehydrogenase changes it to ethyl alcohol and CO_2.

54 Life without air would be **[CBSE AIPMT 1993]**

(a) reductional
(b) free from oxidative damage
(c) impossible
(d) anaerobic

Ans. ***(d)***

Anaerobic means 'in the absence of molecular oxygen', so life without air would be anaerobic. The atmosphere of earth at the time of origin of life was without free oxygen atoms, so the primitive atmosphere was reducing.

55 Out of 36 ATP molecules produced per glucose molecule during respiration **[CBSE AIPMT 1991]**

(a) 2 are produced outside glycolysis and 34 during respiratory chain
(b) 2 are produced outside mitochondria and 34 inside mitochondria
(c) 2 during glycolysis and 34 during Krebs' cycle
(d) all are formed inside mitochondria

Ans. ***(b)***

A total of 38 ATP molecules are produced per glucose molecule during respiration. Out of which, 2 ATP are produced outside mitochondria (i.e. glycolysis in cytoplasm) and 36 ATP inside mitochondria (i.e. 2 ATP through Krebs' cycle and 34 ATP from $NADH/FADH_2$ through respiratory chain). In contrast, in some cells the number of ATP produced inside mitochondria equals to 34 and thus, there is a net synthesis of 36 ATP molecules.