III. 6. Test. Respiració cel·lular

Chapter Questions

1) What is the term for metabolic pathways that release stored energy by breaking down complex molecules?
A) anabolic pathways
B) catabolic pathways
C) fermentation pathways
D) thermodynamic pathways
E) bioenergetic pathways
Answer: B
Topic: Concept 9.1
Skill: Knowledge

2) What is the term used for the metabolic pathway in which glucose ($C_6H_{12}O_6$) is degraded to carbon dioxide (CO_2) and water?
A) cellular respiration
B) glycolysis
C) fermentation
D) citric acid cycle
E) oxidative phosphorylation
Answer: A
Topic: Concept 9.1
Skill: Knowledge

3) Which of the following statements concerning the metabolic degradation of glucose ($C_6H_{12}O_6$) to carbon dioxide (CO_2) and water is (are) *true*?
A) The breakdown of glucose to carbon dioxide and water is exergonic.
B) The breakdown of glucose to carbon dioxide and water has a free energy change of -686 kcal/mol.
C) The breakdown of glucose to carbon dioxide and water involves oxidation-reduction or redox reactions.
D) Only A and B are correct.
E) A, B, and C are correct.
Answer: E
Topic: Concept 9.1
Skill: Comprehension

4) Which of the following statements is (are) correct about an oxidation-reduction (or redox) reaction?
A) The molecule that is reduced gains electrons.
B) The molecule that is oxidized loses electrons.
C) The molecule that is reduced loses electrons.
D) The molecule that is oxidized gains electrons.
E) Both A and B are correct.
Answer: E
Topic: Concept 9.1
Skill: Knowledge

5) Which statement is *not* correct with regard to redox (oxidation-reduction) reactions?
A) A molecule is reduced if it loses electrons.
B) A molecule is oxidized if it loses electrons.
C) An electron donor is called a reducing agent.
D) An electron acceptor is called an oxidizing agent.
E) Oxidation and reduction always go together.
Answer: A
Topic: Concept 9.1
Skill: Knowledge

6) The molecule that functions as the reducing agent (electron donor) in a redox or oxidation-reduction reaction
A) gains electrons and gains energy.
B) loses electrons and loses energy.
C) gains electrons and loses energy.
D) loses electrons and gains energy.
E) neither gains nor loses electrons, but gains or loses energy.
Answer: B
Topic: Concept 9.1
Skill: Comprehension

7) When electrons move closer to a more electronegative atom, what happens?
A) Energy is released.
B) Energy is consumed.
C) The more electronegative atom is reduced.
D) The more electronegative atom is oxidized.
E) A and C are correct.
Answer: E
Topic: Concept 9.1
Skill: Comprehension

8) Why does the oxidation of organic compounds by molecular oxygen to produce CO_2 and water release free energy?
A) The covalent bonds in organic molecules are higher energy bonds than those in water and carbon dioxide.
B) Electrons are being moved from atoms that have a lower affinity for electrons (such as C) to atoms with a higher affinity for electrons (such as O).
C) The oxidation of organic compounds can be used to make ATP.
D) The electrons have a higher potential energy when associated with water and CO_2 than they do in organic compounds.
E) The covalent bond in O_2 is unstable and easily broken by electrons from organic molecules.
Answer: B
Topic: Concept 9.1
Skill: Comprehension

9) Which of the following statements describes the results of this reaction?

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

A) $C_6H_{12}O_6$ is oxidized and O_2 is reduced.
B) O_2 is oxidized and H_2O is reduced.
C) CO_2 is reduced and O_2 is oxidized.
D) $C_6H_{12}O_6$is reduced and CO_2 is oxidized.
E) O_2 is reduced and CO_2 is oxidized.
Answer: A
Topic: Concept 9.1
Skill: Comprehension

10) When a glucose molecule loses a hydrogen atom (not a hydrogen ion) as the result of an oxidation-reduction reaction, the molecule becomes
A) dehydrogenated.
B) hydrogenated.
C) oxidized.
D) reduced.
E) an oxidizing agent.
Answer: C
Topic: Concept 9.1
Skill: Comprehension

