

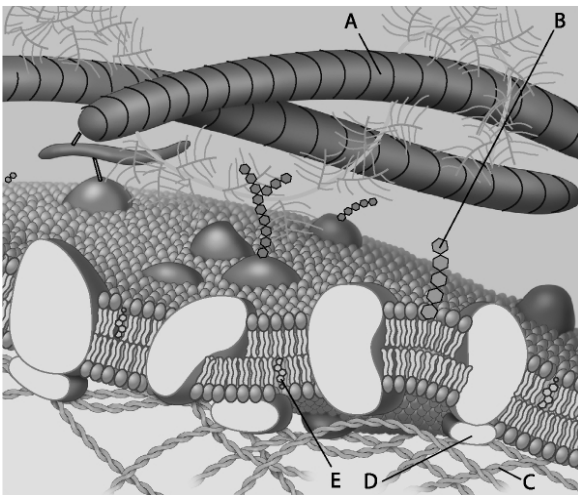
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) All of the following are part of a prokaryotic cell EXCEPT _____. 1) _____
A) ribosomes B) an endoplasmic reticulum
C) a cell wall D) a plasma membrane
- 2) Cell size is limited by _____. 2) _____
A) the surface area of mitochondria in the cytoplasm
B) the size of the endomembrane system
C) surface to volume ratios
D) the number of proteins within the plasma membrane
- 3) Which of the following is a major difference between prokaryotic cells and eukaryotic cells? 3) _____
A) Prokaryotes are generally larger than eukaryotes.
B) Prokaryotes have cells while eukaryotes do not.
C) Eukaryotic cells have more intracellular organelles than prokaryotes.
D) Prokaryotes are not able to carry out aerobic respiration, relying instead on anaerobic metabolism.
- 4) You have a cube of modeling clay in your hands. Which of the following changes to the shape of this cube of clay will decrease its surface area relative to its volume? 4) _____
A) Round the clay up into a sphere.
B) Flatten the cube into a pancake shape.
C) Stretch the cube into a long, shoebox shape.
D) Pinch the edges of the cube into small folds.
- 5) Which structure is common to plant *and* animal cells? 5) _____
A) chloroplast B) mitochondrion C) centriole D) central vacuole
- 6) Which of the following is present in a prokaryotic cell? 6) _____
A) ribosome B) ER C) mitochondrion D) chloroplast
- 7) Which organelle or structure is absent in plant cells? 7) _____
A) centrosomes B) mitochondria C) peroxisomes D) microtubules
- 8) What is the function of the nuclear pore complex found in eukaryotes? 8) _____
A) It selectively transports molecules out of the nucleus, but prevents all inbound molecules from entering the nucleus.
B) It regulates the movement of proteins and RNAs into and out of the nucleus.
C) It assembles ribosomes from raw materials that are synthesized in the nucleus.
D) It synthesizes the proteins required to copy DNA and make mRNA.
- 9) Which of the following macromolecules leaves the nucleus of a eukaryotic cell through pores in the nuclear membrane? 9) _____
A) amino acids B) DNA C) mRNA D) phospholipids

- 10) The nuclear lamina is an array of filaments on the inner side of the nuclear membrane. If a method were found that could cause the lamina to fall into disarray, what would you most likely expect to be the immediate consequence? 10) _____
- A) the loss of all nuclear function
 - B) a change in the shape of the nucleus
 - C) the inability of the nucleus to divide during cell division
 - D) failure of chromosomes to carry genetic information
- 11) Which organelle often takes up much of the volume of a plant cell? 11) _____
- A) peroxisome
 - B) Golgi apparatus
 - C) vacuole
 - D) lysosome
- 12) A cell with an extensive area of smooth endoplasmic reticulum is specialized to _____. 12) _____
- A) synthesize large quantities of lipids
 - B) actively export protein molecules
 - C) import and export protein molecules
 - D) play a role in storage
- 13) The Golgi apparatus has a polarity, or sidedness, to its structure and function. Which of the following statements correctly describes this polarity? 13) _____
- A) Transport vesicles fuse with one side of the Golgi and leave from the opposite side.
 - B) Lipids in the membrane of the Golgi may be sorted and modified as they move from one side of the Golgi to the other.
 - C) Proteins in the membrane of the Golgi may be sorted and modified as they move from one side of the Golgi to the other.
 - D) All of the listed responses correctly describe polarity characteristics of the Golgi function.
- 14) Tay-Sachs disease is a human genetic abnormality that results in cells accumulating and becoming clogged with very large, complex, undigested lipids. Which cellular organelle must be involved in this condition? 14) _____
- A) the endoplasmic reticulum
 - B) mitochondrion
 - C) the Golgi apparatus
 - D) the lysosome
- 15) What is the most likely pathway taken by a newly synthesized protein that will be secreted by a cell? 15) _____
- A) Golgi → ER → lysosome
 - B) ER → Golgi → vesicles that fuse with plasma membrane
 - C) ER → Golgi → nucleus
 - D) ER → lysosomes → vesicles that fuse with plasma membrane
- 16) Which organelle is the primary site of ATP synthesis in eukaryotic cells? 16) _____
- A) mitochondrion
 - B) lysosome
 - C) peroxisome
 - D) Golgi apparatus
- 17) Cyanide binds with at least one molecule involved in producing ATP. If a cell is exposed to cyanide, most of the cyanide will be found within the _____. 17) _____
- A) lysosomes
 - B) endoplasmic reticulum
 - C) peroxisomes
 - D) mitochondria

