

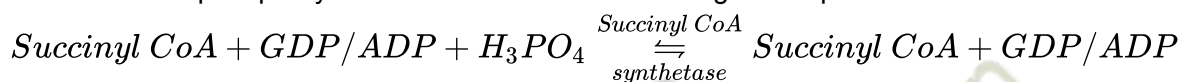
**Respiration in plants Important Questions With Answers**

**NEET Biology 2023**

1. Substrate level phosphorylation occurs during which step of Krebs' cycle?  
**a) Succinyl CoA → Succinic acid**    b) Isocitric acid → Oxalosuccinic acid  
 c) Oxalosuccinic acid → α-ketoglutaric acid    d) Malic acid → OAA

**Solution : -**

During Krebs' or citric acid cycle, succinyl-CoA is acted upon by enzyme succinyl-CoA 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.



2. Mercury (Hg) is generally used in anaerobic respiration experiments because it does not react with \_\_\_\_\_  
 a) O<sub>2</sub>    **b) CO<sub>2</sub>**    c) H<sub>2</sub>O    d) air
3. Oxidation of one NADH and one FADH<sub>2</sub> respectively gives rise to \_\_\_\_\_ and \_\_\_\_\_ ATP molecules.  
**a) 3 and 2**    b) 2 and 1    c) 2 and 3    d) 1 and 1

**Solution : -**

Oxidation of one molecule of NADH gives rise to 3 molecules of ATP while that of one molecule of FADH<sub>2</sub> produces 2 molecules of ATP.

4. In the electron transport chain during terminal oxidation, the cytochrome, which donates electrons to O<sub>2</sub> is  
 a) Cytochrome -b    b) Cycto-C    **c) Cycto-a<sub>3</sub>**    d) Cycto-f
5. In glycolysis, during oxidation electrons are removed by\_\_\_\_  
 a) ATP    b) glyceraldehyde-3-phosphate    **c) NAD<sup>+</sup>**    d) molecular oxygen

**Solution : -**

In all cells ATP is energy currency. During glycolysis Glyceraldehyde 3-Phosphate is reduced. Molecular oxygen is the terminal electron acceptor in ETS

6. Identify the correct terms for the given statements and select the correct answer  
 (i) Sudden increase in the rate of respiration during ripening of fruits.  
 (ii) Reduction in the consumption of respiratory substrate when mode of respiration is changed from anaerobic to aerobic.  
 (iii) Respiratory oxidation of carbohydrates and fats.

a)

Pasteur effect	Floating respiration	Climacteric respiration
(i)	(ii)	(iii)

b)

Pasteur effect	Floating respiration	Climacteric respiration
(ii)	(iii)	(i)

c)

Pasteur effect	Floating respiration	Climacteric respiration
(iii)	(ii)	(i)

d)

Pasteur effect	Floating respiration	Climacteric respiration
(ii)	(i)	(iii)

7. Fermentation is anaerobic production of \_\_\_\_\_

- a) protein and acetic acid    **b) alcohol, lactic acid or similar compounds**    c) ethers and acetones  
d) alcohol and lipoproteins

**Solution : -**

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

8. In alcoholic fermentation \_\_\_\_\_

- 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

**Solution : -**

In alcohol fermentation triose phosphate is the electron donor while acetaldehyde is the electron acceptor

9. Sequence of food materials consumed during respiration is:

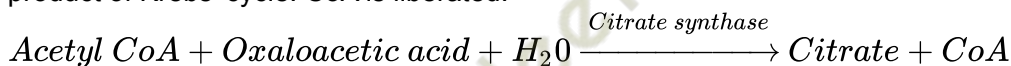
- a) Firstly → carbohydrate → fats → proteins**    b) Carbohydrate → proteins → fats  
c) Proteins → fats → carbohydrate    d) Fats → proteins → carbohydrate

10. In Krebs' cycle, OAA accepts acetyl CoA to form

- a) citric acid**    b) oxalosuccinate    c) fumarate    d) succinyl CoA

**Solution : -**

Acetyl CoA (2-carbon compound) combines with oxaloacetate (4-carbon compound) in the presence of condensing enzyme citrate synthase to form a tricarboxylic 6-carbon compound called citric acid. It is the first product of Krebs' cycle. CoA is liberated.



