**The Chemistry of Life**

**Multiple Choice Questions**

1.  The primary elements making up living organisms are    
A.  carbon, hydrogen, oxygen, and calcium.   
B.  carbon, oxygen, iron, and chlorine.   
C.  carbon, hydrogen, iron, and calcium.   
**D.**  carbon, hydrogen, oxygen, and nitrogen.   
E.  carbon, oxygen, sulfur, and calcium.

2.  The atomic number of an atom or element is    
A.  the number of neutrons in the nucleus.   
B.  the number of electrons in the nucleus.   
**C.**  the number of protons in the nucleus.   
D.  the number of neutrons in the orbitals.   
E.  the number of protons in the orbitals.

3.  An ion is    
A.  an atom that has gained electrons.   
B.  an atom that has a positive charge.   
C.  an atom that has lost electrons.   
D.  an atom that has a negative charge.   
**E.**  All answers are correct.

4.  The mass number of an atom is defined as    
A.  the total number of protons, neutrons, and electrons of an atom.   
B.  the total number of protons and electrons of an atom.   
**C.**  the total number of protons and neutrons of an atom.   
D.  the total number of neutrons and electrons of an atom.   
E.  the total number of protons of an atom.

5.  Isotopes of the same element are different from one another in that    
A.  they have a different number of protons.   
**B.**  they have a different number of neutrons.   
C.  they have a different number of electrons.   
D.  they are a different element.   
E.  only one of the isotopes is matter.

6.  The first energy shell of an atom contains a maximum of    
A.  one electron.   
**B.**  two electrons.   
C.  four electrons.   
D.  eight electrons.   
E.  sixteen electrons.

7.  If an atom has a valence shell that is full, then it    
A.  is highly reactive.   
B.  is chemically unstable.   
C.  is highly likely to combine with other atoms.   
D.  is found only in a gas form.   
**E.**  is inert.

8.  The second energy shell of an atom contains a maximum of    
**A.**  eight electrons.   
B.  two electrons.   
C.  four electrons.   
D.  one electron.   
E.  sixteen electrons.

9.  In a covalent bond    
**A.**  atoms share electrons.   
B.  atoms of opposite charges attract each other.   
C.  atoms share protons.   
D.  atoms share neutrons.   
E.  atoms are repelled by each other.

10.  An ionic bond is a bond in which    
A.  atoms share electrons.   
B.  atoms share protons.   
**C.**  atoms of opposite charges attract each other.   
D.  atoms share neutrons.   
E.  atoms are repelled by each other.

11.  In the example of ionic bond formation between sodium and chlorine, which of the following is a false statement?    
A.  Na is the chemical symbol for sodium.   
**B.**  Chlorine donates an electron.   
C.  Chlorine becomes negatively charged.   
D.  Sodium becomes positively charged.   
E.  The bond that is formed is a strong bond.

12.  In the example of ionic bond formation between sodium and chlorine    
A.  Na is the chemical symbol for chlorine.   
B.  sodium accepts an electron.   
**C.**  chlorine accepts an electron.   
D.  chlorine becomes positively charged.   
E.  both sodium and chlorine accept electrons.

13.  If a covalent bond is polar    
A.  electrons are not shared by atoms.   
B.  protons are shared by atoms.   
C.  it will not form in living organisms.   
**D.**  electronegativity of atoms is unequal in their pull on electrons.   
E.  the bond is weak in strength.

14.  A hydrogen bond    
A.  is generally a strong bond.   
B.  does not occur in living organisms.   
**C.**  does not require electron transfer.   
D.  forms between atoms having the same electronegativity.   
E.  is a specialized type of covalent bond.

15.  Evaporation is    
**A.**  the conversion of a liquid into a vapor.   
B.  the conversion of a solid into a vapor.   
C.  the conversion of a vapor into a liquid.   
D.  the conversion of a vapor into a solid.   
E.  All answers are correct.

16.  Ice floats on liquid water because    
A.  the molecules are closer together in ice than in liquid water.   
**B.**  the molecules are farther apart in ice than in liquid water.   
C.  ice is denser than liquid water.   
D.  convection currents caused by temperature differences push upwards on the ice.   
E.  water vapor is less dense than liquid water.

17.  In a chemical equation    
A.  the reactants are on the right of the yields arrow.   
B.  reactants and products are on both sides of the yields arrow.   
C.  the products are on the left of the yields arrow.   
**D.**  the reactants are on the left of the yields arrow.   
E.  the number of atoms of each element may differ on the two sides of the yields arrow.

18.  An acid    
A.  has a value above seven on the pH scale.   
B.  is a chemical that takes hydrogen ions from a solution.   
C.  has a value of seven on the pH scale.   
**D.**  is a chemical that adds hydrogen ions to a solution.   
E.  All answers are correct.

19.  A base    
A.  has a value of 7 on the pH scale.   
B.  is a chemical that adds hydrogen ions to a solution.   
**C.**  is a chemical that absorbs hydrogen ions from a solution.   
D.  has a value below 7 on the pH scale.

20.  A substance with a pH of 2 is    
A.  neutral.   
B.  a weak acid.   
C.  a weak base.   
D.  a strong base.   
**E.**  a strong acid.

21.  A substance with a pH of 6 is    
**A.**  a weak acid.   
B.  neutral.   
C.  a weak base.   
D.  a strong acid.   
E.  a strong base.

22.  A substance with a pH of 7 is    
A.  a weak acid.   
B.  a weak base.   
**C.**  neutral.   
D.  a strong acid.   
E.  a strong base.

23.  A substance with a pH of 8 is    
A.  neutral.   
**B.**  a weak base.   
C.  a weak acid.   
D.  a strong acid.   
E.  a strong base.

24.  A substance with a pH of 13 is    
A.  a weak acid.   
B.  a weak base.   
C.  neutral.   
D.  a strong acid.   
**E.**  a strong base.

25.  Organic molecules are defined as chemical compounds that contain    
A.  hydrophilic solutions.   
B.  isotopes of carbon.   
C.  ionically bonded atoms.   
D.  strong hydrogen bonds.   
**E.**  carbon and hydrogen.

26.  The four major groups of organic compounds are    
A.  fats, waxes, carbohydrates, and amino acids.   
B.  carbohydrates, lipids, steroids, and monosaccharides.   
C.  lipids, fats, waxes, and steroids.   
**D.**  carbohydrates, lipids, proteins, and nucleic acids.   
E.  carbohydrates, proteins, amino acids, and nucleic acids.

27.  A process by which cells build large molecules from monomers is    
A.  hydrolysis.   
B.  reproduction.   
**C.**  dehydration synthesis.   
D.  hydrolysis and dehydration synthesis.   
E.  unrelated to chemical bonds.

28.  A process by which cells break polymers down into smaller units is    
**A.**  hydrolysis.   
B.  dehydration synthesis.   
C.  reproduction.   
D.  hydrolysis and dehydration synthesis.   
E.  unrelated to chemical bonds.

29.  Examples of monosaccharides are    
A.  cellulose and sucrose.   
B.  lactose and sucrose.   
**C.**  glucose and fructose.   
D.  glucose and cellulose.   
E.  None of the answers are correct.

30.  Which of the following is not a lipid?    
A.  a triglyceride   
B.  a phospholipid   
C.  a wax   
D.  a sterol   
**E.**  a starch molecule

31.  The primary building block (monomer) of proteins is    
A.  a glucose molecule.   
B.  a fatty acid.   
C.  a nucleotide.   
**D.**  an amino acid.   
E.  four interconnected rings.

32.  An amino acid contains    
A.  three R groups and a glycerol.   
**B.**  nitrogen, carbon, and an R group.   
C.  multiple saccharide rings.   
D.  carbon and phosphorus monomers.   
E.  carbon and phosphorus.

33.  A peptide bond    
A.  is an ionic bond in proteins.   
B.  is a covalent bond in carbohydrates.   
**C.**  is a covalent bond in proteins.   
D.  is an ionic bond in carbohydrates.   
E.  is a hydrogen bond in nucleic acids.

34.  The primary building block (monomer) of nucleic acids is    
**A.**  a nucleotide.   
B.  a glucose molecule.   
C.  a fatty acid.   
D.  an amino acid.   
E.  four interconnected carbon rings.

35.  The three major components in a nucleotide are    
A.  glucose, a nitrogen base, and a phosphate group.   
B.  glucose, a fatty acid, and glycerol.   
C.  a nitrogen base, a carboxyl group, and an R group.   
**D.**  a nitrogen base, a five-carbon sugar, and a phosphate group.   
E.  a carboxyl group, an R group, and an amino group.

36.  The four nitrogenous bases found in RNA are    
A.  glycerol, phosphate, adenine, and glucose.   
**B.**  adenine, cytosine, guanine, and uracil.   
C.  adenine, thymine, cytosine, and uracil.   
D.  thymine, cytosine, guanine, and uracil.   
E.  adenine, thymine, guanine, and cytosine.

37.  Water is best described as which of the following?    
A.  an ion   
B.  a non-polar molecule   
C.  an atom   
**D.**  a polar molecule   
E.  an element

38.  Individual water molecules bind to each other with    
A.  covalent bonds.   
B.  ionic bonds.   
**C.**  hydrogen bonds.   
D.  hydrophobic bonds.   
E.  peptide bonds.

39.  Within a single molecule of water, \_\_\_\_ bonds are formed between oxygen and hydrogen.    
A.  ionic   
**B.**  covalent   
C.  hydrogen   
D.  hydrophobic   
E.  nuclear

40.  What do a lemon, a toaster oven, and sand grains have in common?    
**A.**  All are composed of matter and energy.   
B.  All are alive.   
C.  All are composed of organic molecules.   
D.  All are acidic.   
E.  All are basic.

41.  You can painlessly wade into a pool, but doing a belly flop off of the high diving board hurts because of \_\_\_\_\_\_.    
A.  water's high density   
B.  adhesion of your molecules with the water molecules   
C.  water's high boiling point   
D.  a neutral pH   
**E.**  cohesion of the water molecules

42.  Trees are able to transport water hundreds of feet up from the roots because of    
A.  water's high density.   
**B.**  cohesion of the water molecules.   
C.  water's high boiling point.   
D.  adhesion of tree molecules with the water molecules.   
E.  a neutral pH.

43.  Sugars (CH2O)n dissolve well in water and are therefore called \_\_\_\_\_\_ substances.    
A.  covalent   
B.  ionic   
C.  hydrogen   
D.  hydrophobic   
**E.**  hydrophilic

44.  Blood pH is closely maintained at a pH of 7.4. A patient whose blood pH drops below 7.35 is suffering from metabolic acidosis and can go into a coma. What happens to the concentration of H+ ions in a patient with a blood pH of 6.4?    
A.  H+ concentration is decreased 10-fold.   
B.  H+ concentration is decreased 2-fold.   
C.  H+ concentration is increased 2-fold.   
D.  H+ concentration is decreased 4-fold.   
**E.**  H+ concentration is increased 10-fold.

  Scientists use carbon dating to determine the age of fossils. 14C is a rare isotope of carbon that has a half life of 5730 years and decays into 14N. By measuring the amount of 14C remaining in a fossil, scientists can estimate when the organism died to within 60,000 years. The atomic numbers of C is 6 and of N is 7.

45.  14C and 14N are both    
**A.**  atoms.   
B.  molecules.   
C.  compounds.   
D.  polymers.   
E.  ions.

46.  The most common isotope of carbon is 12C. 14C has \_\_\_\_ than 12C.    
A.  more protons   
**B.**  more neutrons   
C.  fewer neutrons   
D.  fewer protons   
E.  more electrons

47.  14C and 14N have the same    
A.  atomic number.   
B.  number of protons.   
**C.**  atomic mass.   
D.  number of neutrons.   
E.  number of electrons.

48.  Which of the following is NOT an example of matter?    
**A.**  wind   
B.  energy   
C.  light   
D.  sound   
E.  None of the answers are correct.

49.  Hydrogen, nitrogen, carbon, and oxygen account for 96% of the human body. These elements are    
**A.**  also the main elements in organic molecules.   
B.  rare in non-human organisms.   
C.  rare on Earth.   
D.  always bonded by hydrogen bonds.   
E.  All answers are correct.

50.  Many digestive enzymes are hydrolases which carry out hydrolysis. What do these enzymes have in common?    
A.  They use water to form bonds between monomers.   
B.  They use water to break bonds in monomers.   
**C.**  They use water to break bonds in polymers.   
D.  They use water to form bonds between polymers.   
E.  They release water in forming bonds between monomers.

51.  \_\_\_\_ bonds are formed between monomers to form a polymer.    
A.  Ionic   
**B.**  Covalent   
C.  Hydrogen   
D.  Hydrophobic   
E.  Nuclear

52.  Hydrogen has 1 proton, 0 neutrons, and 1 electron. Which of the following is correct about hydrogen?    
A.  Hydrogen has an atomic number of 1.   
B.  Hydrogen has an atomic number of 2.   
C.  Hydrogen has an atomic mass of 2.   
D.  Hydrogen has an atomic number and atomic mass of 2.   
**E.**  Hydrogen has an atomic number and atomic mass of 1.

53.  Saturated fats have long straight tails of fatty acids, while unsaturated fats have kinks in their tails created by the double bonds. The kinks prevent the fatty acids from packing together as tightly. Ectothermic (cold blooded) animals need to keep their membranes fluid at cooler temperature and thus contain \_\_\_\_\_\_ their membranes.    
**A.**  mostly unsaturated fats in   
B.  mostly saturated fats in   
C.  no fatty acids in   
D.  a cell wall around   
E.  no lipids in

54.  Saturated fats have long straight tails of fatty acids, while unsaturated fats have kinks in their tails created by the double bonds. The kinks prevent the fatty acids from packing together as tightly. Hydrogenated vegetable oils have hydrogens added back to the double bonds and thus behave like \_\_\_\_.    
A.  unsaturated fats   
B.  waxes   
C.  carbohydrates   
D.  protein   
**E.**  saturated fats

55.  The polymers with the most complex and diverse three-dimensional structures are    
A.  saturated fats.   
B.  unsaturated fats.   
**C.**  proteins.   
D.  waxes.   
E.  carbohydrates.

56.  A nucleotide contains which of the following?    
A.  amino acid and nitrogenous bases   
B.  saturated and unsaturated fatty acids   
**C.**  sugar, nitrogenous base, and phosphate   
D.  amino acid and saccharide   
E.  fatty acid, glycerol, and phosphate

57.  How are the monomers in proteins joined?    
A.  phosphodiester bonds between amino acids   
**B.**  peptide bonds between amino acids   
C.  peptide bonds between nucleotides   
D.  phosphodiester bonds between nucleotides   
E.  peptide bonds between carbohydrates

58.  How are the monomers in nucleic acids joined?    
A.  peptide bonds between carbohydrates   
B.  peptide bonds between amino acids   
C.  phosphodiester bonds between amino acids   
D.  peptide bonds between nucleotides   
**E.**  phosphodiester bonds between nucleotides

59.  In the section "Investigating Life: E. T. and the Origin of Life," which question cannot be explained by evolution?    
A.  The diversity of species on Earth   
B.  The common ancestry of all species on Earth   
**C.**  How life started on Earth   
D.  The same types of molecules are found in all organisms   
E.  The origin of new species

60.  In the section "Investigating Life: E. T. and the Origin of Life," what hypothesis were the scientists testing?    
A.  Organic molecules can be made on Earth.   
B.  Extraterrestrial life can be detected on meteorites.   
C.  Life can be created from a mixture of organic molecules.   
D.  Low-oxygen conditions existed on Earth when production of organic molecules first began.   
**E.**  Meteorites can bring organic molecules from extraterrestrial origins to Earth.

  
   
 

61.  In the section "Investigating Life: E. T. and the Origin of Life," how did the scientists determine if the organic molecules in the meteorite were extraterrestrial?    
A.  By identifying a decrease in 13C and 15N in the meteorite compared to terrestrial measurements   
B.  By measuring the amount of amino acids in the meteorite   
C.  by measuring the amount of nucleotides in the meteorite   
**D.**  By identifying an increase in 13C and 15N in the meteorite compared to terrestrial measurements   
E.  By measuring the total amount of carbon and nitrogen in the meteorite

62.  In the section "Investigating Life: E. T. and the Origin of Life," how are 13C and 15N different from the more abundant isotopes 12C and 14N?    
**A.**  13C and 15N each have one more neutron more than 12C and 14N.   
B.  13C and 15N each have one more proton than 12C and 14N.   
C.  13C and 15N each have one less neutron than 12C and 14N.   
D.  13C and 15N each have one less proton than 12C and 14N.   
E.  13C and 15N each have one less electron than 12C and 14N.

63.  In the section "Investigating Life: E. T. and the Origin of Life," why were amino acids analyzed for 15N levels?  
    
A.  Nitrogen is not present in nucleotides or carbohydrates.   
B.  Nitrogen is not present in nucleotides or lipids.   
**C.**  Nitrogen is not present in carbohydrates or lipids.   
D.  Nitrogen is not present in amino acids or carbohydrates.   
E.  Nitrogen is not present in nucleotides or amino acids.

64.  In the section "Investigating Life: E. T. and the Origin of Life," which of the following conclusions can be made from the data table?  
    
A.  Glycine is a less abundant amino acid in the meteorite than in terrestrial samples.   
**B.**  15N is more abundant in amino acids from the meteorite than from terrestrial samples.   
C.  Amino acids in the meteorite contain more carbon than amino acids from terrestrial samples.   
D.  13C is more abundant in amino acids from terrestrial samples than from the meteorite.   
E.  Uracil is a more abundant amino acid in the meteorite than in terrestrial samples.

65.  In the section "Investigating Life: E. T. and the Origin of Life," what is significant about detecting high levels of amino acids, uracil, and xanthine in the meteorite?    
A.  The meteorite originated from Earth.   
B.  The biological molecules contaminated the meteorite when it hit Earth.   
C.  Life exists somewhere else in our universe besides Earth.   
**D.**  Biological molecules are formed outside of Earth.   
E.  The meteorite was once living material.

66.  What essential function did lipids play in the origin of life?    
**A.**  the formation of biological membranes   
B.  storage of information   
C.  catalysis of reactions   
D.  formation of a cytoskeleton   
E.  anaerobic fermentation

**True / False Questions**

67.  A peptide bond is a covalent bond formed between amino acids.    
**TRUE**

68.  Cohesion is a property of water in which water molecules tend to stick together.    
**TRUE**

69.  A substance in which other substances dissolve is called a solute.    
**FALSE**

70.  Ice is less dense than liquid water, allowing organisms in ponds to live underneath the ice at the surface of the water, instead of trapped in the ice at the bottom of the pond.    
**TRUE**

71.  A fatty acid is unsaturated if there is at least one double bond between the carbon atoms in the hydrocarbon chains.    
**TRUE**

72.  The primary function of hemoglobin is to regulate the level of sugar in the blood.    
**FALSE**

73.  If a protein is denatured, its structure has changed enough to make the protein nonfunctional.    
**TRUE**

74.  Proteins store the genetic information of the cell and transmit it to the next generation.    
**FALSE**

**Multiple Choice Questions**

75.  Two hydrogen atoms bonded together form    
**A.**  a molecule, but not a compound.   
B.  a compound, but not a molecule.   
C.  a molecule and a compound.   
D.  an atom and a molecule.   
E.  an atom, but not a molecule or compound.

76.  Two hydrogen atoms and an oxygen atom bonded together form    
A.  a molecule, but not a compound.   
B.  a compound, but not a molecule.   
**C.**  a molecule and a compound.   
D.  an atom and a molecule.   
E.  an atom, but not a molecule or compound.

77.  Which of the following is an example of a polar covalent bond?    
A.  H2   
**B.**  H2O   
C.  O2   
D.  the bond between separate water molecules   
E.  H2 and H2O

**True / False Questions**

78.  It is biologically important that pure water has a neutral pH, so that it does not alter the internal pH of organisms or pH of ecosystems.    
**TRUE**

**Multiple Choice Questions**

79.  Human blood, saliva, tears, bile, and urine are close to neutral. Why is human stomach acid very acidic?    
**A.**  It must break down eaten polymers into monomers.   
B.  It is not acidic in the stomach, but rather strongly basic.   
C.  To stomach acid will absorb excess H+ in the stomach.   
D.  The stomach acids will add OH- to help digest food.   
E.  The stomach acid neutralizes H+ and OH- from the consumed foods.

**True / False Questions**

80.  Nucleic acids are to nucleotides like amino acids are to proteins and monosaccharides are to carbohydrates.    
**FALSE**