

Chapter 8 An Introduction to Metabolism

Multiple-Choice Questions

- 1) Which term most precisely describes the cellular process of breaking down large molecules into smaller ones?
- A) catalysis
 - B) metabolism
 - C) anabolism
 - D) dehydration
 - E) catabolism

Answer: E

Topic: Concept 8.1

Skill: Knowledge/Comprehension

- 2) Which of the following is (are) *true* for anabolic pathways?
- A) They do not depend on enzymes.
 - B) They are usually highly spontaneous chemical reactions.
 - C) They consume energy to build up polymers from monomers.
 - D) They release energy as they degrade polymers to monomers.

Answer: C

Topic: Concept 8.1

Skill: Knowledge/Comprehension

- 3) Which of the following is a statement of the first law of thermodynamics?
- A) Energy cannot be created or destroyed.
 - B) The entropy of the universe is decreasing.
 - C) The entropy of the universe is constant.
 - D) Kinetic energy is stored energy that results from the specific arrangement of matter.
 - E) Energy cannot be transferred or transformed.

Answer: A

Topic: Concept 8.1

Skill: Knowledge/Comprehension

- 4) For living organisms, which of the following is an important consequence of the first law of thermodynamics?
- A) The energy content of an organism is constant.
 - B) The organism ultimately must obtain all of the necessary energy for life from its environment.
 - C) The entropy of an organism decreases with time as the organism grows in complexity.
 - D) Organisms are unable to transform energy.
 - E) Life does not obey the first law of thermodynamics.

Answer: B

Topic: Concept 8.1

Skill: Synthesis/Evaluation

- 5) 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?
- A) Living organisms do not obey the second law of thermodynamics, which states that entropy must increase with time.
 - B) Life obeys the second law of thermodynamics because the decrease in entropy as the organism grows is balanced by an increase in the entropy of the universe.
 - C) Living organisms do not follow the laws of thermodynamics.
 - D) As a consequence of growing, organisms create more disorder in their environment than the decrease in entropy associated with their growth.
 - E) Living organisms are able to transform energy into entropy.

Answer: D

Topic: Concept 8.1

Skill: Synthesis/Evaluation

- 6) Whenever energy is transformed, there is always an increase in the
- A) free energy of the system.
 - B) free energy of the universe.
 - C) entropy of the system.
 - D) entropy of the universe.
 - E) enthalpy of the universe.

Answer: D

Topic: Concept 8.1

Skill: Knowledge/Comprehension

- 7) Which of the following statements is a logical consequence of the second law of thermodynamics?
- A) If the entropy of a system increases, there must be a corresponding decrease in the entropy of the universe.
 - B) If there is an increase in the energy of a system, there must be a corresponding decrease in the energy of the rest of the universe.
 - C) Every energy transfer requires activation energy from the environment.
 - D) Every chemical reaction must increase the total entropy of the universe.
 - E) Energy can be transferred or transformed, but it cannot be created or destroyed.

Answer: D

Topic: Concept 8.1

Skill: Synthesis/Evaluation

- 8) Which of the following statements is representative of the second law of thermodynamics?
- A) Conversion of energy from one form to another is always accompanied by some gain of free energy.
 - B) Heat represents a form of energy that can be used by most organisms to do work.
 - C) Without an input of energy, organisms would tend toward decreasing entropy.
 - D) Cells require a constant input of energy to maintain their high level of organization.
 - E) Every energy transformation by a cell decreases the entropy of the universe.

Answer: D

Topic: Concept 8.1

Skill: Knowledge/Comprehension

9) Which of the following types of reactions would decrease the entropy within a cell?

- A) dehydration reactions
- B) hydrolysis
- C) respiration
- D) digestion
- E) catabolism

Answer: A

Topic: Concept 8.1

Skill: Application/Analysis

10) The organization of organisms has become increasingly complex with time. This statement

- A) is consistent with the second law of thermodynamics.
- B) requires that due to evolution, the entropy of the universe increased.
- C) is based on the fact that organisms function as closed systems.
- D) A and B only
- E) A, B, and C

Answer: A

Topic: Concept 8.1

Skill: Knowledge/Comprehension

11) Which of the following is an example of potential rather than kinetic energy?

- A) a boy mowing grass
- B) water rushing over Niagara Falls
- C) a firefly using light flashes to attract a mate
- D) a food molecule made up of energy-rich macromolecules
- E) an insect foraging for food

Answer: D

Topic: Concept 8.1

Skill: Knowledge/Comprehension

12) Which of the following is considered an open system?