11. Aerobic respiratory pathway is appropriately termed \_\_\_\_\_

- a) parabolic    **b) amphibolic**    c) anabolic    d) catabolic

**Solution : -**

Aerobic respiratory pathway is appropriately termed as amphibolic pathway. In amphibolic pathway, both anabolic and catabolic process occurs. Krebs Cycle is amphibolic pathway. During this process catabolism of carbohydrates and fatty acids and in anabolic pathway there is a synthesis of, amino acid precursor e. g. Alpha-ketoglutarate and Oxaloacetate.

12. Which complex contains cytochromes a and a<sub>3</sub> and two copper centres?

- a) NADH dehydrogenase complex**    b) FADH reductase    c) Cytochrome bc<sub>1</sub> complex  
d) Cytochrome c oxidase complex

13. When two molecules of acetyl CoA enter the TCA cycle, net gain at the end of the cycle is

- a) 2NADH<sub>2</sub> + 2FADH<sub>2</sub> + 1GTP    b) 3NADH<sub>2</sub> + 2FADH<sub>2</sub> + 2GTP    **c) 6NADH<sub>2</sub> + 2FADH<sub>2</sub> + 2GTP**  
d) 3NADH<sub>2</sub> + 1FADH<sub>2</sub> + 4GTP

**Solution : -**

Krebs' cycle produces 2 GTP (or 2 ATP) through substrate level phosphorylation. Six molecules of  $\text{NADH}_2$  and 2 molecules of  $\text{FADH}_2$  for every two molecules of Acetyl CoA oxidised by it.

14. Which one of the following is the first step of glycolysis?  
a) **Breakdown of glucose**   b) **Phosphorylation of glucose**   c) Conversion of glucose into fructose  
d) Dehydrogenation of glucose
15. Krebs cycle begins with the reaction :  
a) Citric acid + Acetyl CO-A   b) Oxalacetic acid + Pyruvic acid   c) Oxalacetic acid + Citric acid  
d) **Oxaloacetate + Acetyl acid**
16. Electron transport chain (ETC) is a set of \_\_\_ electron carriers present in a specific sequence along \_\_\_ mitochondrial membrane.  
a) **seven, inner**   b) six, inner   c) seven, outer   d) six, outer

**Solution : -**

In electron transport chain, there are 7 electron acceptors, which are as follows  $\text{Co-Q} \rightarrow \text{Cyt b} \rightarrow \text{Cyt } c_1 \rightarrow \text{Cyt } c \rightarrow \text{Cyt } a_3 \rightarrow \text{O}_2$ . Oxygen is the ultimate electron acceptor. These electron acceptors are present in a specific sequence along inner mitochondrial membrane.

17. Select the correct statement.  
a) When ATP is synthesised directly from metabolites, it is substrate level phosphorylation.  
b) In Krebs' cycle, citrate undergoes 2 decarboxylations and 4 dehydrogenations.  
c) Krebs' cycle is an amphibolic process   d) **All of these**
18. Incomplete oxidation of glucose into pyruvic acid with several intermediate steps is known as \_\_\_  
a) TCA-pathway   b) **glycolysis**   c) HMS-pathway   d) Krebs' cycle

**Solution : -**

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.

19.  $\text{NADP}^+$  is reduced to NADPH in \_\_\_\_\_.  
a) **HMP**   b) Calvin cycle   c) glycolysis   d) EMP

**Solution : -**

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  $\text{CO}_2$  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.

20. End product of citric acid/Krebs' cycle is \_\_\_\_\_.  
a) citric acid   b) lactic acid   c) pyruvic acid   d)  **$\text{CO}_2 + \text{H}_2\text{O}$**

**Solution : -**

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  $\text{CO}_2$  and  $\text{H}_2\text{O}$  as end products.

21. Respiratory substrates are the organic substances which are \_\_\_\_\_ during respiration to liberate energy.  
a) **oxidised**   b) reduced   c) synthesised   d) both (a) and (b)

**Solution : -**

Respiration is an oxidative process in which respiratory substrates are oxidised 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.

22. In which one of the following processes, carbon dioxide is not released?  
 a) Aerobic respiration in animals    b) Alcoholic fermentation    **c) Lactate fermentation**  
 d) Aerobic respiration in plants

**Solution :** -

Under anaerobic conditions in some bacteria or in muscles of animals, pyruvate is reduced to lactate to regenerate NAD<sup>+</sup>.

23. If volume of CO<sub>2</sub> liberated during respiration is more than the volume of O<sub>2</sub> used, then the respiratory substrate will be:  
**a) carbohydrate**    b) fat    c) protein    d) organic acid.

