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

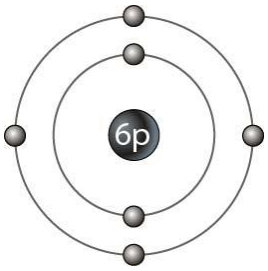
1) Which of the following is a particle found in the nucleus of an atom and that has no electrical charge? 1) _____
A) neutron B) isotope C) element D) electron E) proton

2) Matter composed of a single type of atom is known as a(n) 2) _____
A) element.
B) mineral.
C) electron.
D) compound.
E) molecule.

3) A stable atom has _____ in its valence shell. 3) _____
A) 8 electrons
B) 8 protons
C) 2 neutrons
D) 10 electrons
E) 4 electrons

4) Which parts of the atoms interact in a chemical reaction? 4) _____
A) isotopes B) neutrons C) protons D) ions E) electrons

5) 5) _____



The outer ring in Figure 2-1 represents
A) the nucleus.
B) an electron.
C) an isotope.
D) a neutron.
E) an electron shell.

6) The valence of an atom represents its 6) _____
A) electronegativity.
B) ability to interact with other atoms.
C) radioactivity.
D) ability to interact with water.
E) ability to attract electrons.

7) The type(s) of bond produced when atoms share electrons equally is/are 7) _____
A) an ionic bond.
B) a nonpolar covalent bond.
C) a hydrogen bond.
D) a polar covalent bond.
E) both polar covalent and ionic bonds.

8) The type(s) of bond produced when atoms with somewhat different electronegativities share electrons is/are 8) _____
A) a polar covalent bond.
B) an ionic bond.
C) a nonpolar covalent bond.
D) a hydrogen bond.
E) both nonpolar covalent and ionic bonds.

9) Which of the following types of chemical bonds do carbon atoms generally NOT form? 9) _____
A) polar covalent bonds
B) ionic bonds
C) hydrogen bonds
D) nonpolar covalent bonds
E) neither ionic nor hydrogen bonds

10) Unstable isotopes can be useful 10) _____
A) in the formation of hydrogen bonds.
B) catalysts.
C) in vitamins.
D) in medical diagnosis.
E) as buffers.

11) Which of the following is an INCORRECT pairing? 11) _____
A) hydrolysis; hydrogen bonds
B) dehydration; anabolism
C) catabolism; exothermic
D) synthesis; endothermic
E) electrolytes; anions

12) Compounds that readily dissociate in water are 12) _____
A) ionic.
B) polar.
C) nonpolar.
D) either polar or ionic.
E) never polar or ionic.

13) Which of the following is a property of water? 13) _____
A) It is a nonpolar molecule.
B) It has a high capacity for heat.
C) It is not a good solvent.
D) It is liquid in a very narrow temperature range.
E) It is not a common reactant in metabolic reactions.

14) An acid dissociates in water to release 14) _____
A) hydroxyl group(s).
B) anion(s).
C) cation(s).
D) hydrogen ion(s).
E) both anions and hydrogen ions.

15) The reverse of a dehydration synthesis reaction is a(n) _____ reaction. 15) _____

A) anabolic
B) endothermic
C) exchange
D) metabolic
E) hydrolytic

16) A hydroxyl _____ acts as a base. 16) _____
A) salt B) group C) anion D) atom E) cation

17) Which of the following is NOT a characteristic of saturated fats? 17) _____
A) Their fatty acids pack tightly together.
B) They are found in animals.
C) They contain at least one double bond.
D) They are a form of stored energy.
E) They are usually solid at room temperature.

18) Which of the following is NOT a characteristic of phospholipids? 18) _____
A) They contain fatty acids that associate with water.
B) They can form micelles and bilayers.
C) They contain two fatty acids and a phosphate functional group.
D) They contain a hydrophilic phosphate "head."
E) They are found in cellular membranes.

19) Organisms use carbohydrates in all of the following ways EXCEPT 19) _____
A) as a building block of DNA and RNA molecules.
B) as a long-term energy source.
C) to keep membranes flexible at low temperatures.
D) as a component of cell walls.
E) as a short-term energy source.

20) Nucleic acids, proteins, and complex carbohydrates are all produced by 20) _____
A) dehydration synthesis.
B) exchange reactions.
C) hydrogen bonding.
D) hydrolytic reactions.
E) catabolic reactions.

