CR

MULTIPLE-CHOICE QUESTIONS

1. The role of oxygen in aerobic respiration is

   (A) to transport CO_2
   (B) most important in the Krebs cycle
   (C) to provide electrons for the electron transport chain
   (D) as the final H_2 acceptor in the electron transport chain

2. The loss of hydrogen or electrons is known as

   (A) dehydration
   (B) hydrogenation
   (C) reduction
   (D) oxidation

3. $C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 + 38\ ATP$

   The process shown is

   (A) reduction and is endergonic
   (B) reduction and is exergonic
   (C) oxidation and is endergonic
   (D) oxidation and is exergonic

4. Most energy during cell respiration is harvested during

   (A) the Krebs cycle
   (B) oxidative phosphorylation
   (C) glycolysis
   (D) anaerobic respiration

5. All of the following processes produce ATP EXCEPT

   (A) lactic acid formation
   (B) oxidative phosphorylation
   (C) glycolysis
   (D) the Krebs cycle

6. After strenuous exercise, a muscle cell would contain decreased amounts of _____ and increased amounts of _____.

   (A) glucose; ATP
   (B) ATP; glucose
   (C) ATP; lactic acid
   (D) lactic acid; ATP

Match each process with its correct location

7. Glycolysis
8. Electron transport chain
9. Krebs cycle

(A) The cristae membrane
(B) Cytoplasm
(C) Inner matrix of the mitochondria

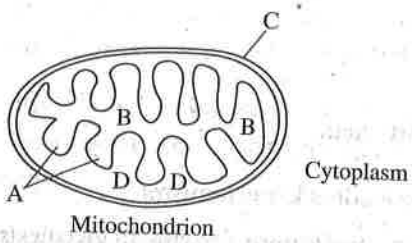
The three circles represent three major processes in aerobic respiration.

glucose → (process *A*) → (process *B*) → (process *C*) → $CO_2 + H_2O$

10. Process *C* represents
    (A) glycolysis
    (B) the Krebs cycle
    (C) the electron transport chain
    (D) substrate level phosphorylation

Questions 11–12

The following questions refer to the sketch of a mitochondrion, shown below.



11. Identify the site of the Krebs cycle in the sketch of the mitochondrion.

12. Identify the site of the ATP synthase.

13. Each NAD molecule carrying hydrogen to the electron transport chain can produce a maximum of _____ molecules of ATP?
    (A) 1
    (B) 2
    (C) 3
    (D) 4

14. Which is true of aerobic respiration but not true of anaerobic respiration?
    (A) CO_2 is produced.
    (B) ATP is produced.
    (C) Water is produced.
    (D) Alcohol is produced.

15. Which of the following is the most important thing that happens during aerobic respiration?

(A) Electrons move down the electron transport chain in a series of redox reactions.
(B) Acetyl CoA enters the Krebs cycle.
(C) NAD carries hydrogen to the electron transport chain.
(D) ATP is produced.

16. The ATP produced during glycolysis is generated by which of the following?

(A) the electron transport chain
(B) substrate level phosphorylation
(C) oxidative phosphorylation
(D) chemiosmosis

17. In addition to ATP, what is produced during glycolysis?

(A) pyruvate and NADH
(B) CO_2 and H_2O
(C) CO_2 and ethyl alcohol
(D) CO_2 and NADH

18. Which of the following probably evolved first?

(A) the Krebs cycle
(B) oxidative phosphorylation
(C) glycolysis
(D) the electron transport chain

19. Which is an example of a feedback mechanism?

(A) Phosphofructokinase, an allosteric enzyme in glycolysis, is inhibited by ATP.
(B) Lactic acid gets converted back to pyruvic acid in the human liver.
(C) ATP is produced in mitochondria as protons flow through the ATP-synthase channel.
(D) Energy is released from glucose as it decomposes into CO_2 and H_2O.

20. Which process of cell respiration is most closely associated with intracellular membranes?

(A) oxidative phosphorylation
(B) the Krebs cycle
(C) glycolysis
(D) substrate level phosphorylation

21. During cell respiration, most ATP is formed as a direct result of the net movement of

(A) electrons flowing against a gradient
(B) electrons flowing through a channel
(C) protons flowing through a channel
(D) protons flowing against a gradient

22. Glycolysis is the first phase of aerobic cellular respiration. It is a complex, enzyme-controlled set of reactions in which glucose molecules are broken down into pyruvate in the absence of oxygen. Although it does not produce much ATP, glycolysis is important because pyruvate is the raw material for the next phase of cellular respiration, which will ultimately produce large amounts of ATP by oxidative phosphorylation. One of the enzymes at the beginning of glycolysis is PFK, phosphofructokinase, an allosteric enzyme. When ATP binds to the allosteric site on PFK, the enzyme changes shape and no longer functions. Which of the following statements best explains the importance of the enzyme PFK in glycolysis?