- A) an organism
- B) liquid in a corked bottle
- C) a sealed terrarium
- D) food cooking in a pressure cooker

Answer: A

Topic: Concept 8.1

Skill: Knowledge/Comprehension

13) Which of the following is true of metabolism in its entirety?

- A) Metabolism depends on a constant supply of energy from food
- B) Metabolism depends on an organism's adequate hydration
- C) Metabolism utilizes all of an organism's resources
- D) Metabolism is a property of organismal life
- E) Metabolism manages the increase of entropy in an organism

Answer: D

Topic: Concepts 8.1, 8.5

Skill: Synthesis/Evaluation

- 14) 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*?
- A) ΔS is the change in enthalpy, a measure of randomness.
 - B) ΔH is the change in entropy, the energy available to do work.
 - C) ΔG is the change in free energy.
 - D) T is the temperature in degrees Celsius.

Answer: C

Topic: Concept 8.2

Skill: Knowledge/Comprehension

- 15) What is the change in free energy of a system at chemical equilibrium?
- A) slightly increasing
 - B) greatly increasing
 - C) slightly decreasing
 - D) greatly decreasing
 - E) no net change

Answer: E

Topic: Concept 8.2

Skill: Knowledge/Comprehension

- 16) Which of the following is *true* for all exergonic reactions?
- A) The products have more total energy than the reactants.
 - B) The reaction proceeds with a net release of free energy.
 - C) Some reactants will be converted to products.
 - D) A net input of energy from the surroundings is required for the reactions to proceed.
 - E) The reactions are nonspontaneous.

Answer: B

Topic: Concept 8.2

Skill: Knowledge/Comprehension

- 17) Chemical equilibrium is relatively rare in living cells. Which of the following *could* be an example of a reaction at chemical equilibrium in a cell?
- A) a reaction in which the free energy at equilibrium is higher than the energy content at any point away from equilibrium
 - B) a chemical reaction 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 only used in a metabolic pathway that is completely inactive
 - E) There is no possibility of having chemical equilibrium in any living cell.

Answer: D

Topic: Concept 8.2

Skill: Synthesis/Evaluation

18) Which of the following shows the correct changes in thermodynamic properties for a chemical reaction in which amino acids are linked to form a protein?

- A) $+\Delta H, +\Delta S, +\Delta G$
- B) $+\Delta H, -\Delta S, -\Delta G$
- C) $+\Delta H, -\Delta S, +\Delta G$
- D) $-\Delta H, -\Delta S, +\Delta G$
- E) $-\Delta H, +\Delta S, +\Delta G$

Answer: C

Topic: Concept 8.2

Skill: Application/Analysis

19) When glucose monomers are joined together by glycosidic linkages to form a cellulose polymer, the changes in free energy, total energy, and entropy are as follows:

- A) $+\Delta G, +\Delta H, +\Delta S$
- B) $+\Delta G, +\Delta H, -\Delta S$
- C) $+\Delta G, -\Delta H, -\Delta S$
- D) $-\Delta G, +\Delta H, +\Delta S$
- E) $-\Delta G, -\Delta H, -\Delta S$

Answer: B

Topic: Concept 8.2

Skill: Application/Analysis

20) A chemical reaction that has a positive ΔG is correctly described as

- A) endergonic.
- B) endothermic.
- C) enthalpic.
- D) spontaneous.
- E) exothermic.

Answer: A

Topic: Concept 8.2

Skill: Knowledge/Comprehension

21) Which of the following best describes enthalpy (H)?

- A) the total kinetic energy of a system
- B) the heat content of a chemical system
- C) the system's entropy
- D) the cell's energy equilibrium
- E) the condition of a cell that is not able to react

Answer: B

Topic: Concept 8.2

Skill: Knowledge/Comprehension

22) Why is ATP an important molecule in metabolism?

