

اللجنة\_الأكاديمية#

# Biology 101

**Test bank :**

Ch3,Ch5,Ch7,C6,  
Ch10,Ch11,Ch16,Ch17



لجان الدفعات كلية الصيدلة

## Chapter 3: Water and the Fitness of the Environment

- 1) In a single molecule of water, two hydrogen atoms are bonded to a single oxygen atom by :  
A) hydrogen bonding      B) nonpolar covalent bonds .    C) polar covalent bonds  
D) van der Waals interactions.    E) ionic bonds.
- 2) The slight negative charge at one end of one water molecule is attracted to the slight positive charge of another water molecule. What is this attraction called?  
A) a covalent bond      B) a hydrogen bond      C) an ionic bond      D) a hydrophilic bond
- 3) An example of a hydrogen bond is the bond between:  
A) C and H in methane (CH<sub>4</sub>).  
B) the H of one water molecule and the O of another water molecule.  
C) Na<sup>+</sup> and Cl<sup>-</sup> in salt.  
D) the two hydrogen atoms in a molecule of hydrogen gas (H<sub>2</sub>).
- 4) Water is able to form hydrogen bonds because  
A) oxygen has a valence of 2.  
B) the water molecule is shaped like a tetrahedron.  
C) the bonds that hold together the atoms in a water molecule are polar covalent bonds.  
D) each of the hydrogen atoms in a water molecule is weakly negative in charge.
- 5) What gives rise to the cohesiveness of water molecules?  
A) hydrophobic interactions      B) nonpolar covalent bonds    C) ionic bonds    D) hydrogen bonds
- 6) Which of the following effects is produced by the high surface tension of water?  
A) Lakes don't freeze solid in winter, despite low temperatures.  
B) A water strider can walk across the surface of a small pond.  
C) Organisms resist temperature changes, although they give off heat due to chemical reactions.  
D) The pH of water remains exactly neutral.
- 7) Which of the following takes place as an ice cube cools a drink?  
A) Molecular collisions in the drink increase.  
B) Kinetic energy in the drink decreases.  
C) A calorie of heat energy is transferred from the ice to the water of the drink.  
D) The specific heat of the water in the drink decreases.

8) Which of the following statements correctly defines a kilocalorie?

- A) the amount of heat required to raise the temperature of 1 g of water by 1°C
- B) the amount of heat required to raise the temperature of 1 kg of water by 1°F
- C) the amount of heat required to raise the temperature of 1 kg of water by 1°C
- D) the amount of heat required to raise the temperature of 1,000 g of water by 1°F

9) The nutritional information on a cereal box shows that one serving of a dry cereal has 200 kilocalories. If one were to burn one serving of the cereal, the amount of heat given off would be sufficient to raise the temperature of 20 kg of water how many degrees Celsius?

- A) 1.0°C
- B) 2.0°C
- C) 20.0°C
- D) 10.0°C

Answer: D

10) Water's high specific heat is mainly a consequence of the

- A) small size of the water molecules.
- B) high specific heat of oxygen and hydrogen atoms.
- C) absorption and release of heat when hydrogen bonds break and form.
- D) fact that water is a poor heat conductor.

11) Which type of bond must be broken for water to vaporize?

- A) ionic bonds
- B) nonpolar covalent bonds
- C) polar covalent bonds
- D) hydrogen bonds

12) Temperature usually increases when water condenses. Which behavior of water is most directly responsible for this phenomenon?

- A) the change in density when it condenses to form a liquid or solid
- B) reactions with other atmospheric compounds
- C) the release of heat by the formation of hydrogen bonds
- D) the release of heat by the breaking of hydrogen bonds

13) At what temperature is water at its densest?

- A) 0°C
- B) 4°C
- C) 32°C
- D) 100°C

14) Why does ice float in liquid water?

- A) The liquid water molecules have more kinetic energy and thus support the ice.
- B) The ionic bonds between the molecules in ice prevent the ice from sinking.
- C) Ice always has air bubbles that keep it afloat.
- D) Hydrogen bonds stabilize and keep the molecules of ice farther apart than the water molecules of liquid water.

15) Based on your knowledge of the polarity of water molecules, the solute molecule is most likely

- A) positively charged.
- B) negatively charged.
- C) without charge.
- D) nonpolar.

16) Hydrophobic substances such as vegetable oil are

- A) nonpolar substances that repel water molecules.

- B) nonpolar substances that have an attraction for water molecules.
- C) polar substances that repel water molecules.
- D) polar substances that have an affinity for water.

**17) One mole (mol) of a substance is**

- A)  $6.02 \times 10^{23}$  molecules of the substance.
- B) 1 g of the substance dissolved in 1 L of solution.
- C) the largest amount of the substance that can be dissolved in 1 L of solution.
- D) the molecular mass of the substance expressed in grams.
- E) A and D only

**18) How many molecules of glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> molecular mass = 180 daltons) would be present in one mole of glucose?**

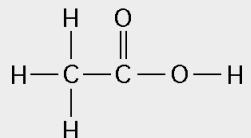
- A) 24
- B)  $23 \times 10^{14}$
- C)  $180 \times 10^{14}$
- D)  $6.02 \times 10^{23}$

**19) How many molecules of glycerol (C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>) would be present in 1 L of a 1 M glycerol solution?**

- A) 1
- B) 14
- C) 92
- D)  $1 \times 10^7$
- E)  $6.02 \times 10^{23}$

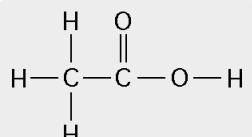
**20) How many grams of the molecule in Figure would be equal to 1 mol of the molecule? (Carbon = 12, Oxygen = 16, Hydrogen = 1)**

- A) 29
- B) 30
- C) 60
- D) 150



**21) How many grams of the molecule in Figure 3.2 would be required to make 1 L of a 0.5 M solution of the molecule? (Carbon = 12, Oxygen = 16, Hydrogen = 1)**

- A) 29
- B) 30
- C) 60
- D) 150



**22) Many mammals control their body temperature by sweating. Which property of water is most directly responsible for the ability of sweat to lower body temperature?**

- A) water's change in density when it condenses
- B) water's ability to dissolve molecules in the air
- C) the release of heat by the formation of hydrogen bonds
- D) the absorption of heat by the breaking of hydrogen bonds

**23) The bonds that are broken when water vaporizes are**

- A) ionic bonds.
- B) hydrogen bonds between water molecules.
- C) covalent bonds between atoms within water molecules.

24) Which of the following is a hydrophobic material?

A) Paper      B) table salt      C) wax      D) sugar

25) We can be sure that a mole of table sugar and a mole of vitamin C are equal in their:

A) mass in daltons.    B) mass in grams.    C) number of molecules.    D) number of atoms.    E) volume

رقم السؤال	الإجابة الصحيحة
1	C
2	B
3	B
4	C
5	D
6	B
7	B
8	D
9	D
10	C
11	D
12	C
13	B
14	D
15	A
16	A
17	E
18	D
19	E
20	C
21	B
22	D
23	B
24	C



# Chapter 5: The Structure and Function of Large Biological Molecules

1) For this pair of items, choose the option that best describes their relationship.

(A) The number of alpha glucose 1-4 linkages in cellulose

(B) The number of alpha glucose 1-4 linkages in starch

A) Item (A) is *greater* than item (B).

B) Item (A) is *less* than item (B).

C) Item (A) is exactly or very approximately *equal* to item (B).

2) For this pair of items, choose the option that best describes their relationship.

(A) The probability of finding chitin in fungal cell walls

(B) The probability of finding chitin in arthropod exoskeletons

A) Item (A) is *greater* than item (B).

B) Item (A) is *less* than item (B).

C) Item (A) is exactly or very approximately *equal* to item (B).

3) For this pair of items, choose the option that best describes their relationship.

(A) The number of *cis* double bonds in saturated fatty acids

(B) The number of *cis* double bonds in unsaturated fatty acids

A) Item (A) is *greater* than item (B).

B) Item (A) is *less* than item (B).

C) Item (A) is exactly or very approximately *equal* to item (B).

4) For this pair of items, choose the option that best describes their relationship.

(A) The probability that amino acids with nonpolar side chains are hydrophobic.

(B) The probability that amino acids with side chains containing a carboxyl group are hydrophobic.

A) Item (A) is *greater* than item (B).

B) Item (A) is *less* than item (B).

C) Item (A) is exactly or very approximately *equal* to item (B).

5) For this pair of items, choose the option that best describes their relationship.

(A) The number of purines in the DNA strand 5'-AAGAGGAGAAAA-3'

(B) The number of pyrimidines in the DNA strand 5'-AAGAGGAGAAAA-3'

A) Item (A) is *greater* than item (B).

B) Item (A) is *less* than item (B).

C) Item (A) is exactly or very approximately *equal* to item (B).

6) Which of the following is not a polymer?

A) glucose   B) starch   C) cellulose   D) chitin   E) DNA

7) What is the chemical mechanism by which cells make polymers from monomers?

A) phosphodiester linkages  
B) hydrolysis  
C) dehydration reactions

8) How many molecules of water are needed to completely hydrolyze a polymer that is 11 monomers long?  
A) 12      B) 11      C) 10      D) 9      E) 8

9) Which of the following best summarizes the relationship between dehydration reactions and hydrolysis?  
A) Dehydration reactions assemble polymers, and hydrolysis reactions break down polymers.  
B) Macromolecular synthesis occurs through the removal of water and digestion occurs through the addition of water.  
C) Dehydration reactions can occur only after hydrolysis.  
D) Hydrolysis creates monomers, and dehydration reactions break down polymers.  
E) A and B are correct.

10) Which of the following polymers contain nitrogen?  
A) Starch    B) glycogen    C) cellulose    D) chitin    E) amylopectin

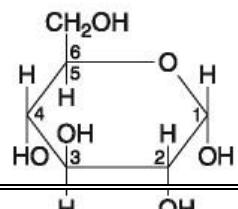
11) The molecular formula for glucose is C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>. What would be the molecular formula for a molecule made by linking three glucose molecules together by dehydration reactions?  
A) C<sub>18</sub>H<sub>36</sub>O<sub>18</sub>    B) C<sub>18</sub>H<sub>30</sub>O<sub>15</sub>    C) C<sub>6</sub>H<sub>10</sub>O<sub>5</sub>    D) C<sub>18</sub>H<sub>10</sub>O<sub>15</sub>

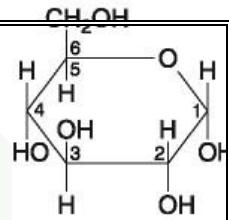
12) The enzyme amylase can break glycosidic linkages between glucose monomers only if the monomers are the  $\alpha$  form. Which of the following could amylase break down?  
A) Glycogen      B) cellulose      C) chitin      D) A and B only

13) On food packages, to what does the term "insoluble fiber" refer?  
A) Cellulose    B) polypeptides    C) starch    D) amylopectin    E) chitin

14) A molecule with the chemical formula C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> is probably a  
A) carbohydrate.    B) lipid.    C) monosaccharide    D) A and B only.    E) A, B, and C.

15) If 2 molecules of the general type shown in Figure were linked together, carbon 1 of one molecule to carbon 4 of the other, the single molecule that would result would be  
A) maltose.    B) fructose.    C) glucose.    D) galactose.    E) sucrose.





16) Which of the following descriptors is true of the molecule shown in Figure?

A) Hexose      B) fructose      C) glucose      D) A and B only      E) A and C only

17) Lactose, a sugar in milk, is composed of one glucose molecule joined by a glycosidic linkage to one galactose molecule. How is lactose classified?

A) as a pentose      B) as a hexose      C) as a monosaccharide      D) as a disaccharide

18) All of the following are polysaccharides except:

A) Glycogen      B) starch      C) chitin      D) cellulose      E) amylopectin

19) Which of the following is *true* of both starch and cellulose?

A) They are both polymers of glucose.      C) They are geometric isomers of each other.  
 B) They can both be digested by humans.      D) They are both used for energy storage in plants.

20) Which of the following is *true* of cellulose?

A) It is a polymer composed of sucrose monomers.  
 B) It is a storage polysaccharide for energy in plant cells.  
 C) It is a storage polysaccharide for energy in animal cells.  
 D) It is a major structural component of plant cell walls.

21) Humans can digest starch but not cellulose because

A) the monomer of starch is glucose, while the monomer of cellulose is galactose.  
 B) humans have enzymes that can hydrolyze the beta ( $\beta$ ) glycosidic linkages of starch but not the alpha ( $\alpha$ ) glycosidic linkages of cellulose.  
 C) humans have enzymes that can hydrolyze the alpha ( $\alpha$ ) glycosidic linkages of starch but not the beta ( $\beta$ ) glycosidic linkages of cellulose.

22) All of the following statements concerning *saturated* fats are true except

A) They are more common in animals than in plants.  
 B) They have multiple double bonds in the carbon chains of their fatty acids.  
 C) They generally solidify at room temperature.

23) A molecule with the formula  $C_{18}H_{36}O_2$  is probably a

A) Carbohydrate      B) fatty acid      C) protein.      D) nucleic acid.      E) hydrocarbon.

24) Which of the following statements is *false* for the class of biological molecules known as lipids?

A) They are soluble in water.  
 B) They are an important constituent of cell membranes.  
 C) They contain more energy than proteins and carbohydrates.  
 D) They are not true polymers.

25) What is a triacylglycerol?

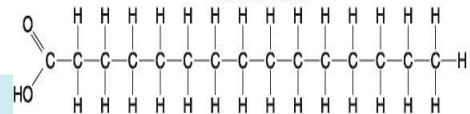
- A) a protein with tertiary structure
- B) a lipid made with three fatty acids and glycerol
- C) a lipid that makes up much of the plasma membrane

26) Which of the following is *true* regarding saturated fatty acids?

- A) They are the predominant fatty acid in corn oil.
- B) They have double bonds between carbon atoms of the fatty acids.
- C) They are the principal molecules in lard and butter.
- D) They are usually liquid at room temperature.
- E) They are usually produced by plants.

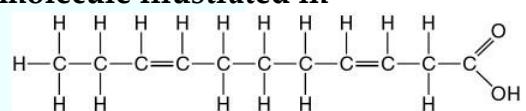
27) Which of the following statements is true regarding the molecule illustrated in Figure?

- A) It is a saturated fatty acid.
- B) A diet rich in this molecule may contribute to atherosclerosis.
- C) Molecules of this type are usually liquid at room temperature.
- D) A and B only



28) Which of the following statements is true regarding the molecule illustrated in Figure ?

A) It is a saturated fatty acid.  
B) A diet rich in this molecule may contribute to atherosclerosis.  
C) Molecules of this type are usually liquid at room temperature.



**Figure 5.3**

29) The molecule shown in Figure 5.3 is a:

A) polysaccharide.      B) polypeptide.      C) saturated fatty acid.  
D) triacylglycerol.      E) unsaturated fatty acid.

30) Large organic molecules are usually assembled by polymerization of a few kinds of simple subunits. Which of the following is an *exception* to this statement?

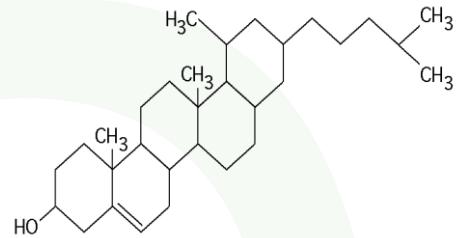
A) a steroid    B) cellulose    C) DNA    D) an enzyme    E) a contractile protein

31) The hydrogenation of vegetable oil results in which of the following?

- A) saturated fats and unsaturated fats with trans double bonds
- B) an increased contribution to atherosclerosis
- C) the oil (fat) being a solid at room temperature
- D) A and C only
- E) A, B, and C

32) What is the structure shown in Figure?

- A) starch molecule
- B) protein molecule
- C) steroid molecule
- D) cellulose molecule
- E) phospholipid molecule
- E)



33) Why are human sex hormones considered to be lipids?

- A) They are essential components of cell membranes.
- B) They are steroids, which are not soluble in water.
- C) They are made of fatty acids.
- D) They are hydrophilic compounds.
- E) They contribute to atherosclerosis.

34) All of the following contain amino acids except

- A) hemoglobin.
- B) cholesterol
- C) antibodies.
- D) enzymes.
- E) insulin.

35) The bonding of two amino acid molecules to form a larger molecule requires

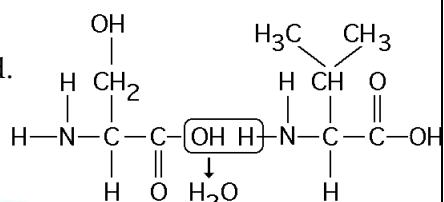
- A) the release of a water molecule.
- B) the addition of a nitrogen atom.
- C) the release of a carbon dioxide molecule.
- D) the addition of a water molecule.

36) There are 20 different amino acids. What makes one amino acid different from another?

- A) different carboxyl groups attached to an alpha ( $\alpha$ ) carbon
- B) different amino groups attached to an alpha ( $\alpha$ ) carbon
- C) different side chains (R groups) attached to an alpha ( $\alpha$ ) carbon

37) Which of the following statements is/are true regarding the chemical reaction illustrated in Figure?

- A) It is a hydrolysis reaction.
- B) It joins two fatty acids together.
- C) It results in a peptide bond.
- D) A and B only



38) The bonding of two amino acid molecules to form a larger molecule requires which of the following?

- A) removal of a water molecule
- B) addition of a water molecule
- C) formation of an ionic bond
- D) formation of a hydrogen bond

39) Polysaccharides, lipids, and proteins are similar in that they

- A) are synthesized from monomers by the process of hydrolysis.
- B) are synthesized from monomers by dehydration reactions.
- C) are synthesized as a result of peptide bond formation between monomers.

40) Dehydration reactions are used in forming which of the following compounds?

- A) Triacyl glycerides
- B) polysaccharide
- C) proteins
- D) A and C only
- E) A, B, and C

41) Upon chemical analysis, a particular polypeptide was found to contain 100 amino acids. How many peptide bonds are present in this protein?

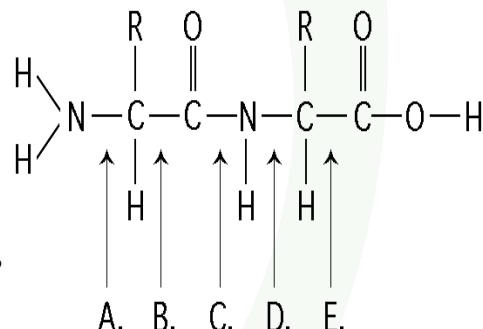
A) 101      B) 100      C) 99      D) 98      E) 97  
B)

42) At which bond would water need to be added to achieve hydrolysis of the peptide, back to its component amino acid?