**Solution :** -

RQ slightly more than unity is found when organic acids are broken down as respiratory substrates under aerobic conditions, e.g., for breakdown of oxalic acid,

$$RQ = \frac{4CO_2}{O_2} = 4.0$$

24. Consider the first reaction of TCA cycle

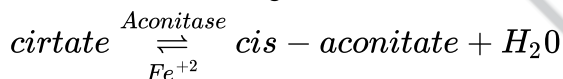


What is true about compound A?

- a) First product of TCA cycle    b) Tricarboxylic acid and six carbon compound  
 c) It undergoes reorganisation in the presence of enzyme aconitase to form cis-aconitate    **d) All of these**

**Solution :** -

The TCA cycle starts with the condensation of acetyl group with oxaloacetic acid and water to yield citric acid. It is a tricarboxylic 6-carbon compound and undergoes reorganisation in the presence of iron containing enzyme aconitase first forming cis aconitate and releasing water.



25. Consider the following statements with respect to respiration.

- (i) Glycolysis occurs in the cytoplasm of the cell.  
 (ii) Aerobic respiration takes place within the mitochondria.  
 (iii) Electron transport system is present in the outer mitochondrial membrane.  
 (iv) C<sub>51</sub>H<sub>98</sub>O<sub>6</sub> is the chemical formula of tripalmitin, a fatty acid  
 (v) Respiratory Quotient =  $\frac{\text{Volume of O}_2 \text{ evolved}}{\text{Volume of CO}_2 \text{ consumed}}$

Of the above statements

- a) (i), (ii) and (iv) are correct**    b) (ii), (iii) and (iv) are correct    c) (iii), (iv) and (v) are correct  
 d) (ii), (iv) and (v) are correct.

**Solution :** -

Electron transport system is present in the inner mitochondrial membrane. Respiratory quotient (RQ) is the ratio of the volume of CO<sub>2</sub> evolved to the volume of O<sub>2</sub> consumed, i.e.,

$$RQ = \frac{\text{Volume of CO}_2 \text{ evolved}}{\text{Volume of O}_2 \text{ consumed}}$$

26. Read the given statements and select the correct option.

**Statement 1:** Glycolysis occurs in mitochondrial matrix.

**Statement 2:** Krebs' cycle occurs on cristae of mitochondria.

- a) Both statements 1 and 2 are correct.    b) Statement 1 is correct but statement 2 incorrect.  
 c) Statement 1 is incorrect but statement 2 is correct    **d) Both statements 1 and 2 are incorrect**

**Solution : -**

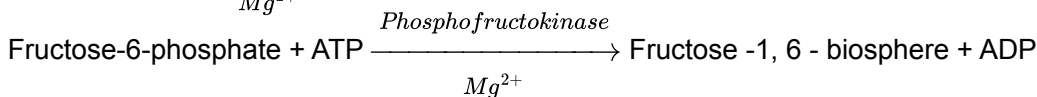
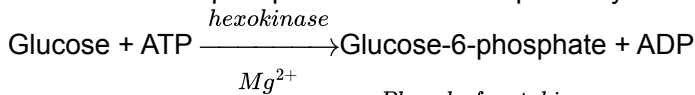
Glycolysis occurs in cell cytoplasm and Krebs' cycle occurs in mitochondrial matrix.

27. Which of the following steps during glycolysis is associated with utilisation of ATP?

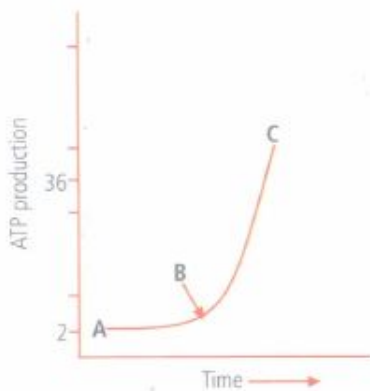
- a) Glucose → Glucose - 6- phosphate    b) Fructose-6-phosphate → Fructose-1,6-biphosphate  
c) PEP → Pyruvic acid    **d) Both (a) and (b)**

**Solution : -**

In the initial phase (energy spending phase) of glycolysis, the hexoses (i.e. glucose and fructose) in a reaction that uses ATP at two steps: First in the conversion of glucose into glucose-6-phosphate and second in the conversion of fructose-6-phosphate to fructose-1, 6-biphosphate. These reactions are catalysed by the hexokinase and phosphofructokinase respectively.



28. Animal cells are suspended in a culture medium that contains excess glucose. The graph below shows glucose utilisation under different growth conditions. (A), (B), and (C) in the graph indicate.