- A) Its hydrolysis provides an input of free energy for exergonic reactions.
- B) It provides energy coupling between exergonic and endergonic reactions.
- C) Its terminal phosphate group contains a strong covalent bond that when hydrolyzed releases free energy.
- D) Its terminal phosphate bond has higher energy than the other two.
- E) A, B, C, and D

Answer: B

Topic: Concept 8.3

Skill: Knowledge/Comprehension

- 23) When 10,000 molecules of ATP are hydrolyzed to ADP and Pi in a test tube, about twice as much heat is liberated as when a cell hydrolyzes the same amount of ATP. Which of the following is the best explanation for this observation?
- A) Cells are open systems, but a test tube is a closed system.
 - B) Cells are less efficient at heat production than nonliving systems.
 - C) The hydrolysis of ATP in a cell produces different chemical products than does the reaction in a test tube.
 - D) The reaction in cells must be catalyzed by enzymes, but the reaction in a test tube does not need enzymes.
 - E) Reactant and product concentrations are not the same

Answer: E

Topic: Concept 8.3

Skill: Application/Analysis

- 24) Which of the following is most similar in structure to ATP?
- A) an anabolic steroid
 - B) a DNA helix
 - C) an RNA nucleotide
 - D) an amino acid with three phosphate groups attached
 - E) a phospholipid

Answer: C

Topic: Concept 8.3

Skill: Knowledge/Comprehension

- 25) What term is used to describe the transfer of free energy from catabolic pathways to anabolic pathways?
- A) feedback regulation
 - B) bioenergetics
 - C) energy coupling
 - D) entropy
 - E) cooperativity

Answer: C

Topic: Concept 8.3

Skill: Knowledge/Comprehension

- 26) Which of the following statements is *true* concerning catabolic pathways?
- A) They combine molecules into more energy-rich molecules.
 - B) They are usually coupled with anabolic pathways to which they supply energy in the form of ATP.
 - C) They are endergonic.
 - D) They are spontaneous and do not need enzyme catalysis.
 - E) They build up complex molecules such as protein from simpler compounds.

Answer: B

Topic: Concept 8.3

Skill: Knowledge/Comprehension

- 27) When chemical, transport, or mechanical work is done by an organism, what happens to the heat generated?
- A) It is used to power yet more cellular work.
 - B) It is used to store energy as more ATP.
 - C) It is used to generate ADP from nucleotide precursors.
 - D) It is lost to the environment.
 - E) It is transported to specific organs such as the brain.

Answer: D

Topic: Concept 8.3

Skill: Knowledge/Comprehension

- 28) When ATP releases some energy, it also releases inorganic phosphate. What purpose does this serve (if any) in the cell?
- A) It is released as an excretory waste.
 - B) It can only be used to regenerate more ATP.
 - C) It can be added to water and excreted as a liquid.
 - D) It can be added to other molecules in order to activate them.
 - E) It can enter the nucleus to affect gene expression.

Answer: D

Topic: Concept 8.3

Skill: Application/Analysis

- 29) A number of systems for pumping across membranes are powered by ATP. Such ATP-powered pumps are often called ATPases although they don't often hydrolyze ATP unless they are simultaneously transporting ions. Small increases in calcium ions in the cytosol trigger a number of different intracellular reactions, so the cells must keep the calcium concentration quite low. Muscle cells also transport calcium from the cytosol into the membranous system called the sarcoplasmic reticulum (SR). If a muscle cell cytosol has a free calcium ion concentration of 10^{-7} in a resting cell, while the concentration in the SR can be 10^{-2} , then how is the ATPase acting?
- A) The ATP must be powering an inflow of calcium from the outside of the cell into the SR.
 - B) ATP must be transferring P_i to the SR to enable this to occur.
 - C) ATPase activity must be pumping calcium from the cytosol to the SR against the concentration gradient.
 - D) The calcium ions must be diffusing back into the SR along the concentration gradient.
 - E) The route of calcium ions must be from SR to the cytosol, to the cell's environment.

Answer: C

Topic: Concept 8.3

Skill: Synthesis/Evaluation

- 30) What must be the difference (if any) between the structure of ATP and the structure of the precursor of the A nucleotide in DNA and RNA?
- A) The sugar molecule is different.
 - B) The nitrogen-containing base is different.
 - C) The number of phosphates is three instead of one.
 - D) The number of phosphates is three instead of two.
 - E) There is no difference.

Answer: E

Topic: Concept 8.3

Skill: Knowledge/Comprehension

- 31) Which of the following statements is (are) *true* about enzyme-catalyzed reactions?
- A) The reaction is faster than the same reaction in the absence of the enzyme.
 - B) The free energy change of the reaction is opposite from the reaction in the absence of the enzyme.
 - C) The reaction always goes in the direction toward chemical equilibrium.
 - D) A and B only
 - E) A, B, and C

Answer: A

Topic: Concept 8.4

Skill: Knowledge/Comprehension

32) How can one increase the rate of a chemical reaction?

- A) Increase the activation energy needed.
- B) Cool the reactants.
- C) Decrease the concentration of the reactants.
- D) Add a catalyst.
- E) Increase the entropy of the reactants.

