Cellular Energy Acquisition

1. Organisms that can manufacture their own chemical energy sources are called _____.
2. _____ depend on energy stored in chemical bonds by autotrophs for their food energy.
3. Simple molecules are further broken down in cells in a process called _____, during which energy stored in their chemical bonds is used to power the production of ATP.
4. Glucose is broken down to carbon dioxide and water in organisms which breathe air in a process called as _____ respiration.
5. In glycolysis, a major portion of the energy remains in the final product, which is called _____.
6. For further derivation of energy, aerobic cells must convert pyruvate into acetyl coenzyme A by stripping off a $C0_2$ molecule. This process is known as _____.
7. All of the reactions of glucose oxidation that follow glycolysis involving the transfer of electrons to their final acceptor, oxygen, take place in eukaryotic cells in the _____.
8. Because the chemical formation of ATP is driven by a diffusion force similar to osmosis, this process is referred to as _____.
9. The return of the protons into the mitochondrial matrix through mitochondrial membrane channels occurs by the process of _____.
10. The amino acids must be first _____ before they can be used in catabolic reactions.
11. Fats undergo a process called ____ oxidation, in which the products are acetyl coenzyme molecules.
12. The first stage of cellular respiration,_____, occurs with or without oxygen present.
13. When oxygen is limiting, during heavy exercise, muscle cells revert to _____ fermentation for energy production.
14. A molecule that stores energy by linking charged phosphate groups near each other is called
    A. ATP
    B. NADH
    C. FADH
    D. cyclic AMP
    E. pyruvate

15. An electron carrier that is used in harvesting energy from glucose molecules in a series of gradual steps in the cytoplasm is

    A. pyruvate
    B. cyclic AMP
    C. ATP
    D. NAD+
    E. NADH

16. In eukaryotes, the glycolytic reactions take place in the

    A. mitochondria of the cell
    B. cytoplasm of the cell
    C. ribosomes of the cell
    D. endoplasmic reticulium of each cell
    E. Golgi bodies of the cell

17. The first stage of cellular respiration, and the oldest in terms of evolution is

    A. decarboxylation
    B. deamination
    C. fermentation
    D. chemiosmosis
    E. glycolysis

18. In the absence of oxygen, hydrogen atoms generated by glycolysis are donated to organic molecules in a process called

    A. fermentation
    B. decarboxylation
    C. chemiosmosis
    D. electron transport chain reactions
    E. acetyl-CoA formation

19. At least 90% of organisms on the earth are heterotrophs. Examples include all of the following except

    A. plants
    B. fungi
    C. most eubacteria
    D. animals
    E. most protists

20. In digestion, which is a prelude to metabolism, all of the following occur except

    A. carbohydrates are degraded to sugars
    B. proteins are degraded into amino acids
    C. lipids are degraded to fatty acids
    D. water is degraded into hydrogen and oxygen
    E. all of these occur

21. Fermentation can be described as a process

A. that takes place only in the absence of oxygen
B. in which the recipient of hydrogen atoms is an organic molecule
C. in which water is not one of the by-products
D. in which the Krebs cycle and electron transfer through ETS do not occur
E. all of the above are true

22. Chemiosmotic generation of ATP is driven by

A. phosphate transfer through the plasma membrane
B. sodium, potassium pump
C. a difference in H+ concentration on the two sides of the mitochondrial membrane
D. osmosis of macromolecules
E. large quantities of ADP

23. The reaction, $C_6H_6O_6 + 6O_2 = 6\ CO_2 + 6\ H_2O$, when it occurs in living cells is known as

A. aerobic fermentation
B. anaerobic fermentation
C. aerobic respiration
D. glycolysis
E. oxidative phosphorylation

24. Out of the total amount of free energy potentially available from total oxidation of glucose, the number of ATP made by cells is equal to an energy efficiency of about

A. 2%
B. 25%
C. 32%
D. 75%
E. 90%

25. In oxidative respiration, energy is harvested from glucose molecules in a sequence of four major pathways. Which of the following is not one of these four pathways?