21) Which of the following is an example of a polysaccharide? 21) _____
A) glycogen
B) fructose
C) glucose
D) sucrose
E) deoxyribose

22) Which of the following statements about proteins is FALSE? 22) _____
A) They are formed by dehydration synthesis reactions.
B) They are composed of amino acids.
C) They can be hydrophobic, hydrophilic, or both.
D) Their primary function is energy storage.
E) They have multiple levels of structural organization.

23) All of the following are components of an amino acid EXCEPT a(n) 23) _____

A) carboxyl group.
B) pentose group.
C) amino group.
D) R group.
E) α-carbon.

24) Which of the following is found in nucleic acids? 24) _____
A) carboxylic acid
B) purines
C) glycerol
D) R group
E) amines

25) Hydrogen bonds are found in all of the following EXCEPT 25) _____
A) in the DNA double helix between nucleotides.
B) between the R groups of amino acids in proteins.
C) in α-helices.
D) between water molecules.
E) between phosphates in ATP.

26) Tertiary and quaternary structure of proteins involves _____ bonds. 26) _____
A) ionic
B) nonpolar covalent
C) polar covalent
D) hydrogen
E) ionic, hydrogen, polar, and nonpolar covalent

27) Which of the following are examples of pyrimidines? 27) _____
A) cytosine and guanine
B) cytosine and thymine
C) uracil and adenine
D) thymine and guanine
E) thymine and adenine

28) All of the following bases are found in RNA molecules EXCEPT 28) _____
A) guanine. B) adenine. C) thymine. D) uracil. E) cytosine.

29) The "backbone" of the DNA molecule is composed of 29) _____
A) pentoses.
B) phosphates.
C) amino acids.
D) alternating phosphates and pentoses.
E) nitrogenous bases.

30) Which of the following would NOT normally be found as a component of a cell's nucleic acids? 30) _____
A) cytosine ribonucleotides
B) adenine deoxyribonucleotides
C) adenine ribonucleotides
D) thymine deoxyribonucleotides
E) uracil deoxyribonucleotides

31) All of the following are associated with ATP molecules EXCEPT 31) _____

A) high-energy bonds.
B) a recyclable energy supply.
C) a long-term energy supply.
D) formation of coenzymes.
E) three phosphate groups.

32) Which of the following statements concerning nucleic acids is FALSE? 32) _____
A) Cytosine is found in all nucleic acid molecules.
B) Not all DNA is double stranded.
C) Nucleic acid strands are held together by hydrogen bonds between complementary bases.
D) The nucleic acid polymer is composed of peptide bonds.
E) Some viruses have DNA as their genomes.

33) Which of the following is an INCORRECT pairing? 33) _____
A) secondary structure; β-pleated sheets
B) secondary structure; disulfide bridges
C) primary structure; amino acid sequence
D) tertiary structure; covalent bonds
E) quaternary structure; two or more polypeptides

34) Proteins contain both acidic and basic R groups, and can therefore function as 34) _____
A) catalysts.
B) structural macromolecules.
C) energy storage macromolecules.
D) buffers.
E) genetic material.

35) A(n) _____ is a compound that dissolves into anions and cations in water. 35) _____
A) salt B) buffer C) acid D) catalyst. E) base

36) Plant cell walls are composed of _____ held together by _____. 36) _____
A) polysaccharides; hydrogen bonds
B) amino acids; peptide bonds
C) fatty acids; polar covalent bonds
D) peptidoglycan; ionic bonds
E) disaccharides; hydrophobic interactions

37) A(n) _____ is an arrangement of atoms found in a variety of macromolecules. 37) _____
A) salt
B) functional group
C) buffer
D) isotope
E) stereoisomer

38) Decomposition reactions are commonly _____ reactions. 38) _____
A) anabolic
B) exchange
C) endothermic
D) exothermic
E) dehydration

39) Lipids found in the membranes of all eukaryotic cells are 39) _____

A) phospholipids.
B) waxes.
C) steroids.
D) triglycerides.
E) polyunsaturated fats.

40) A protein is a _____ of amino acids. 40) _____
A) bilayer
B) polymer
C) decomposition product
D) monomer
E) solution

41) DNA is composed of repeating units of sugars, phosphates, and nucleic acids. This is an example of a 41) _____
A) micelle. B) polymer. C) salt. D) lipid. E) monomer.

42) A polymer composed of simple sugars is a(n) 42) _____
A) protein.
B) starch.
C) amino acid.
D) glycoprotein.
E) triglyceride.

