

9. Complete the following analogy and select the correct option.
Respiration: Catabolic process :: _____ :
Anabolic process

(A) Photolysis of water
(B) Photosynthesis
(C) Glycolysis
(D) Proteolysis

13.2 Anaerobic Respiration

10. Which of the following is the correct description of anaerobic respiration?

(A) It is the extracellular respiration that involves atmospheric oxygen.
(B) It is the cellular respiration that involves atmospheric oxygen.
(C) It is the cellular respiration that does not involve atmospheric oxygen.
(D) It is the substrate level phosphorylation that does not involve atmospheric oxygen.

11. Anaerobic respiration is also known as _____.

(A) oxidative decarboxylation
(B) substrate level dephosphorylation
(C) fermentation
(D) Krebs cycle

12. Anaerobic respiration occurs through _____.

(A) 10 steps (B) 5 steps
(C) 2 steps (D) 1 step

13. The term 'glycolysis' indicates breakdown of _____.

(A) glycogen
(B) glucose
(C) glucagon
(D) glyceraldehyde

14. In glycolysis, glucose is broken down into _____.

(A) one molecule of pyruvic acid
(B) two molecules of glycogen
(C) two molecules of lactic acid
(D) two molecules of pyruvic acid

15. Glycolysis occurs in _____.

(A) mitochondrial matrix
(B) inner mitochondrial membrane
(C) outer mitochondrial membrane
(D) cytoplasm

16. Glycolysis is completed through _____.

(A) 10 steps (B) 8 steps
(C) 6 steps (D) 2 steps

17. In glycolysis, preparatory phase involves _____.

(A) phosphorylation of glucose
(B) cleavage of hexose into two triose molecules.
(C) oxidation of phosphoglyceraldehyde
(D) both (A) and (B)

18. From the following identify the first step of glycolysis.

(A) Dehydrogenation of glucose
(B) Conversion of glucose into glyceraldehyde
(C) Isomerisation of DHAP
(D) Phosphorylation of glucose

19. Which of the following enzyme converts glucose to glucose-6-phosphate?

(A) Phosphofructokinase
(B) Hexokinase
(C) Phosphohexose isomerase
(D) Phosphoglyceromutase

20. The conversion of glucose-6-phosphate to fructose-6-phosphate is catalyzed by the enzyme _____.

(A) Fructokinase
(B) Hexokinase
(C) Phosphohexose isomerase
(D) Aldolase

21. Fructose 1,6-bisphosphate formed from fructose-6-phosphate is cleaved into _____.

(A) 3-PGAL and pyruvic acid
(B) 3-PGAL and DHAP
(C) 2-PGA and DHAP
(D) PEPA and 3-PGAL

22. Fructose-1,6-diphosphate splits into two triose phosphates by enzyme _____.

(A) aldolase (B) kinase
(C) zymase (D) fructokinase

23. DHAP is converted to 3-PGAL by enzyme _____.

(A) phospho-glycero-dehydrogenase
(B) phosphoglyceraldehyde dehydrogenase
(C) triose-phosphate isomerase
(D) phospho-glycero-mutase

24. Identify the CORRECT statement with respect to the steps involved in glycolysis.

(A) DHAP and PEPA are the products of cleavage in glycolysis.
(B) In glycolysis, dehydration occurs when 3-PGAL loses a water molecule (dehydration) to form PEPA.
(C) 3-PGAL undergoes oxidation and phosphorylation to form 1,3-diPGA.
(D) PEPA is phosphorylated to pyruvic acid in the presence of the enzyme pyruvate dehydrogenase.

25. Which enzyme is used for conversion of 3-PGA to 2-PGA in glycolysis?

(A) Aldolase
(B) Isomerase
(C) Hexokinase
(D) Phosphoglycerate mutase

26. In which of the following glycolysis is the source of energy production?
 (A) Erythrocytes (B) Renal medulla
 (C) Sperm (D) All of the above
27. Identify 'X' in the following reaction.
 $C_6H_{12}O_6 \xrightarrow{\text{Glycolysis}} 'X' + 2NADH + H^+ \rightarrow 2CH_3CHOHCOOH + 2NAD^+$
 (A) $6CH_3COCOOH$ (B) $2CH_3COCOOH$
 (C) $4CH_3COCOOH$ (D) $2CH_3CHO$
28. Alcoholic fermentation is a type of anaerobic respiration where the pyruvate is _____
 (A) phosphorylated to acetaldehyde
 (B) deoxygenated to acetaldehyde
 (C) decarboxylated to lactic acid
 (D) decarboxylated to acetaldehyde
29. Acetaldehyde formed during alcoholic fermentation is reduced by $NADH + H^+$ to _____
 (A) lactic acid (B) ethanol
 (C) OAA (D) fumaric acid
30. Identify the gas produced during alcoholic fermentation.
 (A) CH_4 (B) O_2
 (C) CO_2 (D) Ethephon