**A - Anaerobic respiration**

**B - Introduction of O<sub>2</sub> to culture medium**

**a) C - Aerobic respiration**

A - Aerobic respiration

B - Supply of organic triphosphate

c) C - Aerobic respiration

A - Aerobic respiration

B - Introduction of CO<sub>2</sub> to culture medium

b) C - Anaerobic respiration

A - Aerobic respiration

B - Introduction of CO to culture medium

d) C - Anaerobic respiration

**Solution : -**

Anaerobic respiration takes place in the absence of oxygen. It leads to incomplete degradation of substrate into alcohol and CO<sub>2</sub> releasing some energy (2ATP). Aerobic respiration occurs in the presence of oxygen. It results in complete oxidation of substrate into CO<sub>2</sub>, water and energy (38 ATP).

29. Krebs' cycle is also called metabolic sink as it is a common pathway for:

- a) carbohydrates, fats and proteins (amino acids)**    b) carbohydrates and fats only  
c) carbohydrates and organic acids only    d) proteins and fats only

**Solution : -**

Krebs' cycle also know as TCA cycle or citric acid cycle, is a common pathway of oxidative breakdown of carbohydrates, fatty acids and amino acids. Amino acids enter the Krebs' cycle directly as glutamate (for α-ketoglutarate) and asparate (for oxaloacetate) after their deamination. Fats produce fatty acids and glycerol. Glycerol is phosphorylated and oxidised to form glyceraldehyde 3-phosphate. Fatty acids undergo β-oxidation to produce acetyl CoA. Acetyl CoA enters Krebs' cycle.

30. An organic substance bound to an enzyme and essential for its activity is called

- a) Apoenzyme   b) Isoenzyme   **c) Coenzyme**   d) Holoenzyme

31. Which of the following steps of respiration is amphibolic?

- a) Glycolysis   b) Oxidative decarboxylation of pyruvate   **c) TCA cycle**   d) Oxidative phosphorylation

**Solution : -**

TCA or Krebs' cycle is amphibolic (both catabolic and anabolic) because it provides a number of intermediates for anabolic pathways.

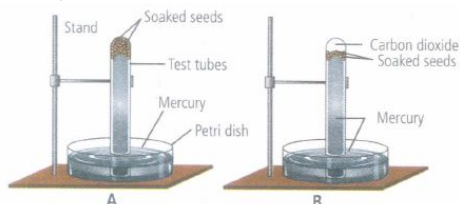
32. As per chemiosmotic coupling hypothesis, in mitochondria, protons accumulate in the

- a) outer membrane   b) inner membrane   **c) intermembrane space**   d) matrix

**Solution : -**

Chemiosmotic coupling hypothesis, proposed by Peter Mitchell (1961/ 66) (Nobel Prize in 1978), is the most widely accepted theory for oxidative phosphorylation. Reduced NAD (i.e., NADH), released from Krebs' cycle, when enters in the ETS, transports three pairs of H<sup>+</sup> across the inner mitochondrial membrane to the intermembrane space. Similarly, NADH from glycolysis and FADH<sub>2</sub> from Krebs' cycle also transport pairs of H<sup>+</sup> into intermembrane space. Each molecule of NADH released from glycolysis or FADH<sub>2</sub> from Krebs' cycle transports two pairs of protons into intermembrane space. This unidirectional flow of protons results in the accumulation of protons in the intermembrane space.

33. The given experimental set-up demonstrates



- a) photosynthesis   b) aerobic respiration   **c) anaerobic respiration**   d) ascent of sap

**Solution : -**

In the test tube full of mercury (figure A) there is no air and, therefore, the introduced soaked seeds do not get air for their respiration. But they are capable of respiration in the absence of oxygen as is indicated by the evolution of carbon dioxide (figure B). Therefore, anaerobic respiration takes place in the seeds in the absence of free oxygen. The experiment also shows that CO<sub>2</sub> is evolved in anaerobic respiration of seeds.

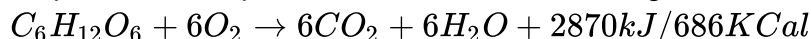
34. During the process of aerobic respiration, \_\_\_\_ (i) \_\_\_\_ gets oxidised and its electrons get transferred to the electron transport chain while in photosynthesis \_\_\_\_ (ii) \_\_\_\_ gets oxidised to transfer molecules to the electron transport chain.