A. Krebs cycle
B. glycolysis
C. electron transfer through the transport chain
D. beta oxidation
E. pyruvate oxidation

26. In which of the following steps of glycolysis, 2 ATP molecules are required?

A. cleavage and rearrangement
B. glucose priming
C. oxidation
D. pyruvate formation
E. acetyl-CoA formation

27. A process common to all living organisms, aerobic and anaerobic, is

A. glycolysis
B. fermentation
C. the Krebs cycle
D. electron transport chain reactions
E. pyruvate oxidation

28. All of the following are the end products of glycolysis except

A. pyruvate
B. ATP
C. NADH
D. NAD+
E. energy

29. The fate of the end-product of glycolysis depends on the type of organism. The name of the end-product is

A. ATP
B. NAD+
C. alcohol
D. ADP
E. pyruvate

30. The enzymes catalyzing the reactions of glycolysis occur in the

A. mitochondria
B. cytoplasm
C. chloroplasts
D. nucleus
E. Golgi apparatus

31. The decarboxylation step of oxidation of pyruvate takes place in the

A. cytoplasm
B. Golgi body
C. ribosome
D. mitochondrion
E. nucleus

32. The decarboxylation of pyruvate produces

A. NADH
B. acetylCoA
C. CO_2
D. ATP
E. only a, b, and c are correct

33. When ATP levels are high, acetylCoA is channeled into

A. fermentation
B. fatty acid biosynthesis
C. protein synthesis
D. nucleic acid synthesis
E. all of the above

34. In the cyclic reaction sequence called the Krebs cycle, the following chemical events take place except

A. the acetyl group is joined with a four carbon molecule, oxaloacetate
B. the resulting six carbon molecule is oxidized
C. electrons generated are used to produce NADH
D. two carbons per cycle are made into CO_2 molecules
E. pyruvate molecules are restored to the cycle

35. A single glucose molecule can drive the Krebs cycle

A. one turn
B. two turns
C. three turns
D. four turns
E. six turns

36. The coenzyme electron carriers produced in the Krebs cycle are

A. ATP and ADP
B. pyruvate and acetyl-CoA
C. $FADH_2$ and NADH
D. NAD and NADH
E. NADH and ATP

37. The oxygen utilized in cellular respiration finally shows up as

A. CO_2
B. ATP
C. new O_2
D. H_2O
E. part of a sugar

38. The electron transport chain, a series of membrane-associated electron carriers, loses most of the energy by driving several transmembrane

A. proton pumps
B. electron pumps
C. sodium, potassium pumps
D. active transport pumps
E. water pumps

39. The enzymes of the Krebs cycle are located in the

A. cytoplasm
B. inter-membrane space of mitochondria
C. vesicles of the ER
D. outer membrane of the mitochondria
E. matrix of the mitochondria

40. The electron transport chain consists of all of the following except

A. NADH dehydrogenase
B. cytochrome complex
C. oxygenase
D. cytochrome c oxidase
E. ubiquinone, Q

41. The energy released in the mitochondrial electron transport chain is used to transport protons into the

A. matrix
B. cytoplasm
C. ER
D. inter-membrane space of mitochondria
E. enzyme complex of the Krebs cycle

42. Since membranes are relatively impermeable to ions, most of the protons re-enter the matrix by passing through special channels in the inner mitochondrial membrane. Because of the inward flow of protons these channels allow the synthesis of

A. ADP from ATP and P*i*
B. ATP from ADP and P*i*
C. glucose from pyruvate
D. acetyl-CoA from pyruvate
E. citrate from oxaloacetate and acetyl-CoA

43. Regardless of the electron or hydrogen acceptor used, one of the products of fermentation is always

A. ADP
B. ATP
C. NAD^+
D. pyruvate
E. alcohol

44. Yeast cells under anaerobic conditions

A. die
B. produce ethyl alcohol (ethanol)
C. produce oxygen
D. switch to oxidative respiration
E. push the glycolytic pathway backward

45. In muscle cells, fermentation produces not alcohol but

A. ATP
B. NADH
C. pyruvate
D. kinetic energy
E. lactate

46. Beta oxidation of these molecules converts them into acetyl-CoA, which can then enter the Krebs cycle for energy derivation. These are

A. fatty acids
B. amino acids
C. ATP
D. nucleic acids
E. sugars

47. A gram of fatty acid can yield how many more times the energy as one gram of glucose?

A. 6
B. 5
C. 4
D. 3
E. 2

48. During aerobic respiration the final acceptor of the hydrogen atoms is

A. oxygen
B. carbon dioxide
C. water
D. glucose
E. pyruvate

49. What type of cell respiration occurs when an organic molecule accepts hydrogen atoms?

A. aerobic respiration
B. anaerobic respiration
C. fermentation
D. catabolism
E. digestion

50. A biochemist wants to control the initial substrate-level phosphorylation that occurs in the tracheal cells of grasshoppers once glucose has crossed the plasma membrane. This means that he will

A. have to prevent cAMP from entering the tracheal cells
B. have to prevent pyruvate reduction from occurring
C. have to prevent glycolysis from occurring in the mitochondria
D. have to prevent glycolysis from occurring in the cytoplasm
E. have to prevent aerobic respiration in the cytoplasm

51. Select the correct sequence concerning glucose catabolism.

A. glycolysis → Pyruvate → Acetyl CoA → Electron Transport Chain → Kreb Cycle
B. glycolysis → Pyruvate → Acetyl CoA → Kreb Cycle → Electron Transport Chain
C. glycolysis → Acetyl CoA → Pyruvate → Electron Transport Chain → Kreb Cycle
D. glycolysis → Acetyl CoA → Pyruvate → Kreb Cycle → Electron Transport Chain

52. Which of the following statements accurately reflects what happens to a glucose molecule during the initial five phases of glycolysis?