11) When a molecule of NAD^+ (nicotinamide adenine dinucleotide) gains a hydrogen atom (not a hydrogen ion) the molecule becomes
A) hydrogenated.
B) oxidized.
C) reduced.
D) redoxed.
E) a reducing agent.
Answer: C
Topic: Concept 9.1
Skill: Comprehension

12) Which of the following statements about NAD^+ is *false*?
A) NAD^+ is reduced to NADH during both glycolysis and the citric acid cycle.
B) NAD^+ has more chemical energy than NADH.
C) NAD^+ is reduced by the action of dehydrogenases.
D) NAD^+ can receive electrons for use in oxidative phosphorylation.
E) In the absence of NAD^+, glycolysis cannot function.
Answer: B
Topic: Concept 9.1
Skill: Comprehension

13) In order for NAD^+ to remove electrons from glucose or other organic molecules, which of the following must be true?
A) The organic molecule or glucose must be negatively charged in order to reduce the positively charged NAD^+.
B) Oxygen must be present to oxidize the NADH produced back to NAD^+.
C) The free energy liberated when electrons are removed from the organic molecules must be greater than the energy required to give the electrons to NAD^+.
D) A and B are both correct.
E) A, B, and C are all correct.
Answer: C
Topic: Concept 9.1
Skill: Comprehension

14) Where does glycolysis takes place?
A) mitochondrial matrix
B) mitochondrial outer membrane
C) mitochondrial inner membrane
D) mitochondrial intermembrane space
E) cytosol
Answer: E
Topic: Concept 9.1
Skill: Knowledge

15) The ATP made during glycolysis is generated by
A) substrate-level phosphorylation.
B) electron transport.
C) photophosphorylation.
D) chemiosmosis.
E) oxidation of NADH to NAD^+.
Answer: A
Topic: Concept 9.1
Skill: Knowledge

16) The oxygen consumed during cellular respiration is involved directly in which process or event?
A) glycolysis
B) accepting electrons at the end of the electron transport chain
C) the citric acid cycle
D) the oxidation of pyruvate to acetyl CoA
E) the phosphorylation of ADP to form ATP
Answer: B
Topic: Concept 9.1
Skill: Knowledge

17) Which process in eukaryotic cells will proceed normally whether oxygen (O_2) is present or absent?
A) electron transport
B) glycolysis
C) the citric acid cycle
D) oxidative phosphorylation
E) chemiosmosis
Answer: B
Topic: Concept 9.1
Skill: Knowledge

18) Which of the following statements about glycolysis *false*?
A) Glycolysis has steps involving oxidation-reduction reactions.
B) The enzymes of glycolysis are located in the cytosol of the cell.
C) Glycolysis can operate in the complete absence of O_2.
D) The end products of glycolysis are CO_2 and H_2O.
E) Glycolysis makes ATP exclusively through substrate-level phosphorylation.
Answer: D
Topic: Concepts 9.1, 9.2
Skill: Knowledge

Refer to Figure 9.1 to answer the following questions.

Figure 9.1 illustrates some of the steps (reactions) of glycolysis in their proper sequence. Each step is lettered. Use these letters to answer the questions.

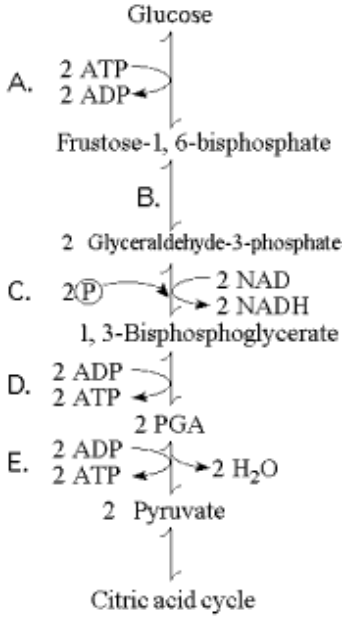

Figure 9.1

19) Which step shows a split of one molecule into two smaller molecules?
Answer: B
Topic: Concept 9.2
Skill: Comprehension