- 24) The membranes of winter wheat are able to remain fluid when it is extremely cold by _____. 24) _____
 A) increasing the percentage of cholesterol molecules in the membrane
 B) decreasing the number of hydrophobic proteins in the membrane
 C) increasing the percentage of unsaturated phospholipids in the membrane
 D) cotransport of glucose and hydrogen
- 25) An animal cell lacking oligosaccharides on the external surface of its plasma membrane would likely be impaired in which function? 25) _____
 A) attaching the plasma membrane to the cytoskeleton
 B) establishing a diffusion barrier to charged molecules
 C) cell-cell recognition
 D) transporting ions against an electrochemical gradient
- 26) Which of these are NOT embedded in the hydrophobic portion of the lipid bilayer at all? 26) _____
 A) integral proteins
 B) peripheral proteins
 C) transmembrane proteins
 D) All of these are embedded in the hydrophobic portion of the lipid bilayer.

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

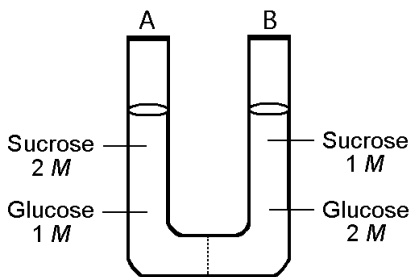


- 27) Which component is a peripheral protein? 27) _____
 A) A B) B C) C D) D
- 28) Which component is cholesterol? 28) _____
 A) B B) C C) D D) E
- 29) Which component is a protein fiber of the extracellular matrix? 29) _____
 A) A B) B C) C D) E

- 30) Cell membranes are asymmetrical. Which of the following statements is the most likely explanation for the membrane's asymmetrical nature? 30) _____
- A) Since cell membranes communicate signals from one organism to another, the cell membranes must be asymmetrical.
 - B) Proteins only function on the cytoplasmic side of the cell membrane, which results in the membrane's asymmetrical nature.
 - C) The two sides of a cell membrane face different environments and carry out different functions.
 - D) Since the cell membrane forms a border between one cell and another in tightly packed tissues such as epithelium, the membrane must be asymmetrical
- 31) In what way do the membranes of a eukaryotic cell vary? 31) _____
- A) Certain proteins are unique to each membrane.
 - B) Some membranes have hydrophobic surfaces exposed to the cytoplasm, while others have hydrophilic surfaces facing the cytoplasm.
 - C) Only certain membranes of the cell are selectively permeable.
 - D) Phospholipids are found only in certain membranes.
- 32) What kinds of molecules pass through a cell membrane most easily? 32) _____
- A) ionic
 - B) large and hydrophobic
 - C) small and hydrophobic
 - D) large polar
- 33) Which of the following most accurately describes selective permeability? 33) _____
- A) There must be a concentration gradient for molecules to pass through a membrane.
 - B) Lipid-soluble molecules pass through a membrane.
 - C) Only certain molecules can cross a cell membrane.
 - D) An input of energy is required for transport.
- 34) Which of the following is a characteristic feature of a carrier protein in a plasma membrane? 34) _____
- A) It exhibits a specificity for a particular type of molecule.
 - B) It works against diffusion.
 - C) It has no hydrophobic regions.
 - D) It requires the expenditure of cellular energy to function.
- 35) Which of the following would likely move through the lipid bilayer of a plasma membrane most rapidly? 35) _____
- A) an amino acid
 - B) K^+
 - C) CO_2
 - D) glucose
- 36) Which of the following allows water to move much faster across cell membranes? 36) _____
- A) peripheral proteins
 - B) the sodium-potassium pump
 - C) aquaporins
 - D) ATP
- 37) 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? 37) _____
- A) similarity of the drug molecule to other molecules transported by the target cells
 - B) hydrophobicity of the drug molecule
 - C) lipid composition of the target cells' plasma membrane
 - D) lack of charge on the drug molecule