13.3 Aerobic Respiration

31. Which of the following statements are CORRECT with respect to aerobic respiration?
 (A) It occurs in the presence of free molecular oxygen.
 (B) It involves complete oxidation of glucose to CO_2 and H_2O with release of large amount of energy.
 (C) It involves glycolysis, acetyl CoA formation, Krebs cycle, electron transfer chain reaction and terminal oxidation.
 (D) All of the above
32. The conversion of pyruvic acid to _____ is an oxidative decarboxylation reaction.
 (A) oxaloacetic acid
 (B) acetyl CoA
 (C) phosphoenolpyruvic acid
 (D) NADP
33. The glycolytic product is converted to acetyl CoA in _____ of prokaryotes and in _____ of eukaryotes.
 (A) nucleoid, mitochondrial matrix
 (B) ribosomes, Golgi complex
 (C) cytoplasm, mitochondrial matrix
 (D) cell membrane, ER
34. The enzyme _____, converts pyruvate to acetyl CoA and CO_2 .
 (A) hexokinase
 (B) Phosphoglycerate mutase

- (C) pyruvate dehydrogenase
 (D) enolase

35. Identify the coenzyme required by pyruvate dehydrogenase.
 (A) Vitamin C (B) Thiamin
 (C) Vitamin D (D) Vitamin E
36. Which of the following is known as 'connecting link reaction' between glycolysis and Krebs cycle?
 (A) Conversion of $CH_3COCOOH$ to PEPA
 (B) Conversion of $CH_3COCOOH$ to Acetyl CoA
 (C) Conversion of CH_3COOH to 3-PGA
 (D) Conversion of $CH_3COCOOH$ to OAA
37. Where does Krebs cycle occur in cell?
 (A) Inner mitochondrial membrane
 (B) Outer mitochondrial membrane
 (C) Mitochondrial matrix
 (D) Cytoplasm
38. Identify the CORRECT statement with respect to Krebs cycle.
 (A) Some intermediates of the TCA cycle are used in synthesizing important biomolecules like glutamate and aspartate.
 (B) Krebs cycle occurs on inner mitochondrial membrane.
 (C) Some intermediates of TCA cycle are formed on inner mitochondrial matrix.
 (D) Krebs cycle acts as a connecting link between glycolysis and alcoholic fermentation.
39. Identify the number of carboxylic groups present in 1st organic acid formed during Krebs cycle.
 (A) 3 (B) 5 (C) 6 (D) 8
40. Acetyl Co-A (2C) combines with water and Oxaloacetic acid (4C) to form _____.
 (A) cis-Aconitic acid (6C)
 (B) Citric acid (6C)
 (C) Oxalosuccinic acid (6C)
 (D) Iso-citric acid (6C)
41. $OAA + \text{acetyl-Co-A} \rightarrow \text{Citrate} + \text{Co-A}$, is catalyzed by
 (A) aconitase
 (B) citrate synthase
 (C) citrate synthase
 (D) iso-citrate dehydrogenase
42. When _____ α -ketoglutarate undergoes dehydrogenation and decarboxylation reaction
 (A) CO_2 is released
 (B) formation of succinyl Co-A by the action of α -ketoglutarate dehydrogenase
 (C) $NADH_2$ is formed
 (D) all of the above

63. Respiratory quotient refers to
 (A) the ratio between the amount of CO_2 produced to the amount of O_2 consumed.
 (B) the ratio of amount of ATP produced to the amount of ATP lost during respiration.
 (C) amount of CO_2 produced.
 (D) the number of glucose molecules breaking up to produce energy in one hour.
64. The respiratory quotient (R.Q.) of carbohydrate is _____
 (A) 0.7 (B) 1 (C) 0.9 (D) 0.1
65. R. Q. for proteins is about _____.
 (A) 0.7 (B) 0.8 (C) 0.9 (D) 1.0