20) In which step is an inorganic phosphate added to the reactant?
Answer: C
Topic: Concept 9.2
Skill: Comprehension

21) In which reaction does an intermediate pathway become oxidized?
Answer: C
Topic: Concept 9.2
Skill: Comprehension

22) Which step involves an endergonic reaction?
Answer: A
Topic: Concept 9.2
Skill: Comprehension

23) Which step consists of a phosphorylation reaction in which ATP is the phosphate source?
Answer: A
Topic: Concept 9.2
Skill: Comprehension

24) Substrate-level phosphorylation accounts for approximately what percentage of the ATP formed during glycolysis?
A) 0%
B) 2%
C) 10%
D) 38%
E) 100%
Answer: E
Topic: Concept 9.2
Skill: Application

25) During glycolysis, when glucose is catabolized to pyruvate, most of the energy of glucose is
A) transferred to ADP, forming ATP.
B) transferred directly to ATP.
C) retained in the pyruvate.
D) stored in the NADH produced.
E) used to phosphorylate fructose to form fructose-6-phosphate.
Answer: C
Topic: Concept 9.2
Skill: Comprehension

26) In addition to ATP, what are the end products of glycolysis?
A) CO_2 and H_2O
B) CO_2 and pyruvate
C) NADH and pyruvate
D) CO_2 and NADH
E) H_2O, $FADH_2$, and citrate
Answer: C
Topic: Concept 9.2
Skill: Knowledge

27) The free energy for the oxidation of glucose to CO_2 and water is -686 kcal/mole and the free energy for the reduction of NAD^+ to NADH is +53 kcal/mole. Why are only two molecules of NADH formed during glycolysis when it appears that as many as a dozen could be formed?
A) Most of the free energy available from the oxidation of glucose is used in the production of ATP in glycolysis.
B) Glycolysis is a very inefficient reaction, with much of the energy of glucose released as heat.
C) Most of the free energy available from the oxidation of glucose remains in pyruvate, one of the products of glycolysis.
D) There is no CO_2 or water produced as products of glycolysis.
E) Glycolysis consists of many enzymatic reactions, each of which extracts some energy from the glucose molecule.
Answer: C
Topic: Concept 9.2
Skill: Comprehension

28) Starting with one molecule of glucose, the "net" products of glycolysis are
A) 2 NAD^+, 2 H^+, 2 pyruvate, 2 ATP, and 2 H_2O.
B) 2 NADH, 2 H^+, 2 pyruvate, 2 ATP, and 2 H_2O.
C) 2 $FADH_2$, 2 pyruvate, 4 ATP, and 2 H_2O.
D) 6 CO_2, 6 H_2O, 2 ATP, and 2 pyruvate.
E) 6 CO_2, 6 H_2O, 36 ATP, and 2 citrate.
Answer: B
Topic: Concept 9.2
Skill: Comprehension

29) In glycolysis, for each molecule of glucose oxidized to pyruvate
A) 2 molecules of ATP are used and 2 molecules of ATP are produced.
B) 2 molecules of ATP are used and 4 molecules of ATP are produced.
C) 4 molecules of ATP are used and 2 molecules of ATP are produced.
D) 2 molecules of ATP are used and 6 molecules of ATP are produced.
E) 6 molecules of ATP are used and 6 molecules of ATP are produced.
Answer: B
Topic: Concept 9.2
Skill: Comprehension

30) A molecule that is phosphorylated
A) has an increased chemical reactivity; it is primed to do cellular work.
B) has a decreased chemical reactivity; it is less likely to provide energy for cellular work.
C) has been oxidized as a result of a redox reaction involving the gain of an inorganic phosphate.
D) has been reduced as a result of a redox reaction involving the loss of an inorganic phosphate.
E) has less energy than before its phosphorylation and therefore less energy for cellular work.
Answer: A
Topic: Concept 9.2
Skill: Comprehension