Answer: D

Topic: Concept 8.4

Skill: Knowledge/Comprehension

33) Sucrose is a disaccharide, composed of the monosaccharides glucose and fructose. The hydrolysis of sucrose by the enzyme sucrase results in

- A) bringing glucose and fructose together to form sucrose.
- B) the release of water from sucrose as the bond between glucose and fructose is broken.
- C) breaking the bond between glucose and fructose and forming new bonds from the atoms of water.
- D) production of water from the sugar as bonds are broken between the glucose monomers.
- E) utilization of water as a covalent bond is formed between glucose and fructose to form sucrose.

Answer: C

Topic: Concept 8.4

Skill: Application/Analysis

34) Reactants capable of interacting to form products in a chemical reaction must first overcome a thermodynamic barrier known as the reaction's

- A) entropy.
- B) activation energy.
- C) endothermic level.
- D) heat content.
- E) free-energy content.

Answer: B

Topic: Concept 8.4

Skill: Knowledge/Comprehension

35) A solution of starch at room temperature does not readily decompose to form a solution of simple sugars because

- A) the starch solution has less free energy than the sugar solution.
- B) the hydrolysis of starch to sugar is endergonic.
- C) the activation energy barrier for this reaction cannot be surmounted.
- D) starch cannot be hydrolyzed in the presence of so much water.
- E) starch hydrolysis is nonspontaneous.

Answer: C

Topic: Concept 8.4

Skill: Application/Analysis

36) Which of the following statements regarding enzymes is *true*?

- A) Enzymes decrease the free energy change of a reaction.
- B) Enzymes increase the rate of a reaction.
- C) Enzymes change the direction of chemical reactions.
- D) Enzymes are permanently altered by the reactions they catalyze.
- E) Enzymes prevent changes in substrate concentrations.

Answer: B

Topic: Concept 8.4

Skill: Knowledge/Comprehension

- 37) 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?
- A) -40 kcal/mol
 - B) -20 kcal/mol
 - C) 0 kcal/mol
 - D) $+20$ kcal/mol
 - E) $+40$ kcal/mol

Answer: B

Topic: Concept 8.4

Skill: Application/Analysis

- 38) The active site of an enzyme is the region that
- A) binds allosteric regulators of the enzyme.
 - B) is involved in the catalytic reaction of the enzyme.
 - C) binds the products of the catalytic reaction.
 - D) is inhibited by the presence of a coenzyme or a cofactor.

Answer: B

Topic: Concept 8.4

Skill: Knowledge/Comprehension

- 39) According to the induced fit hypothesis of enzyme catalysis, which of the following is *correct*?
- A) The binding of the substrate depends on the shape of the active site.
 - B) Some enzymes change their structure when activators bind to the enzyme.
 - C) A competitive inhibitor can outcompete the substrate for the active site.
 - D) The binding of the substrate changes the shape of the enzyme's active site.
 - E) The active site creates a microenvironment ideal for the reaction.

Answer: D

Topic: Concept 8.4

Skill: Knowledge/Comprehension

Refer to Figure 8.1 to answer the following questions.

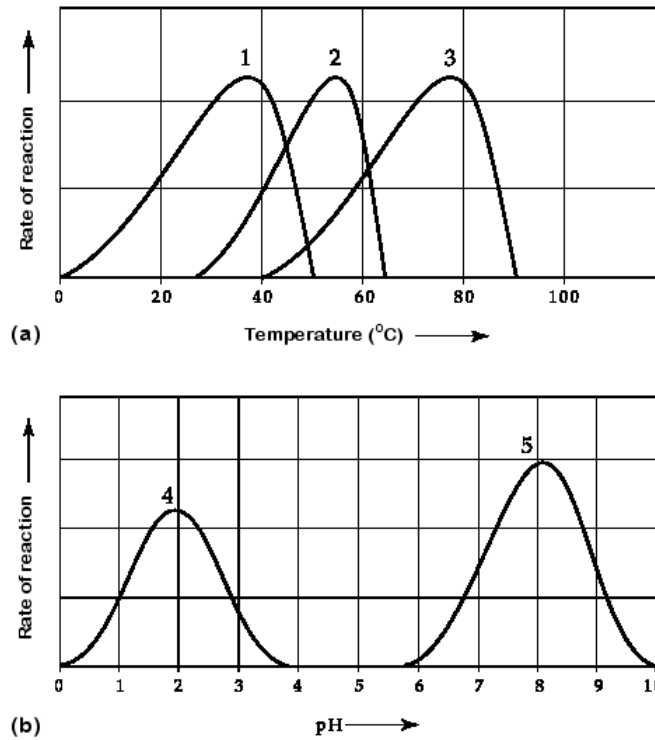


Figure 8.1

40) Which curve represents the behavior of an enzyme taken from a bacterium that lives in hot springs at temperatures of 70°C or higher?

