

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) What kinds of molecules pass through a cell membrane most easily? 1) _____
A) ionic B) large and hydrophobic
C) large polar D) small and hydrophobic
- 2) HIV is the virus that causes AIDS. In the mid-1990s, researchers discovered an enzyme in HIV called *protease*. Once the enzyme's structure was known, researchers began looking for drugs that would fit into the active site and block it. If this strategy for stopping HIV infections were successful, it would be an example of what phenomenon? 2) _____
A) allosteric regulation B) competitive inhibition
C) vaccination D) denaturation
- 3) Which of the following normally occurs regardless of whether or not oxygen (O₂) is present? 3) _____
A) glycolysis
B) citric acid cycle
C) oxidative phosphorylation (chemiosmosis)
D) fermentation

Use the following information to answer the questions below.

A series of enzymes catalyze the reaction $X \rightarrow Y \rightarrow Z \rightarrow A$. Product A binds to the enzyme that converts X to Y at a position remote from its active site. This binding decreases the activity of the enzyme.

- 4) What is substance X? 4) _____
A) the product B) a substrate
C) an intermediate D) an allosteric inhibitor
- 5) The mathematical expression for the change in free energy of a system is $\Delta G = \Delta H - T\Delta S$. Which of the following is (are) correct? 5) _____
A) ΔG is the change in free energy.
B) T is the temperature in degrees Celsius.
C) ΔS is the change in enthalpy, a measure of randomness.
D) ΔH is the change in entropy, the energy available to do work.
- 6) Starting with one molecule of glucose, the energy-containing products of glycolysis are _____. 6) _____
A) 6 CO₂, 2 pyruvate, and 2 ATP B) 2 NAD⁺, 2 pyruvate, and 2 ATP
C) 2 NADH, 2 pyruvate, and 2 ATP D) 2 FADH₂, 2 pyruvate, and 4 ATP

- 7) Chemical equilibrium is relatively rare in living cells. An example of a reaction at chemical equilibrium in a cell would be _____. 7) _____
- A) one in which the free energy at equilibrium is higher than the energy content at any point away from equilibrium
 - B) one in which the entropy change in the reaction is just balanced by an opposite entropy change in the cell's surroundings
 - C) an endergonic reaction in an active metabolic pathway where the energy for that reaction is supplied only by heat from the environment
 - D) a chemical reaction in which both the reactants and products are not being produced or used in any active metabolic pathway at that time in the cell
- 8) Some regions of the plasma membrane, called *lipid rafts*, have a higher concentration of cholesterol molecules. At higher temperatures, these regions _____. 8) _____
- A) are more fluid than the surrounding membrane
 - B) detach from the plasma membrane and clog arteries
 - C) have higher rates of lateral diffusion of lipids and proteins into and out of these regions
 - D) are less fluid than the surrounding membrane
- 9) Which of the following is true of enzymes? 9) _____
- A) Enzyme function is independent of physical and chemical environmental factors such as pH and temperature.
 - B) Enzyme function is increased if the 3-D structure or conformation of an enzyme is altered.
 - C) Enzymes increase the rate of chemical reaction by lowering activation energy barriers.
 - D) Enzymes increase the rate of chemical reaction by providing activation energy to the substrate.
- 10) The voltage across a membrane is called the _____. 10) _____
- A) membrane potential
 - B) osmotic potential
 - C) electrochemical gradient
 - D) chemical gradient
- 11) Which of the following is a reasonable explanation for why unsaturated fatty acids help keep a membrane more fluid at lower temperatures? 11) _____
- A) Unsaturated fatty acids are more polar than saturated fatty acids.
 - B) Unsaturated fatty acids have a higher cholesterol content and, therefore, more cholesterol in membranes.
 - C) The double bonds form kinks in the fatty acid tails, preventing adjacent lipids from packing tightly.
 - D) The double bonds block interaction among the hydrophilic head groups of the lipids.
- 12) Which of the following statements is representative of the second law of thermodynamics? 12) _____
- A) Every energy transformation by a cell decreases the entropy of the universe.
 - B) Without an input of energy, organisms would tend toward decreasing entropy.
 - C) Conversion of energy from one form to another is always accompanied by some gain of free energy.
 - D) Cells require a constant input of energy to maintain their high level of organization.

Use the following information to answer the questions below.