- a) (i)-glucose; (ii)-xanthophyll   b) (i)-carbon dioxide, (ii) - xanthophyll   c) (i)-carbon dioxide, (ii)-chlorophyll-a

**d) (i)-glucose, (ii)-chlorophyll-a**

**Solution : -**

The oxidative breakdown of respiratory substrates with the help of atmospheric O<sub>2</sub> is known as aerobic respiration. It involves complete breakdown of substrates into CO<sub>2</sub> and water, releasing energy. For example, the simple chemical equation for aerobic breakdown of glucose is



While during photosynthesis chlorophyll a gets oxidised to transfer molecules to the electron transport chain.

35. A test tube containing molasses solution and yeast is kept in a warm place overnight. The gas collected from this mixture

- a) extinguishes the flame   b) bursts into flame when ignited   c) turns lime water milky   **d) both (a) and (c).**

**Solution : -**

The given process is an example of alcoholic fermentation, thus the gas produced is CO<sub>2</sub>.

36. During anaerobic digestion of organic waste, such as in producing biogas, which one of the following is left undegraded?

- a) Cellulose   b) Lipids   c) **Lignin**   d) Hemi-cellulose

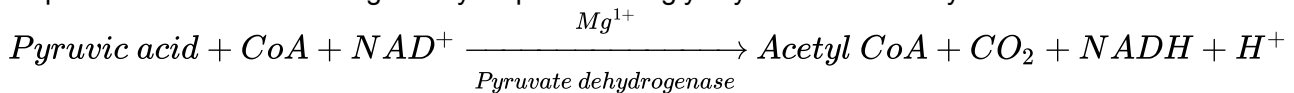
**Solution :** -

Lignin is a complex polymer of phenylpropane units, which are crossed linked to each other with a number of various chemical bonds.

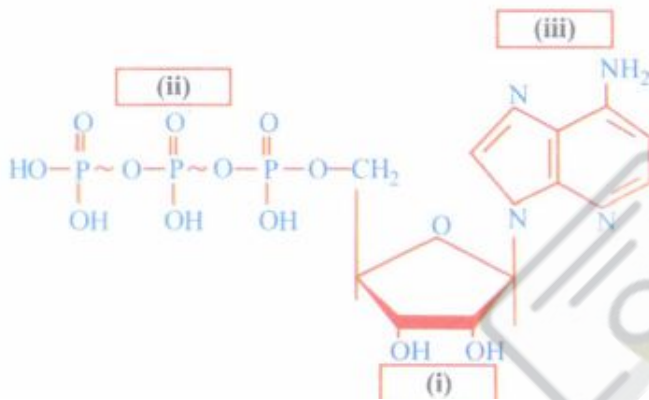
37. Fate of pyruvic acid during aerobic respiration is:

**Solution :** -

During aerobic respiration, pyruvic acid which is formed during glycolysis enters mitochondrial matrix. It undergoes oxidative decarboxylation to produce  $CO_2$  and NADH. The product combines with sulphur containing coenzyme A to form acetyl CoA. This reaction is catalysed by an enzyme complex pyruvate dehydrogenase. This step is called link reaction or gateway step as it links glycolysis with Krebs' cycle.



38. Identify the three components [(i), (ii) and (iii)] of ATP molecule shown in the given figure.



a)

(i)	(ii)	(iii)
Ribose	Triphosphate group	Adenine

b)

(i)	(ii)	(iii)
Adenine	Triphosphate group	Ribose

c)

(i)	(ii)	(iii)
Glucose	Triphosphate group	Adenine

d)

(i)	(ii)	(iii)
Ribose	Triphosphate group	Guanine

39. Total yield in one Kerb cycle:

- a)  $3FADH_2$ ,  $2NADH_2$ , 1ATP   b)  $2FADH_2$ ,  $2NADH_2$ , 2ATP   c)  $2NADH_2$ ,  $1FADH_2$ , 2ATP

**d)  $3NADH_2$ ,  $1FADH_2$ , 1ATP**

40. Pyruvate dehydrogenase complex is used ion converting-

- a) Pyruvate to glucose   b) Glucose to pyruvate   c) Pyruvic acid to lactic acid   **d) Pyruvate to acetyl Co-A**

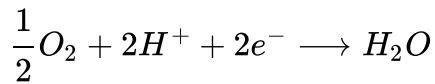
41. The ultimate electron acceptor of respiration in an aerobic organism is:

- a) cytochrome   **b) oxygen**   c) hydrogen   d) glucose.

**Solution :** -

The electron transport chain catalyses an electron flow from NADH ( $FADH_2$ ) to oxygen, which is the final electron acceptor of the respiratory process. It produces water in the mitochondrial matrix.