- A) curve 1
- B) curve 2
- C) curve 3
- D) curve 4
- E) curve 5

Answer: C

Topic: Concept 8.4

Skill: Application/Analysis

41) Which curve was most likely generated from analysis of an enzyme from a human stomach where conditions are strongly acid?

- A) curve 1
- B) curve 2
- C) curve 3
- D) curve 4
- E) curve 5

Answer: D

Topic: Concept 8.4

Skill: Application/Analysis

- 42) Which curve was most likely generated from an enzyme that requires a cofactor?
- A) curve 1
 - B) curve 2
 - C) curve 4
 - D) curve 5
 - E) It is not possible to determine whether an enzyme requires a cofactor from these data.

Answer: E

Topic: Concept 8.4

Skill: Application/Analysis

- 43) Increasing the substrate concentration in an enzymatic reaction could overcome which of the following?
- A) denaturization of the enzyme
 - B) allosteric inhibition
 - C) competitive inhibition
 - D) saturation of the enzyme activity
 - E) insufficient cofactors

Answer: C

Topic: Concept 8.4

Skill: Application/Analysis

- 44) Which of the following is true of enzymes?
- A) Enzymes may require a nonprotein cofactor or ion for catalysis to take speed up more appreciably than if the enzymes act alone.
 - B) Enzyme function is increased if the three-dimensional structure or conformation of an enzyme is altered.
 - C) Enzyme function is independent of physical and chemical environmental factors such as pH and temperature.
 - D) Enzymes increase the rate of chemical reaction by lowering activation energy barriers.

Answer: D

Topic: Concept 8.4

Skill: Knowledge/Comprehension

- 45) Zinc, an essential trace element for most organisms, is present in the active site of the enzyme carboxypeptidase. The zinc most likely functions as a(n)
- A) competitive inhibitor of the enzyme.
 - B) noncompetitive inhibitor of the enzyme.
 - C) allosteric activator of the enzyme.
 - D) cofactor necessary for enzyme activity.
 - E) coenzyme derived from a vitamin.

Answer: D

Topic: Concept 8.4

Skill: Application/Analysis

Use the following information to answer the following questions.

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.

- 46) Based on this information, which of the following is correct?
- A) Succinate dehydrogenase is the enzyme, and fumarate is the substrate.
 - B) Succinate dehydrogenase is the enzyme, and malonic acid 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.
 - E) Malonic acid is the product, and fumarate is a competitive inhibitor.

Answer: C

Topic: Concept 8.4

Skill: Application/Analysis

- 47) What is the purpose of using malonic acid in this experiment?
- A) It is a competitive inhibitor.
 - B) It blocks the binding of fumarate.
 - C) It is a noncompetitive inhibitor.
 - D) It is able to bind to succinate.
 - E) It replaces the usual enzyme.

Answer: A

Topic: Concept 8.4

Skill: Application/Analysis

The following questions are based on the reaction $A + B \rightarrow C + D$ shown in Figure 8.2.

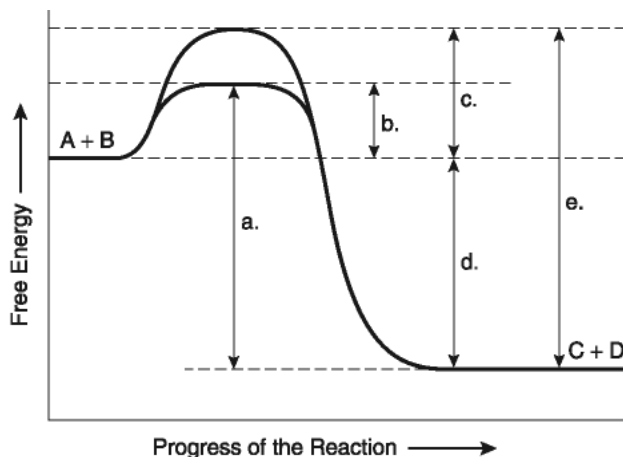


Figure 8.2

- 48) Which of the following terms best describes the reaction?
- A) endergonic
 - B) exergonic
 - C) anabolic
 - D) allosteric
 - E) nonspontaneous

Answer: B

Topic: Concept 8.4

Skill: Application/Analysis

49) Which of the following represents the ΔG of the reaction?