A. Glucose, a six-carbon sugar, enters the cell by passive transport and is primed and converted into glucose three-phosphate, which requires two ATP molecules. The remaining four steps involve splitting the six-carbon molecule into two three-carbon molecules.
B. Glucose, a six-carbon sugar, enters the cell by active transport and is primed and converted into glucose three-phosphate, which requires two ATP molecules. The remaining four steps involve splitting the six-carbon molecule into two three-carbon molecules.
C. Glucose, a six-carbon sugar, enters the cell by simple diffusion and is primed and converted into glucose three-phosphate, which requires two ATP molecules. The remaining four steps involve splitting the six-carbon molecule into two three-carbon molecules.
D. Glucose, a six-carbon sugar, enters the cell by G protein mediation and is primed and converted into glucose three-phosphate, which requires two ATP molecules. The remaining four steps involve splitting the six-carbon molecule into two three-carbon molecules.

53. Which of the following statements accurately reflects the process of glycolysis?

A. Glycolysis is most likely one of the earliest of all biochemical reactions to evolve. Glycolysis uses molecular oxygen, however it occurs in anaerobic environments.
B. Glycolysis is most likely one of the earliest of all biochemical reactions to evolve. Glycolysis uses no molecular oxygen. All reactions of glycolysis occur free in the cytoplasm.
C. Glycolysis is most likely one of the earliest of all biochemical reactions to evolve. Glycolysis uses molecular oxygen, however it occurs in aerobic environments.
D. Glycolysis is most likely one of the earliest of all biochemical reactions to evolve. Glycolysis uses molecular oxygen and occurs in the mitochondria.

54. When substrate-level phosphorylation occurs, it means that

A. NAD is converted into NADH
B. ATP is converted into ADP + a phosphate group
C. ADP is converted into ATP by addition of a phosphate group
D. cAMP is converted into ADP by adding a phosphate group
E. NADH is converted into NAD + H

55. When ATP levels are high, oxidative pathways are inhibited, so acetyl-CoA is channeled into

A. fatty acid synthesis
B. pyruvate formation
C. the Kreb cycle
D. the electron transport system
E. NAD production

56. The Kreb cycle occurs in the mitochondria. There are nine biochemical reactions involved in the Kreb cycle, and they are highly ordered. Select the correct order from the following choices. (Note: these are abbreviated and do not show NAD, ADP, ATP, or FAD.)

A. acetyl-CoA joins the Kreb cycle and unites with oxaloacetate → forming citrate → which forms beta-ketoglutarate → which forms succinylCoA → which forms succinate → which forms fumarate → which forms malate → which forms oxaloacetate
B. acetyl-CoA joins the Kreb cycle and unites with oxaloacetate → forming citrate → which forms alpha-ketoglutarate → which forms succinylCoA → which forms succinate → which forms malate → which forms fumarate → which forms oxaloacetate
C. acetyl-CoA joins the Kreb cycle and unites with oxaloacetate → which forms alpha-ketoglutarate → forming citrate → which forms succinylCoA → which forms succinate → which forms fumarate → which forms malate → which forms oxaloacetate
D. acetyl-CoA joins the Kreb cycle and unites with oxaloacetate → forming citrate → which forms alpha-ketoglutarate → which forms succinylCoA → which forms succinate → which forms fumarate → which forms malate → which forms oxaloacetate

57. Cytochromes are respiratory proteins. Which of the following statements accurately reflects their true nature?

A. Cytochrome proteins reside free in the lung cells of all vertebrates. These molecules contain a heme group with an iron atom at its center.
B. Cytochrome proteins reside in the mitochondria and are specifically associated with the electron transport system.
C. Cytochrome proteins reside in the mitochondria and are specifically associated with the Kreb cycle.
D. Cytochrome proteins reside in the mitochondria and are specifically associated with glycolysis.

58. Cells release energy from molecules such as glucose in a process very similar to inhalation

of air and exhalation of carbon dioxide by humans. This process is known as cellular

A. oxidation
B. reduction
C. photosynthesis
D. radiation
E. respiration

59. Match each of the following.

_____A. Pyruvate oxidation; carrier of acetyl groups.	1. ATP
_____B. Chief energy currency of cells; formed by chemiosmosis.	2. FAD
_____C. Coenzyme electron carrier; associated with Krebs cycle only.	3. G-3-P
_____D. Intermediate in glycolysis; finally oxidized to pyruvate.	4. NAD^+
_____E. Oxidized form of the most common electron carrier; needed in both glycolysis and Krebs cycle.	5. acetylCoA

Answer Key

No. on Test	Correct Answer
1	autotrophs
2	Heterotrophs
3	catabolism
4	oxidative
5	pyruvate
6	decarboxylation
7	mitochondrion
8	chemiosmosis
9	diffusion
10	deaminated
11	beta
12	glycolysis
13	lactic acid
14	A
15	D
16	B
17	E
18	A
19	A
20	E
21	E
22	C
23	C
24	C
25	D
26	B
27	A
28	D
29	E
30	B
31	D
32	E
33	B
34	E

35	B
36	C
37	D
38	A
39	E
40	C
41	D
42	B
43	C
44	B
45	E
46	A
47	E
48	A
49	B
50	D
51	B
52	A
53	B
54	C
55	A
56	D
57	B
58	E
59	1-E, 2-A, 3-B, 4-C, 5-D