31) Which kind of metabolic poison would most directly interfere with glycolysis?
A) An agent that reacts with oxygen and depletes its concentration in the cell
B) An agent that binds to pyruvate and inactivates it
C) An agent that closely mimics the structure of glucose but is not metabolized
D) An agent that reacts with NADH and oxidizes it to NAD^+
E) An agent that blocks the passage of electrons along the electron transport chain

Topic: Concept 9.2
Skill: Application

32) In the presence of oxygen, the three-carbon compound pyruvate can be catabolized in the citric acid cycle. First, however, the pyruvate 1) loses a carbon, which is given off as a molecule of CO_2, 2) is oxidized to form a two-carbon compound called acetate, and 3) is bonded to coenzyme A. These three steps result in the formation of
A) acetyl CoA, O_2, and ATP.
B) acetyl CoA, $FADH_2$, and CO_2.
C) acetyl CoA, FAD, H_2, and CO_2.
D) acetyl CoA, NADH, H^+, and CO_2.
E) acetyl CoA, NAD^+, ATP, and CO_2.

Topic: Concept 9.3
Skill: Application

33) Which of the following intermediary metabolites enters the citric acid cycle and is formed, in part, by the removal of a carbon (CO_2) from one molecule of pyruvate?
A) lactate
B) glyceraldehydes-3-phosphate
C) oxaloacetate
D) acetyl CoA
E) citrate

Topic: Concept 9.3
Skill: Knowledge

34) During cellular respiration, acetyl CoA accumulates in which location?
A) cytosol
B) mitochondrial outer membrane
C) mitochondrial inner membrane
D) mitochondrial intermembrane space
E) mitochondrial matrix

Topic: Concept 9.3
Skill: Knowledge

35) How many carbon atoms are fed into the citric acid cycle as a result of the oxidation of one molecule of pyruvate?
A) 2
B) 4
C) 6
D) 8
E) 10

Topic: Concept 9.3
Skill: Comprehension

36) All of the following are functions of the citric acid cycle *except*
A) production of ATP.
B) production of NADH.
C) production of $FADH_2$.
D) release of carbon dioxide.
E) adding electrons and protons to oxygen, forming water.

Topic: Concept 9.3
Skill: Application

Refer to Figure 9.2, showing the citric acid cycle, as a guide to answer the following questions.

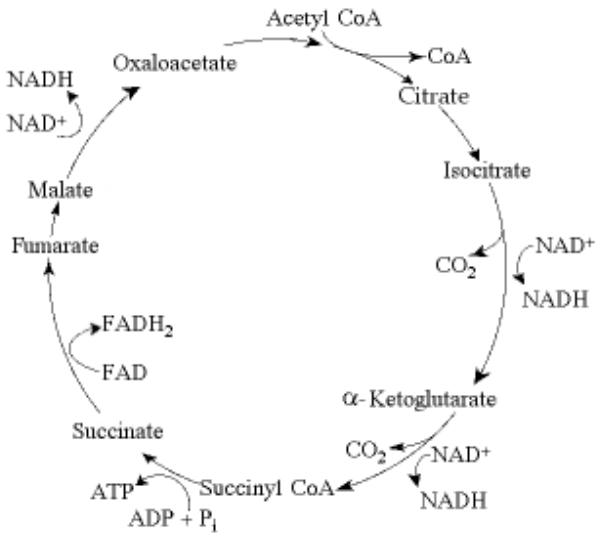

Figure 9.2

37) Starting with one molecule of isocitrate and ending with fumarate, what is the maximum number of ATP molecules that could be made through substrate-level phosphorylation?
A) 1
B) 2
C) 11
D) 12
E) 24