- A) a
- B) b
- C) c
- D) d
- E) e

Answer: D

Topic: Concept 8.4

Skill: Knowledge/Comprehension

50) Which of the following would be the same in an enzyme-catalyzed or noncatalyzed reaction?

- A) a
- B) b
- C) c
- D) d
- E) e

Answer: D

Topic: Concept 8.4

Skill: Knowledge/Comprehension

51) Which of the following best describes the reaction?

- A) negative ΔG , spontaneous
- B) positive ΔG , nonspontaneous
- C) positive ΔG , exergonic
- D) negative ΔG , endergonic
- E) ΔG of zero, chemical equilibrium

Answer: A

Topic: Concept 8.4

Skill: Knowledge/Comprehension

52) Which of the following represents the difference between the free-energy content of the reaction and the free-energy content of the products?

- A) a
- B) b
- C) c
- D) d
- E) e

Answer: D

Topic: Concept 8.4

Skill: Knowledge/Comprehension

53) Which of the following represents the activation energy required for the enzyme-catalyzed reaction?

- A) a
- B) b
- C) c
- D) d
- E) e

Answer: B

Topic: Concept 8.4

Skill: Knowledge/Comprehension

54) Which of the following represents the activation energy required for a noncatalyzed reaction?

- A) a
- B) b
- C) c
- D) d
- E) e

Answer: C

Topic: Concept 8.4

Skill: Knowledge/Comprehension

55) Which *best* describes the reaction?

- A) The amount of free energy initially present in the reactants is indicated by "a."
- B) The amount of free energy present in the products is indicated by "e."
- C) The amount of free energy released as a result of the noncatalyzed reaction is indicated by "c."
- D) The amount of free energy released as a result of the catalyzed reaction is indicated by "d."
- E) The difference between "b" and "c" is the activation energy added by the presence of the enzyme.

Answer: D

Topic: Concept 8.4

Skill: Application/Analysis

56) Assume that the reaction has a ΔG of -5.6 kcal/mol. Which of the following would be true?

- A) The reaction could be coupled to power an endergonic reaction with a ΔG of $+6.2$ kcal/mol.
- B) The reaction could be coupled to power an exergonic reaction with a ΔG of $+8.8$ kcal/mol.
- C) The reaction would result in a decrease in entropy (S) and an increase in the total energy content (H) of the system.
- D) The reaction would result in an increase in entropy (S) and a decrease in the total energy content (H) of the system.
- E) The reaction would result in products ($C + D$) with a greater free-energy content than in the initial reactants ($A + B$).

Answer: D

Topic: Concept 8.4

Skill: Application/Analysis

57) In order to attach a particular amino acid to the tRNA molecule that will transport it, an enzyme, an aminoacyl-tRNA synthetase, is required, along with ATP. Initially, the enzyme has an active site for ATP and another for the amino acid, but it is not able to attach the tRNA. What must occur in order for the final attachment to occur?

- A) The ATP must first have to attach to the tRNA.
- B) The binding of the first two molecules must cause a 3-dimensional change that opens another active site on the enzyme.
- C) The hydrolysis of the ATP must be needed to allow the amino acid to bind to the synthetase.
- D) The tRNA molecule must have to alter its shape in order to be able to fit into the active site with the other two molecules.
- E) The 3' end of the tRNA must have to be cleaved before it can have an attached amino acid.

Answer: B

Topic: Concept 8.4

Skill: Synthesis/Evaluation

- 58) Competitive inhibitors block the entry of substrate into the active site of an enzyme. On which of the following properties of an active site does this primarily depend?
- A) the ability of an enzyme to form a template for holding and joining molecules
 - B) the enzyme's ability to stretch reactants and move them toward a transition state
 - C) the enzyme providing an appropriate microenvironment conducive to a reaction's occurrence
 - D) the enzyme forming covalent bonds with the reactants
 - E) the enzyme becoming too saturated because of the concentration of substrate

Answer: A

Topic: Concept 8.4

Skill: Knowledge/Comprehension

- 59) Which of the following is likely to lead to an increase in the concentration of ATP in a cell?
- A) an increase in a cell's anabolic activity
 - B) an increase in a cell's catabolic activity
 - C) an increased influx of cofactor molecules
 - D) an increased amino acid concentration
 - E) the cell's increased transport of materials to the environment