Critical Thinking



13.1 ATP Formation

1. Study the following statements and select the CORRECT option.
Statement I: Substrate-level phosphorylation is a direct phosphorylation of ADP by transfer of a phosphate group from any suitable substrate.
Statement II: In oxidative phosphorylation ATP is synthesized by using the energy released during the oxidation of substrates like $\text{NADH} + \text{H}^+$ and FADH_2 .
 (A) Statement I is correct.
 (B) Statement II is correct.
 (C) Both statements I and II are correct.
 (D) Both statements I and II are incorrect.
2. Chemically, ATP is a
 (A) pentose sugar called ribose.
 (B) diphosphate ester of purine.
 (C) triphosphate ester of thymine ribonucleoside.
 (D) triphosphate ester of adenosine ribonucleoside.



13.2 Anaerobic Respiration

3. First chemical step in respiration is
 (A) glycolysis
 (B) Krebs cycle
 (C) Calvin cycle
 (D) photophosphorylation
4. First _____ constitute the preparatory phase through which glucose is phosphorylated twice at the cost of _____ molecules.
 (A) 6 steps, 2 ATP (B) 5 steps, 4 ATP
 (C) 5 steps, 2 ATP (D) 5 steps, 6 ATP
5. In glycolysis, phosphorylation reaction leads to conversion of glucose to glucose-6-phosphate. How many carbon atoms are added to glucose to make it glucose-6-phosphate?
 (A) 0 (B) 1 (C) 2 (D) 4

6. Arrange the following in the order of their occurrence in the glycolytic pathway.
 i. Dihydroxy acetone phosphate \rightarrow Glyceraldehyde-3-phosphate
 ii. Fructose-6-phosphate \rightarrow Fructose 1, 6-bisphosphate
 iii. Phosphoenolpyruvate \rightarrow Pyruvic acid
 iv. 2-Phosphoglycerate \rightarrow Phosphoenolpyruvate
 v. Glucose-6-phosphate \rightarrow Fructose-6-phosphate
 vi. 1,3-bisphosphoglyceric acid \rightarrow 3-phosphoglyceric acid
 (A) v, vi, ii, i, iv, iii
 (B) ii, i, iv, v, iii, vi
 (C) v, ii, iv, i, vi, iii
 (D) v, ii, i, vi, iv, iii
7. The total no. of ATP formed directly in glycolysis
 (A) 4 (B) 10 (C) 8 (D) 6
8. In which of the following reactions ATP is NOT used?
 (A) Fructose-6-phosphate \rightarrow fructose-1, 6-diphosphate
 (B) Glucose \rightarrow glucose-6-phosphate
 (C) 3 phosphoglyceraldehyde \rightarrow 1,3-diphosphoglyceric acid
 (D) Both (A) and (B)
9. Which of the following is NOT a phosphate donor in glycolysis?
 (A) PEPA (B) ATP
 (C) H_3PO_4 (D) NADP
10. Pyruvic acid formed in glycolysis is
 (A) 2 carbon (B) 3 carbon
 (C) 4 carbon (D) 6 carbon
11. How many 3 carbon compounds are formed during glycolysis?
 (A) 4 (B) 5 (C) 6 (D) 7
12. For which of the following reasons less energy is produced during anaerobic respiration than in aerobic respiration?
 i. Incomplete breakdown of respiratory substrate.
 ii. NADH_2 does not produce ATP, as electron transport is absent.
 iii. Glycolysis does not occur during anaerobic respiration.
 (A) i (B) ii
 (C) i and iii (D) i and ii
13. Which of the following are end products of pyruvic acid during alcoholic fermentation?
 (A) Ethanol + O_2
 (B) Ethanol + Energy + FADH_2
 (C) $\text{CH}_2\text{O}_2 + \text{H}_2\text{O} + \text{Energy}$
 (D) Ethanol + $\text{CO}_2 + \text{Energy}$



Competitive Thinking



13.1 ATP Formation

1. Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP? [NEET (UG) 2017]
- (A) Lysosome (B) Ribosome
(C) Chloroplast (D) Mitochondrion