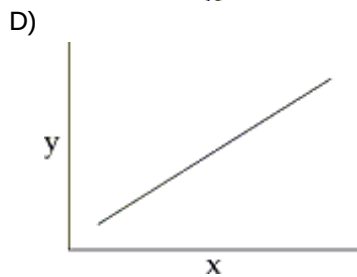
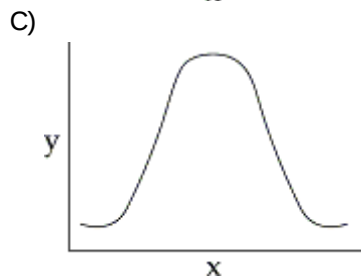
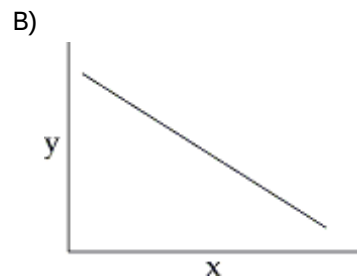
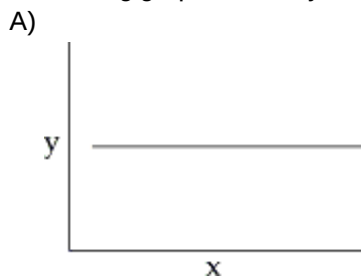
Succinate dehydrogenase catalyzes the conversion of succinate to fumarate. The reaction is inhibited by malonic acid, which resembles succinate but cannot be acted upon by succinate dehydrogenase. Increasing the ratio of succinate to malonic acid reduces the inhibitory effect of malonic acid.

- 13) Based on this information, which of the following is correct? 13) _____
A) Succinate dehydrogenase is the enzyme, and malonic acid is the substrate.
B) Succinate dehydrogenase is the enzyme, and fumarate is the substrate.
C) Succinate is the substrate, and fumarate is the product.
D) Fumarate is the product, and malonic acid is a noncompetitive inhibitor.
- 14) An organism is discovered that thrives in both the presence and absence of oxygen in the air. 14) _____
Curiously, the consumption of sugar increases as oxygen is removed from the organism's environment, even though the organism does not gain much weight. This organism _____.
A) is photosynthetic B) is a normal eukaryotic organism
C) is an anaerobic organism D) is a facultative anaerobe
- 15) Which of the following statements about NAD^+ is true? 15) _____
A) NAD^+ is reduced to NADH during glycolysis, pyruvate oxidation, and the citric acid cycle.
B) NAD^+ has more chemical energy than NADH.
C) NAD^+ can donate electrons for use in oxidative phosphorylation.
D) In the absence of NAD^+ , glycolysis can still function.
- 16) Which of the following occurs in the cytosol of a eukaryotic cell? 16) _____
A) glycolysis and fermentation B) citric acid cycle
C) fermentation and chemiosmosis D) oxidation of pyruvate to acetyl CoA
- 17) Which of the following is a statement of the first law of thermodynamics? 17) _____
A) The entropy of the universe is constant.
B) Energy cannot be transferred or transformed.
C) Energy cannot be created or destroyed.
D) The entropy of the universe is decreasing.
- 18) You have a friend who lost 7 kg (about 15 pounds) of fat on a regimen of strict diet and exercise. 18) _____
How did the fat leave his body?
A) It was converted to urine and eliminated from the body.
B) It was converted to heat and then released.
C) It was released as CO_2 and H_2O .
D) It was converted to ATP, which weighs much less than fat.
- 19) In liver cells, the inner mitochondrial membranes are about five times the area of the outer 19) _____
mitochondrial membranes. What purpose must this serve?
A) It allows for an increased rate of glycolysis.
B) It increases the surface for substrate-level phosphorylation.
C) It allows for an increased rate of the citric acid cycle.
D) It increases the surface for oxidative phosphorylation.

- 20) The force driving simple diffusion is _____, while the energy source for active transport is _____. 20) _____
- A) transmembrane pumps; electron transport
 - B) phosphorylated protein carriers; ATP
 - C) the concentration gradient; ADP
 - D) the concentration gradient; ATP

- 21) An animal cell lacking oligosaccharides on the external surface of its plasma membrane would likely be impaired in which function? 21) _____
- A) establishing a diffusion barrier to charged molecules
 - B) cell-cell recognition
 - C) attaching the plasma membrane to the cytoskeleton
 - D) transporting ions against an electrochemical gradient

- 22) You collect data on the effect of pH on the function of the enzyme catalase in human cells. Which of the following graphs would you expect? 22) _____



- 23) Which of the listed statements describes the results of the following reaction? 23) _____
- $$\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{Energy}$$

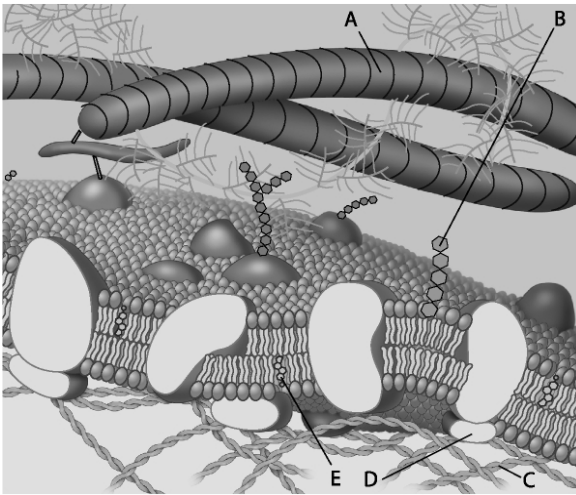
- A) O_2 is oxidized and H_2O is reduced.
- B) $\text{C}_6\text{H}_{12}\text{O}_6$ is oxidized and O_2 is reduced.
- C) O_2 is reduced and CO_2 is oxidized.
- D) CO_2 is reduced and O_2 is oxidized.