Answer: B

Topic: Concept 8.4

Skill: Application/Analysis

- 60) When you have a severe fever, what may be a grave consequence if this is not controlled?
- A) destruction of your enzymes' primary structure
 - B) removal of amine groups from your proteins
 - C) change in the folding of enzymes
 - D) removal of the amino acids in active sites
 - E) binding of enzymes to inappropriate substrates

Answer: C

Topic: Concept 8.4

Skill: Application/Analysis

- 61) How does a noncompetitive inhibitor decrease the rate of an enzyme reaction?
- A) by binding at the active site of the enzyme
 - B) by changing the shape of a reactant
 - C) by changing the free energy change of the reaction
 - D) by acting as a coenzyme for the reaction
 - E) by decreasing the activation energy of the reaction

Answer: B

Topic: Concept 8.4

Skill: Knowledge/Comprehension

The next questions are based on the following information.

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.

62) What is substance X?

- A) a coenzyme
- B) an allosteric inhibitor
- C) a substrate
- D) an intermediate
- E) the product

Answer: C

Topic: Concept 8.5

Skill: Application/Analysis

63) Substance A functions as

- A) a coenzyme.
- B) an allosteric inhibitor.
- C) the substrate.
- D) an intermediate.
- E) a competitive inhibitor.

Answer: B

Topic: Concept 8.5

Skill: Application/Analysis

64) The mechanism in which the end product of a metabolic pathway inhibits an earlier step in the pathway is known as

- A) metabolic inhibition.
- B) feedback inhibition.
- C) allosteric inhibition.
- D) noncooperative inhibition.
- E) reversible inhibition.

Answer: B

Topic: Concept 8.5

Skill: Knowledge/Comprehension

65) Which of the following statements describes enzyme cooperativity?

- A) A multi-enzyme complex contains all the enzymes of a metabolic pathway.
- B) A product of a pathway serves as a competitive inhibitor of an early enzyme in the pathway.
- C) A substrate molecule bound to an active site affects the active site of several subunits.
- D) Several substrate molecules can be catalyzed by the same enzyme.
- E) A substrate binds to an active site and inhibits cooperation between enzymes in a pathway.

Answer: C

Topic: Concept 8.5

Skill: Knowledge/Comprehension

Use Figure 8.3 to answer the following questions.

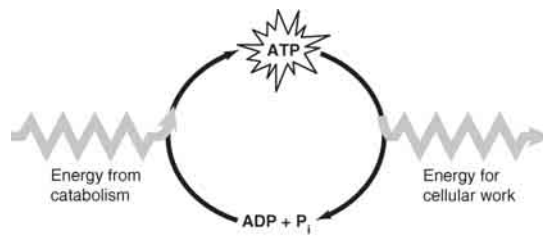


Figure 8.3

- 66) Which of the following is the most correct interpretation of the figure?
- A) Inorganic phosphate is created from organic phosphate.
 - B) Energy from catabolism can be used directly for performing cellular work.
 - C) ADP + Pi are a set of molecules that store energy for catabolism.
 - D) ATP is a molecule that acts as an intermediary to store energy for cellular work.
 - E) Pi acts as a shuttle molecule to move energy from ATP to ADP.

Answer: D

Topic: Concept 8.5

Skill: Application/Analysis

- 67) In coupled reactions, in which direction would the endergonic reaction be driven relative to the clockwise direction of the ATP reaction above and shown in the figure?
- A) from left to right at the top of the figure
 - B) under the symbol for energy doing cellular work in the figure
 - C) from right to left at the bottom of the figure
 - D) it would be shown separately after the figure
 - E) it would be shown in a clockwise direction at the top of the figure

Answer: E

Topic: Concept 8.5

Skill: Synthesis/Evaluation

- 68) Some enzymatic regulation is allosteric. In such cases, which of the following would usually be found?
- A) cooperativity
 - B) feedback inhibition
 - C) both activating and inhibitory activity
 - D) an enzyme with more than one subunit
 - E) the need for cofactors

Answer: D

Topic: Concept 8.5

Skill: Knowledge/Comprehension

- 69) Which of the following is an example of cooperativity?
- A) the binding of an end product of a metabolic pathway to the first enzyme that acts in the pathway
 - B) protein function at one site affected by binding at another of its active sites
 - C) a molecule binding at one unit of a tetramer allowing faster binding at each of the other three
 - D) the effect of increasing temperature on the rate of an enzymatic reaction
 - E) binding of an ATP molecule along with one of the substrate molecules in an active site