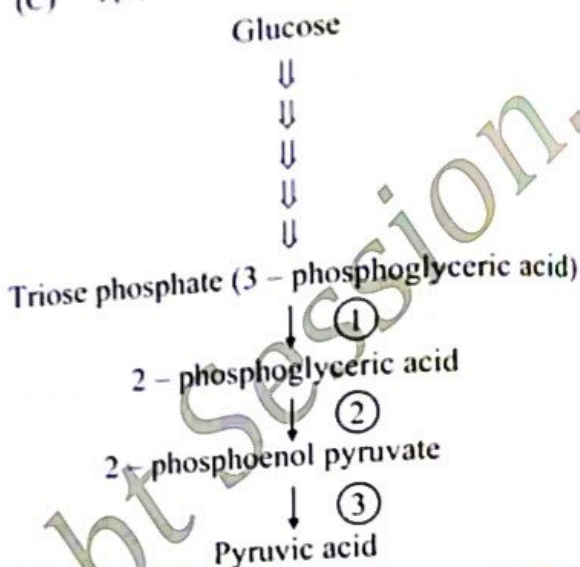
13.2 Anaerobic Respiration

2. Number of oxygen molecules utilized in glycolysis is [MHT CET 2017]
- (A) 0 (B) 2
(C) 4 (D) 6
3. The number of ATP molecules utilized for the breakdown of one molecule of glucose during glycolysis is [KCET 2017]
- (A) 4 (B) 2 (C) 6 (D) 8
4. During glycolysis the compounds PGAL and DHAP are formed from fructose 1, 6 diphosphate by [MHT CET 2017]
- (A) cleavage (B) isomerisation
(C) phosphorylation (D) condensation
5. Enzyme enolase catalyses the conversion of 2 PGA to Phosphoenol Pyruvic acid in presence of _____ which is the cofactor [MH CET 2014]
- (A) Mn^{++} (B) Fe^{++}
(C) Mg^{++} (D) Zn^{++}
6. How many glucose molecules are required for the formation of 52 pyruvic acid molecules at the end of glycolysis? [MHT CET 2016]
- (A) 52 (B) 46
(C) 32 (D) 26
7. In EMP pathway, ATP is directly formed in the conversion of:
- Fructose 1, 6 - bisphosphate to glyceraldehyde - 3 - phosphate
 - Phosphoenolpyruvate to pyruvic acid
 - 1, 3 - bisphosphoglyceric acid to 2 - phosphoglycerate
 - 3 - phosphoglyceric acid to 2 - phosphoglycerate
- [ITS EAMCET 2017]
- (A) iv, i (B) ii, iv
(C) iii, ii (D) i, iii
8. Arrange the following in the order of their occurrence with regard to glycolysis [ITS EAMCET 2019]
- Phosphoenolpyruvate
 - 2 - phosphoglycerate
 - 1, 3 - bisphosphoglyceric acid

- IV. 3 - Phosphoglyceric acid
V. Pyruvic acid

The correct sequence is:

- (A) II, III, I, V, IV (B) III, IV, II, I, V
(C) V, I, III, II, IV (D) IV, II, III, I, V



[ITS EAMCET 2017]

The enzymes catalyzing reactions 1, 2 and 3 respectively in the above steps are

- (A) Phosphoglyceromutase, Enolase, Pyruvate kinase
(B) Enolase, Phosphofructokinase, Pyruvate kinase
(C) Phosphoglycerokinase, Enolase, Pyruvate kinase
(D) G-3-P dehydrogenase, Enolase, Phosphoglyceromutase
10. What is the end product of glycolysis process? [GUJ CET 2017]
- (A) CH_3CH_2OH
(B) $CH_3CO.COOH$
(C) $CH_3HCOH-COOH$
(D) CH_3CH_2COOH
11. During anaerobic respiration, number of ATP molecules generated by the breakdown of 20 glucose molecules is [MHT CET 2017]
- (A) 90 (B) 60 (C) 40 (D) 20
12. Which process does the following equation represent?
- $$C_6H_{12}O_6 + 2NAD + 2ADP + 2P_i \longrightarrow CH_3-CO-COOH + 2NADH_2 + 2ATP$$
- [MH CET 2015]
- (A) Complete glycolysis
(B) Complete aerobic respiration
(C) Complete anaerobic respiration
(D) Complete fermentation
13. How many NAD molecules get reduced during incomplete oxidation of one glucose molecule? [MH CET 2014]
- (A) 2 (B) 5 (C) 10 (D) 12