- 24) A bacterium engulfed by a white blood cell through phagocytosis will be digested by enzymes contained in _____. 24) _____
- A) Golgi vesicles
 - B) secretory vesicles
 - C) vacuoles
 - D) lysosomes

- 25) A cell has enough available ATP to meet its needs for about 30 seconds. What is likely to happen when an athlete exhausts his or her ATP supply? 25) _____
- A) Other cells take over, and the muscle cells that have used up their ATP cease to function.
 - B) ATP is transported into the cell from the circulatory system.
 - C) He or she has to sit down and rest.
 - D) Catabolic processes are activated that generate more ATP.

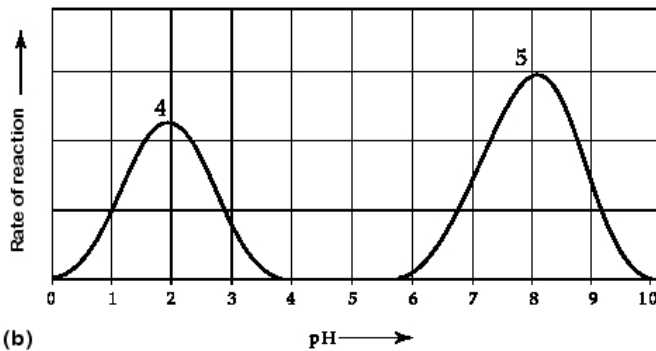
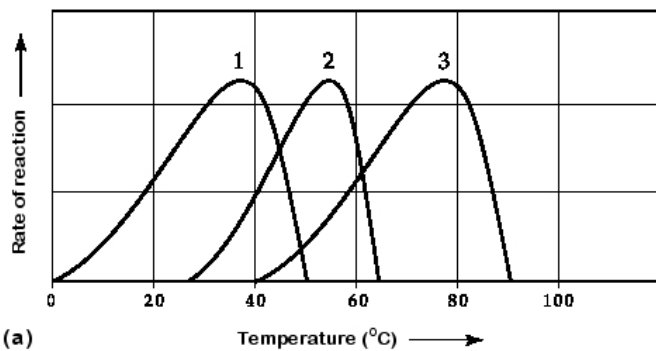
- 26) Which of the following is true of metabolism in its entirety in all organisms? 26) _____
- A) Metabolism uses all of an organism's resources.
 - B) Metabolism manages the increase of entropy in an organism.
 - C) Metabolism consists of all the energy transformation reactions in an organism.
 - D) Metabolism depends on a constant supply of energy from food.
- 27) Where are the proteins of the electron transport chain located? 27) _____
- A) mitochondrial outer membrane
 - B) mitochondrial matrix
 - C) mitochondrial inner membrane
 - D) mitochondrial intermembrane space
- 28) During aerobic respiration, electrons travel downhill in which sequence? 28) _____
- A) food → glycolysis → citric acid cycle → NADH → ATP
 - B) glucose → pyruvate → ATP → oxygen
 - C) glucose → NADH → electron transport chain → oxygen
 - D) glucose → ATP → electron transport chain → NADH

For the following questions, match the labeled component of the cell membrane in the figure with its description.



- 29) Which component is a glycolipid? 29) _____
- A) A
 - B) B
 - C) C
 - D) E
- 30) Which component is a microfilament (actin filament) of the cytoskeleton? 30) _____
- A) A
 - B) B
 - C) C
 - D) D
- 31) Singer and Nicolson's fluid mosaic model of the membrane proposed that membranes _____. 31) _____
- A) consist of protein molecules embedded in a fluid bilayer of phospholipids
 - B) are a single layer of phospholipids and proteins
 - C) consist of a mosaic of polysaccharides and proteins
 - D) are a phospholipid bilayer between two layers of hydrophilic proteins
- 32) Which of the following would likely move through the lipid bilayer of a plasma membrane most rapidly? 32) _____
- A) glucose
 - B) CO₂
 - C) an amino acid
 - D) K⁺