A) A      B) B      C) C      D) D      E) E

43) Which bond is a peptide bond?

A) A      B) B      C) C      D) D      E) E



44) Which bond is closest to the N-terminus of the molecule?

A) A      B) B      C) C      D) D      E) E

45) Which bond is closest to the carboxyl end of the molecule?

A) A      B) B      C) C      D) D      E) E

46) How many different kinds of polypeptides, each composed of 12 amino acids, could be synthesized using the 20 common amino acids?

A)  $4^{12}$       B)  $12^{20}$       C)  $12^5$       D) 20      E)  $20^{12}$

47) Which bonds are created during the formation of the primary structure of a protein?

A) peptide bonds      B) hydrogen bonds      C) disulfide bonds      D) phosphodiester bonds

48) What maintains the secondary structure of a protein?

A) peptide bonds      B) hydrogen bonds      C) disulfide bonds      D) phosphodiester bonds

49) Which type of interaction stabilizes the alpha ( $\alpha$ ) helix and the beta ( $\beta$ ) pleated sheet structures of proteins?

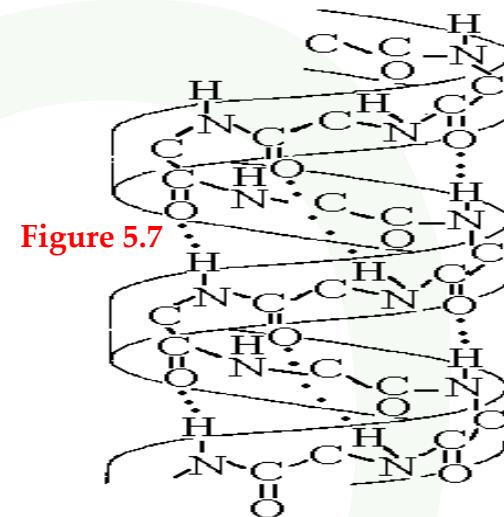
A) hydrophobic interactions      B) nonpolar covalent bonds      C) ionic bonds      D) hydrogen bonds

50) The  $\alpha$  helix and the  $\beta$  pleated sheet are both common polypeptide forms found in which level of protein structure?

A) Primary      B) secondary      C) tertiary      D) quaternary      E) all of the above

51) The structure depicted in **Figure 5.7** shows the

- A) 1-4 linkage of the  $\alpha$  glucose monomers of starch.
- B) 1-4 linkage of the  $\beta$  glucose monomers of cellulose.
- C) double helical structure of a DNA molecule.
- D)  $\alpha$  helix secondary structure of a polypeptide.



**Figure 5.7**

52) **Figure 5.7** best illustrates the

- A) secondary structure of a polypeptide.
- B) tertiary structure of a polypeptide.
- C) quaternary structure of a protein.
- D) double helix structure of DNA.

53) The tertiary structure of a protein is the

- A) bonding together of several polypeptide chains by weak bonds.
- B) order in which amino acids are joined in a polypeptide chain.
- C) unique three-dimensional shape of the fully folded polypeptide.

54) A strong covalent bond between amino acids that functions in maintaining a polypeptide's specific three-dimensional shape is a (an)

- A) ionic bond. B) hydrophobic interaction. C) van der Waals interaction. D) disulfide bond.
- E) hydrogen bond.

55) At which level of protein structure are interactions between the side chains (R groups) most important?

- A) primary B) secondary C) tertiary D) quaternary E) all of the above

56) The R group or side chain of the amino acid serine is  $-\text{CH}_2\text{OH}$ . The R group or side chain of the amino acid alanine is  $-\text{CH}_3$ . Where would you expect to find these amino acids in a globular protein in aqueous solution?

- A) Serine would be in the interior, and alanine would be on the exterior of the globular protein.
- B) Alanine would be in the interior, and serine would be on the exterior of the globular protein.
- C) Both serine and alanine would be in the interior of the globular protein.

57) Misfolding of polypeptides is a serious problem in cells. Which of the following diseases are associated with an accumulation of misfolded proteins?

- A) Alzheimer's B) Parkinson's C) diabetes D) A and B only

58) What would be an unexpected consequence of changing one amino acid in a protein consisting of 325 amino acids?

- A) The primary structure of the protein would be changed.

- B) The tertiary structure of the protein might be changed.
- C) The biological activity or function of the protein might be altered.
- D) Only A and C are correct.
- E) A, B, and C are correct.

59) **Altering which of the following levels of structural organization could change the function of a protein?**

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) all of the above

60) **What method did Frederick Sanger use to elucidate the structure of insulin?**

- A) X-ray crystallography
- B) bioinformatics
- C) high-speed centrifugation
- D) analysis of amino acid sequence of small fragments
- E) NMR spectroscopy

61) **Roger Kornberg used this method for elucidating the structure of RNA polymerase.**

- A) X-ray crystallography
- B) bioinformatics
- C) NMR spectroscopy
- D) analysis of amino acid sequence of small fragments
- E) high-speed centrifugation

62) **Which of the following uses the amino acid sequences of polypeptides to predict a protein's three-dimensional structure?**

- A) X-ray crystallography
- B) bioinformatics
- C) NMR spectroscopy
- D) analysis of amino acid sequence of small fragments
- E) high-speed centrifugation

63) **The function of each protein is a consequence of its specific shape. What is the term used for a change in a protein's three-dimensional shape or conformation due to disruption of hydrogen bonds, disulfide bridges, or ionic bonds?**

- A) Hydrolysis
- B) stabilization
- C) destabilization
- D) renaturation
- E) denaturation

64) **What is the term used for a protein molecule that assists in the proper folding of other proteins?**

- A) tertiary protein
- B) chaperonin
- C) enzyme protein
- D) renaturing protein

65) **DNAase is an enzyme that catalyzes the hydrolysis of the covalent bonds that join nucleotides together. What would first happen to DNA molecules treated with DNAase?**

- A) The two strands of the double helix would separate.
- B) The phosphodiester bonds between deoxyribose sugars would be broken.
- C) The purines would be separated from the deoxyribose sugars.

66) **Which of the following statements about the 5' end of a polynucleotide strand of DNA is correct?**

- A) The 5' end has a hydroxyl group attached to the number 5 carbon of ribose.
- B) The 5' end has a phosphate group attached to the number 5 carbon of ribose.
- C) The 5' end has thymine attached to the number 5 carbon of ribose.

67) Of the following functions, the major purpose of RNA is to

- A) transmit genetic information to offspring.
- B) act as a pattern or blueprint to form DNA.
- C) function in the synthesis of protein.
- D) form the genes of higher organisms.

68) Which of the following *best* describes the flow of information in eukaryotic cells?

- A) DNA → RNA → proteins
- B) RNA → proteins → DNA
- C) proteins → DNA → RNA
- D) RNA → DNA → proteins
- E) DNA → proteins → RNA

69) Which of the following descriptions *best* fits the class of molecules known as nucleotides?

- A) a nitrogenous base and a phosphate group
- B) a nitrogenous base and a pentose sugar
- C) a nitrogenous base, a phosphate group, and a pentose sugar
- D) a phosphate group and an adenine or uracil

70) Which of the following are nitrogenous bases of the pyrimidine type?

- A) guanine and adenine
- B) cytosine and uracil
- C) thymine and guanine
- D) ribose and deoxyribose
- E) adenine and thymine

71) Which of the following are nitrogenous bases of the purine type?

- A) cytosine and guanine
- B) guanine and adenine
- C) adenine and thymine
- D) thymine and uracil
- E) uracil and cytosine

72) If a DNA sample were composed of 10% thymine, what would be the percentage of guanine?

- A) 10
- B) 20
- C) 40
- D) 80
- E) impossible to tell from the information given

73) A double-stranded DNA molecule contains a total of 120 purines and 120 pyrimidines. This DNA molecule could be composed of

- A) 120 adenine and 120 uracil molecules.
- B) 120 thymine and 120 adenine molecules.
- C) 120 cytosine and 120 thymine molecules.
- D) 240 adenine and 240 cytosine molecules.

74) The difference between the sugar in DNA and the sugar in RNA is that the sugar in DNA

- A) is a six-carbon sugar and the sugar in RNA is a five-carbon sugar.
- B) can form a double-stranded molecule.
- C) has a six-membered ring of carbon and nitrogen atoms.
- D) can attach to a phosphate.
- E) contains one less oxygen atom.

75) Which of the following statements *best* summarizes the structural differences between DNA and RNA?

- A) RNA is a protein, whereas DNA is a nucleic acid.

- B) DNA is a protein, whereas RNA is a nucleic acid.
- C) DNA nucleotides contain a different sugar than RNA nucleotides.
- D) A and D are correct.

76) In the double helix structure of nucleic acids, cytosine hydrogen bonds to

- A) deoxyribose.
- B) ribose.
- C) adenine.
- D) thymine.
- E) guanine.

77) If one strand of a DNA molecule has the sequence of bases 5'ATTGCA3', the other complementary strand would have the sequence

- A) 5'TAACGT3'.
- B) 3'TAACGT5'.
- C) 5'UAACGU3'.
- D) 3'UAACGU5'.

78) What is the structural feature that allows DNA to replicate?

- A) sugar-phosphate backbone
- B) complementary pairing of the nitrogenous bases
- C) disulfide bonding (bridging) of the two helices
- D) twisting of the molecule to form an  $\alpha$  helix

79) Which of the following is an example of hydrolysis?

- A) the reaction of two monosaccharides, forming a disaccharide with the release of water
- B) the synthesis of two amino acids, forming a peptide with the release of water
- C) the reaction of a fat, forming glycerol and fatty acids with the release of water
- D) the reaction of a fat, forming glycerol and fatty acids with the utilization of water

80) The element nitrogen is present in all of the following except

- A) proteins.
- B) nucleic acids.
- C) amino acids.
- D) DNA.
- E) monosaccharides.

81) Which of the following is a diverse group of hydrophobic molecules?

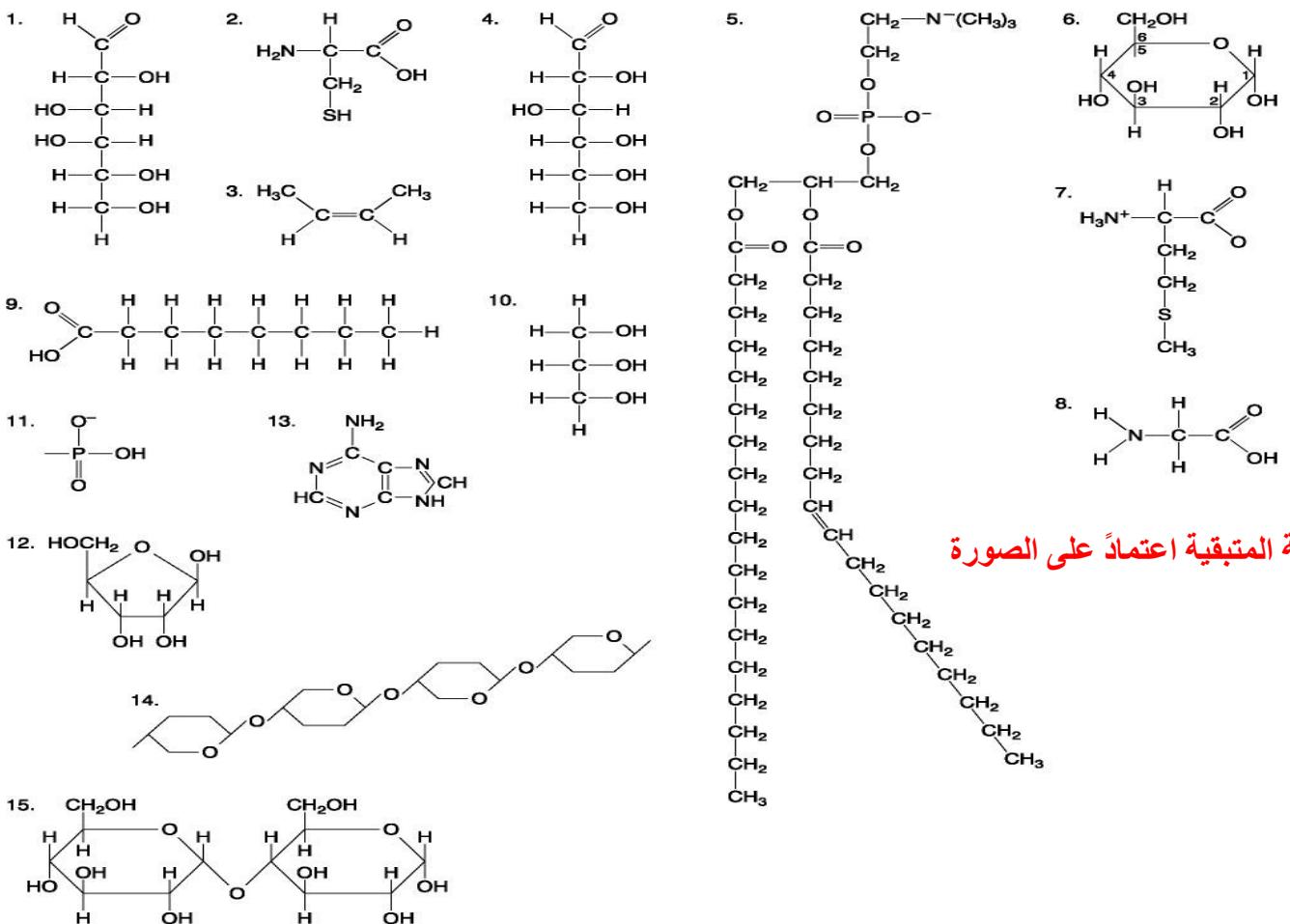
- A) Carbohydrates
- B) lipids
- C) proteins
- D) nucleic acids

82) Which of the following store and transmit hereditary information?

- A) Carbohydrates
- B) lipids
- C) proteins
- D) nucleic acids

83) Enzymes are

- A) Carbohydrates
- B) lipids
- C) proteins
- D) nucleic acids



الأسئلة المتبقية اعتماداً على الصورة

84) In figure which molecule has hydrophilic and hydrophobic properties and would be found in plasma membranes?

A) 1      B) 5      C) 6      D) 12      E) 14

85) Which combinations could be linked together to form a nucleotide?

A) 1, 2, and 11      B) 3, 7, and 8      C) 5, 9, and 10      D) 11, 12, and 13

86) Which of the following molecules contain(s) an aldehyde type of carbonyl functional group?

A) 1      B) 4      C) 8      D) 10      E) 1 and 4

87) Which molecule is glycerol?

A) 1      B) 6      C) 10      D) 14      E) 15

88) Which molecule is a saturated fatty acid?

B) 1      B) 5      C) 6      D) 8      E) 9

89) Which of the following molecules is a purine type of nitrogenous base?  
C) 2    B) 3    C) 5    D) 12    E) 13

90) Which molecules act as building blocks (monomers) of polypeptides?  
D) 1, 4, and 6    B) 2, 7, and 8    C) 7, 8, and 13    D) 11, 12, and 13

91) Which of the following molecules is an amino acid with a hydrophobic R group or side chain?  
E) 3    B) 5    C) 7    D) 8    E) 12

92) Which of the following molecules could be joined together by a peptide bond as a result of a dehydration reaction?  
A) 2 and 3    B) 3 and 7    C) 7 and 8    D) 8 and 9

93) A fat (or triacylglycerol) would be formed as a result of a dehydration reaction between  
A) one molecule of 9 and three molecules of 10.  
B) three molecules of 9 and one molecule of 10.  
C) one molecule of 5 and three molecules of 9.

94) Which of the following molecules could be joined together by a phosphodiester type of covalent bond?  
A) 3 and 4    B) 3 and 8    C) 6 and 15    D) 11 and 12

95) Which molecules is the pentose sugar found in RNA?  
F) 1    B) 4    C) 6    D) 12    E) 13

96) Which of the following molecules contains a glycosidic linkage type of covalent bond?  
G) 4    B) 6    C) 12    D) 13    E) 15

97) Which of the following molecules has (have) a functional group that frequently is involved in maintaining the tertiary structure of a protein?  
H) 2    B) 3    C) 9    D) 11

of the following

98) Which of the following molecules consists of a hydrophilic "head" region and a hydrophobic "tail" region?

I) 2      B) 5      C) 7      D) 9      E) 11

99) Which of the following statements is *false*?

J) 1 and 4 could be joined together by a glycosidic linkage to form a disaccharide.  
K) 9 and 10 could be joined together by ester bonds to form a triacylglycerol.  
L) 2 and 7 could be joined together to form a short peptide.  
M) 2, 7, and 8 could be joined together to form a short peptide.  
N) 14 and 15 could be joined together to form a polypeptide.

رقم السؤال	الإجابة الصحيحة
1	B
2	C
3	B
4	A
5	A
6	A
7	C
8	C
9	E
10	D
11	B
12	A
13	A
14	E
15	A
16	E
17	D
18	A
19	A
20	D
21	C
22	B

of the following

B	23
A	24
B	25
C	26
D	27
C	28
E	29
A	30
E	31
C	32
B	33
B	34
A	35
C	36
B	37
A	38
B	39
E	40
C	41
C	42
C	43
A	44
E	45
E	46
A	47
B	48
D	49
B	50
D	51
A	52
C	53
D	54
C	55
B	56
D	57
E	58

of the following

E	59
C	60
A	61
B	62
E	63
B	64
B	65
B	66
B	67
A	68
C	69
B	70
B	71
C	72
B	73
E	74
C	75
E	76
B	77
B	78
D	79
E	80
B	81
D	82
C	83
B	84
D	85
E	86
C	87
E	88
E	89
B	90
C	91
C	92
B	93
D	94

of the following

<b>D</b>	<b>95</b>
<b>E</b>	<b>96</b>
<b>A</b>	<b>97</b>
<b>B</b>	<b>98</b>
<b>E</b>	<b>99</b>



## Chapter 7: Cell Structure and Function

1) When biologists wish to study the internal ultrastructure of cells, they most likely would use :

A) a light microscope. B) a scanning electron microscope.  
C) a transmission electronic microscope. D) A and B E) B and C

2) The advantage of light microscopy over electron microscopy is that:

A) light microscopy provides for higher magnification than electron microscopy.  
B) light microscopy provides for higher resolving power than electron microscopy.  
C) light microscopy allows one to view dynamic processes in living cells.

