1. Which of the following statements concerning polymers is not true?
   A) Polymers are synthesized from monomers during condensation.
   B) Polymers are synthesized from monomers during dehydration.
   C) Polymers consist of at least two types of monomers.
   D) Both b and c

2. You are a biochemist and have recently discovered a new macromolecule. Studies of the bond types found in this macromolecule reveal many hydrogen bonds and peptide bonds. You most likely have found what type of macromolecule?
   A) Carbohydrate
   B) Lipid
   C) Protein
   D) Nucleic acid

3. An α helix is an example of which level of protein structure?
   A) Primary
   B) Secondary
   C) Tertiary
   D) Quaternary

4. You have isolated a monomer with the following components: a phosphate group, a sugar, and a nitrogen-containing base. Polymers synthesized from this monomer belong to what class of macromolecule?
   A) Carbohydrate
   B) Lipid
   C) Protein
   D) Nucleic acid

5. Cellulose and starch are composed of the same monomers. Which of the following results in their being structurally and functionally different?
   A) They have different types of glycosidic linkages.
   B) They have different numbers of glucose monomers.
   C) They are held together by different bond types.
   D) None of the above

6. DNA utilizes the bases guanine, cytosine, thymine, and adenine. In RNA, _______ is replaced by _______.
   A) adenine; arginine
   B) thymine; uracil
   C) cytosine; uracil
   D) cytosine; arginine

7. The pairing of purines with pyrimidines to create a double-stranded DNA molecule is called
   A) complementary base pairing.
   B) phosphodiester linkages.
   C) antiparallel synthesis.
   D) dehydration.
8. Triglycerides are synthesized from
   A) glycerol and amino acids.
   B) fatty acids and glycerol.
   C) steroid precursors and starch.
   D) cholesterol and glycerol.

9. Amino acids are linked together into proteins by which of the following bond types?
   A) Noncovalent bonds
   B) Peptide bonds
   C) Phosphodiester bonds
   D) Both a and b

10. Which of the following characteristics differentiate carbohydrates from other macromolecule types?
   A) Carbohydrates are constructed of monomers that always have a ring structure.
   B) Carbohydrates never contain nitrogen.
   C) Carbohydrates consist of a carbon bonded to hydrogen and a hydroxyl group.
   D) None of the above

11. Which of the following statements about carbohydrates is not true?
   A) Monomers of carbohydrates have six carbon atoms.
   B) Monomers of carbohydrates are linked together during dehydration.
   C) Carbohydrates are energy storage molecules.
   D) None of the above

12. What would you expect to be true of the R groups of amino acids located on the surface of protein molecules found within the interior of biological membranes?
   A) The R groups would be hydrophobic.
   B) The R groups would be hydrophilic.
   C) The R groups would be polar.
   D) The R groups would be able to form disulfide.

13. What characteristic of phospholipids allows them to form a bilayer?
   A) They have a hydrophilic fatty acid tail.
   B) They have a hydrophobic head.
   C) They have a hydrophobic fatty acid tail.
   D) All of the above

14. The first biological catalyst may have been _______.
   A) glucose
   B) DNA
   C) a protein
   D) a ribozyme

15. The double helix formation of DNA is due to _______.
   A) ionic bonds
   B) covalent bonds
   C) hydrogen bonds
   D) hydrophobic side chains
16. You have found a mass of cells in the sediment surrounding a thermal vent in the ocean floor. The salinity in the area is quite high. Upon microscopic examination of the cells, you find no evidence of membrane-enclosed organelles. How would you classify this cell?
   A) As a eukaryotic cell
   B) As a prokaryotic cell
   C) As a member of domain Archaea or Bacteria
   D) Both b and c

17. Centrifugation of a cell results in the rupture of the cell membrane and the contents compacting into a pellet in the bottom of the centrifuge tube. Bathing this pellet with a glucose solution yields metabolic activity, including the production of ATP. One of the contents of this pellet is most likely which of the following?
   A) Cytosol
   B) Mitochondria
   C) Lysosomes
   D) Golgi bodies

18. Eukaryotic cells are thought to be derived from prokaryotic cells that underwent phagocytosis without digestion of the phagocytized cell. This mutualistic relationship is explained by the ________ theory.
   A) endosymbiotic
   B) cell
   C) evolutionary
   D) parasite

19. Though science fiction has produced stories like "The Blob," we don't see very many large single-celled organisms. Which of the following tends to limit cell size?
   A) The ability to maintain a continuous large membrane
   B) The ability to reproduce a large cell
   C) Surface area-to-volume ratios
   D) All of the above

20. Microscopes are used to resolve images that cannot be seen with the unaided eye. Electron microscopes use ________ to resolve images, whereas light microscopes use ________ to resolve images.
   A) light and lenses; diffraction of electron beams
   B) diffraction of electron beams; light and lenses
   C) lasers; light and lenses
   D) None of the above

21. What is the correct cellular function of the RER?
   A) DNA synthesis
   B) Photosynthesis
   C) Cellular respiration
   D) Protein synthesis
22. Photosynthesis occurs in the _______.
   A) chloroplast
   B) mitochondria
   C) Golgi apparatus
   D) nucleus