- 33) You are working on a team that is designing a new drug. For this drug to work, it must enter the cytoplasm of specific target cells. Which of the following would be a factor that determines whether the molecule selectively enters the target cells? 33) _____
- A) lipid composition of the target cells' plasma membrane
 - B) hydrophobicity of the drug molecule
 - C) similarity of the drug molecule to other molecules transported by the target cells
 - D) lack of charge on the drug molecule
- 34) The lock-and-key analogy for enzymes applies to the specificity of enzymes _____. 34) _____
- A) binding to their substrate
 - B) interacting with water
 - C) interacting with ions
 - D) as they form their tertiary and quaternary structure
- 35) In what way do the membranes of a eukaryotic cell vary? 35) _____
- A) Some membranes have hydrophobic surfaces exposed to the cytoplasm, while others have hydrophilic surfaces facing the cytoplasm.
 - B) Phospholipids are found only in certain membranes.
 - C) Only certain membranes of the cell are selectively permeable.
 - D) Certain proteins are unique to each membrane.
- 36) White blood cells engulf bacteria using _____. 36) _____
- A) receptor - mediated exocytosis
 - B) pinocytosis
 - C) phagocytosis
 - D) osmosis
- 37) Carbohydrates and fats are considered high-energy foods because they _____. 37) _____
- A) are easily reduced.
 - B) have a lot of oxygen atoms.
 - C) have a lot of electrons associated with hydrogen.
 - D) have no nitrogen in their makeup.



Activity of various enzymes at various temperatures (a) and at various pH (b).

38) Which temperature and pH profile curves on the graphs were most likely generated from analysis of an enzyme from a human stomach where conditions are strongly acid?

- A) curves 3 and 4 B) curves 1 and 5 C) curves 2 and 4 D) curves 1 and 4

38) _____

39) When a glucose molecule loses a hydrogen atom as the result of an oxidation-reduction reaction, the molecule becomes ____.

- A) oxidized B) hydrolyzed
C) an oxidizing agent D) reduced

39) _____

40) The active site of an enzyme is the region that ____.

- A) is inhibited by the presence of a coenzyme or a cofactor
B) binds allosteric regulators of the enzyme
C) is involved in the catalytic reaction of the enzyme
D) binds noncompetitive inhibitors of the enzyme

40) _____

41) Which term most precisely describes the cellular process of breaking down large molecules into smaller ones?

- A) metabolism B) catabolism (catabolic pathways)
C) anabolism (anabolic pathways) D) dehydration

41) _____

42) Substrate-level phosphorylation occurs ____.

- A) in both glycolysis and the citric acid cycle B) during oxidative phosphorylation
C) in the citric acid cycle D) in glycolysis

42) _____

- 43) Why is ATP an important molecule in metabolism? 43) _____
A) Its terminal phosphate group contains a strong covalent bond that, when hydrolyzed, releases free energy.
B) It provides energy coupling between exergonic and endergonic reactions.
C) Its hydrolysis provides an input of free energy for exergonic reactions.
D) Its terminal phosphate bond has higher energy than the other two phosphate bonds.
- 44) Which electron carrier(s) function in the citric acid cycle? 44) _____
A) the electron transport chain B) ADP and ATP
C) NADH and FADH₂ D) NAD⁺ only
- 45) The electron transport chain _____. 45) _____
A) is a series of redox reactions
B) takes place in the cytoplasm of prokaryotic cells
C) is a series of substitution reactions
D) is driven by ATP consumption
- 46) In glycolysis, for each molecule of glucose oxidized to pyruvate _____. 46) _____
A) two molecules of ATP are used and four molecules of ATP are produced.
B) two molecules of ATP are used and two molecules of ATP are produced.
C) two molecules of ATP are used and six molecules of ATP are produced.
D) four molecules of ATP are used and two molecules of ATP are produced.
- 47) In the absence of oxygen, yeast cells can obtain energy by fermentation, resulting in the production of _____. 47) _____
A) ATP, pyruvate, and acetyl CoA B) ATP, CO₂, and lactate
C) ATP, NADH, and pyruvate D) ATP, CO₂, and ethanol (ethyl alcohol)
- 48) Which of the following is most similar in structure to ATP? 48) _____
A) an RNA nucleotide
B) a pentose sugar
C) an amino acid with three phosphate groups attached
D) a DNA nucleotide
- 49) Which of the following events takes place in the electron transport chain? 49) _____
A) substrate-level phosphorylation
B) the breakdown of glucose into two pyruvate molecules
C) the extraction of energy from high-energy electrons remaining from glycolysis and the citric acid cycle
D) the breakdown of an acetyl group to carbon dioxide
- 50) Which of the following is true of osmosis? 50) _____
A) In osmosis, water moves across a membrane from areas of lower solute concentration to areas of higher solute concentration.
B) Osmosis is an energy-demanding or "active" process.
C) In osmosis, solutes move across a membrane from areas of lower water concentration to areas of higher water concentration.
D) Osmosis only takes place in red blood cells.