3) A primary objective of cell fractionation is to

A) view the structure of cell membranes.  
B) identify the enzymes outside the organelles.  
C) determine the size of various organelles.  
D) separate the major organelles so that their particular functions can be determined.

4) In the fractionation of homogenized cells using centrifugation, the primary factor that determines whether a specific cellular component ends up in the supernatant or the pellet is

A) the relative solubility of the component. B) the size and weight of the component.  
C) the percentage of carbohydrates in the component.

5) Which of the following *correctly* lists the order in which cellular components will be found in the pellet when homogenized cells are treated with increasingly rapid spins in a centrifuge?

A) ribosomes, nucleus, mitochondria C) chloroplasts, ribosomes, vacuoles  
B) nucleus, ribosomes, chloroplasts D) vacuoles, ribosomes, nucleus  
E) nucleus, mitochondria, ribosomes

6) If a modern electron microscope (TEM) can resolve biological images to the nanometer level, as opposed to the best light microscope, this is due to which of the following?

A) The focal length of the electron microscope is significantly longer.  
B) Contrast is enhanced by staining with atoms of heavy metal.  
C) Electron beams have much shorter wavelengths than visible light.

7) All of the following are part of a prokaryotic cell *except*

A) DNA. B) a cell wall. C) a plasma membrane. D) ribosome.  
E) endoplasmic reticulum.

8) The volume enclosed by the plasma membrane of plant cells is often much larger than the corresponding volume in animal cells. The most reasonable explanation for this observation is that

- A) plant cells are capable of having a much higher surface-to-volume ratio than animal cells.
- B) plant cells have a much more highly convoluted (folded) plasma membrane than animal cells.
- C) plant cells contain a large vacuole that reduces the volume of the cytoplasm.

9) A mycoplasma is an organism with a diameter between 0.1 and 1.0  $\mu\text{m}$ . What does its size tell you about how it might be classified?

- A) It must be a single celled protist.
- B) It must be a single celled fungus.
- C) It could be almost any typical bacterium.
- D) It could be a typical virus.
- E) It could be a very small bacterium.

10) Large numbers of ribosomes are present in cells that specialize in producing which of the following molecules?

- A) lipids
- B) starches
- C) proteins
- D) steroids
- E) glucose

11) 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 expect to be the most likely consequence?

- A) the loss of all nuclear function
- B) the inability of the cell to withstand enzymatic digestion
- C) a change in the shape of the nucleus

12) Recent evidence shows that individual chromosomes occupy fairly defined territories within the nucleus. Given the structure and location of the following parts of the nucleus, which would be more probably involved in chromosome location?

- A) nuclear pores
- B) the nucleolus
- C) the outer lipid bilayer
- D) the nuclear lamina
- E) the nuclear matrix

13) Under which of the following conditions would you expect to find a cell with a predominance of free ribosomes?

- A) a cell that is secreting proteins
- B) a cell that is producing cytoplasmic enzymes
- C) a cell that is constructing its cell wall or extracellular matrix

14) Which type of organelle is primarily involved in the synthesis of oils, phospholipids, and steroids?

- A) ribosome
- B) lysosome
- C) smooth endoplasmic reticulum
- D) mitochondrion

15) Which structure is the site of the synthesis of proteins that may be exported from the cell?

A) rough ER      B) lysosome      C) plasmodesmata      D) Golgi vesicles

16) The Golgi apparatus has a polarity or sidedness to its structure and function. Which of the following statements *correctly* describes this polarity?

A) Transport vesicles fuse with one side of the Golgi and leave from the opposite side.  
B) Proteins in the membrane of the Golgi may be sorted and modified as they move from one side of the Golgi to the other.  
C) Lipids in the membrane of the Golgi may be sorted and modified as they move from one side of the Golgi to the other.  
D) Soluble proteins in the cisternae (interior) of the Golgi may be sorted and modified as they move from one side of the Golgi to the other.  
E) All of the above correctly describe polar characteristics of the Golgi function.

17) The fact that the outer membrane of the nuclear envelope has bound ribosomes allows one to *most reliably* conclude that

A) at least some of the proteins that function in the nuclear envelope are made by the ribosomes on the nuclear envelope.  
B) the nuclear envelope is not part of the endomembrane system.  
C) the nuclear envelope is physically continuous with the endoplasmic reticulum.

18) The difference in lipid and protein composition between the membranes of the endomembrane system is largely determined by

A) the physical separation of most membranes from each other.  
B) the transportation of membrane among the endomembrane system by small membrane vesicles.  
C) the function of the Golgi apparatus in sorting membrane components.

19) In animal cells, hydrolytic enzymes are packaged to prevent general destruction of cellular components. Which of the following organelles functions in this compartmentalization?

A) chloroplast      B) lysosome      C) central vacuole      D) peroxisome

20) Which of the following statements *correctly* describes some aspect of protein disposal from prokaryotic cells?

A) Prokaryotes are unlikely to be able to excrete proteins because they lack an endomembrane system.  
B) The mechanism of protein excretion in prokaryotes is probably the same as that in eukaryotes.

C) Proteins that are excreted by prokaryotes are synthesized on ribosomes that are bound to the cytoplasmic surface of the plasma membrane.

21) **Tay-Sachs disease is a human genetic abnormality that results in cells accumulating and becoming clogged with very large and complex lipids. Which cellular organelle must be involved in this condition?**

A) the endoplasmic reticulum      B) the Golgi apparatus      C) the lysosome

22) **The liver is involved in detoxification of many poisons and drugs. Which of the following structures is primarily involved in this process and therefore abundant in liver cells?**

A) rough ER      B) smooth ER      C) Golgi apparatus      D) Nuclear envelope

23) **Which produces and modifies polysaccharides that will be secreted?**

A) lysosome      B) vacuole      C) mitochondrion      D) Golgi apparatus

24) **Which of the following contains hydrolytic enzymes?**

A) lysosome      B) vacuole      C) mitochondrion      D) Golgi apparatus

25) **Which of the following is a compartment that often takes up much of the volume of a plant cell?**

A) lysosome      B) vacuole      C) mitochondrion      D) Golgi apparatus

26) **Which is one of the main energy transformers of cells?**

A) lysosome      B) vacuole      C) mitochondrion      D) Golgi apparatus

27) **Which of the following contains its own DNA and ribosomes?**

A) lysosome      B) vacuole      C) mitochondrion      D) Golgi apparatus

28) **Which contains enzymes that transfer hydrogen from various substrates to oxygen?**

A) lysosome      B) vacuole      C) mitochondrion      D) Golgi apparatus  
E) peroxisome

29) **Grana, thylakoids, and stroma are all components found in**

A) vacuoles.      B) chloroplasts.      C) mitochondria.      D) lysosomes.      E) nuclei.

30) **Organelles other than the nucleus that contain DNA include**

A) ribosomes.      B) mitochondria.      C) chloroplasts.      D) B and C only

31) The chemical reactions involved in respiration are virtually identical between prokaryotic and eukaryotic cells. In eukaryotic cells, ATP is synthesized primarily on the inner membrane of the mitochondria. Where are the corresponding reactions likely to occur in prokaryotic respiration?

- A) in the cytoplasm
- B) on the inner mitochondrial membrane
- C) on the endoplasmic reticulum
- D) on the inner plasma membrane

32) Which are capable of converting light energy to chemical energy?

- A) chloroplasts
- B) mitochondria
- C) leucoplasts
- D) peroxisomes

33) A cell has the following molecules and structures: enzymes, DNA, ribosomes, plasma membrane, and mitochondria. It could be a cell from

- A) a bacterium.
- B) an animal, but not a plant.
- C) a plant, but not an animal.
- D) a plant or an animal.

34) The mitochondrion, like the nucleus, has two or more membrane layers. How is the innermost of these layers different from that of the nucleus?

- A) The inner mitochondrial membrane is highly folded.
- B) The two membranes are biochemically very different.
- C) The space between the two layers of the nuclear membrane is larger.

35) Why isn't the mitochondrion classified as part of the endomembrane system?

- A) It only has two membrane layers.
- B) Its structure is not derived from the ER.
- C) It has too many vesicles.

36) The peroxisome gets its name from its interaction with hydrogen peroxide. If a liver cell is detoxifying alcohol and some other poisons, it does so by removal of hydrogen from the molecules. What, then, do the enzymes of the peroxisome do?

- A) combine the hydrogen with ATP
- B) use the hydrogen to break down hydrogen peroxide
- C) transfer the harmful substances to the mitochondria
- D) transfer the hydrogens to oxygen molecules

37) **How does the cell multiply its peroxisomes?**

- A) They bud off from the ER.
- B) They are brought into the cell from the environment.
- C) They are built de novo from cytosol materials.
- D) They split in two after they are too large.

38) **Motor proteins provide for molecular motion in cells by interacting with what types of cellular structures?**

- A) sites of energy production in cellular respiration
- B) Ribosomes
- C) membrane proteins
- D) cytoskeletons

39) **Cells can be described as having a cytoskeleton of internal structures that contribute to the shape, organization, and movement of the cell. Which of the following are part of the cytoskeleton?**

- A) the nuclear envelope
- B) mitochondria
- C) microfilaments

40) **Of the following, which cell structure would most likely be visible with a light microscope that has been manufactured to the maximum resolving power possible?**

- A) Mitochondrion
- B) microtubule
- C) ribosome
- D) largest microfilament

41) **Which of the following contain the 9 + 2 arrangement of microtubules?**

- A) cilia
- B) centrioles
- C) flagella
- D) A and C only

42) **Which of the following possesses a microtubular structure similar to a basal body?**

- A) Centriole
- B) lysosome
- C) nucleolus
- D) peroxisome
- E) ribosome

43) **Microfilaments are well known for their role in which of the following?**

- A) ameboid movement
- B) formation of cleavage furrows
- C) contracting of muscle cells
- D) A and B only
- E) A, B, and C

44) **Which of the following statements about the cytoskeleton is *true*?**

- A) The dynamic aspect of cytoskeletal function is made possible by the assembly and disassembly of a large number of complex proteins into larger aggregates.
- B) Microfilaments are structurally rigid and resist compression, while microtubules resist tension (stretching).
- C) Movement of cilia and flagella is the result of motor proteins causing microtubules to move relative to each other.

45) **Cells require which of the following to form cilia or flagella?**

- A) centrosomes
- B) ribosomes
- C) actin
- D) A and B only
- E) A, B, and C

46) All of the following serve an important role in determining or maintaining the structure of plant cells. Which of the following are distinct from the others in their composition?

A) microtubules      B) microfilaments      C) plant cell walls

47) Which of the following relationships between cell structures and their respective functions is correct?

A) cell wall: support, protection  
B) chloroplasts: chief sites of cellular respiration  
C) chromosomes: cytoskeleton of the nucleus

48) The cell walls of bacteria, fungi, and plant cells and the extracellular matrix of animal cells are all external to the plasma membrane. Which of the following is a characteristic of all of these extracellular structures?

A) They must block water and small molecules in order to regulate the exchange of matter and energy with their environment.  
B) They must permit information transfer between the cell's cytoplasm and the nucleus.  
C) They are composed of a mixture of lipids and carbohydrates.  
D) They are constructed of materials that are largely synthesized in the cytoplasm and then transported out of the cell.

49) When a potassium ion ( $K^+$ ) moves from the soil into the vacuole of a cell on the surface of a root, it must pass through several cellular structures. Which of the following correctly describes the order in which these structures will be encountered by the ion?

A) plasma membrane  $\rightarrow$  primary cell wall  $\rightarrow$  cytoplasm  $\rightarrow$  tonoplast  
B) secondary cell wall  $\rightarrow$  plasma membrane  $\rightarrow$  primary cell wall  $\rightarrow$  cytoplasm  $\rightarrow$  tonoplast  
C) primary cell wall  $\rightarrow$  plasma membrane  $\rightarrow$  cytoplasm  $\rightarrow$  tonoplast

50) A cell lacking the ability to make and secrete glycoproteins would most likely be deficient in its

A) nuclear DNA.      B) extracellular matrix.      C) Golgi apparatus.      D) B and C only

51) The extracellular matrix is thought to participate in the regulation of animal cell behavior by communicating information from the outside to the inside of the cell via which of the following?

A) gap junctions      B) the nucleus      C) DNA and RNA      D) integrins

52) Plasmodesmata in plant cells are *most similar* in function to which of the following structures in animal cells?

- A) peroxisomes
- B) desmosomes
- C) gap junctions
- D) extracellular matrix

53) Ions can travel directly from the cytoplasm of one animal cell to the cytoplasm of an adjacent cell through

- A) plasmodesmata.
- B) intermediate filaments.
- C) tight junctions.
- D) desmosomes.
- E) gap junctions.

54) Which of the following makes it necessary for animal cells, although they have no cell walls, to have intercellular junctions?

- A) Cell membranes do not distinguish the types of ions and molecules passing through them.
- B) Large molecules, especially proteins, do not readily get through one, much less two adjacent cell membranes.
- C) Cell-to-cell communication requires physical attachment of one cell to another.

55) Recent evidence shows that the extracellular matrix can take part in regulating the expression of genes. A likely possibility for this might be which of the following?

- A) Mechanical signals of the ECM can alter the cytoskeleton, which can alter intracellular signaling.
- B) Intracellular signals might cause changes in the fibronectin binding to the cell surface.
- C) Orientation of microfilaments to the ECM can change the gene activity.

56) Of the following molecules of the ECM, which is capable of transmitting signals between the ECM and the cytoskeleton?

- A) Fibronectin
- B) proteoglycans
- C) integrins
- D) collagen

57) Which statement *correctly* characterizes bound ribosomes?

- A) Bound ribosomes are enclosed in their own membrane.
- B) Bound and free ribosomes are structurally different.
- C) Bound ribosomes generally synthesize membrane proteins and secretory proteins.

58) Which structure *is not* part of the endomembrane system?

- A) nuclear envelope
- B) chloroplast
- C) Golgi apparatus
- D) plasma membrane
- E) ER

59) Cells of the pancreas will incorporate radioactively labeled amino acids into proteins. This "tagging" of newly synthesized proteins enables a researcher to track their location. In this case, we are tracking an enzyme secreted by pancreatic cells. What is its most likely pathway?

- A) ER → Golgi → nucleus
- B) Golgi → ER → lysosome
- C) nucleus → ER → Golgi
- D) ER → Golgi → vesicles that fuse with plasma membrane

60) Which structure is common to plant and animal cells?

- A) chloroplast
- B) wall made of cellulose
- C) central vacuole
- D) mitochondrion

61) Which of the following is present in a prokaryotic cell?

- A) mitochondrion
- B) ribosome
- C) nuclear envelope
- D) chloroplast
- E) ER

62) Which cell would be best for studying lysosomes?

- A) muscle cell
- B) nerve cell
- C) phagocytic white blood cell
- D) leaf cell of a plant

63) Which structure-function pair is *mismatched*?

- A) nucleolus; production of ribosomal subunits
- B) lysosome; intracellular digestion
- C) ribosome; protein synthesis
- D) Golgi; protein trafficking
- E) microtubule; muscle contraction

64) Cyanide binds with at least one molecule involved in producing ATP. If a cell is exposed to cyanide, most of the cyanide would be found within the

- A) mitochondria.
- B) ribosomes.
- C) peroxisomes.
- D) lysosomes.

رقم السؤال	الإجابة الصحيحة
1	C
2	C
3	D
4	B
5	E

C	6
E	7
C	8
E	9
C	10
C	11
E	12
B	13
C	14
A	15
E	16
A	17
C	18
B	19
C	20
C	21
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A	24
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A	42
E	43
C	44
D	45
C	46
B	47

D	48
C	49
D	50
D	51
C	52
E	53
B	54
A	55
C	56
C	57
B	58
D	59
D	60
B	61
C	62
E	63
A	64

# Chapter 6 An Introduction to Metabolism

- 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
  
- 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.
  
- 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.
  
- 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.
  
- 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.

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.

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.

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.

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

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

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

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

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

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)  $\Delta S$  is the change in enthalpy, a measure of randomness.
- B)  $\Delta H$  is the change in entropy, the energy available to do work.
- C)  $\Delta G$  is the change in free energy.
- D)  $T$  is the temperature in degrees Celsius.

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

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.

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.

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)  $-\Delta H$ ,  $+\Delta S$ ,  $+\Delta G$

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)  $-\Delta G$ ,  $-\Delta H$ ,  $-\Delta S$

20) A chemical reaction that has a positive  $\Delta G$  is correctly described as

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

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

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

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

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

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

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.

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.

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.

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 Pi 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.

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.

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

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.

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 sucrase.

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.

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.

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.

37) During a laboratory experiment, you discover that an enzyme-catalyzed reaction has a  $\Delta G$  of -20 kcal/mol. If you double the amount of enzyme in the reaction, what will be the  $\Delta G$  for the new reaction?  
A) -40 kcal/mol  
B) -20 kcal/mol

- C) 0 kcal/mol
- D) +20 kcal/mol
- E) +40 kcal/mol

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.

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.

Refer to Figure 8.1 to answer the following questions.

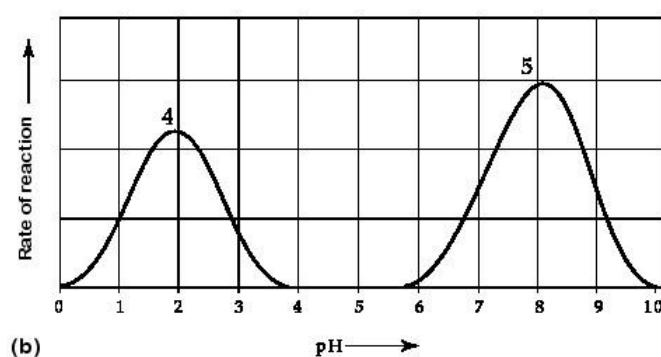
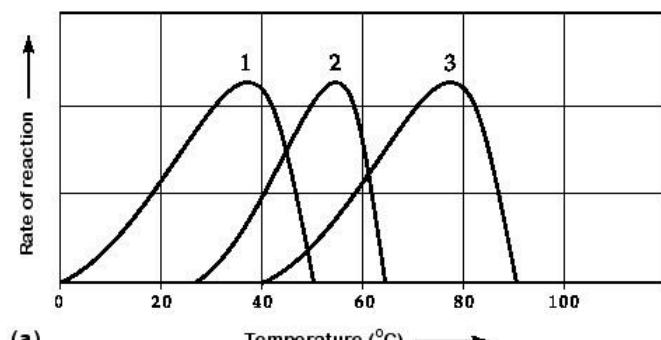


Figure 8.1

40) Which curve represents the behavior of an enzyme taken from a bacterium that lives in hot springs at temperatures of 70  $^{\circ}\text{C}$  or higher?