42. End products of aerobic respiration are \_\_\_\_\_  
 a) sugar and oxygen    b) water and energy    **c) carbon dioxide, water and energy**  
 d) carbon dioxide and energy

**Solution :** -

Aerobic respiration is an enzyme mediated energy liberating catabolic process which involves the step-wise oxidative break down of organic substrate into CO<sub>2</sub> and water with oxygen acting as a terminal oxidant.

43. The net gain of ATP molecules in glycolysis during aerobic respiration is  
 a) 0    b) 2    c) 4    **d) 8**
44. Link between glycolysis, Krebs' cycle and  $\beta$ -oxidation of fatty acid or carbohydrate and fat metabolism is \_\_\_\_\_.  
 a) oxaloacetic acid    b) succinic acid    c) citric acid    **d) acetyl Co-A**

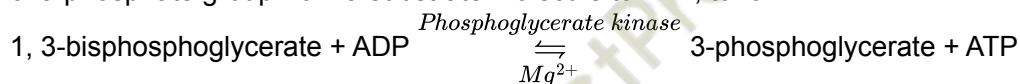
**Solution :** -

The pyruvic acid synthesised from glycolysis enters into mitochondria and undergoes oxidative decarboxylation to produce CO<sub>2</sub> and NADH<sub>2</sub>. The product combines with coenzyme-A to form acetyl Co-A, It is the connecting link between glycolysis, Krebs' cycle and fat oxidation.

45. Which of the following conversions involve ATP synthesis during glycolysis?  
 a) Glucose  $\rightarrow$  Glucose - 6- phosphate    b) Fructose-6-phosphate  $\rightarrow$  Fructose-1,6-biphosphate  
**c) 1,3-bisphosphoglyceric acid (BPGA)  $\rightarrow$  3-phosphoglyceric acid (PGA)**    d) All of these

**Solution :** -

In the energy conserving phase of glycolysis, the conversion of BPGA to PGA is catalysed by phosphoglycerate kinase. The phosphate on carbon 1 is transferred to a molecule of ADP, yielding ATP and 3-phosphoglycerate. This type of ATP synthesis, traditionally referred to as substrate-level phosphorylation, involves the direct transfer of a phosphate group from a substrate molecule to ADP, to form ATP.



46. All of the following processes can release CO<sub>2</sub> except  
 a) alcoholic fermentation    b) oxidative decarboxylation and Krebs' cycle    **c) oxidative phosphorylation**  
 d) conversion of a-ketoglutaric acid to succinic acid.
47. The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that adenosine triphosphate (ATP) is formed because \_\_\_\_\_  
 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)'.

**Solution :** -

The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that Adenosine Triphosphate (ATP) is formed because a proton gradient forms across the inner membrane. Oxidative phosphorylation is the production of ATP with the help of energy liberated during oxidation of reduced coenzymes and terminal oxidation. Peter Mitchell (1961) proposed chemiosmotic theory for ATP production. According to this hypothesis when electrons flow from dual proton, electron carrier to a non-hydrogen carrier the H<sup>+</sup> are released and expelled



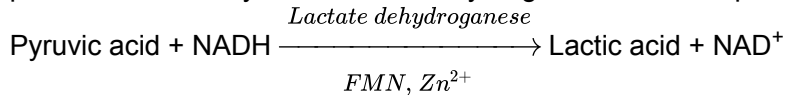
into the intermembrane space. Due to this, proton gradient is created due to higher concentration of  $H^+$  in the inter membrane space than the matrix. Due to proton motive force, the proton flow back and energy liberated during this back flow of protons activate ATPase present in F1 head to synthesise ATP.

48. Select the incorrectly matched pair

- a) End products of alcoholic fermentation - Ethanol +  $CO_2$
- b) End products of lactic acid fermentation - Lactic acid +  $CO_2$
- c) Glycolysis - Cytoplasm
- d) Key product of glycolysis - Pyruvic acid

**Solution : -**

Lactic acid fermentation occurs in lactic acid bacteria (e.g., *Lactobacillus*), some fungi and muscles. In lactic acid fermentation, pyruvic acid produced in glycolysis is directly reduced by NADH to form lactic acid. No  $CO_2$  is produced. The enzyme is lactate dehydrogenase which requires FMN and  $Zn^{2+}$



49. Apparatus to measure rate of respiration and RQ is \_\_\_\_\_

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

**Solution : -**

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

50. Life without air would be \_\_\_\_\_

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

**Solution : -**

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.