23. Lysosomes are involved in _______.
   A) DNA synthesis
   B) breakdown of phagocytized material
   C) protein folding
   D) pigment production

24. The packaging of proteins to be used outside the cell occurs in the _______.
   A) nucleus
   B) SER
   C) Golgi apparatus
   D) chromoplast

25. Which of the following organelles are enclosed in double membranes?
   A) Nucleus
   B) Chloroplast
   C) Mitochondrion
   D) All of the above

26. Movement of cells is accomplished in both prokaryotes and eukaryotes with which of the following structures?
   A) Cilia
   B) Pili
   C) Dynein
   D) Flagella

27. Which of the following statements is true regarding mitochondria and chloroplasts?
   A) Animal cells produce chloroplasts.
   B) Mitochondria and chloroplasts may be found in the same cell.
   C) Mitochondria and chloroplasts are not found in the same cell.
   D) Chloroplasts can revert to mitochondria in certain conditions.

28. Which of the following best describes ribosomes?
   A) Ribosomes guide protein synthesis.
   B) Ribosomes are found only in the nucleus or on the RER.
   C) There are no ribosomes in the mitochondria.
   D) All of the above

29. Nuclear DNA exists as a complex of proteins called _______ that condenses into _______ during cellular division.
   A) chromosomes; chromatin
   B) chromatids; chromosomes
   C) chromophors; chromatin
   D) chromatin; chromosomes
30. Rough endoplasmic reticulum and smooth endoplasmic reticulum differ
   A) only by the presence or absence of ribosomes.
   B) both in the presence or absence of ribosomes and in their function.
   C) only in microscopic appearance.
   D) None of the above

31. Which of the following statements regarding cellular membranes is not true?
   A) The hydrophobic nature of the phospholipid tails limits the migration of polar molecules across the membrane.
   B) Integral proteins and phospholipids move fluidly throughout the membrane.
   C) Membrane phospholipids flip back and forth from one side of the bilayer to the other.
   D) Glycolipids and glycoproteins serve as recognition sites on the cell membrane.

32. Which of the following contributes to differences in the two sides of the cell membrane?
   A) Differences in peripheral proteins
   B) Different domains expressed on the ends of integral proteins
   C) Differences in phospholipid types
   D) All of the above

33. Which of the following cell membrane components serve as recognition signals for interactions between cells?
   A) Cholesterol
   B) Glycolipids or glycoproteins
   C) Phospholipids
   D) All of the above

34. Which of the following types of junctions are responsible for communication between cells?
   A) Tight junctions
   B) Desmosomes
   C) Gap junctions
   D) None of the above

35. You are monitoring the diffusion of a molecule across a membrane. Which of the following will result in the fastest rate of diffusion?
   A) An internal concentration of 5 percent and an external concentration of 60 percent
   B) An internal concentration of 60 percent and an external concentration of 5 percent
   C) An internal concentration of 35 percent and an external concentration of 40 percent
   D) Both a and b

36. If a red blood cell with an internal salt concentration of about 0.85 percent is placed in a saline solution (salt solution) that is 4 percent, which of the following will most likely happen?
   A) The red blood cell will lose water and shrivel.
   B) The red blood cell will gain water and burst.
   C) The turgor pressure in the cell will greatly increase.
   D) The cell will remain the same.
37. In which of the following is solution X hypotonic relative to solution Y?
   A) Solution X has a greater solute concentration than solution Y.
   B) Solution X has a lower solute concentration than solution Y.
   C) Solution X and solution Y have the same solute concentration.
   D) None of the above

38. Which of the following statements regarding osmosis is not true?
   A) Osmosis refers to the movement of water along a concentration gradient.
   B) In osmosis, water moves to equalize solute concentrations on either side of the membrane.
   C) If osmosis occurs across a membrane, then diffusion is not occurring.
   D) The movement of water across a membrane can affect the turgor pressure of some cells.

39. Channel proteins allow ions that would not normally pass through the cell membrane to pass through via the channel. What properties of the proteins are responsible for this?
   A) The channels are often composed of polar amino acid groups.
   B) The channels are often composed of hydrophobic amino acid groups.
   C) Both a and b
   D) None of the above

40. Which of the following limits the movement of molecules when carrier-mediated facilitated diffusion is involved?
   A) Concentration gradient
   B) Availability of carrier molecules
   C) Temperature
   D) All of the above

41. Active transport differs from passive transport in that active transport
   A) requires energy.
   B) never requires direct input of ATP.
   C) moves molecules with a concentration gradient.
   D) Both a and c

42. Single-celled animals like amoebas engulf entire cells for food. Which of the following represents the manner in which amoebas “eat”?
   A) Exocytosis
   B) Phagocytosis
   C) Facilitative transport
   D) Active transport