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

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

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.

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

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.

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.

*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.

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.

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

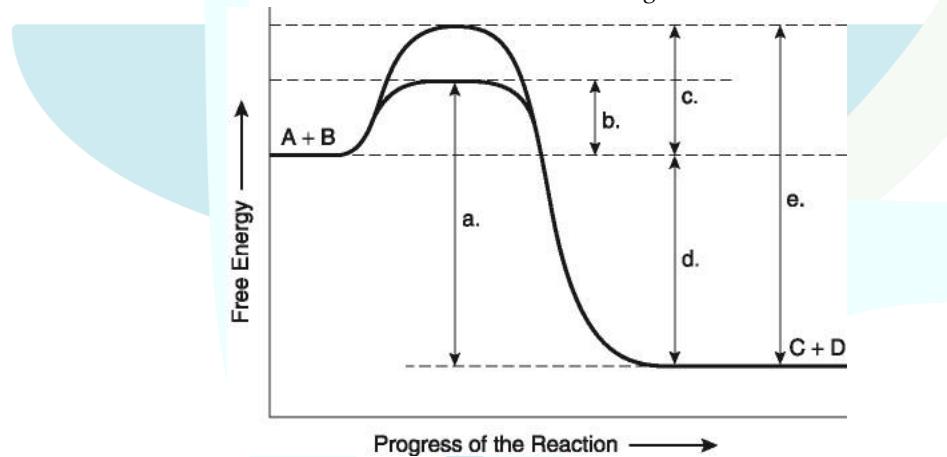


Figure 8.2

48) Which of the following terms best describes the reaction?

- A) endergonic
- B) exergonic
- C) anabolic
- D) allosteric
- E) nonspontaneous

49) Which of the following represents the  $\Delta G$  of the reaction?

- A) aB) b
- C) c
- D) d
- E) e

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

- A) aB) b
- C) c
- D) d
- E) e

51) Which of the following bests describes the reaction?

- A) negative  $\Delta G$ , spontaneous
- B) positive  $\Delta G$ , nonspontaneous
- C) positive  $\Delta G$ , exergonic
- D) negative  $\Delta G$ , endergonic
- E)  $\Delta G$  of zero, chemical equilibrium

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) aB) b
- C) c
- D) d
- E) e

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

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

- A) aB) b
- C) c
- D) d
- E) e

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.

56) Assume that the reaction has a  $\Delta G$  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  $\Delta G$  of +6.2 kcal/mol.
- B) The reaction could be coupled to power an exergonic reaction with a  $\Delta G$  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 ( $A + B$ ).

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.

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

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

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

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

*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

**Topic: Concept 8.5**

63) Substance A functions as

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

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.

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.

*Use Figure 8.3 to answer the following questions.*

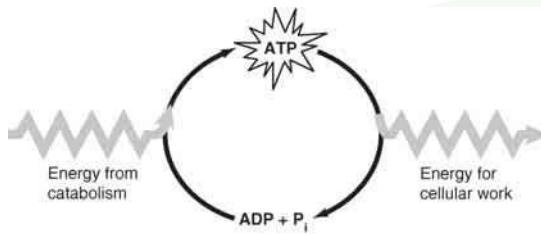


Figure 8.3

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.

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

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

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

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

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

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

N.Q	Answer	N.Q	Answer
1	E	36	B
2	C	37	B
3	A	38	B
4	B	39	D
5	D	40	C
6	D	41	D
7	D	42	E

8	D	43	C
9	A	44	D
10	A	45	D
11	D	46	C
12	A	47	A
13	D	48	B
14	C	49	D
15	E	50	D
16	B	51	A
17	D	52	D
18	C	53	B
19	B	54	C
20	A	55	D
21	B	56	D
22	B	57	B
23	E	58	A
24	C	59	B
25	C	60	C
26	B	61	B
27	D	62	C
28	D	63	B
29	C	64	B

30	E	65	C
31	A	66	D
32	D	67	E
33	C	68	D
34	B	69	C
35	C	70	A
71	B	72	C

## Ch6+Ch10

1) Which of the following statement is FALSE?

- a. Endergonic reactions are not spontaneous and exergonic reactions are spontaneous
- b. Endergonic reactions have a positive AG and exergonic reactions have a negative AG
- c. None of the option is correct
- d. All endergonic and exergonic reactions require the same amount of energy to overcome an activation barrier
- e. Endergonic reactions consume energy and exergonic reactions release energy

answer : d

2) In cellular respiration, the process that generates almost 90% of the ATP is:

- a. oxidative phosphorylation
- b. de-phosphorylation
- c. phosphorylation
- d. substrate-level phosphorylation
- e. re-phosphorylation

answer : a

3) Catalysts are always proteins that are consumed by the reaction to speed it up:

- a. True
- b. False

answer: b

4) Which of the following is FALSE about fermentation:

- a. In lactic acid fermentation NADH donates hydrogen and becomes NAD<sup>+</sup> which is reused by glycolysis
- b. Fermentation is an anaerobic process which means it does not use oxygen
- c. Fermentation begins at the end of glycolysis so the substrate for fermentation is pyruvate
- d. The reactants of alcoholic fermentation are sugar, and CO<sub>2</sub>
- e. Alcohol fermentation is conducted by yeast

answer : d

5) What is ATP made from:

- a. ADP+ phosphate

b. Deoxy ribose and 3 phosphate groups

C. adenosine+ high energy electrons

d.AMP+ ADP

e.none of these are correct

**answer : a**

6)What term is used to describe the transfer of free energy from exergonic reactions to endergonic pathways:

a. entropy

b. energy coupling

c. feedback regulation

d. bioenergetics

e. Cooperativity

**answer : b**

7)Which of the following steps are in correct order

A. glycolysis----- pyruvate oxidation ---- oxidative phosphorylation---- citric acid cycle

b.glycolysis----- pyruvate reduction ---- citric acid cycle---- oxidative phosphorylation

c .glycolysis---citric acid cycle ---- oxidative phosphorylation--- pyruvate reduction

d. glycolysis---- pyruvate oxidation---- citric acid cycle ---- oxidative phosphorylation

e. glycolysis---- pyruvate reduction---- oxidative phosphorylation--- citric acid ccycle

**answer :d**

8)In lactic acid fermentation, the final electron acceptor is:

a. alcohol

b. sugar

c. pyruvate

d.co2

e oxygen

**answer : c**

9)Glycolysis has..... steps, while citric acid cycle has.....steps

a. ten, eight

b. ten, two

c. two, ten

d. eight, ten

e. ten, eight

**answer : a**

10)Which of the following is FALSE about the using of proteins as fuel:

A. The nitrogenous waste is excreted from the animal in the form of ammonia (NH3), urea, or other waste products

b. All of the options are false

- c. Many of the amino acids are used by the organism to build new proteins
- d. After amino acids can feed into glycolysis or the citric acid cycle, their amino groups must be removed, a process called deamination
- e .Firstly, they must be digested to their building blocks amino acids

answer : e

11)In alcohol fermentation, NAD<sup>+</sup> is regenerated from NADH by:

- A. reduction of acetaldehyde to form ethanol
- b. oxidation of pyruvate to form acetyl CoA
- c. oxidation of acetaldehyde to form ethanol
- d .reduction of pyruvate to form lactate
- e .reduction of ethanol to form pyruvate

answer : a

12)Cells endorse fermentation reaction to regenerate the .....needed for glycolysis

- a. pyruvic acid
- b. glucose
- c. Urea
- d. NAD<sup>+</sup>
- e. NADH

answer : d

13)The process oxidation of pyruvate to Acetyl Co-A, takes place..... the citric acid cycle

- a while
- b. before
- c. all given choices are correct
- d. after
- e. all given choices are incorrect

answer: b

14)Plant and animal cells break down organic molecules by cellular respiration in the..... and some of the energy is released to the environment.as .....

- a. mitochondria.....AMP
- b. mitochondria ---- heat
- c. mitochondria---- ATP
- d. chloroplast. ----Heat
- e. chloroplast... ATP

answer : b

15) If an enzyme in solution is saturated with its substrate, the most effective way to obtain a higher reaction rate is to:

- a. add more of the enzyme
- b. add more substrate
- c. add a noncompetitive inhibitor
- d. All of the options are correct
- e. heat the solution to 95°C

answer : a

16) beta oxidation involves the -----

- a. oxidation of pyruvate
- b. oxidation of glucose
- c. breakdown of fatty acids
- d. regulation of glycolysis
- e. production of alcohol

answer : c

17) With regards to glycolysis, all of the following statements are correct except

- a. 4 ATP are formed in the energy payoff phase
- b. All of the options are correct
- c. glycolysis requires oxygen
- d. 2 ATP are used in the energy investment phase
- e. glycolysis occurs in the cytoplasm

answer : b

18) Allosteric enzyme regulation is usually associated with

- a. lack of cooperativity
- b. feedback inhibition
- c. activating activity
- d. an enzyme with more than one subunit
- e. the need for cofactors

answer : d

19) In citric acid cycle, the Acetyl Co-A enters the cycle by reacting with:

- a. succinate
- b. alpha keto-glutarate
- c. citrate

- d. malonate
- e. oxaloacetate

answer : e

20) Coenzymes are nonorganic enzyme cofactors:

- a. True
- b. False

answer : b

## Chapter11: Photosynthesis

1) If photosynthesizing green algae are provided with CO<sub>2</sub> synthesized with heavy oxygen (18O), later analysis

will show that all but one of the following compounds produced by the algae contain the 18O label. That one is

- A) PGA.
- B) PGAL.
- C) glucose.
- D) RuBP.
- E) O<sub>2</sub>.

2) Which of the following are products of the light reactions of photosynthesis that are utilized in the Calvin cycle?

- A) CO<sub>2</sub> and glucose
- B) H<sub>2</sub>O and O<sub>2</sub>
- C) ADP, Pi, and NADP<sup>+</sup>
- D) electrons and H<sup>+</sup>
- E) ATP and NADPH

3) What are the products of the light reactions that are subsequently used by the Calvin cycle?

- A) oxygen and carbon dioxide
- B) carbon dioxide and RuBP
- C) water and carbon
- D) electrons and photons
- E) ATP and NADPH

4) Where does the Calvin cycle take place?

- A) stroma of the chloroplast
- B) thylakoid membrane
- C) cytoplasm surrounding the chloroplast
- D) chlorophyll molecule
- E) outer membrane of the chloroplast

5) In any ecosystem, terrestrial or aquatic, what group(s) is (are) always necessary?

- A) autotrophs and heterotrophs
- B) producers and primary consumers
- C) photosynthesizers
- D) autotrophs
- E) green plants

6) In autotrophic bacteria, where are the enzymes located that can carry on organic synthesis?

- A) chloroplast membranes
- B) nuclear membranes
- C) free in the cytosol

D) along the outer edge of the nucleoid  
E) along the inner surface of the plasma membrane

7) When oxygen is released as a result of photosynthesis, it is a by-product of which of the following?

- A) reducing NADP<sup>+</sup>
- B) splitting the water molecules
- C) chemiosmosis
- D) the electron transfer system of photosystem I
- E) the electron transfer system of photosystem II

8) A plant has a unique photosynthetic pigment. The leaves of this plant appear to be reddish yellow. What wavelengths of visible light are being absorbed by this pigment?

- A) red and yellow
- B) blue and violet
- C) green and yellow
- D) blue, green, and red
- E) green, blue, and yellow

**Use the following information to answer the questions below.**

Theodor W. Engelmann illuminated a filament of algae with light that passed through a prism, thus exposing different segments of algae to different wavelengths of light. He added aerobic bacteria and then noted in which areas the bacteria congregated. He noted that the largest groups were found in the areas illuminated by the red and blue light.

9) What did Engelmann conclude about the congregation of bacteria in the red and blue areas?

- A) Bacteria released excess carbon dioxide in these areas.
- B) Bacteria congregated in these areas due to an increase in the temperature of the red and blue light.
- C) Bacteria congregated in these areas because these areas had the most oxygen being released.
- D) Bacteria are attracted to red and blue light and thus these wavelengths are more reactive than other wavelengths.
- E) Bacteria congregated in these areas due to an increase in the temperature caused by an increase in photosynthesis.

10) An outcome of this experiment was to help determine

- A) the relationship between heterotrophic and autotrophic organisms.
- B) the relationship between wavelengths of light and the rate of aerobic respiration.
- C) the relationship between wavelengths of light and the amount of heat released.
- D) the relationship between wavelengths of light and the oxygen released during photosynthesis.
- E) the relationship between the concentration of carbon dioxide and the rate of photosynthesis.

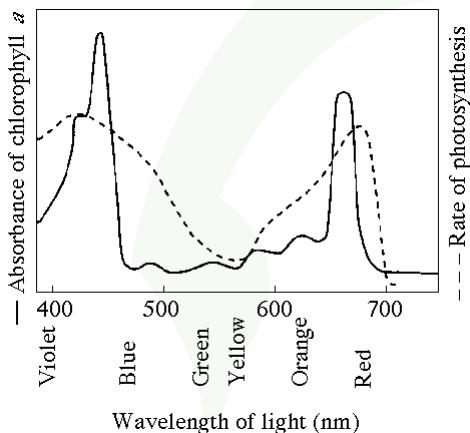
Topic: Concept 10.2

Skill: Synthesis/Evaluation

11) If you ran the same experiment without passing light through a prism, what would you predict?

- A) There would be no difference in results.
- B) The bacteria would be relatively evenly distributed along the algal filaments.
- C) The number of bacteria present would decrease due to an increase in the carbon dioxide concentration.
- D) The number of bacteria present would increase due to an increase in the carbon dioxide concentration.

E) The number of bacteria would decrease due to a decrease in the temperature of the water.



**Figure 10.1**

12) Figure 10.1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis.

Why are they different?

- A) Green and yellow wavelengths inhibit the absorption of red and blue wavelengths.
- B) Bright sunlight destroys photosynthetic pigments.
- C) Oxygen given off during photosynthesis interferes with the absorption of light.
- D) Other pigments absorb light in addition to chlorophyll *a*.
- E) Aerobic bacteria take up oxygen which changes the measurement of the rate of photosynthesis.

13) What wavelength of light in the figure is *most* effective in driving photosynthesis?

- A) 420 mm
- B) 475 mm
- C) 575 mm
- D) 625 mm
- E) 730 mm

14) Compared with the lines for chlorophyll *a* in the figure, where would you expect to find the lines to differ for chlorophyll *b*?

- A) The absorption spectrum line would be lowest for chlorophyll *b* somewhat to the right of that for chlorophyll *a* (500–600).
- B) The rate of photosynthesis line for chlorophyll *b* would be lowest from 600–700 nm.
- C) The lines for the two types of chlorophyll would be almost completely opposite.
- D) The lines for the two types of chlorophyll would be almost completely identical.
- E) The peaks of the line for absorbance of *b* would be shifted to the left, and for rate of photosynthesis would be shifted to the right.

15) In the thylakoid membranes, what is the main role of the antenna pigment molecules?

- A) split water and release oxygen to the reaction-center chlorophyll
- B) harvest photons and transfer light energy to the reaction-center chlorophyll
- C) synthesize ATP from ADP and Pi
- D) transfer electrons to ferredoxin and then NADPH
- E) concentrate photons within the stroma

16) The reaction-center chlorophyll of photosystem I is known as P700 because

- A) there are 700 chlorophyll molecules in the center.
- B) this pigment is best at absorbing light with a wavelength of 700 nm.
- C) there are 700 photosystem I components to each chloroplast.
- D) it absorbs 700 photons per microsecond.
- E) the plastoquinone reflects light with a wavelength of 700 nm.

17) Which of the events listed below occur in the light reactions of photosynthesis? A) NADP is produced.

- B) NADPH is reduced to NADP+.
- C) carbon dioxide is incorporated into PGA.
- D) ATP is phosphorylated to yield ADP.
- E) light is absorbed and funneled to reaction-center chlorophyll *a*.

18) Which statement describes the functioning of photosystem II?

- A) Light energy excites electrons in the electron transport chain in a photosynthetic unit.
- B) The excitation is passed along to a molecule of P700 chlorophyll in the photosynthetic unit.
- C) The P680 chlorophyll donates a pair of protons to NADPH, which is thus converted to NADP+.
- D) The electron vacancies in P680 are filled by electrons derived from water.
- E) The splitting of water yields molecular carbon dioxide as a by-product.

19) Which of the following are directly associated with photosystem I?

- A) harvesting of light energy by ATP
- B) receiving electrons from plastocyanin
- C) P680 reaction-center chlorophyll
- D) extraction of hydrogen electrons from the splitting of water
- E) passing electrons to plastoquinone

20) Some photosynthetic organisms contain chloroplasts that lack photosystem II, yet are able to survive. The best way to detect the lack of photosystem II in these organisms would be

- A) to determine if they have thylakoids in the chloroplasts.
- B) to test for liberation of O<sub>2</sub> in the light.
- C) to test for CO<sub>2</sub> fixation in the dark.
- D) to do experiments to generate an action spectrum.
- E) to test for production of either sucrose or starch.

21) What are the products of linear photophosphorylation?

- A) heat and fluorescence
- B) ATP and P700
- C) ATP and NADPH
- D) ADP and NADP
- E) P700 and P680

22) As a research scientist, you measure the amount of ATP and NADPH consumed by the Calvin cycle in 1 hour. You find 30,000 molecules of ATP consumed, but only 20,000 molecules of NADPH. Where did the extra ATP molecules come from?

- A) photosystem II
- B) photosystem I
- C) cyclic electron flow
- D) linear electron flow
- E) chlorophyll

23) Assume a thylakoid is somehow punctured so that the interior of the thylakoid is no longer separated from the stroma. This damage will have the most direct effect on which of the following processes?

- A) the splitting of water
- B) the absorption of light energy by chlorophyll
- C) the flow of electrons from photosystem II to photosystem I
- D) the synthesis of ATP
- E) the reduction of NADP+

24) What does the chemiosmotic process in chloroplasts involve?