Topic: Concept 9.3
Skill: Comprehension

38) Carbon skeletons for amino acid biosynthesis are supplied by intermediates of the citric acid cycle. Which intermediate would supply the carbon skeleton for synthesis of a five-carbon amino acid?
A) succinate
B) malate
C) citrate
D) α-ketoglutarate
E) isocitrate

Topic: Concept 9.3
Skill: Application

39) Starting with one molecule of citrate and ending with oxaloacetate, how many ATP molecules can be formed from oxidative phosphorylation (chemiosmosis)?
A) 1
B) 3
C) 4
D) 11
E) 12

Topic: Concepts 9.3, 9.4
Skill: Comprehension

40) How many ATP molecules could be made through substrate-level phosphorylation plus oxidative phosphorylation (chemiosmosis) if you started with three molecules of succinyl CoA and ended with oxaloacetate?
A) 6
B) 12
C) 18
D) 24
E) 36

Topic: Concepts 9.3, 9.4
Skill: Application

41) How many molecules of carbon dioxide (CO_2) would be produced by five turns of the citric acid cycle?
A) 2
B) 5
C) 10
D) 12
E) 60

Topic: Concept 9.3
Skill: Application

42) How many reduced dinucleotides would be produced with four turns of the citric acid cycle?
A) 1 $FADH_2$ and 4 NADH
B) 2 $FADH_2$ and 8 NADH
C) 4 $FADH_2$ and 12 NADH
D) 1 FAD and 4 NAD^+
E) 4 FAD^+ and 12 NAD^+

Topic: Concept 9.3
Skill: Comprehension

43) Starting with citrate, how many of the following would be produced with three turns of the citric acid cycle?
A) 1 ATP, 2 CO_2, 3 NADH, and 1 $FADH_2$
B) 2 ATP, 2 CO_2, 1 NADH, and 3 $FADH_2$
C) 3 ATP, 3 CO_2, 3 NADH, and 3 $FADH_2$
D) 3 ATP, 6 CO_2, 9 NADH, and 3 $FADH_2$
E) 38 ATP, 6 CO_2, 3 NADH, and 12 $FADH_2$

Topic: Concept 9.3
Skill: Comprehension

44) Carbon dioxide (CO_2) is released during which of the following stages of cellular respiration?
A) glycolysis and the oxidation of pyruvate to acetyl CoA
B) oxidation of pyruvate to acetyl CoA and the citric acid cycle
C) the citric acid cycle and oxidative phosphorylation
D) oxidative phosphorylation and fermentation
E) fermentation and glycolysis

Topic: Concept 9.3
Skill: Knowledge

45) For each molecule of glucose that is metabolized by glycolysis and the citric acid cycle, what is the total number of NADH + $FADH_2$ molecules produced?
A) 4
B) 5
C) 6
D) 10
E) 12

Topic: Concept 9.3
Skill: Comprehension

47) Cellular respiration harvests the most chemical energy from which of the following?
A) substrate-level phosphorylation
B) chemiosmotic phosphorylation
C) converting oxygen to ATP
D) transferring electrons from organic molecules to pyruvate
E) generating carbon dioxide and oxygen in the electron transport chain

Topic: Concept 9.3
Skill: Knowledge

48) During aerobic respiration, electrons travel downhill in which sequence?
A) food → citric acid cycle → ATP → NAD^+
B) food → NADH → electron transport chain → oxygen
C) glucose → pyruvate → ATP→ oxygen
D) glucose → ATP → electron transport chain → NADH
E) food → glycolysis → citric acid cycle → NADH → ATP

Topic: Concept 9.3
Skill: Application

49) Where do the catabolic products of fatty acid breakdown enter into the citric acid cycle?
A) pyruvate
B) malate or fumarate
C) acetyl CoA
D) α-ketoglutarate
E) succinyl CoA

Topic: Concept 9.3
Skill: Comprehension

50) Where are the proteins of the electron transport chain located?
A) cytosol
B) mitochondrial outer membrane
C) mitochondrial inner membrane
D) mitochondrial intermembrane space
E) mitochondrial matrix