43) Anna is conducting an experiment using a pH indicator that is red at low pH, green at neutral pH and purple at high pH. She starts with a green solution. When she adds compound X to her solution it turns purple. Then she adds compound Z to the solution and it turns green. She adds more Z, the solution remains green. These observations suggest X is _____ and Z is _____. 43) _____
A) a base; a strong acid
B) a base; a buffer
C) a buffer; a base
D) an acid; a base
E) an acid; a buffer

44) An amine group is removed from an amino acid and bonded to a second compound to form a different amino acid. No other molecules are used or produced. What type of reaction is likely to be involved? 44) _____
A) a decomposition reaction
B) a synthesis reaction
C) a hydrolysis reaction
D) an exchange reaction
E) The answer cannot be determined for the available information.

45) Adenosine triphosphate (ATP) is a 45) _____
A) monomer.
B) polymer.
C) simple carbohydrate.
D) bilayer.
E) lipid.

46) Amylose is a(n) _____ carbohydrate. 46) _____
A) polymer B) ionic C) monomer D) simple E) nucleotide

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

47) The smallest chemical units of matter are elements. 47) _____

48) The side groups of amino acids can interact with each other and with other molecules. 48) _____

49) A molecule composed of carbon and hydrogen is a compound. 49) _____

50) The electron shells of atoms hold eight electrons each. 50) _____

51) Hydrogen bonds are stronger then covalent bonds. 51) _____

52) An organic molecule with the chemical formula $C_4H_5O_1N_3$ is probably a pyrimidine. 52) _____

53) Denaturation of a protein is always permanent. 53) _____

54) The long-term chemical energy storage molecules in plants are triglycerides. 54) _____

55) One of the products of dehydration synthesis reactions is water. 55) _____

56) Salts are produced from exchange reactions in which acids and bases neutralize each other. 56) _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

57) Radioactive iodine is sometimes used to treat thyroid cancer. This is an example of the use of (isotopes/elements/radiation) in medical treatment. 57) _____

58) The phosphorylation of a protein by ATP is a(n) (exchange/transfer) reaction 58) _____

59) Cell surface markers composed of both carbohydrate and lipid molecules are known as (glycoproteins/glycolipids/LPS). 59) _____

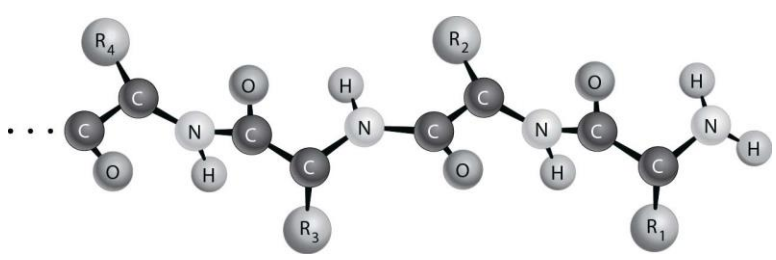
60) An atom or molecule becomes a(n) (anion/ion/cation) when it loses an electron to a more electronegative molecule. 60) _____

61) A chemical reaction in which a water molecule is a reactant is known as a(n) (dehydration/hydrolysis) reaction. 61) _____

62) A(n) (base/acid) is a molecule that binds with hydrogen ions when it is dissolved in water. 62) _____

63) The folding of a polypeptide into a three-dimensional shape is its (secondary/tertiary/quaternary) structure. 63) _____

64) The DNA double helix is held together by (covalent/ionic/hydrogen) bonds. 64) _____

65) 

(primary/secondary/tertiary) structure of a protein.

Figure 2.2 depicts the

65) _____

66) A(n) (catalyst/enzyme) is any molecule that speeds up a chemical reaction. 66) _____

67) The monomer of a nucleic acid is called a (nucleoside/nucleotide/base). 67) _____

68) A chemical reaction that traps energy within newly formed chemical bonds is an (exothermic/endothermic) reaction. 68) _____

69) A(n) (indicator/base/buffer) is a substance that maintains the pH even when the amounts of acid and / or base are changing. 69) _____

70) The sum of all the chemical reactions within an organism is referred to as its (metabolism/physiology). 70) _____

71) The (atoms/isotopes/stereoisomers) of an element vary in the number of neutrons in the nucleus. 71) _____

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

72) Compare and contrast synthesis reactions with decomposition reactions.

73) Discuss the importance of hydrogen bonds in the chemistry of the cell.

74) Max is exploring the properties of various compounds. Some of his explorations involve the use of a pH indicator that is red at low pH, yellow-green at neutral pH and blue to purple at high pH. He sets up several tubes containing water and the pH indicator and then begins to add some of the compounds he is characterizing in various combinations. His results are shown on the Figure 2.3.

Compound	None	1 × L	1 × M	2 × M	5 × M	1 × N	1 × L + 1 × M	1 × L + 5 × M	1 × L + 1 × M + 1 × N
Color	Green	Red	Green	Blue	Purple	Green	Red	Green	Green

What can Max conclude about his compounds based on these results? Describe the likely events in terms of hydrogen and hydroxyl ions.

75) Describe the chemical properties of phospholipids that account for their behavior in water.

76) Nitrogen is an essential element for living things, as demonstrated by the fact that nearly all fertilizers contain nitrogenous compounds. Discuss why nitrogen is essential.

1) A
2) A
3) A
4) E
5) E
6) B
7) B
8) A
9) E
10) D
11) A
12) D
13) B
14) E
15) E
16) C
17) C
18) A
19) C
20) A
21) A
22) D
23) B
24) B
25) E
26) E
27) B
28) C
29) D
30) E
31) C
32) D
33) B
34) D
35) A
36) A
37) B
38) D
39) A
40) B
41) B
42) B
43) B
44) E
45) A
46) A
47) FALSE
48) TRUE
49) TRUE
50) FALSE
51) FALSE

52) TRUE
53) FALSE
54) FALSE
55) TRUE
56) TRUE
57) isotopes
58) exchange
59) glycolipids
60) cation
61) hydrolysis
62) base
63) tertiary
64) hydrogen
65) primary
66) catalyst
67) nucleotide
68) endothermic
69) buffer
70) metabolism
71) isotopes
72) Synthesis and decomposition reactions are often the reverse of each other. Synthesis reactions consume energy (are endothermic), whereas decomposition reactions release energy (are exothermic). Synthesis reactions often release water molecules in a process called dehydration synthesis, whereas decomposition reactions often consume water molecules in a process called hydrolysis. Finally, decomposition reactions break large macromolecules into their component monomers, which can then be used in synthesis reactions to build new macromolecules for use by the cell, whereas synthesis reactions utilize component monomers to build larger molecules.
73) The chemistry of the cell would basically be impossible without hydrogen bonds. Water, which is required by all cellular reactions, would not have its unique properties of cohesiveness and polarity without hydrogen bonds. Hydrogen bonds hold the double helix of DNA together and contribute to the overall shape of protein molecules. However, unlike covalent bonds, hydrogen bonds are not permanent bonds, so they can easily and temporarily be broken, a characteristic that is important at certain points in the cell's life cycle (such as during DNA replication).
74) Max's results are consistent with L being an acid and M being a weak base. Compound N appears to be a buffer. The green color of the indicator is seen when the concentrations of hydroxyl and hydrogen ions are equal. The red color of the solution indicates the concentration of hydrogen ions is greater than the hydroxyl ion concentration. The data does not provide information for calculating the concentrations. Blue and purple indicator colors show the hydroxyl ion concentrations exceed the hydrogen ion concentrations. The results with the mixes of L and M suggest that L dissolves to release 5 times more hydrogen ions than the concentration of hydroxyl ions produced by the ionization of M. Compound N accepts or releases ions with changing hydrogen ion concentrations to maintain equal concentrations of cations and anions.
75) Phospholipids have polar phosphate "heads" and nonpolar fatty acid "tails," which interact in different ways with water molecules. The phospholipid heads are attracted to polar water molecules, but the nonpolar tails of the phospholipid are repelled by water. As the tails are driven away from the water molecules, they congregate together, either in the interior of a ball of lipid (called a micelle) or within the interior of a double layer of phospholipids (called a bilayer). This leaves the phosphate heads "outside," where they can easily interact with the water molecules.
76) Nitrogen is a component in the structure of two of the four types of organic macromolecules. The amino group of an amino acid is a key reactant in the formation of peptide bonds, or primary structure, of proteins. Nitrogen also participates in hydrogen bonding and thereby contributes to the secondary, tertiary, and quaternary structure of proteins. Nitrogen is a key structural component of the bases in nucleic acids, and its participation in hydrogen bonding results in the formation of the base pairs and therefore the double helix of DNA.