- A) establishment of a proton gradient
- B) diffusion of electrons through the thylakoid membrane
- C) reduction of water to produce ATP energy
- D) movement of water by osmosis into the thylakoid space from the stroma
- E) formation of glucose, using carbon dioxide, NADPH, and ATP

25) Suppose the interior of the thylakoids of isolated chloroplasts were made acidic and then transferred in the dark to a pH-8 solution. What would be likely to happen?

- A) The isolated chloroplasts will make ATP.
- B) The Calvin cycle will be activated.
- C) Cyclic photophosphorylation will occur.
- D) Only A and B will occur.
- E) A, B, and C will occur.

26) In a plant cell, where are the ATP synthase complexes located?

- A) thylakoid membrane
- B) plasma membrane
- C) inner mitochondrial membrane
- D) A and C
- E) A, B, and C

27) In mitochondria, chemiosmosis translocates protons from the matrix into the intermembrane space, whereas in chloroplasts, chemiosmosis translocates protons from

- A) the stroma to the photosystem II.
- B) the matrix to the stroma.
- C) the stroma to the thylakoid space.
- D) the intermembrane space to the matrix.
- E) ATP synthase to NADP+ reductase.

28) Which of the following statements *best* describes the relationship between photosynthesis and respiration?

- A) Respiration is the reversal of the biochemical pathways of photosynthesis.
- B) Photosynthesis stores energy in complex organic molecules, while respiration releases it.
- C) Photosynthesis occurs only in plants and respiration occurs only in animals.
- D) ATP molecules are produced in photosynthesis and used up in respiration.
- E) Respiration is anabolic and photosynthesis is catabolic.

29) Where are the molecules of the electron transport chain found in plant cells?

- A) thylakoid membranes of chloroplasts
- B) stroma of chloroplasts
- C) inner membrane of mitochondria
- D) matrix of mitochondria
- E) cytoplasm

30) Synthesis of ATP by the chemiosmotic mechanism occurs during

- A) photosynthesis.
- B) respiration.
- C) both photosynthesis and respiration.
- D) neither photosynthesis nor respiration.
- E) photorespiration.

31) Reduction of oxygen which forms water occurs during

- A) photosynthesis.
- B) respiration.
- C) both photosynthesis and respiration.
- D) neither photosynthesis nor respiration.
- E) photorespiration.

32) Reduction of NADP<sup>+</sup> occurs during

- A) photosynthesis.
- B) respiration.
- C) both photosynthesis and respiration.
- D) neither photosynthesis nor respiration.
- E) photorespiration.

33) The splitting of carbon dioxide to form oxygen gas and carbon compounds occurs during

- A) photosynthesis.
- B) respiration.
- C) both photosynthesis and respiration.
- D) neither photosynthesis nor respiration.
- E) photorespiration.

34) Generation of proton gradients across membranes occurs during

- A) photosynthesis.
- B) respiration.
- C) both photosynthesis and respiration.
- D) neither photosynthesis nor respiration.
- E) photorespiration.

35) What is the relationship between wavelength of light and the quantity of energy per photon? A) They have a direct, linear relationship.  
B) They are inversely related.  
C) They are logarithmically related.  
D) They are separate phenomena.  
E) They are only related in certain parts of the spectrum.

36) In a protein complex for the light reaction (a reaction center), energy is transferred from pigment molecule to pigment molecule, to a special chlorophyll a molecule, and eventually to the primary electron acceptor. Why does this occur?  
A) The action spectrum of that molecule is such that it is different from other molecules of chlorophyll.  
B) The potential energy of the electron has to go back to the ground state.  
C) The molecular environment lets it boost an electron to a higher energy level and also to transfer the electron to another molecule.  
D) Each pigment molecule has to be able to act independently to excite electrons.  
E) These chlorophyll a molecules are associated with higher concentrations of ATP.

37) P680+ is said to be the strongest biological oxidizing agent. Why?  
A) It is the receptor for the most excited electron in either photosystem.  
B) It is the molecule that transfers electrons to plastoquinone (Pq) of the electron transfer system.  
C) NADP reductase will then catalyze the shift of the electron from Fd to NADP+ to reduce it to NADPH.  
D) This molecule results from the transfer of an electron to the primary electron acceptor of photosystem II and strongly attracts another electron.  
E) This molecule is found far more frequently among bacteria as well as in plants and plantlike Protists.

38) Some photosynthetic bacteria (e.g., purple sulfur bacteria) have photosystem I but not II, while others (e.g. cyanobacteria) have both PSI and PSII. Which of the following might this observation imply?  
A) Photosystem II must have been selected against in some species.  
B) Photosystem I must be more ancestral.  
C) Photosystem II may have evolved to be more photoprotective.  
D) Cyclic flow must be more primitive than linear flow of electrons.  
E) Cyclic flow must be the most necessary of the two processes.

39) Cyclic electron flow may be photoprotective (protective to light-induced damage). Which of the following experiments could provide information on this phenomenon?  
A) using mutated organisms that can grow but that cannot carry out cyclic flow of electrons and compare their abilities to photosynthesize in different light intensities  
B) using plants that can carry out both linear and cyclic electron flow, or only one or another of these processes, and measuring their light absorbance  
C) using bacteria that have only cyclic flow and look for their frequency of mutation damage

- D) using bacteria with only cyclic flow and measuring the number and types of photosynthetic pigments they have in their membranes
- E) using plants with only photosystem I operative and measure how much damage occurs at different wavelengths.

40) Carotenoids are often found in foods that are considered to have antioxidant properties in human nutrition.

What related function do they have in plants?

- A) They serve as accessory pigments.
- B) They dissipate excessive light energy.
- C) They cover the sensitive chromosomes of the plant.
- D) They reflect orange light.
- E) They take up toxins from the water.

41) In thylakoids, protons travel through ATP synthase from the stroma to the thylakoid space. Therefore the catalytic "knobs" of ATP synthase would be located A) on the side facing the thylakoid space.

- B) on the ATP molecules themselves.
- C) on the pigment molecules of PSI and PSII.
- D) on the stroma side of the membrane.
- E) built into the center of the thylakoid stack (grana).

42) Which of the following statements best represents the relationships between the light reactions and the Calvin cycle?

- A) The light reactions provide ATP and NADPH to the Calvin cycle, and the cycle returns ADP, Pi, and NADP<sup>+</sup> to the light reactions.
- B) The light reactions provide ATP and NADPH to the carbon fixation step of the Calvin cycle, and the cycle provides water and electrons to the light reactions.
- C) The light reactions supply the Calvin cycle with CO<sub>2</sub> to produce sugars, and the Calvin cycle supplies the light reactions with sugars to produce ATP.
- D) The light reactions provide the Calvin cycle with oxygen for electron flow, and the Calvin cycle provides the light reactions with water to split.
- E) There is no relationship between the light reactions and the Calvin cycle.

43) Where do the enzymatic reactions of the Calvin cycle take place?

- A) stroma of the chloroplast
- B) thylakoid membranes
- C) outer membrane of the chloroplast
- D) electron transport chain
- E) thylakoid space

44) What is the primary function of the Calvin cycle?

- A) use ATP to release carbon dioxide
- B) use NADPH to release carbon dioxide
- C) split water and release oxygen

- D) transport RuBP out of the chloroplast
- E) synthesize simple sugars from carbon dioxide

For the following questions, compare the light reactions with the Calvin cycle of photosynthesis in plants.

45) Produces molecular oxygen (O<sub>2</sub>)

- A) light reactions alone
- B) the Calvin cycle alone
- C) both the light reactions and the Calvin cycle
- D) neither the light reactions nor the Calvin cycle
- E) occurs in the chloroplast but is not part of photosynthesis

Topic: Concept 10.2

Skill: Knowledge/Comprehension

46) Requires ATP

- A) light reactions alone
- B) the Calvin cycle alone
- C) both the light reactions and the Calvin cycle
- D) neither the light reactions nor the Calvin cycle
- E) occurs in the chloroplast but is not part of photosynthesis

47) Produces NADH

- A) light reactions alone
- B) the Calvin cycle alone
- C) both the light reactions and the Calvin cycle
- D) neither the light reactions nor the Calvin cycle
- E) occurs in the chloroplast but is not part of photosynthesis

48) Produces NADPH

- A) light reactions alone
- B) the Calvin cycle alone
- C) both the light reactions and the Calvin cycle
- D) neither the light reactions nor the Calvin cycle
- E) occurs in the chloroplast but is not part of photosynthesis

49) Produces three-carbon sugars

- A) light reactions alone
- B) the Calvin cycle alone
- C) both the light reactions and the Calvin cycle
- D) neither the light reactions nor the Calvin cycle
- E) occurs in the chloroplast but is not part of photosynthesis

Topic: Concept 10.3

Skill: Knowledge/Comprehension

50) Requires CO<sub>2</sub>

- A) light reactions alone
- B) the Calvin cycle alone
- C) both the light reactions and the Calvin cycle
- D) neither the light reactions nor the Calvin cycle
- E) occurs in the chloroplast but is not part of photosynthesis

51) Requires glucose

- A) light reactions alone
- B) the Calvin cycle alone
- C) both the light reactions and the Calvin cycle
- D) neither the light reactions nor the Calvin cycle
- E) occurs in the chloroplast but is not part of photosynthesis

52) The sugar that results from three "turns" of the Calvin cycle is glyceraldehyde-3-phosphate (G3P). Which of the following is a consequence of this?

- A) Formation of a molecule of glucose would require 9 "turns."
- B) G3P more readily forms sucrose and other disaccharides than it does monosaccharides.
- C) Some plants would not taste sweet to us.
- D) The formation of starch in plants involves assembling many G3P molecules, with or without further rearrangements.
- E) G3P is easier for a plant to store.

53) In the process of carbon fixation, RuBP attaches a CO<sub>2</sub> to produce a 6 carbon molecule, which is then split in two. After phosphorylation and reduction, what more needs to happen in the Calvin cycle?

- A) addition of a pair of electrons from NADPH
- B) inactivation of RuBP carboxylase enzyme
- C) regeneration of ATP from ADP
- D) regeneration of rubisco
- E) a gain of NADPH

**Use the following figure and the stages labeled A, B, C, D, and E to answer the following questions.**

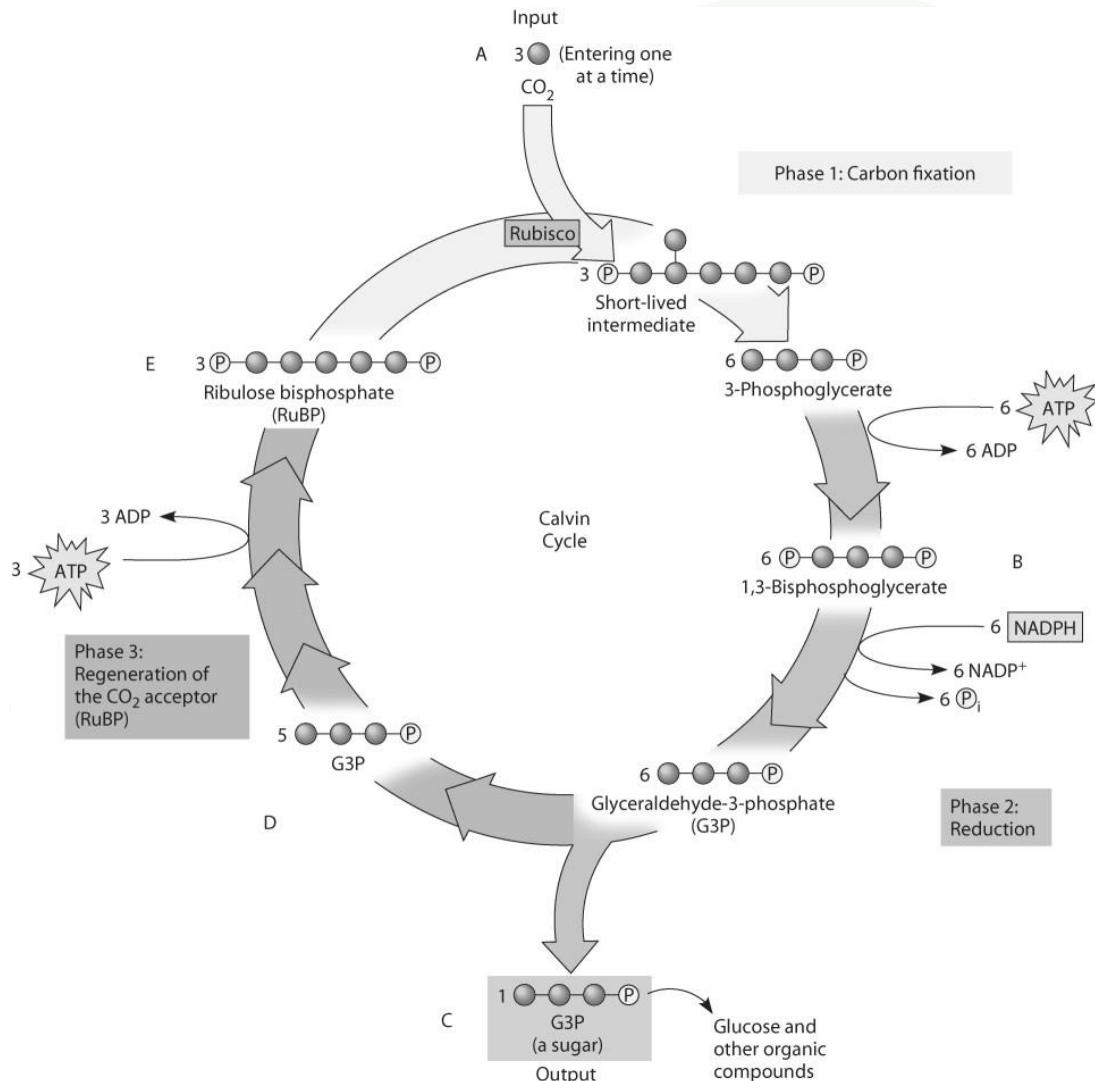


Figure 10.2

54) If ATP used by this plant is labeled with radioactive phosphorus, in which molecules will the radioactivity be measurable after one "turn" of the cycle?

- A) in B only
- B) in B and C only
- C) in B, C, and D only
- D) in B and E only
- E) in B, C, D, and E

55) If the carbon atom of the incoming  $\text{CO}_2$  molecule is labeled with a radioactive isotope of carbon, where will the

radioactivity be measurable after one cycle?

- A) in C only

- B) in E only
- C) in C, D, and E
- D) in A, B, and C E) in B and C

56) Which molecule(s) of the Calvin cycle is/are most like molecules found in glycolysis?

- A) A, B, C, and E B) B, C, and E
- C) A only
- D) C and D only E) E only

57) In metabolic processes of cell respiration and photosynthesis, prosthetic groups such as heme and iron-sulfur complexes are encountered. What do they do?

- A) donate electrons
- B) act as reducing agents
- C) act as oxidizing agents
- D) transport protons within the mitochondria and chloroplasts E) both oxidize and reduce during electron transport

Topic: Concept 10.3

Skill: Synthesis/Evaluation

58) The pH of the inner thylakoid space has been measured, as have the pH of the stroma and of the cytosol of a particular plant cell. Which, if any, relationship would you expect to find? A) The pH within the thylakoid is less than that of the stroma.

- B) The pH of the stroma is higher than that of the other two measurements.
- C) The pH of the stroma is higher than that of the thylakoid space but lower than that of the cytosol.
- D) The pH of the thylakoid space is higher than that anywhere else in the cell.
- E) There is no consistent relationship.

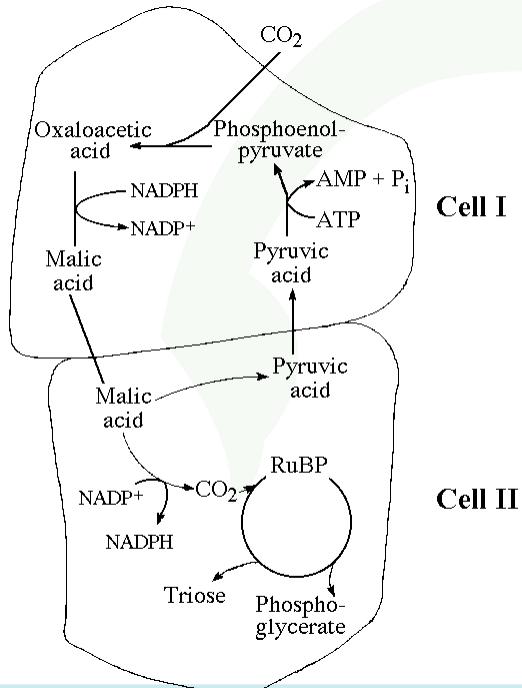


Figure 10.3

59) Which of the following statements is *true* concerning Figure 10.3? A) It represents cell processes involved in C4 photosynthesis.  
 B) It represents the type of cell structures found in CAM plants.  
 C) It represents an adaptation that maximizes photorespiration.  
 D) It represents a C3 photosynthetic system.  
 E) It represents a relationship between plant cells that photosynthesize and those that cannot.

60) Referring to Figure 10.3, oxygen would inhibit the  $\text{CO}_2$  fixation reactions in  
 A) cell I only.  
 B) cell II only.  
 C) neither cell I nor cell II.  
 D) both cell I and cell II.  
 E) cell I during the night and cell II during the day.

61) In which cell would you expect photorespiration?  
 A) Cell I  
 B) Cell II  
 C) Cell I at night  
 D) Cell II at night  
 E) neither Cell I nor Cell II

62) In an experiment studying photosynthesis performed during the day, you provide a plant with radioactive carbon ( $^{14}\text{C}$ ) dioxide as a metabolic tracer. The  $^{14}\text{C}$  is incorporated first into oxaloacetate. The plant is best characterized as a A) C4 plant. B) C3 plant.  
C) CAM plant.  
D) heterotroph.  
E) chemoautotroph.

63) Why are C4 plants able to photosynthesize with no apparent photorespiration?  
A) They do not participate in the Calvin cycle.  
B) They use PEP carboxylase to initially fix  $\text{CO}_2$ .  
C) They are adapted to cold, wet climates.  
D) They conserve water more efficiently.  
E) They exclude oxygen from their tissues.