43. Sodium–potassium pumps are common in many cells. Which of the following are necessary for the pumps to work?
   A) ATP
   B) A channel protein
   C) No concentration gradient
   D) All of the above
44. Bacterial cells are often found in very hypotonic environments. Which of the following characteristics keeps them from continuing to take on water from their environment?
   A) The presence of a cell wall allows a buildup of turgor pressure that prevents any more water from entering the cell.
   B) The presence of a cell wall allows a buildup of tonic pressure that prevents any more water from entering the cell.
   C) The cell expels water as fast as it takes it up.
   D) None of the above

45. Which of the following may affect the rate of diffusion?
   A) Temperature
   B) Molecule size
   C) Concentration gradient
   D) All of the above

46. Complex carbohydrates should be a mainstay of your diet. What properties make them excellent food sources?

47. Amino acid R groups have a variety of chemical properties. How do these different properties contribute to the final three-dimensional shape of the molecule?
48. Consider the following triglycerides (A and B) in answering a–d.

\[ \text{CH}_3\text{(CH}_2\text{)}_{16}\text{O-CH}_2 \hspace{1cm} \text{CH}_3\text{(CH}_2\text{)}_3\text{O-CH}_2 \]

\[ \text{CH}_3\text{(CH}_2\text{)}_{16}\text{O-CH}_2 \hspace{1cm} \text{CH}_3\text{-CH-CH}_2\text{O-CH}_2 \]

\[ \text{CH}_3\text{(CH}_2\text{)}_{16}\text{O-CH}_2 \hspace{1cm} \text{CH}_3\text{-CH-CH}_2\text{O-CH}_2 \]

\[ \text{A} \hspace{1cm} \text{B} \]

a. In B, circle the remnant of the glycerol portion of the triglyceride.
b. Which triglyceride (A or B) is probably a solid at room temperature? Explain your answer.
c. Which triglyceride (A or B) is probably derived from a plant? Explain your answer.
d. How many water molecules result from the formation of triglyceride B from glycerol and three fatty acids?

49. The role of a certain cell in an organism is to secrete a protein. Trace the production of that protein from the nucleus through all necessary organelles to the point of release from the cell.

50. Compare and contrast prokaryotic and eukaryotic cells.

51. Explain the significance of organelles. What are the costs and benefits of having large compartmentalized cells?
52. What is the primary function of a cell membrane? What characteristics of membranes allow them to contribute to metabolic activity?

53. There are structural similarities between mitochondria and chloroplasts. Using the idea that form follows function, why are there similarities in these two organelles?

54. Compare and contrast active and passive transport.

55. Barrier formation is only one function of the cell membrane. Describe some other functions of the membrane and discuss how the membrane is suited for those functions.
46. Complex carbohydrates are easily broken down into glucose monomers, which provide nearly all cellular energy. By storing glucose monomers in large carbohydrates, the osmotic strain on any given cell is reduced without sacrificing availability of energy.
47. The size of the R group, the charge of the R group, and any special binding properties all contribute to the final orientation of a protein molecule.

48. a.

b. Triglyceride A is probably solid at room temperature. Its fatty acid chains are saturated (no double bonds) and relatively long, both characteristics of solid, animal-derived triglycerides.

c. Triglyceride B is probably derived from a plant. Its fatty acid chains are unsaturated (double bonds) and relatively short, both characteristics of liquid, plant-derived triglycerides.

d. Three water molecules will result. A water molecule results for each of the three fatty acids added to glycerol by a condensation reaction.

49. The protein could be synthesized on ribosomes in the nucleus, or synthesis could take place in the cytosol or on the RER. From there it most likely would be transported along the RER for further modification before being packaged in a bit of ER membrane and transported to the cis region of the Golgi. Further modification might take place in the cisternae of the Golgi before the protein is encased in a final vesicle. When the vesicle fuses with the plasma membrane of the cell, its contents are released to the outside.

50. Prokaryotic Cells
   - Small in size
   - No membrane-enclosed organelles
   - Found only in domains Archaea and Bacteria
   - DNA is in nucleoid

Eukaryotic Cells
   - 10 or more times greater in size
   - Membrane-enclosed organelles
   - Found in all domains other than Archaea and Bacteria
   - DNA is in nucleus

51. Organelles allow different metabolic environments to exist in the same cell. This partitioning of jobs allows for greater specialization but comes at an energy cost. Eukaryotic cells are more energy expensive.

52. A cell membrane exists to form an inside and an outside of a cell. The presence of an inside and an outside allows the establishment of different environments. In addition, membranes hold integral proteins with a variety of chemical properties and activities. This allows for the enzymatic activity associated with membranes. Stacks of membranes, such as those in mitochondria and chloroplasts, increase the amount of chemical activity in an area.

53. Both mitochondria and chloroplasts are involved in energy-transformation activities that require many enzymes. The stacking or folding of membranes provides enzymatic activity centers for these reactions.
54. The main difference between active and passive transport is that active transport goes against a concentration gradient and requires energy, whereas passive transport diffuses passively and does not require energy.

55. Membranes function in processing energy transformation and in the organization of chemical reactions. Integral and peripheral proteins contribute to these functions. The membrane serves as a holding site for the catalytic enzymes associated with these processes.