Answer: C

Topic: Concept 8.5

Skill: Application/Analysis

- 70) Among enzymes, kinases catalyze phosphorylation, while phosphatases catalyze removal of phosphate(s). A cell's use of these enzymes can therefore function as an on-off switch for various processes. Which of the following is probably involved?
- A) the change in a protein's charge leading to a conformational change
 - B) the change in a protein's charge leading to cleavage
 - C) a change in the optimal pH at which a reaction will occur
 - D) a change in the optimal temperature at which a reaction will occur
 - E) the excision of one or more peptides

Answer: A

Topic: Concept 8.5

Skill: Synthesis/Evaluation

- 71) Besides turning enzymes on or off, what other means does a cell use to control enzymatic activity?
- A) cessation of all enzyme formation
 - B) compartmentalization of enzymes into defined organelles
 - C) exporting enzymes out of the cell
 - D) connecting enzymes into large aggregates
 - E) hydrophobic interactions

Answer: B

Topic: Concept 8.5

Skill: Knowledge/Comprehension

- 72) An important group of peripheral membrane proteins are enzymes, such as the phospholipases that attack the head groups of phospholipids leading to the degradation of damaged membranes. What properties must these enzymes exhibit?
- A) resistance to degradation
 - B) independence from cofactor interaction
 - C) water solubility
 - D) lipid solubility
 - E) membrane spanning domains

Answer: C

Topic: Concept 8.5

Skill: Synthesis/Evaluation

Self-Quiz Questions

- 1) Choose the pair of terms that correctly completes this sentence: Catabolism is to anabolism as _____ is to _____.
- A) exergonic; spontaneous
 - B) exergonic; endergonic
 - C) free energy; entropy
 - D) work; energy
 - E) entropy; enthalpy

Answer: B

Topic:

Skill:

- 2) Most cells cannot harness heat to perform work because
- A) heat is not a form of energy.
 - B) cells do not have much heat; they are relatively cool.
 - C) temperature is usually uniform throughout a cell.
 - D) heat can never be used to do work.
 - E) heat denatures enzymes.

Answer: C

Topic:

Skill:

- 3) Which of the following metabolic processes can occur without a net influx of energy from some other process?
- A) $\text{ADP} + \text{P}_i \rightarrow \text{ATP} + \text{H}_2\text{O}$
 - B) $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6\text{H}_2\text{O}$
 - C) $6 \text{CO}_2 + 6 \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$
 - D) amino acids \rightarrow protein
 - E) glucose + fructose \rightarrow sucrose

Answer: B

Topic:

Skill:

- 4) If an enzyme solution is saturated with substrate, the most effective way to obtain a faster yield of products is to
- A) add more of the enzyme.
 - B) heat the solution to 90°C.
 - C) add more substrate.
 - D) add an allosteric inhibitor.
 - E) add a noncompetitive inhibitor.

Answer: A

Topic:

Skill:

- 5) If an enzyme is added to a solution where its substrate and product are in equilibrium, what would occur?
- A) Additional product would be formed.
 - B) Additional substrate would be formed.
 - C) The reaction would change from endergonic to exergonic.
 - D) The free energy of the system would change.
 - E) Nothing; the reaction would stay at equilibrium.

Answer: E

Topic:

Skill:

- 6) Some bacteria are metabolically active in hot springs because
- A) they are able to maintain a cooler internal temperature.
 - B) high temperatures make catalysis unnecessary.
 - C) their enzymes have high optimal temperatures.
 - D) their enzymes are completely insensitive to temperature.
 - E) they use molecules other than proteins or RNAs as their main catalysts.

Answer: C

Topic:

Skill:

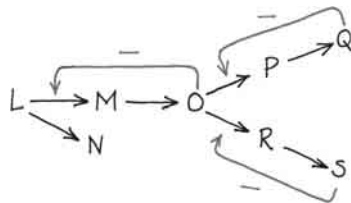
7) Using a series of arrows, draw the branched metabolic reaction pathway described by the following statements, then answer the question at the end.

- L can form either M or N.
- M can form O.
- O can form either P or R.
- P can form Q.
- R can form S.
- O inhibits the reaction of L to form M.
- Q inhibits the reaction of O to form P.
- S inhibits the reaction of O to form R.

Which reaction would prevail if both Q and S were present in the cell in high concentrations?

- A) $L \rightarrow M$
- B) $M \rightarrow O$
- C) $L \rightarrow N$
- D) $O \rightarrow P$
- E) $R \rightarrow S$

Answer: C



Topic:
Skill: