

Name _____

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) element C) electron D) isotope E) proton

Answer: A

- 2) Matter composed of a single type of atom is known as a(n) 2) _____

A) mineral.
B) electron.
C) molecule.
D) element.
E) compound.

Answer: D

- 3) A stable atom has _____ in its valence shell. 3) _____

A) 4 electrons
B) 2 neutrons
C) 10 electrons
D) 8 protons
E) 8 electrons

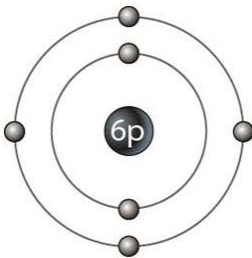
Answer: E

- 4) Which parts of the atoms interact in a chemical reaction? 4) _____

A) ions B) electrons C) neutrons D) isotopes E) protons

Answer: B

- 5) 5) _____



The outer ring in Figure 2-1 represents

A) a neutron.
B) the nucleus.
C) an electron.
D) an isotope.
E) an electron shell.

Answer: E

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

Answer: B

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

Answer: B

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

Answer: C

- 9) A research microbiologist wants to determine whether a microbe can metabolize a new synthetic organic molecule composed of carbon, hydrogen and oxygen. Which of the following would be useful in tracing the fate of the compound? _____
A) the ^2H isotope
B) the ^{13}C isotope
C) a $^{13}\text{C}^+$ ion.
D) the ^{14}C isotope
E) the ^{12}C isotope

Answer: D

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

Answer: A

- 11) Which of the following is a CORRECT pairing of metabolic terms? _____
A) hydrolysis: decomposition
B) synthesis: exothermic
C) synthesis: catabolism
D) catabolism: endothermic
E) dehydration: decomposition

Answer: A

- 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.

Answer: D

- 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.

Answer: B

- 14) An acid dissociates in water to release 14) _____
A) hydroxyl groups.
B) anions.
C) cations.
D) hydrogen ions.
E) both anions and hydrogen ions.

Answer: E

- 15) The reverse of a dehydration synthesis reaction is a(n) _____ reaction. 15) _____
A) anabolic
B) endothermic
C) exchange
D) metabolic
E) hydrolysis

Answer: E

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

Answer: C

- 17) The chemical formula of a solid indicates it contains two groups with different electronegativities. 17) _____
This substance is most likely
A) radioactive.
B) a nonpolar molecule.
C) a salt.
D) non-ionic.
E) a mixture.

Answer: C

- 18) You are performing an experiment in your chemistry lab class. The directions advise caution because the reaction is exothermic. Which of the following is the hazard the directions warn about? 18) _____
- A) The reaction may cause the container to become dangerously hot.
 - B) The reaction will produce a noxious vapor.
 - C) The reaction will generate enough light to require eye protection.
 - D) The reaction may cause the container to freeze and break.
 - E) The reaction will generate radiation.

Answer: A

- 19) The reaction described below is consistent with 19) _____
- $$\text{Serine} + \text{ATP} \longrightarrow \text{Serine-(P)} + \text{AMP}$$
- A) a catabolic reaction.
 - B) an exchange reaction.
 - C) a synthesis reaction.
 - D) a decomposition reaction.
 - E) both synthesis and decomposition.

Answer: B

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

Answer: A

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

Answer: A

- 22) Research suggests taking antacids may make people more susceptible to infection with *Vibrio vulnificus* by making the stomach environment more tolerable to the bacteria. Based on this information and the name "antacid," which of the following are antacids likely to be? 22) _____
- A) acids
 - B) non-polar compounds
 - C) buffers
 - D) bases
 - E) either base or buffer

Answer: E

- 23) All of the following are components of an amino acid EXCEPT a(n) _____
A) carboxyl group.
B) pentose group.
C) amino group.
D) R group.
E) α -carbon.
Answer: B
- 24) Which of the following is found in nucleic acids? _____
A) carboxylic acid
B) purines
C) glycerol
D) R group
E) amino groups
Answer: B
- 25) Hydrogen bonds are found in all of the following EXCEPT _____
A) in the DNA double helix between nucleotides.
B) between the R groups of amino acids in proteins.
C) in the structure of complex polysaccharides.
D) between water molecules.
E) between phosphates in ATP.
Answer: E
- 26) Tertiary and quaternary structure of proteins involves _____ bonds. _____
A) ionic
B) nonpolar covalent
C) polar covalent
D) hydrogen
E) hydrogen, ionic, polar, and nonpolar covalent
Answer: E
- 27) Which of the following are examples of pyrimidines? _____
A) cytosine and guanine
B) cytosine and thymine
C) uracil and adenine
D) thymine and guanine
E) thymine and adenine
Answer: B
- 28) A macromolecule containing two fatty acids and a phosphate group is a _____
A) glycerol.
B) wax.
C) phospholipid.
D) steroid.
E) saturated fatty acid.
Answer: C

- 29) The "backbone" of the DNA molecule is composed of _____
A) pentoses.
B) phosphates.
C) amino acids.
D) alternating phosphates and pentoses.
E) nitrogenous bases.
Answer: D
- 30) Which of the following would NOT normally be found as a component of a cell's nucleic acids? _____
A) cytosine ribonucleotides
B) adenine deoxyribonucleotides
C) adenine ribonucleotides
D) thymine deoxyribonucleotides
E) uracil deoxyribonucleotides
Answer: E
- 31) All of the following are associated with ATP molecules EXCEPT _____
A) high-energy bonds.
B) a recyclable energy supply.
C) a long-term energy supply.
D) formation of coenzymes.
E) three phosphate groups.
Answer: C
- 32) Which of the following is TRUE of both DNA and RNA? _____
A) They are highly hydrophobic macromolecules.
B) They contain adenine, cytosine, guanine and thymine.
C) The "backbone" is composed of riboses and phosphates.
D) The purines and pyrimidines form hydrogen-bonded pairs.
E) They are usually double-stranded helices.
Answer: D
- 33) Which of the following is an INCORRECT pairing? _____
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
Answer: B
- 34) Proteins contain both acidic and basic R groups, and can therefore function as _____
A) catalysts.
B) structural macromolecules.
C) energy storage macromolecules.
D) buffers.
E) genetic material.
Answer: D

- 35) Which of the following is characteristic of proteins? 35) _____
- A) Their secondary structure is composed of β -helices.
 - B) They have multiple layers of structural organization.
 - C) They are composed of carbohydrate.
 - D) They are primarily hydrophobic.
 - E) They are composed of nucleic acids.

Answer: B

- 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

Answer: A

- 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

Answer: B

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

Answer: D

- 39) Lipids found in the membranes of most eukaryotic cells are 39) _____
- A) phospholipids.
 - B) waxes.
 - C) steroids.
 - D) triglycerides.
 - E) polyunsaturated fats.

Answer: A

- 40) Which of the following lipids has the lowest ratio of hydrogens to carbons? 40) _____
- A) monounsaturated fats
 - B) polyunsaturated fats
 - C) saturated fats
 - D) both saturated and monounsaturated fats
 - E) Saturated, unsaturated, and polyunsaturated fats have equal ratios of hydrogens to carbons.

Answer: B

- 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.
Answer: B

- 42) Bacterial cell walls are composed of _____ 42) _____
A) peptides.
B) waxes.
C) peptides and polysaccharides.
D) carbohydrates and waxes.
E) polysaccharides.
Answer: C

- 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 and 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
Answer: B

- 44) A reaction requires water as a reactant and produces heat. 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 with the available information.
Answer: A

- 45) What functional groups are present in ALL amino acids? 45) _____
A) amino groups
B) carboxyl groups
C) hydroxyl groups.
D) amino and sulfhydryl groups.
E) amino and carboxyl groups
Answer: E

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

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) _____
Answer: True ☒ False

- 48) The side groups of amino acids can interact with each other and with other molecules. 48) _____
Answer: ☒ True ☐ False
- 49) A molecule composed of carbon and hydrogen is a compound. 49) _____
Answer: ☒ True ☐ False
- 50) The electron shells of atoms hold eight electrons each. 50) _____
Answer: ☐ True ☒ False
- 51) Carbon atoms have four valence electrons and typically form polar covalent bonds. 51) _____
Answer: ☐ True ☒ False
- 52) An organic molecule with the chemical formula $C_4H_5O_1N_3$ is probably a pyrimidine. 52) _____
Answer: ☒ True ☐ False
- 53) Denaturation of a protein is always permanent. 53) _____
Answer: ☐ True ☒ False
- 54) Glycolipids are an example of a mixture. 54) _____
Answer: ☐ True ☒ False
- 55) One of the products of dehydration synthesis reactions is water. 55) _____
Answer: ☒ True ☐ False
- 56) Salts are produced from exchange reactions in which acids and bases neutralize each other. 56) _____
Answer: ☒ True ☐ False

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) _____
Answer: isotopes
- 58) The phosphorylation of a protein by ATP is a(n) (exchange/transfer/group) reaction 58) _____
Answer: exchange
- 59) Neon generally does not react with other atoms because it has (2/4/6/8) electrons in its outer shell. 59) _____
Answer: 8
- 60) An atom or molecule becomes a(n) (anion/ion/cation) when it loses an electron to a more electronegative molecule. 60) _____
Answer: cation
- 61) A chemical reaction in which a water molecule is a reactant is known as a (dehydration/hydrolysis) reaction. 61) _____
Answer: hydrolysis

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

Answer: base

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

Answer: tertiary

64) The "double helix" of DNA is the result of (covalent/ionic/hydrogen) bonds. 64) _____

Answer: hydrogen

65) 65) _____

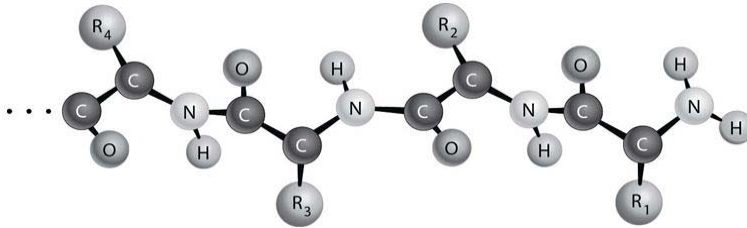


Figure 2-2 depicts the (primary/secondary/tertiary) structure of a protein.

Answer: primary

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

Answer: catalyst

67) A fatty acid with two double bonds is a (saturated/monounsaturated/polyunsaturated) fat. 67) _____

Answer: polyunsaturated

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

Answer: endothermic

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) _____

Answer: buffer

70) The functional group of a monosaccharide is a(n) (amino/carboxyl/hydroxyl/carbonyl) 70) _____

Answer: hydroxyl

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

Answer: isotopes

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

72) Compare and contrast synthesis reactions with decomposition reactions.

Answer: 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) Discuss the importance of hydrogen bonds in the chemistry of the cell.

Answer: 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 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.

Answer: 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) A student is given a compound to identify in an organic chemistry class. The first thing she notices is that it is not soluble in pure water or saline. Analysis of the ratios of atoms indicates the ratio of carbon to hydrogen to oxygen is 1:1.5:0.05. There is no nitrogen. Based on this information, what class of biological macromolecule is the student working with? Justify your answer.

Answer: The macromolecule is a sterol. The lack of nitrogen eliminates amino acids and nucleic acids. The ratio eliminates carbohydrates, which have a C:H:O ration of 1:2:1. Thus the compound is a lipid. Fatty acids and waxes have a C:H ratio of about 1:2 with only one (wax) or two (fatty acid) oxygens per molecule (C:O ranging from 12:1 to 24:1). The low ratio of H to C suggests many carbons are bonded to three other carbons, consistent with steroids. The presence of some oxygen indicates there are hydroxyl groups, found in sterols.

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.

Answer: 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.