64) CAM plants keep stomata closed in daytime, thus reducing loss of water. They can do this because they A) fix  $\text{CO}_2$  into organic acids during the night.  
B) fix  $\text{CO}_2$  into sugars in the bundle-sheath cells.  
C) fix  $\text{CO}_2$  into pyruvate in the mesophyll cells.  
D) use the enzyme phosphofructokinase, which outcompetes rubisco for  $\text{CO}_2$ .  
E) use photosystems I and II at night.

65) Photorespiration lowers the efficiency of photosynthesis by preventing the formation of A) carbon dioxide molecules.  
B) 3-phosphoglycerate molecules.  
C) ATP molecules.  
D) ribulose bisphosphate molecules.  
E) RuBP carboxylase molecules.

66) The alternative pathways of photosynthesis using the C4 or CAM systems are said to be compromises. Why?  
A) Each one minimizes both water loss and rate of photosynthesis.  
B) C4 compromises on water loss and CAM compromises on photorespiration.  
C) Each one both minimizes photorespiration and optimizes the Calvin cycle.  
D) CAM plants allow more water loss, while C4 plants allow less  $\text{CO}_2$  into the plant.  
E) C4 plants allow less water loss but CAM plants but allow more water loss.

67) If plant gene alterations cause the plants to be deficient in photorespiration, what would most probably occur? A) Cells would carry on more photosynthesis.  
B) Cells would carry on the Calvin cycle at a much slower rate.  
C) Less ATP would be generated.  
D) There would be more light-induced damage to the cells.  
E) More sugars would be produced.

N.Q	Answer	N.Q	Answer
1	E	35	B
2	E	36	C
3	E	37	D
4	A	38	B
5	D	39	A
6	E	40	B
7	B	41	D
8	B	42	A
9	C	43	A
10	D	44	E
11	B	45	A
12	D	46	B
13	A	47	D
14	A	48	A
15	B	49	B
16	B	50	B
17	E	51	D

18	D	52	D
19	B	53	D
20	B	54	E
21	C	55	B
22	C	56	D
23	D	57	E
24	A	58	A
25	A	59	A
26	D	60	B
27	C	61	B
28	B	62	A
29	A	63	B
30	C	64	A
31	B	65	B
32	A	66	C
33	D	67	C
34	C		

## Chapter 16 Nucleic Acids and Inheritance

- 1) For a couple of decades, biologists knew the nucleus contained DNA and proteins. The prevailing opinion was that the genetic material was proteins, and not DNA. The reason for this belief was that proteins are more complex than DNA. What was the basis of this thinking?
  - A) Proteins have a greater variety of three-dimensional forms than does DNA.
  - B) Proteins have two different levels of structural organization; DNA has four.
  - C) Proteins are made of 40 amino acids and DNA is made of four nucleotides.
  - D) Some viruses only transmit proteins.
  - E) A and B are correct.
  
- 2) In his transformation experiments, what did Griffith observe?
  - A) Mutant mice were resistant to bacterial infections.
  - B) Mixing a heat-killed pathogenic strain of bacteria with a living nonpathogenic strain can convert some of the living cells into the pathogenic form.
  - C) Mixing a heat-killed nonpathogenic strain of bacteria with a living pathogenic strain makes the pathogenic strain nonpathogenic.
  - D) Infecting mice with nonpathogenic strains of bacteria makes them resistant to pathogenic strains.
  - E) Mice infected with a pathogenic strain of bacteria can spread the infection to other mice.
  
- 3) What does transformation involve in bacteria?
  - A) the creation of a strand of DNA from an RNA molecule
  - B) the creation of a strand of RNA from a DNA molecule
  - C) the infection of cells by a phage DNA molecule
  - D) the type of semiconservative replication shown by DNA
  - E) assimilation of external DNA into a cell
  
- 4) The following scientists made significant contributions to our understanding of the structure and function of DNA. Place the scientists' names in the correct chronological order, starting with the first scientist(s) to make a contribution.
  - I. Avery, McCarty, and MacLeod
  - II. Griffith
  - III. Hershey and Chase
  - IV. Meselson and Stahl
  - V. Watson and Crick
  - A) V, IV, II, I, III
  - B) II, I, III, V, IV
  - C) I, II, III, V, IV
  - D) I, II, V, IV, III
  - E) II, III, IV, V, I

5) After mixing a heat-killed, phosphorescent strain of bacteria with a living non-phosphorescent strain, you discover that some of the living cells are now phosphorescent. Which observations would provide the best evidence that the ability to fluoresce is a heritable trait?

- A) DNA passed from the heat-killed strain to the living strain.
- B) Protein passed from the heat-killed strain to the living strain.
- C) The phosphorescence in the living strain is especially bright.
- D) Descendants of the living cells are also phosphorescent.
- E) Both DNA and protein passed from the heat-killed strain to the living strain.

6) In trying to determine whether DNA or protein is the genetic material, Hershey and Chase made use of which of the following facts?

- A) DNA contains sulfur, whereas protein does not.
- B) DNA contains phosphorus, but protein does not.
- C) DNA contains nitrogen, whereas protein does not.
- D) DNA contains purines, whereas protein includes pyrimidines.
- E) RNA includes ribose, while DNA includes deoxyribose sugars.

7) For a science fair project, two students decided to repeat the Hershey and Chase experiment, with modifications. They decided to label the nitrogen of the DNA, rather than the phosphate. They reasoned that each nucleotide has only one phosphate and two to five nitrogens. Thus, labeling the nitrogens would provide a stronger signal than labeling the phosphates. Why won't this experiment work?

- A) There is no radioactive isotope of nitrogen.
- B) Radioactive nitrogen has a half-life of 100,000 years, and the material would be too dangerous for too long.
- C) Avery et al. have already concluded that this experiment showed inconclusive results.
- D) Although there are more nitrogens in a nucleotide, labeled phosphates actually have 16 extra neutrons; therefore, they are more radioactive.
- E) Amino acids (and thus proteins) also have nitrogen atoms; thus, the radioactivity would not distinguish between DNA and proteins.

8) Which of the following investigators was/were responsible for the following discovery?

Chemicals from heat-killed S cells were purified. The chemicals were tested for the ability to transform live R cells. The transforming agent was found to be DNA.

- A) Frederick Griffith
- B) Alfred Hershey and Martha Chase
- C) Oswald Avery, Maclyn McCarty, and Colin MacLeod
- D) Erwin Chargaff

E) Matthew Meselson and Franklin Stahl

9) Which of the following investigators was/were responsible for the following discovery?

Phage with labeled proteins or DNA was allowed to infect bacteria. It was shown that the DNA, but not the protein, entered the bacterial cells, and was therefore concluded to be the genetic material.

- A) Frederick Griffith
- B) Alfred Hershey and Martha Chase
- C) Oswald Avery, Maclyn McCarty, and Colin MacLeod
- D) Erwin Chargaff
- E) Matthew Meselson and Franklin Stahl

10) Which of the following investigators was/were responsible for the following discovery?

In DNA from any species, the amount of adenine equals the amount of thymine, and the amount of guanine equals the amount of cytosine.

- A) Frederick Griffith
- B) Alfred Hershey and Martha Chase
- C) Oswald Avery, Maclyn McCarty, and Colin MacLeod
- D) Erwin Chargaff
- E) Matthew Meselson and Franklin Stahl

11) When T2 phages infect bacteria and make more viruses in the presence of radioactive sulfur, what is the result? A) The viral DNA will be radioactive.

- B) The viral proteins will be radioactive.
- C) The bacterial DNA will be radioactive.
- D) both A and B E) both A and C

12) Cytosine makes up 38% of the nucleotides in a sample of DNA from an organism. Approximately what percentage of the nucleotides in this sample will be thymine?

- A) 12
- B) 24
- C) 31
- D) 38
- E) It cannot be determined from the information provided.

13) Chargaff's analysis of the relative base composition of DNA was significant because he was able to show that

- A) the relative proportion of each of the four bases differs within individuals of a species.
- B) the human genome is more complex than that of other species.
- C) the amount of A is always equivalent to T, and C to G.
- D) the amount of ribose is always equivalent to deoxyribose.
- E) transformation causes protein to be brought into the cell.

14) Which of the following can be determined directly from X-ray diffraction photographs of crystallized DNA?

- A) the diameter of the helix
- B) the rate of replication
- C) the sequence of nucleotides
- D) the bond angles of the subunits
- E) the frequency of A vs. T nucleotides

15) Why does the DNA double helix have a uniform diameter?

- A) Purines pair with pyrimidines.
- B) C nucleotides pair with A nucleotides.
- C) Deoxyribose sugars bind with ribose sugars.
- D) Nucleotides bind with nucleosides.
- E) Nucleotides bind with nucleoside triphosphates.

16) What kind of chemical bond is found between paired bases of the DNA double helix?

- A) hydrogen
- B) ionic
- C) covalent
- D) sulfhydryl
- E) phosphate

17) It became apparent to Watson and Crick after completion of their model that the DNA molecule could carry a vast amount of hereditary information in which of the following?

- A) sequence of bases
- B) phosphate-sugar backbones
- C) complementary pairing of bases
- D) side groups of nitrogenous bases
- E) different five-carbon sugars

18) In an analysis of the nucleotide composition of DNA, which of the following will be found?

- A) A = C

- B)  $A = G$  and  $C = T$
- C)  $A + C = G + T$
- D)  $G + C = T + A$

19) Mendel and Morgan did not know about the structure of DNA; however, which of the following of their contributions was (were) necessary to Watson and Crick?

- A) the particulate nature of the hereditary material
- B) dominance vs. recessiveness
- C) sex-linkage
- D) genetic distance and mapping
- E) the usefulness of peas and *Drosophila*

20) Replication in prokaryotes differs from replication in eukaryotes for which of these reasons? A) The prokaryotic chromosome has histones, whereas eukaryotic chromosomes do not.

- B) Prokaryotic chromosomes have a single origin of replication, whereas eukaryotic chromosomes have many.
- C) The rate of elongation during DNA replication is slower in prokaryotes than in eukaryotes.
- D) Prokaryotes produce Okazaki fragments during DNA replication, but eukaryotes do not.
- E) Prokaryotes have telomeres, and eukaryotes do not.

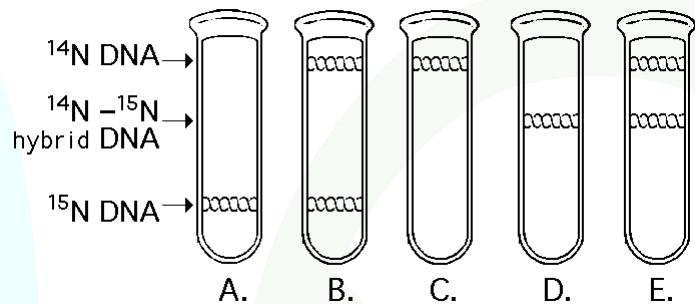
21) What is meant by the description "antiparallel" regarding the strands that make up DNA? A) The twisting nature of DNA creates nonparallel strands.

- B) The 5' to 3' direction of one strand runs counter to the 5' to 3' direction of the other strand.
- C) Base pairings create unequal spacing between the two DNA strands.
- D) One strand is positively charged and the other is negatively charged.
- E) One strand contains only purines and the other contains only pyrimidines.

22) Suppose you are provided with an actively dividing culture of *E. coli* bacteria to which radioactive thymine has been added. What would happen if a cell replicates once in the presence of this radioactive base? A) One of the daughter cells, but not the other, would have radioactive DNA.

- B) Neither of the two daughter cells would be radioactive.
- C) All four bases of the DNA would be radioactive.
- D) Radioactive thymine would pair with nonradioactive guanine.
- E) DNA in both daughter cells would be radioactive.

Use Figure 16.1 to answer the following questions.



**Figure 16.1**

23) In the late 1950s, Meselson and Stahl grew bacteria in a medium containing "heavy" nitrogen ( <sup>15</sup>N) and then transferred them to a medium containing <sup>14</sup>N. Which of the results in Figure 16.1 would be expected after one round of DNA replication in the presence of <sup>14</sup>N?

24) A space probe returns with a culture of a microorganism found on a distant planet. Analysis shows that it is a carbon-based life-form that has DNA. You grow the cells in <sup>15</sup>N medium for several generations and then transfer them to <sup>14</sup>N medium. Which pattern in Figure 16.1 would you expect if the DNA was replicated in a conservative manner?

25) Once the pattern found after one round of replication was observed, Meselson and Stahl could be confident of which of the following conclusions?

- Replication is semi-conservative.
- Replication is not dispersive.
- Replication is not semi-conservative.
- Replication is not conservative.
- Replication is neither dispersive nor conservative.

26) An Okazaki fragment has which of the following arrangements?

- primase, polymerase, ligase
- 3' RNA nucleotides, DNA nucleotides 5' C) 5' RNA nucleotides, DNA nucleotides 3'
- DNA polymerase I, DNA polymerase III
- 5' DNA to 3'

27) In *E. coli*, there is a mutation in a gene called dnaB that alters the helicase that normally acts at the origin. Which of the following would you expect as a result of this mutation?

- No proofreading will occur.

- B) No replication fork will be formed.
- C) The DNA will supercoil.
- D) Replication will occur via RNA polymerase alone.
- E) Replication will require a DNA template from another source.

28) Which enzyme catalyzes the elongation of a DNA strand in the 5' → 3' direction?

- A) primase
- B) DNA ligase
- C) DNA polymerase III
- D) topoisomerase
- E) helicase

29) What determines the nucleotide sequence of the newly synthesized strand during DNA replication?

- A) the particular DNA polymerase catalyzing the reaction
- B) the relative amounts of the four nucleoside triphosphates in the cell
- C) the nucleotide sequence of the template strand
- D) the primase used in the reaction
- E) the arrangement of histones in the sugar phosphate backbone

30) Eukaryotic telomeres replicate differently than the rest of the chromosome. This is a consequence of which of the following?

- A) The evolution of telomerase enzyme
- B) DNA polymerase that cannot replicate the leading strand template to its 5' end
- C) Gaps left at the 5' end of the lagging strand because of the need for a 3' onto which nucleotides can attach
- D) Gaps left at the 3' end of the lagging strand because of the need for a primer
- E) The "no ends" of a circular chromosome

31) The enzyme telomerase solves the problem of replication at the ends of linear chromosomes by which method?

- A) adding a single 5' cap structure that resists degradation by nucleases
- B) causing specific double strand DNA breaks that result in blunt ends on both strands
- C) causing linear ends of the newly replicated DNA to circularize
- D) adding numerous short DNA sequences such as TTAGGG, which form a hairpin turn
- E) adding numerous GC pairs which resist hydrolysis and maintain chromosome integrity

32) The DNA of telomeres has been found to be highly conserved throughout the evolution of eukaryotes. What does this most probably reflect?

- A) the inactivity of this DNA
- B) the low frequency of mutations occurring in this DNA
- C) that new evolution of telomeres continues
- D) that mutations in telomeres are relatively advantageous
- E) that the critical function of telomeres must be maintained

33) In an experiment, DNA is allowed to replicate in an environment with all necessary enzymes, dATP, dCTP, dGTP, and radioactively labeled dTTP ( $^3\text{H}$  thymidine) for several minutes and then switched to nonradioactive medium. It is then viewed by electron microscopy and autoradiography. The drawing below represents the results.



Grains represent radioactive material within the replicating eye.

Figure 16.2

Which is the most likely interpretation?

- A) There are two replication forks going in opposite directions.
- B) Thymidine is only being added where the DNA strands are furthest apart.
- C) Thymidine is only added at the very beginning of replication.
- D) Replication proceeds in one direction only.

34) At a specific area of a chromosome, the sequence of nucleotides below is present where the chain opens to form a replication fork:

3' C C T A G G C T G C A A T C C 5'

An RNA primer is formed starting at the underlined T (T) of the template. Which of the following represents the primer sequence?

- A) 5' G C C T A G G 3'
- B) 3' G C C T A G G 5'
- C) 5' A C G T T A G G 3'
- D) 5' A C G U U A G G 3' E) 5' G C C U A G G 3'

35) Polytene chromosomes of *Drosophila* salivary glands each consist of multiple identical DNA strands that are aligned in parallel arrays. How could these arise?

- A) replication followed by mitosis
- B) replication without separation
- C) meiosis followed by mitosis
- D) fertilization by multiple sperm
- E) special association with histone proteins

36) To repair a thymine dimer by nucleotide excision repair, in which order do the necessary enzymes act?

- A) exonuclease, DNA polymerase III, RNA primase
- B) helicase, DNA polymerase I, DNA ligase
- C) DNA ligase, nuclease, helicase
- D) DNA polymerase I, DNA polymerase III, DNA ligase
- E) endonuclease, DNA polymerase I, DNA ligase

37) What is the function of DNA polymerase III?

- A) to unwind the DNA helix during replication
- B) to seal together the broken ends of DNA strands
- C) to add nucleotides to the end of a growing DNA strand
- D) to degrade damaged DNA molecules
- E) to rejoin the two DNA strands (one new and one old) after replication

38) You briefly expose bacteria undergoing DNA replication to radioactively labeled nucleotides. When you centrifuge the DNA isolated from the bacteria, the DNA separates into two classes. One class of labeled DNA includes very large molecules (thousands or even millions of nucleotides long), and the other includes short stretches of DNA (several hundred to a few thousand nucleotides in length). These two classes of DNA probably represent

- A) leading strands and Okazaki fragments.
- B) lagging strands and Okazaki fragments.
- C) Okazaki fragments and RNA primers.
- D) leading strands and RNA primers.
- E) RNA primers and mitochondrial DNA.

39) Which of the following removes the RNA nucleotides from the primer and adds equivalent DNA nucleotides to the 3' end of Okazaki fragments?

- A) helicase
- B) DNA polymerase III
- C) ligase
- D) DNA polymerase I
- E) primase

40) Which of the following separates the DNA strands during replication?

- A) helicase
- B) DNA polymerase III

- C) ligase
- D) DNA polymerase I E) primase

41) Which of the following covalently connects segments of DNA?

- A) helicase
- B) DNA polymerase III
- C) ligase
- D) DNA polymerase I E) primase

42) Which of the following synthesizes short segments of RNA?

- A) helicase
- B) DNA polymerase III
- C) ligase
- D) DNA polymerase I E) primase

43) The difference between ATP and the nucleoside triphosphates used during DNA synthesis is that A) the nucleoside triphosphates have the sugar deoxyribose; ATP has the sugar ribose.