Topic: Concept 9.4
Skill: Knowledge

52) During aerobic respiration, which of the following directly donates electrons to the electron transport chain at the lowest energy level?
A) NAD^+
B) NADH
C) ATP
D) ADP + P_i
E) $FADH_2$

Topic: Concept 9.4
Skill: Knowledge

53) The primary role of oxygen in cellular respiration is to
A) yield energy in the form of ATP as it is passed down the respiratory chain.
B) act as an acceptor for electrons and hydrogen, forming water.
C) combine with carbon, forming CO_2.
D) combine with lactate, forming pyruvate.
E) catalyze the reactions of glycolysis.

Topic: Concept 9.4
Skill: Knowledge

54) Inside an active mitochondrion, most electrons follow which pathway?
A) glycolysis → NADH → oxidative phosphorylation → ATP → oxygen
B) citric acid cycle → $FADH_2$ → electron transport chain → ATP
C) electron transport chain → citric acid cycle → ATP → oxygen
D) pyruvate → citric acid cycle → ATP → NADH → oxygen
E) citric acid cycle → NADH → electron transport chain → oxygen

Topic: Concept 9.4
Skill: Comprehension

55) During oxidative phosphorylation, H_2O is formed. Where does the oxygen for the synthesis of the water come from?
A) carbon dioxide (CO_2)
B) glucose ($C_6H_{12}O_6$)
C) molecular oxygen (O_2)
D) pyruvate ($C_3H_3O_3^-$)
E) lactate ($C_3H_5O_3^{--}$)
A
Topic: Concept 9.4
Skill: Knowledge

56) Which metabolic process is most closely associated with intracellular membranes?
A) substrate-level phosphorylation
B) oxidative phosphorylation
C) glycolysis
D) the citric acid cycle
E) alcohol fermentation

Topic: Concept 9.4
Skill: Comprehension

57) In chemiosmotic phosphorylation, what is the most direct source of energy that is used to convert ADP + P_i to ATP?
A) energy released as electrons flow through the electron transport system
B) energy released from substrate-level phosphorylation
C) energy released from ATP synthase pumping hydrogen ions against their concentration gradient
D) energy released from movement of protons through ATP synthase
E) No external source of energy is required because the reaction is exergonic.

Topic: Concept 9.4
Skill: Comprehension

58) Energy released by the electron transport chain is used to pump H^+ ions into which location?
A) cytosol
B) mitochondrial outer membrane
C) mitochondrial inner membrane
D) mitochondrial intermembrane space
E) mitochondrial matrix

Topic: Concept 9.4
Skill: Knowledge

59) During aerobic cellular respiration, a proton gradient in mitochondria is generated by _____ and used primarily for _____.
A) the electron transport chain; ATP synthesis
B) the electron transport chain; substrate-level phosphorylation
C) glycolysis; production of H_2O
D) fermentation; NAD^+ reduction
E) diffusion of protons; ATP synthesis

Topic: Concept 9.4
Skill: Comprehension

60) The direct energy source that drives ATP synthesis during respiratory oxidative phosphorylation is
A) oxidation of glucose to CO_2 and water.
B) the thermodynamically favorable flow of electrons from NADH to the mitochondrial electron transport carriers.
C) the final transfer of electrons to oxygen.
D) the difference in H^+ concentrations on opposite sides of the inner mitochondrial membrane.
E) the thermodynamically favorable transfer of phosphate from glycolysis and the citric acid cycle intermediate molecules of ADP.

Topic: Concept 9.4
Skill: Comprehension

Key

1B	11C	22A	33D	43D	55C
2A	12B	23[a]	34E	44B	56B
3E	13C	25C	35A	45E	57D
4E	14E	26C	36E	47B	58D
5A	16B	27C	37A	48B	59[a]
6B	17B	28B	38D	49C	60D
7E	18D	29B	39D	50C	
8B	19B	30A	40C	52E	
9A	20C	31C	41C	53B	
10C	21C	32D	42C	54E	