- 38) Diffusion _____. 38) _____
- A) requires an expenditure of energy by the cell
 - B) is very rapid over long distances
 - C) is a passive process in which molecules move from a region of higher concentration to a region of lower concentration
 - D) requires integral proteins in the cell membrane
- 39) Which of the following processes includes all others? 39) _____
- A) osmosis
 - B) passive transport
 - C) facilitated diffusion
 - D) transport of an ion down its electrochemical gradient
- 40) When a cell is in equilibrium with its environment, which of the following occurs for substances that can diffuse through the cell? 40) _____
- A) All movement of molecules is directed by active transport.
 - B) There is no movement of substances into and out of the cell.
 - C) There is directed movement of substances into and out of the cell.
 - D) There is random movement of substances into and out of the cell.
- 41) Which of the following is true of osmosis? 41) _____
- A) Osmosis is an energy-demanding or "active" process.
 - B) In osmosis, water moves across a membrane from areas of lower solute concentration to areas of higher solute concentration.
 - 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.

The solutions in the two arms of this U-tube are separated by a membrane that is permeable to water and glucose but not to sucrose. Side A is half-filled with a solution of 2 M sucrose and 1 M glucose. Side B is half-filled with 1 M sucrose and 2 M glucose. Initially, the liquid levels on both sides are equal.



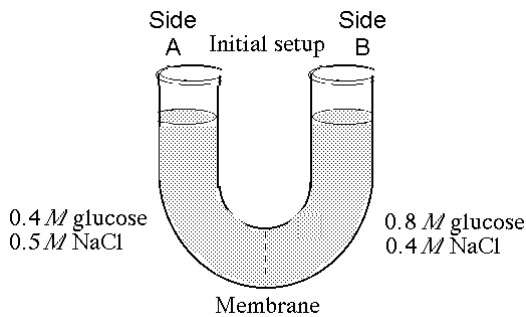
- 42) Refer to the figure. Initially, in terms of tonicity, the solution in side A with respect to the solution in side B is _____. 42) _____
- A) hypertonic
 - B) hypotonic
 - C) saturated
 - D) isotonic
- 43) Refer to the figure. After the system reaches equilibrium, what changes are observed? 43) _____
- A) The molarity of sucrose is higher than that of glucose on side A.
 - B) The water level is higher in side B than in side A.
 - C) The water level is higher in side A than in side B.
 - D) The water level is unchanged.

44) A patient was involved in a serious accident and lost a large quantity of blood. In an attempt to replenish body fluids, distilled water—equal to the volume of blood lost—is added to the blood directly via one of his veins. What will be the most probable result of this transfusion?

44) _____

- A) The patient's red blood cells will swell and possibly burst because the blood has become hypotonic compared to the cells.
- B) The patient's red blood cells will shrivel up because the blood has become hypertonic compared to the cells.
- C) The patient's red blood cells will shrivel up because the blood has become hypotonic compared to the cells.
- D) The patient's red blood cells will burst because the blood has become hypertonic compared to the cells.

The solutions in the arms of a U-tube are separated at the bottom of the tube by a selectively permeable membrane. The membrane is permeable to sodium chloride but not to glucose. Side A is filled with a solution of 0.4 M glucose and 0.5 M sodium chloride (NaCl), and side B is filled with a solution containing 0.8 M glucose and 0.4 M sodium chloride. Initially, the volume in both arms is the same.



45) Refer to the figure. At the beginning of the experiment,

45) _____

- A) side A is hypotonic to side B.
- B) side A is hypertonic to side B.
- C) side A is hypotonic to side B with respect to NaCl.
- D) side A is hypertonic to side B with respect to glucose.