- B) the nucleoside triphosphates have two phosphate groups; ATP has three phosphate groups.
- C) ATP contains three high-energy bonds; the nucleoside triphosphates have two.
- D) ATP is found only in human cells; the nucleoside triphosphates are found in all animal and plant cells.
- E) triphosphate monomers are active in the nucleoside triphosphates, but not in ATP.

44) The leading and the lagging strands differ in that

- A) the leading strand is synthesized in the same direction as the movement of the replication fork, and the lagging strand is synthesized in the opposite direction.
- B) the leading strand is synthesized by adding nucleotides to the 3' end of the growing strand, and the lagging strand is synthesized by adding nucleotides to the 5' end.
- C) the lagging strand is synthesized continuously, whereas the leading strand is synthesized in short fragments that are ultimately stitched together.
- D) the leading strand is synthesized at twice the rate of the lagging strand.

45) Which of the following best describes the addition of nucleotides to a growing DNA chain?

- A) A nucleoside triphosphate is added to the 5' end of the DNA, releasing a molecule of pyrophosphate.
- B) A nucleoside triphosphate is added to the 3' end of the DNA, releasing a molecule of pyrophosphate.

- C) A nucleoside diphosphate is added to the 5' end of the DNA, releasing a molecule of phosphate.
- D) A nucleoside diphosphate is added to the 3' end of the DNA, releasing a molecule of phosphate.
- E) A nucleoside monophosphate is added to the 5' end of the DNA.

46) A new DNA strand elongates only in the 5' to 3' direction because

- A) DNA polymerase begins adding nucleotides at the 5' end of the template.
- B) Okazaki fragments prevent elongation in the 3' to 5' direction.
- C) the polarity of the DNA molecule prevents addition of nucleotides at the 3' end.
- D) replication must progress toward the replication fork.
- E) DNA polymerase can only add nucleotides to the free 3' end.

47) What is the function of topoisomerase?

- A) relieving strain in the DNA ahead of the replication fork
- B) elongation of new DNA at a replication fork by addition of nucleotides to the existing chain
- C) the addition of methyl groups to bases of DNA
- D) unwinding of the double helix
- E) stabilizing single-stranded DNA at the replication fork

48) What is the role of DNA ligase in the elongation of the lagging strand during DNA replication?

- A) synthesize RNA nucleotides to make a primer
- B) catalyze the lengthening of telomeres
- C) join Okazaki fragments together
- D) unwind the parental double helix
- E) stabilize the unwound parental DNA

49) Which of the following help to hold the DNA strands apart while they are being replicated?

- A) primase
- B) ligase
- C) DNA polymerase
- D) single-strand binding proteins
- E) exonuclease

50) Individuals with the disorder xeroderma pigmentosum are hypersensitive to sunlight. This occurs because their cells have which impaired ability? A) They cannot replicate DNA.

- B) They cannot undergo mitosis.

- C) They cannot exchange DNA with other cells.
- D) They cannot repair thymine dimers.
- E) They do not recombine homologous chromosomes during meiosis.

51) Which would you expect of a eukaryotic cell lacking telomerase?

- A) a high probability of becoming cancerous
- B) production of Okazaki fragments
- C) inability to repair thymine dimers
- D) a reduction in chromosome length
- E) high sensitivity to sunlight

52) Which of the following sets of materials are required by both eukaryotes and prokaryotes for replication?

- A) double-stranded DNA, 4 kinds of dNTPs, primers, origins
- B) topoisomerases, telomerase, polymerases
- C) G-C rich regions, polymerases, chromosome nicks
- D) nucleosome loosening, 4 dNTPs, 4 rNTPs
- E) ligase, primers, nucleases

53) A typical bacterial chromosome has ~4.6 million nucleotides. This supports approximately how many genes?

- A) 4.6 million
- B) 4.4 thousand
- C) 45 thousand
- D) about 400

54) Studies of nucleosomes have shown that histones (except H1) exist in each nucleosome as two kinds of tetramers: one of 2 H2A molecules and 2 H2B molecules, and the other as 2 H3 and 2 H4 molecules. Which of the following is supported by this data?

- A) DNA can wind itself around either of the two kinds of tetramers.
- B) The two types of tetramers associate to form an octamer.
- C) DNA has to associate with individual histones before they form tetramers.
- D) Only H2A can form associations with DNA molecules.
- E) The structure of H3 and H4 molecules is not basic like that of the other histones.

55) When DNA is compacted by histones into 10 nm and 30 nm fibers, the DNA is unable to interact with proteins required for gene expression. Therefore, to allow for these proteins to act, the chromatin must constantly alter its structure. Which processes contribute to this dynamic activity?

- A) DNA supercoiling at or around H1
- B) methylation and phosphorylation of histone tails
- C) hydrolysis of DNA molecules where they are wrapped around the nucleosome core

D) accessibility of heterochromatin to phosphorylating enzymes E) nucleotide excision and reconstruction

56) About how many more genes are there in the haploid human genome than in a typical bacterial genome? A) 10 X B) 100 X C) 1000 X D) 10,000 X E) 100,000 X

57) In prophase I of meiosis in female *Drosophila*, studies have shown that there is phosphorylation of an amino acid in the tails of histones. A mutation in flies that interferes with this process results in sterility. Which of the following is the most likely hypothesis? A) These oocytes have no histones. B) Any mutation during oogenesis results in sterility. C) Phosphorylation of all proteins in the cell must result. D) Histone tail phosphorylation prohibits chromosome condensation. E) Histone tails must be removed from the rest of the histones.

58) In a linear eukaryotic chromatin sample, which of the following strands is looped into domains by scaffolding? A) DNA without attached histones B) DNA with H1 only C) the 10 nm chromatin fiber D) the 30 nm chromatin fiber E) the metaphase chromosome

59) Which of the following statements describes the eukaryotic chromosome? A) It is composed of DNA alone. B) The nucleosome is its most basic functional subunit. C) The number of genes on each chromosome is different in different cell types of an organism. D) It consists of a single linear molecule of double-stranded DNA. E) Active transcription occurs on heterochromatin.

60) If a cell were unable to produce histone proteins, which of the following would be a likely effect? A) There would be an increase in the amount of "satellite" DNA produced during centrifugation. B) The cell's DNA couldn't be packed into its nucleus. C) Spindle fibers would not form during prophase. D) Amplification of other genes would compensate for the lack of histones. E) Pseudogenes would be transcribed to compensate for the decreased protein in the cell.

61) Which of the following statements describes histones?

- A) Each nucleosome consists of two molecules of histone H1.
- B) Histone H1 is not present in the nucleosome bead; instead it is involved in the formation of higher-level chromatin structures.
- C) The carboxyl end of each histone extends outward from the nucleosome and is called a "histone tail."
- D) Histones are found in mammals, but not in other animals or in plants.
- E) The mass of histone in chromatin is approximately nine times the mass of DNA.

62) Why do histones bind tightly to DNA?

- A) Histones are positively charged, and DNA is negatively charged.
- B) Histones are negatively charged, and DNA is positively charged.
- C) Both histones and DNA are strongly hydrophobic.
- D) Histones are covalently linked to the DNA.
- E) Histones are highly hydrophobic, and DNA is hydrophilic.

63) Which of the following represents the order of increasingly higher levels of organization of chromatin?

- A) nucleosome, 30-nm chromatin fiber, looped domain
- B) looped domain, 30-nm chromatin fiber, nucleosome
- C) looped domain, nucleosome, 30-nm chromatin fiber
- D) nucleosome, looped domain, 30-nm chromatin fiber
- E) 30-nm chromatin fiber, nucleosome, looped domain

64) Which of the following statements is *true* of chromatin?

- A) Heterochromatin is composed of DNA, whereas euchromatin is made of DNA and RNA.
- B) Both heterochromatin and euchromatin are found in the cytoplasm.
- C) Heterochromatin is highly condensed, whereas euchromatin is less compact.
- D) Euchromatin is not transcribed, whereas heterochromatin is transcribed.
- E) Only euchromatin is visible under the light microscope.

N.Q	Answer	N.Q	Answer
1.	A	33	A
2.	B	34	D
3.	E	35	B
4.	B	36	E

5.	D	37	C
6.	B	38	A
7.	E	39	D
8.	C	40	A
9.	B	41	C
10.	D	42	E
11.	B	43	A
12.	A	44	A
13.	C	45	B
14.	A	46	E
15.	A	47	A
16.	A	48	C
17.	A	49	D
18.	C	50	D
19.	A	51	D
20.	B	52	A
21.	B	53	B
22.	E	54	B
23.	D	55	B
24.	B	56	C
25.	D	57	D

26.	C	58	D
27.	B	59	D
28.	C	60	B
29.	C	61	B
30.	C	62	A
31.	D	63	A
32.	E	64	C

# Chapter 17 Expression of Genes

1) Garrod hypothesized that "inborn errors of metabolism" such as alkaptonuria occur because

- A) genes dictate the production of specific enzymes, and affected individuals have genetic defects that cause them to lack certain enzymes.
- B) enzymes are made of DNA, and affected individuals lack DNA polymerase.
- C) many metabolic enzymes use DNA as a cofactor, and affected individuals have mutations that prevent their enzymes from interacting efficiently with DNA.
- D) certain metabolic reactions are carried out by ribozymes, and affected individuals lack key splicing factors.
- E) metabolic enzymes require vitamin cofactors, and affected individuals have significant nutritional deficiencies.

The following questions refer to Figure 17.1, a simple metabolic pathway:

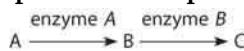


Figure 17.1

2) According to Beadle and Tatum's hypothesis, how many genes are necessary for this pathway?

- A) 0
- B) 1
- C) 2
- D) 3
- E) It cannot be determined from the pathway.

3) A mutation results in a defective enzyme A. Which of the following would be a consequence of that mutation?

- A) an accumulation of A and no production of B and C
- B) an accumulation of A and B and no production of C
- C) an accumulation of B and no production of A and C
- D) an accumulation of B and C and no production of A
- E) an accumulation of C and no production of A and B

4) If A, B, and C are all required for growth, a strain that is mutant for the gene encoding enzyme A would be able to grow on which of the following media?

- A) minimal medium
- B) minimal medium supplemented with nutrient "A" only
- C) minimal medium supplemented with nutrient "B" only
- D) minimal medium supplemented with nutrient "C" only
- E) minimal medium supplemented with nutrients "A" and "C"

5) If A, B, and C are all required for growth, a strain mutant for the gene encoding enzyme B would be capable of growing on which of the following media?

- A) minimal medium
- B) minimal medium supplemented with "A" only
- C) minimal medium supplemented with "B" only
- D) minimal medium supplemented with "C" only
- E) minimal medium supplemented with nutrients "A" and "B"

6) The nitrogenous base adenine is found in all members of which group?

- A) proteins, triglycerides, and testosterone
- B) proteins, ATP, and DNA
- C) ATP, RNA, and DNA
- D) alpha glucose, ATP, and DNA
- E) proteins, carbohydrates, and ATP

7) Using RNA as a template for protein synthesis instead of translating proteins directly from the DNA is advantageous for the cell because

- A) RNA is much more stable than DNA.
- B) RNA acts as an expendable copy of the genetic material.
- C) only one mRNA molecule can be transcribed from a single gene, lowering the potential rate of gene expression.
- D) tRNA, rRNA and others are not transcribed.
- E) mRNA molecules are subject to mutation but DNA is not.

8) If proteins were composed of only 12 different kinds of amino acids, what would be the smallest possible codon size in a genetic system with four different nucleotides?

- A) 1
- B) 2C) 3
- D) 4
- E) 12

9) The enzyme polynucleotide phosphorylase randomly assembles nucleotides into a polynucleotide polymer. You add polynucleotide phosphorylase to a solution of adenosine triphosphate and guanosine triphosphate. How many artificial mRNA 3 nucleotide codons would be possible?

- A) 3
- B) 4
- C) 8
- D) 16

E) 64

10) A particular triplet of bases in the template strand of DNA is 5' AGT 3'. The corresponding codon for the mRNA transcribed is A) 3' UCA 5'.  
B) 3' UGA 5'.  
C) 5' TCA 3'.  
D) 3'ACU 5'.  
E) either UCA or TCA, depending on wobble in the first base.

The following questions refer to Figure 17.2, a table of codons.

		Second Base					
		U	C	A	G		
First Base	U	UUU UUC UUA UUG	UCU UCC UCA UCG	UAU UAC UAA UAG	UGU UGC UGA UGG	C A G	
	C	CUU CUC CUA CUG	CCU CCC CCA CCG	CAU CAC CAA CAG	CGU CGC CGA CGG	U C A G	
	A	AUU AUC AUA AUG	ACU ACC ACA ACG	AAU AAC AAA AAG	AGU AGC AGA AGG	U C A G	
	G	GUU GUC GUA GUG	GCU GCC GCA GCG	GAU GAC GAA GAG	GGU GGC GGA GGG	U C A G	

Figure 17.2

11) A possible sequence of nucleotides in the template strand of DNA that would code for the polypeptide sequence phe-leu-ile-val would be A) 5' TTG-CTA-CAG-TAG 3'.  
B) 3' AAC-GAC-GUC-AUA 5'.  
C) 5' AUG-CTG-CAG-TAT 3'.  
D) 3' AAA-AAT-ATA-ACA 5'.  
E) 3' AAA-GAA-TAA-CAA 5'.

12) What amino acid sequence will be generated, based on the following mRNA codon sequence?

5' AUG-UCU-UCG-UUA-UCC-UUG 3'

- A) met-arg-glu-arg-glu-arg
- B) met-glu-arg-arg-gln-leu
- C) met-ser-leu-ser-leu-ser
- D) met-ser-ser-leu-ser-leu
- E) met-leu-phe-arg-glu-glu

13) A peptide has the sequence NH<sub>2</sub>-phe-pro-lys-gly-phe-pro-COOH. Which of the following sequences in the coding strand of the DNA could code for this peptide?

- A) 3' UUU-CCC-AAA-GGG-UUU-CCC
- B) 3' AUG-AAA-GGG-TTT-CCC-AAA-GGG
- C) 5' TTT-CCC-AAA-GGG-TTT-CCC
- D) 5' GGG-AAA-TTT-AAA-CCC-ACT-GGG
- E) 5' ACT-TAC-CAT-AAA-CAT-TAC-UGA

14) What is the sequence of a peptide based on the following mRNA sequence?

5' ... UUUUCUUAUUGUCUU 3'

- A) leu-cys-tyr-ser-phe
- B) cyc-phe-tyr-cys-leu
- C) phe-leu-ile-met-val
- D) leu-pro-asp-lys-gly
- E) phe-ser-tyr-cys-leu

15) The genetic code is essentially the same for all organisms. From this, one can logically assume all of the following *except*

- A) a gene from an organism could theoretically be expressed by any other organism.
- B) all organisms have a common ancestor.
- C) DNA was the first genetic material.
- D) the same codons in different organisms usually translate into the same amino acids.
- E) different organisms have the same number of different types of amino acids.

16) The "universal" genetic code is now known to have exceptions. Evidence for this could be found if which of the following is true?

- A) If UGA, usually a stop codon, is found to code for an amino acid such as tryptophan (usually coded for by UGG only).
- B) If one stop codon, such as UGA, is found to have a different effect on translation than another stop codon, such as UAA.
- C) If prokaryotic organisms are able to translate a eukaryotic mRNA and produce the same polypeptide.
- D) If several codons are found to translate to the same amino acid, such as serine.

E) If a single mRNA molecule is found to translate to more than one polypeptide when there are two or more AUG sites.

17) Which of the following nucleotide triplets best represents a codon?

- A) a triplet separated spatially from other triplets
- B) a triplet that has no corresponding amino acid
- C) a triplet at the opposite end of tRNA from the attachment site of the amino acid
- D) a triplet in the same reading frame as an upstream AUG
- E) a sequence in tRNA at the 3' end

18) Which of the following is *true* for both prokaryotic and eukaryotic gene expression? A) After transcription, a 3' poly-A tail and a 5' cap are added to mRNA.

- B) Translation of mRNA can begin before transcription is complete.
- C) RNA polymerase binds to the promoter region to begin transcription.
- D) mRNA is synthesized in the 3' → 5' direction.
- E) The mRNA transcript is the exact complement of the gene from which it was copied.

19) In which of the following actions does RNA polymerase differ from DNA polymerase?

- A) RNA polymerase uses RNA as a template, and DNA polymerase uses a DNA template.
- B) RNA polymerase binds to single-stranded DNA, and DNA polymerase binds to double-stranded DNA.
- C) RNA polymerase is much more accurate than DNA polymerase.
- D) RNA polymerase can initiate RNA synthesis, but DNA polymerase requires a primer to initiate DNA synthesis.
- E) RNA polymerase does not need to separate the two strands of DNA in order to synthesize an RNA copy, whereas DNA polymerase must unwind the double helix before it can replicate the DNA.

20) Which of the following statements best describes the termination of transcription in prokaryotes?

- A) RNA polymerase transcribes through the polyadenylation signal, causing proteins to associate with the transcript and cut it free from the polymerase.
- B) RNA polymerase transcribes through the terminator sequence, causing the polymerase to fall off the DNA and release the transcript.
- C) RNA polymerase transcribes through an intron, and the snRNPs cause the polymerase to let go of the transcript.
- D) Once transcription has initiated, RNA polymerase transcribes until it reaches the end of the chromosome.
- E) RNA polymerase transcribes through a stop codon, causing the polymerase to stop advancing through the gene and release the mRNA.

21) RNA polymerase moves in which direction along the DNA?

- A) 3' → 5' along the template strand
- B) 3' → 5' along the coding (sense) strand
- C) 5' → 3' along the template strand
- D) 3' → 5' along the coding strand
- E) 5' → 3' along the double-stranded DNA

22) RNA polymerase in a prokaryote is composed of several subunits. Most of these subunits are the same for the transcription of any gene, but one, known as sigma, varies considerably. Which of the following is the most probable advantage for the organism of such sigma switching?

- A) It might allow the transcription process to vary from one cell to another.
- B) It might allow the polymerase to recognize different promoters under certain environmental conditions.
- C) It could allow the polymerase to react differently to each stop codon.
- D) It could allow ribosomal subunits to assemble at faster rates.
- E) It could alter the rate of translation and of exon splicing.

23) Which of these is the function of a poly (A) signal sequence? A) It adds the poly (A) tail to the 3' end of the mRNA.

- B) It codes for a sequence in eukaryotic transcripts that signals enzymatic cleavage ~10–35 nucleotides away.
- C) It allows the 3' end of the mRNA to attach to the ribosome.
- D) It is a sequence that codes for the hydrolysis of the RNA polymerase.
- E) It adds a 7-methylguanosine cap to the 3' end of the mRNA.