(A) PFK inhibits glycolysis when oxygen levels are high.
(B) PFK enables glycolysis to continue when no oxygen is present.
(C) PFK inhibits the production of ATP when ATP levels are high.
(D) PFK enhances the production of ATP when ATP levels are high.

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Answers to Multiple-Choice Questions

1. **(D)** Oxygen is the final hydrogen and electron acceptor in the electron transport chain. CO_2 is formed and released by cellular respiration. Oxygen does not take part in glycolysis or in the Krebs cycle.

2. **(D)** The loss of protons (H^+) or loss of electrons is known as oxidation. The gain of protons (H^+) or of electrons is known as reduction because when electrons are added to an atom, the charge on the atom is reduced.

3. **(D)** This process, cell respiration, is exergonic because energy is being released. It is an oxidation reaction because carbon loses hydrogen atoms and oxidation is defined as the loss of hydrogen atoms.

4. **(B)** A small amount of ATP is produced by substrate level phosphorylation during glycolysis and the Krebs cycle. However, most of the ATP produced during cell respiration occurs by chemiosmosis or oxidative phosphorylation during the electron transport chain.

5. **(A)** Lactic acid is produced from pyruvic acid during fermentation but does not result in the production of energy. All the other choices produce ATP. Oxidative phosphorylation is the process by which ATP is produced during the ETC.

6. **(C)** During sustained strenuous exercise, muscle cells use up ATP and oxygen as they carry out anaerobic respiration. Anaerobic respiration produces lactic acid, which causes weakness and fatigue in the muscle.

7. **(B)** Glycolysis occurs in the cytoplasm.

8. **(A)** The electron transport chain is located within the cristae membrane of the mitochondria.

9. **(C)** The Krebs cycle occurs in the matrix of the mitochondria.

10. **(C)** The order of energy in producing processes in cell respiration is glycolysis, the Krebs cycle, then the electron transport chain.

11. **(B)** The Krebs cycle takes place in the matrix of the mitochondrion.

12. **(A)** The ATP synthase molecules lie within the cristae membrane.

13. **(C)** Each NADH can produce up to 3 ATP, and each FAD produces 2 ATP.

14. **(C)** Water is produced as oxygen combines with hydrogen flowing through the ATP synthase during chemiosmosis of aerobic respiration only. This does not occur in anaerobic respiration. CO_2 is produced in both the aerobic (Krebs cycle) and in anaerobic fermentation. ATP is produced in anaerobic and aerobic respiration. Alcohol is produced only in anaerobic respiration.

15. **(D)** Choices A, B, and C all describe events that occur during cell respiration and lead up to the production of ATP. However, the most important event in respiration is the production of ATP.

16. **(B)** Substrate level phosphorylation is responsible for the production of ATP during glycolysis and the citric acid cycle (also known as the Krebs cycle). It does not produce as much ATP as does chemiosmosis.

17. **(A)** ATP, NADH, and pyruvate are the end products of glycolysis. CO_2 is a by-product of the Krebs cycle. H_2O is a waste product of chemiosmosis and is formed when protons combine with electrons and oxygen. Ethyl alcohol is a by-product of alcoholic fermentation.

18. **(C)** Glycolysis occurs in the first phase of cell respiration and does not require oxygen. The first organisms on earth were probably anaerobes because no free oxygen was available in the atmosphere. Choices A, B, and D all require free oxygen.

19. **(A)** Choices B–D are all correct statements about respiration, but they are not examples of a feedback mechanism. Choice A is an example of negative feedback because when plenty of ATP is available in the cell to meet demand, respiration slows down, conserving valuable molecules and energy for other functions.

20. **(A)** Oxidative phosphorylation occurs as protons flow through the ATP synthase channel within the cristae membrane of the mitochondria. The Krebs cycle occurs within the matrix of the mitochondria. Glycolysis occurs in the cytoplasm of the cell. Substrate level phosphorylation explains how ATP is produced from the Krebs cycle and glycolysis.

21. **(C)** Most of the ATP produced during cell respiration comes from oxidative phosphorylation as protons flow through the ATP synthase channel in the cristae membrane.

22. **(C)** The focus of the question is on PFK and the fact that it is an allosteric enzyme. The stem of the question states that ATP is an inhibitor of PFK. So when ATP levels are high, PFK does not function. That means that when ATP levels are high, PFK stops functioning and glycolysis and the rest of cellular respiration are shut down. This makes sense because the purpose of cellular respiration is to produce ATP. So, if ATP is present, there is no need to produce more. PFK is the key to that feedback—or allosteric—mechanism.