46) Refer to the figure. If you examine side A after three days, you should find _____.

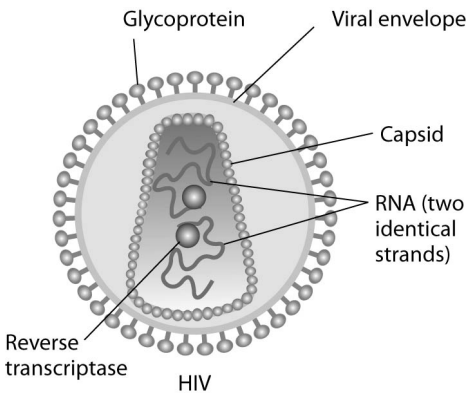
46) _____

- A) a decrease in the concentration of NaCl and a decrease in the water level
- B) no change in the concentration of NaCl and glucose and an increase in the water level
- C) a decrease in the concentration of NaCl, an increase in water level, and no change in the concentration of glucose
- D) a decrease in the concentration of NaCl and glucose and an increase in the water level

- 53) The voltage across a membrane is called the _____. 53) _____
 A) membrane potential B) electrochemical gradient
 C) chemical gradient D) osmotic potential
- 54) Which of the following would increase the electrochemical gradient across a membrane? 54) _____
 A) a potassium channel
 B) a proton pump
 C) a sucrose-proton cotransporter
 D) both a proton pump and a potassium channel
- 55) An organism with a cell wall would most likely be unable to take in materials through _____. 55) _____
 A) facilitated diffusion B) active transport
 C) osmosis D) phagocytosis

Use the paragraph and accompanying figure to answer the following questions.

Human immunodeficiency virus (HIV) infects cells that have both CD4 and CCR5 cell surface molecules. The viral nucleic acid molecules are enclosed in a protein capsid, and the protein capsid is itself contained inside an envelope consisting of a lipid bilayer membrane and viral glycoproteins. One hypothesis for viral entry into cells is that binding of HIV membrane glycoproteins to CD4 and CCR5 initiates fusion of the HIV membrane with the plasma membrane, releasing the viral capsid into the cytoplasm. An alternative hypothesis is that HIV gains entry into the cell via receptor-mediated endocytosis, and membrane fusion occurs in the endocytotic vesicle. To test these alternative hypotheses for HIV entry, researchers labeled the lipids on the HIV membrane with a red fluorescent dye.



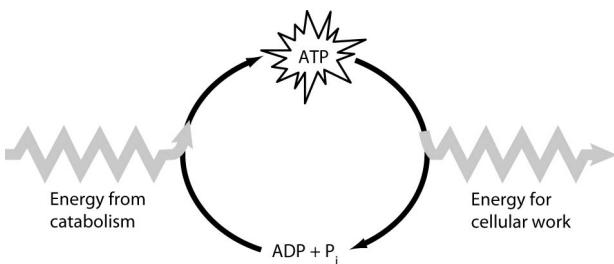
- 56) In an HIV-infected cell producing HIV virus particles, the viral glycoprotein is expressed on the plasma membrane. How do the viral glycoproteins get to the plasma membrane? They are synthesized _____. 56) _____
 A) by ribosomes in the rough ER, secreted from the cell, and inserted into the plasma membrane from the outside
 B) by ribosomes in the rough ER and arrive at the plasma membrane in the membrane of secretory vesicles
 C) on free cytoplasmic ribosomes and then inserted into the plasma membrane
 D) on ribosomes on the plasma membrane
- 57) Which of the following is true of metabolism in its entirety in all organisms? 57) _____
 A) Metabolism consists of all the energy transformation reactions in an organism.
 B) Metabolism depends on a constant supply of energy from food.
 C) Metabolism uses all of an organism's resources.
 D) Metabolism manages the increase of entropy in an organism.

- 58) Which term most precisely describes the cellular process of breaking down large molecules into smaller ones? 58) _____
 A) anabolism (anabolic pathways) B) catabolism (catabolic pathways)
 C) dehydration D) metabolism
- 59) Anabolic pathways _____. 59) _____
 A) consume energy to decrease the entropy of the organism and its environment
 B) release energy as they degrade polymers to monomers
 C) are usually highly spontaneous chemical reactions
 D) consume energy to build up polymers from monomers
- 60) Living organisms increase in complexity as they grow, resulting in a decrease in the entropy of an organism. How does this relate to the second law of thermodynamics? 60) _____
 A) Living organisms do not obey the second law of thermodynamics, which states that entropy must increase with time.
 B) As a consequence of growing, organisms cause a greater increase in entropy in their environment than the decrease in entropy associated with their growth.
 C) Living organisms are able to transform energy into entropy.
 D) Life obeys the second law of thermodynamics because the decrease in entropy as the organism grows is exactly balanced by an increase in the entropy of the universe.
- 61) Which of the following is true for all exergonic reactions? 61) _____
 A) The products have more total energy than the reactants.
 B) The reaction goes only in a forward direction: all reactants will be converted to products, but no products will be converted to reactants.
 C) A net input of energy from the surroundings is required for the reactions to proceed.
 D) The reaction proceeds with a net release of free energy.
- 62) A chemical reaction that has a positive ΔG is best described as _____. 62) _____
 A) endergonic B) spontaneous C) enthalpic D) exergonic
- 63) Chemical equilibrium is relatively rare in living cells. An example of a reaction at chemical equilibrium in a cell would be _____. 63) _____
 A) an endergonic reaction in an active metabolic pathway where the energy for that reaction is supplied only by heat from the environment
 B) one in which the free energy at equilibrium is higher than the energy content at any point away from equilibrium
 C) 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
 D) one in which the entropy change in the reaction is just balanced by an opposite entropy change in the cell's surroundings
- 64) Why is ATP an important molecule in metabolism? 64) _____
 A) Its terminal phosphate bond has higher energy than the other two phosphate bonds.
 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 group contains a strong covalent bond that, when hydrolyzed, releases free energy.

65) Which of the following is most similar in structure to ATP? 65) _____
 A) a DNA nucleotide
 B) an amino acid with three phosphate groups attached
 C) an RNA nucleotide
 D) a pentose sugar

66) Catabolic pathways _____. 66) _____
 A) are endergonic
 B) combine molecules into more energy-rich molecules
 C) supply energy, primarily in the form of ATP, for the cell's work
 D) are spontaneous and do not need enzyme catalysis

67) A number of systems for pumping ions across membranes are powered by ATP. Such ATP-powered pumps are often called ATPases, although they do not often hydrolyze ATP unless they are simultaneously transporting ions. Because small increases in calcium ions in the cytosol can trigger a number of different intracellular reactions, cells keep the cytosolic calcium concentration quite low under normal conditions, using ATP-powered calcium pumps. For example, muscle cells transport calcium from the cytosol into the membranous system called the sarcoplasmic reticulum (SR). If a resting muscle cell's cytosol has a free calcium ion concentration of 10^{-7} while the concentration in the SR is 10^{-2} , then how is the ATPase acting? 67) _____
 A) ATPase activity must be powering an inflow of calcium from the outside of the cell into the SR.
 B) ATPase activity must be transferring P_i to the SR to enable this to occur.
 C) ATPase activity must be opening a channel for the calcium ions to diffuse back into the SR along the concentration gradient.
 D) ATPase activity must be pumping calcium from the cytosol to the SR against the concentration gradient.



68) Which of the following is the most correct interpretation of the figure? 68) _____
 A) P_i acts as a shuttle molecule to move energy from ATP to ADP.
 B) Energy from catabolism can be used directly for performing cellular work.
 C) ATP is a molecule that acts as an intermediary to store energy for cellular work.
 D) $\text{ADP} + \text{P}_i$ are a set of molecules that store energy for catabolism.

69) How do cells use the ATP cycle shown in the figure? 69) _____
 A) Cells use the cycle to recycle ADP, phosphate, and the energy released by ATP hydrolysis.
 B) Cells use the cycle primarily to generate heat.
 C) Cells use the cycle to recycle ADP and phosphate.
 D) Cells use the cycle to recycle energy released by ATP hydrolysis.

70) Which of the following is true of enzymes? 70) _____

A) Enzymes increase the rate of chemical reaction by providing activation energy to the substrate.

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) Enzyme function is independent of physical and chemical environmental factors such as pH and temperature.

71) The lock-and-key analogy for enzymes applies to the specificity of enzymes _____. 71) _____

A) as they form their tertiary and quaternary structure

B) interacting with water

C) binding to their substrate

D) interacting with ions

72) You have discovered an enzyme that can catalyze two different chemical reactions. Which of the following is most likely to be correct? 72) _____

A) Either the enzyme has two distinct active sites or the reactants involved in the two reactions are very similar in size and shape.

B) The enzyme contains α -helices and β -pleated sheets.

C) Two types of allosteric regulation occur: The binding of one molecule activates the enzyme, while the binding of a different molecule inhibits it.

D) The enzyme is subject to competitive inhibition and allosteric regulation.

73) During a laboratory experiment, you discover that an enzyme-catalyzed reaction has a ΔG of -20 kcal/mol. If you double the amount of enzyme in the reaction, what will be the ΔG for the new reaction? 73) _____

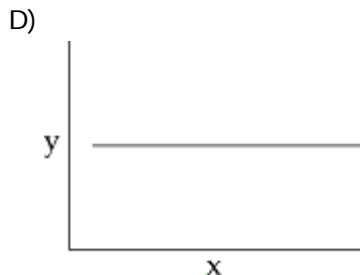
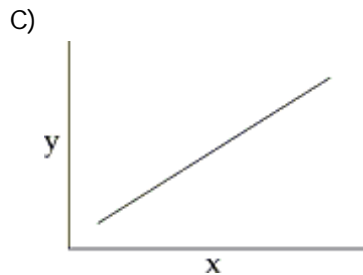
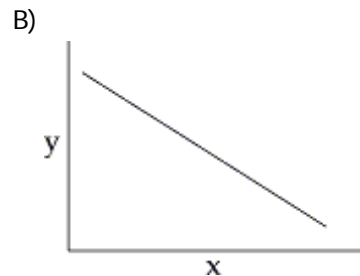
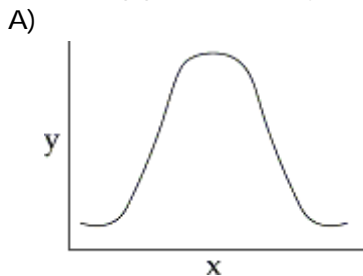
A) +20 kcal/mol B) 0 kcal/mol C) -40 kcal/mol D) -20 kcal/mol

74) Increasing the substrate concentration in an enzymatic reaction could overcome which of the following? 74) _____

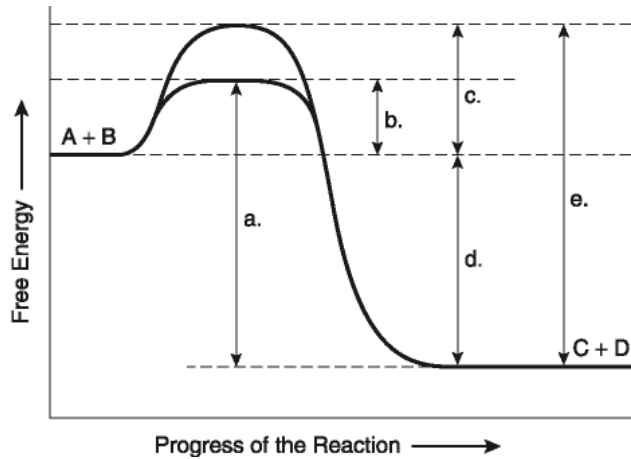
A) the need for a coenzyme B) insufficient cofactors

C) allosteric inhibition D) competitive inhibition

75) 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? 75) _____



The following questions are based on the reaction $A + B \leftrightarrow C + D$ shown in the accompanying figure.



- 76) Which of the following terms best describes the forward reaction in the figure?
- | | |
|-------------------------------|-------------------------------|
| A) exergonic, $\Delta G < 0$ | B) exergonic, $\Delta G > 0$ |
| C) endergonic, $\Delta G < 0$ | D) endergonic, $\Delta G > 0$ |

76) _____

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.

- 77) What is substance X?
- | | |
|----------------------------|--------------------|
| A) a substrate | B) the product |
| C) an allosteric inhibitor | D) an intermediate |
- 78) The mechanism in which the end product of a metabolic pathway inhibits an earlier step in the pathway is most precisely described as ____.
- | | |
|-------------------------|------------------------------|
| A) metabolic inhibition | B) noncooperative inhibition |
| C) feedback inhibition | D) allosteric inhibition |

77) _____

78) _____