24) In eukaryotes there are several different types of RNA polymerase. Which type is involved in transcription of mRNA for a globin protein?

- A) ligase
- B) RNA polymerase I
- C) RNA polymerase II
- D) RNA polymerase III
- E) primase

25) Transcription in eukaryotes requires which of the following in addition to RNA polymerase?

- A) the protein product of the promoter
- B) start and stop codons
- C) ribosomes and tRNA
- D) several transcription factors (TFs)
- E) aminoacyl synthetase

26) A part of the promoter, called the TATA box, is said to be highly conserved in evolution. Which might this illustrate?

- A) The sequence evolves very rapidly.
- B) The sequence does not mutate.
- C) Any mutation in the sequence is selected against.
- D) The sequence is found in many but not all promoters.
- E) The sequence is transcribed at the start of every gene.

27) The TATA sequence is found only several nucleotides away from the start site of transcription. This most probably relates to which of the following?

- A) the number of hydrogen bonds between A and T in DNA
- B) the triplet nature of the codon
- C) the ability of this sequence to bind to the start site
- D) the supercoiling of the DNA near the start site
- E) the 3-dimensional shape of a DNA molecule

28) Which of the following help(s) to stabilize mRNA by inhibiting its degradation?

- A) TATA box
- B) spliceosomes
- C) 5' cap and poly (A) tail
- D) introns
- E) RNA polymerase

29) What is a ribozyme?

- A) an enzyme that uses RNA as a substrate
- B) an RNA with enzymatic activity
- C) an enzyme that catalyzes the association between the large and small ribosomal subunits
- D) an enzyme that synthesizes RNA as part of the transcription process
- E) an enzyme that synthesizes RNA primers during DNA replication

30) What are the coding segments of a stretch of eukaryotic DNA called?

- A) introns
- B) exons

- C) codons
- D) replicons
- E) transposons

31) A transcription unit that is 8,000 nucleotides long may use 1,200 nucleotides to make a protein consisting of approximately 400 amino acids. This is best explained by the fact that A) many noncoding stretches of nucleotides are present in mRNA.

- B) there is redundancy and ambiguity in the genetic code.
- C) many nucleotides are needed to code for each amino acid.
- D) nucleotides break off and are lost during the transcription process.
- E) there are termination exons near the beginning of mRNA.

32) Once transcribed, eukaryotic mRNA typically undergoes substantial alteration that includes A) union with ribosomes.

- B) fusion into circular forms known as plasmids.
- C) linkage to histone molecules.
- D) excision of introns.
- E) fusion with other newly transcribed mRNA.

33) Introns are significant to biological evolution because A) their presence allows exons to be shuffled.

- B) they protect the mRNA from degeneration.
- C) they are translated into essential amino acids.
- D) they maintain the genetic code by preventing incorrect DNA base pairings.
- E) they correct enzymatic alterations of DNA bases.

34) A mutation in which of the following parts of a gene is likely to be most damaging to a cell?

- A) intron
- B) exon
- C) 5' UTR
- D) 3' UTR
- E) All would be equally damaging.

35) Which of the following is (are) true of snRNPs?

- A) They are made up of both DNA and RNA.
- B) They bind to splice sites at each end of the exon.
- C) They join together to form a large structure called the spliceosome.
- D) They act only in the cytosol.

E) They attach introns to exons in the correct order.

36) During splicing, which molecular component of the spliceosome catalyzes the excision reaction?

- A) protein
- B) DNA
- C) RNA
- D) lipid
- E) sugar

37) Alternative RNA splicing

- A) is a mechanism for increasing the rate of transcription.
- B) can allow the production of proteins of different sizes from a single mRNA.
- C) can allow the production of similar proteins from different RNAs.
- D) increases the rate of transcription.
- E) is due to the presence or absence of particular snRNPs.

38) In the structural organization of many eukaryotic genes, individual exons may be related to which of the following?

- A) the sequence of the intron that immediately precedes each exon
- B) the number of polypeptides making up the functional protein
- C) the various domains of the polypeptide product
- D) the number of restriction enzyme cutting sites
- E) the number of start sites for transcription

39) Each eukaryotic mRNA, even after post-transcriptional modification, includes 5' and 3' UTRs. Which are these?

- A) the cap and tail at each end of the mRNA
- B) the untranslated regions at either end of the coding sequence
- C) the U attachment sites for the tRNAs
- D) the U translation sites that signal the beginning of translation
- E) the U – A pairs that are found in high frequency at the ends

40) In an experimental situation, a student researcher inserts an mRNA molecule into a eukaryotic cell after he has removed its 5' cap and poly(A) tail. Which of the following would you expect him to find? A) The mRNA could not exit the nucleus to be translated.

- B) The cell recognizes the absence of the tail and polyadenylates the mRNA.
- C) The molecule is digested by restriction enzymes in the nucleus.

- D) The molecule is digested by exonucleases since it is no longer protected at the 5' end.
- E) The molecule attaches to a ribosome and is translated, but more slowly.

41) A particular triplet of bases in the coding sequence of DNA is AAA. The anticodon on the tRNA that binds the mRNA codon is A) TTT.  
B) UUA. C) UUU. D) AAA.  
E) either UAA or TAA, depending on first base wobble.

42) Accuracy in the translation of mRNA into the primary structure of a polypeptide depends on specificity in the A) binding of ribosomes to mRNA.  
B) shape of the A and P sites of ribosomes.  
C) bonding of the anticodon to the codon.  
D) attachment of amino acids to tRNAs.  
E) both C and D

43) A part of an mRNA molecule with the following sequence is being read by a ribosome: 5' CCG -ACG 3' (mRNA). The following charged transfer RNA molecules (with their anticodons shown in the 3' to 5' direction) are available. Two of them can correctly match the mRNA so that a dipeptide can form.

tRNA Anticodon	Amino Acid
GGC	Proline
CGU	Alanine
UGC	Threonine
CCG	Glycine
ACG	Cysteine
CGG	Alanine

Figure 17.3

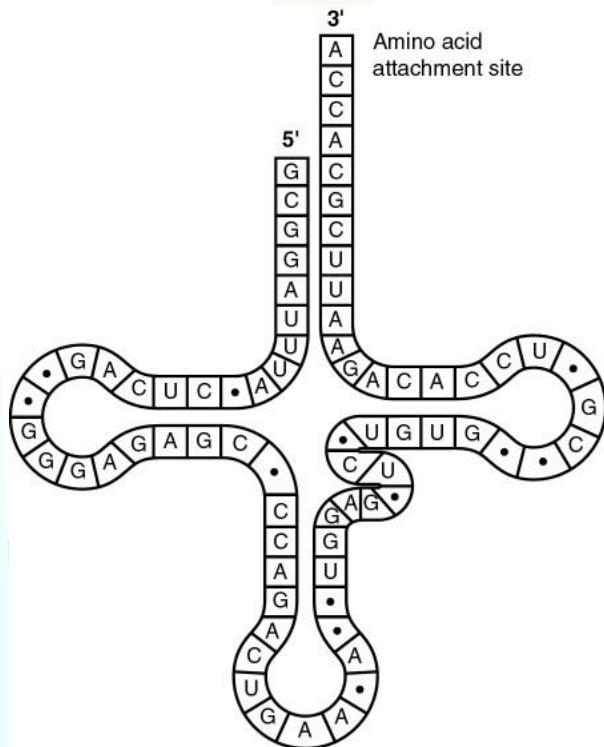
The dipeptide that will form will be

- A) cysteine-alanine.
- B) proline-threonine.
- C) glycine-cysteine.
- D) alanine-alanine.
- E) threonine-glycine.

44) What type of bonding is responsible for maintaining the shape of the tRNA molecule?

- A) covalent bonding between sulfur atoms
- B) ionic bonding between phosphates
- C) hydrogen bonding between base pairs

D) van der Waals interactions between hydrogen atoms E) peptide bonding between amino acids



**Figure 17.4**

45) Figure 17.4 represents tRNA that recognizes and binds a particular amino acid (in this instance, phenylalanine). Which codon on the mRNA strand codes for this amino acid?

- A) UGG
- B) GUG
- C) GUA
- D) UUC
- E) CAU

46) The tRNA shown in Figure 17.4 has its 3' end projecting beyond its 5' end. What will occur at this 3' end? A) The codon and anticodon complement one another.

- B) The amino acid binds covalently.
- C) The excess nucleotides (ACCA) will be cleaved off at the ribosome.
- D) The small and large subunits of the ribosome will attach to it.
- E) The 5' cap of the mRNA will become covalently bound.

47) A mutant bacterial cell has a defective aminoacyl synthetase that attaches a lysine to tRNAs with the anticodon AAA instead of a phenylalanine. The consequence of this for the cell will be that A) none of the proteins in the cell will contain phenylalanine.  
B) proteins in the cell will include lysine instead of phenylalanine at amino acid positions specified by the codon UUU.  
C) the cell will compensate for the defect by attaching phenylalanine to tRNAs with lysine-specifying anticodons.  
D) the ribosome will skip a codon every time a UUU is encountered.  
E) None of the above will occur; the cell will recognize the error and destroy the tRNA.

48) There are 61 mRNA codons that specify an amino acid, but only 45 tRNAs. This is best explained by the fact that  
A) some tRNAs have anticodons that recognize four or more different codons.  
B) the rules for base pairing between the third base of a codon and tRNA are flexible.  
C) many codons are never used, so the tRNAs that recognize them are dispensable.  
D) the DNA codes for all 61 tRNAs but some are then destroyed.  
E) competitive exclusion forces some tRNAs to be destroyed by nucleases.

49) What is the most abundant type of RNA?  
A) mRNA  
B) tRNA  
C) rRNA  
D) pre-mRNA E) hnRNA

50) From the following list, which is the first event in translation in eukaryotes?  
A) elongation of the polypeptide  
B) base pairing of activated methionine-tRNA to AUG of the messenger RNA  
C) the larger ribosomal subunit binds to smaller ribosomal subunits  
D) covalent bonding between the first two amino acids  
E) the small subunit of the ribosome recognizes and attaches to the 5' cap of mRNA

51) Choose the answer that has these events of protein synthesis in the proper sequence.  
1. An aminoacyl-tRNA binds to the A site.  
2. A peptide bond forms between the new amino acid and a polypeptide chain.  
3. tRNA leaves the P site, and the P site remains vacant.  
4. A small ribosomal subunit binds with mRNA.  
5. tRNA translocates to the P site.  
A) 1, 3, 2, 4, 5

- B) 4, 1, 2, 5, 3 C) 5, 4, 3, 2, 1
- D) 4, 1, 3, 2, 5
- E) 2, 4, 5, 1, 3

52) As a ribosome translocates along an mRNA molecule by one codon, which of the following occurs? A) The tRNA that was in the A site moves into the P site. B) The tRNA that was in the P site moves into the A site. C) The tRNA that was in the A site moves to the E site and is released. D) The tRNA that was in the A site departs from the ribosome via a tunnel. E) The polypeptide enters the E site.

53) What are polyribosomes?

- A) groups of ribosomes reading a single mRNA simultaneously
- B) ribosomes containing more than two subunits
- C) multiple copies of ribosomes associated with giant chromosomes
- D) aggregations of vesicles containing ribosomal RNA E) ribosomes associated with more than one tRNA

54) Which of the following is a function of a signal peptide?

- A) to direct an mRNA molecule into the cisternal space of the ER
- B) to bind RNA polymerase to DNA and initiate transcription
- C) to terminate translation of the messenger RNA
- D) to translocate polypeptides across the ER membrane
- E) to signal the initiation of transcription

55) When translating secretory or membrane proteins, ribosomes are directed to the ER membrane by

- A) a specific characteristic of the ribosome itself, which distinguishes free ribosomes from bound ribosomes.
- B) a signal-recognition particle that brings ribosomes to a receptor protein in the ER membrane.
- C) moving through a specialized channel of the nucleus.
- D) a chemical signal given off by the ER.
- E) a signal sequence of RNA that precedes the start codon of the message.

56) When does translation begin in prokaryotic cells?

- A) after a transcription initiation complex has been formed
- B) as soon as transcription has begun
- C) after the 5' caps are converted to mRNA
- D) once the pre-mRNA has been converted to mRNA

E) as soon as the DNA introns are removed from the template

57) When a tRNA molecule is shown twisted into an L shape, the form represented is A) its linear sequence.

- B) its 2-dimensional shape.
- C) its 3-dimensional shape.
- D) its microscopic image.

58) An experimenter has altered the 3' end of the tRNA corresponding to the amino acid methionine in such a way as to remove the 3' AC. Which of the following hypotheses describes the most likely result? A) tRNA will not form a cloverleaf.

- B) The nearby stem end will pair improperly.
- C) The amino acid methionine will not bind.
- D) The anticodon will not bind with the mRNA codon.
- E) The aminoacyl synthetase will not be formed.

**Use the following information to answer the following questions.**

A transfer RNA (#1) attached to the amino acid lysine enters the ribosome. The lysine binds to the growing polypeptide on the other tRNA (#2) in the ribosome already.

59) Which enzyme causes a covalent bond to attach lysine to the polypeptide?

- A) ATPase
- B) lysine synthetase
- C) RNA polymerase
- D) ligase
- E) peptidyl transferase

60) Where does tRNA #2 move to after this bonding of lysine to the polypeptide?

- A) A site
- B) P site
- C) E site
- D) Exit tunnel
- E) Directly to the cytosol

61) Which component of the complex described enters the exit tunnel through the large subunit of the ribosome? A) tRNA with attached lysine (#1) B) tRNA with polypeptide (#2)

- C) tRNA that no longer has attached amino acid

- D) newly formed polypeptide
- E) initiation and elongation factors

62) The process of translation, whether in prokaryotes or eukaryotes, requires tRNAs, amino acids, ribosomal subunits, and which of the following?

- A) polypeptide factors plus ATP
- B) polypeptide factors plus GTP
- C) polymerases plus GTP
- D) SRP plus chaperones
- E) signal peptides plus release factor

63) When the ribosome reaches a stop codon on the mRNA, no corresponding tRNA enters the A site. If the translation reaction were to be experimentally stopped at this point, which of the following would you be able to isolate?

- A) an assembled ribosome with a polypeptide attached to the tRNA in the P site B) separated ribosomal subunits, a polypeptide, and free tRNA C) an assembled ribosome with a separated polypeptide
- D) separated ribosomal subunits with a polypeptide attached to the tRNA
- E) a cell with fewer ribosomes

64) Why might a point mutation in DNA make a difference in the level of protein's activity? A) It might result in a chromosomal translocation.

- B) It might exchange one stop codon for another stop codon.
- C) It might exchange one serine codon for a different serine codon.
- D) It might substitute an amino acid in the active site.
- E) It might substitute the N terminus of the polypeptide for the C terminus.

65) In the 1920s Muller discovered that X-rays caused mutation in *Drosophila*. In a related series of experiments, in the 1940s, Charlotte Auerbach discovered that chemicals she used nitrogen mustards have a similar effect. A new chemical food additive is developed by a cereal manufacturer. Why do we test for its ability to induce mutation?

- A) We worry that it might cause mutation in cereal grain plants.
- B) We want to make sure that it does not emit radiation.
- C) We want to be sure that it increases the rate of mutation sufficiently.
- D) We want to prevent any increase in mutation frequency.
- E) We worry about its ability to cause infection.

66) Which of the following types of mutation, resulting in an error in the mRNA just after the AUG start of translation, is likely to have the most serious effect on the polypeptide product?

- A) a deletion of a codon
- B) a deletion of 2 nucleotides
- C) a substitution of the third nucleotide in an ACC codon
- D) a substitution of the first nucleotide of a GGG codon
- E) an insertion of a codon

67) What is the effect of a nonsense mutation in a gene?

- A) It changes an amino acid in the encoded protein.
- B) It has no effect on the amino acid sequence of the encoded protein.
- C) It introduces a premature stop codon into the mRNA.
- D) It alters the reading frame of the mRNA.
- E) It prevents introns from being excised.

68) Each of the following options is a modification of the sentence THECATA TETHERAT. Which of the following is analogous to a frameshift mutation?

- A) THERATATETHECAT
- B) THETACATETETHERAT
- C) THECATARETHERAT
- D) THECATAT THERAT
- E) CATA TETHERAT

69) Each of the following options is a modification of the sentence THECATA TETHERAT. Which of the following is analogous to a single substitution mutation?

- A) THERATATETHECAT
- B) THETACATETETHERAT
- C) THECATARETHERAT
- D) THECATAT THERAT
- E) CATA TETHERAT

70) Sickle-cell disease is probably the result of which kind of mutation?

- A) point
- B) frameshift
- C) nonsense
- D) nondisjunction
- E) both B and D

71) A frameshift mutation could result from A) a base insertion only.  
B) a base deletion only.  
C) a base substitution only.  
D) deletion of three consecutive bases.  
E) either an insertion or a deletion of a base.

72) Which of the following DNA mutations is the most likely to be damaging to the protein it specifies? A) a base-pair deletion B) a codon substitution  
C) a substitution in the last base of a codon  
D) a codon deletion E) a point mutation

73) Which point mutation would be most likely to have a catastrophic effect on the functioning of a protein?  
A) a base substitution  
B) a base deletion near the start of a gene  
C) a base deletion near the end of the coding sequence, but not in the terminator codon  
D) deletion of three bases near the start of the coding sequence, but not in the initiator codon E) a base insertion near the end of the coding sequence, but not in the terminator codon

N.Q	Answer	N.Q	Answer
1.	A	38	C
2.	C	39	B
3.	A	40	D
4.	C	41	C
5.	D	42	E
6.	C	43	B
7.	B	44	C
8.	B	45	D
9.	C	46	B
10.	A	47	B
11.	E	48	B
12.	D	49	C
13.	C	50	E
14.	E	51	B
15.	C	52	A
16.	A	53	A
17.	D	54	D
18.	C	55	B
19.	D	56	B

20.	B	57	C
21.	A	58	C
22.	B	59	E
23.	B	60	D
24.	C	61	D
25.	D	62	B
26.	C	63	A
27.	A	64	D
28.	C	65	D
29.	B	66	B
30.	B	67	C
31.	A	68	D
32.	D	69	C
33.	A	70	A
34.	B	71	E
35.	C	72	A
36.	C	73	B
37.	B		