**Basic Chemistry and Cells**

**Multiple Choice Questions**

1. Which of the following elements is not predominately found in living organisms?   
A. Hydrogen  
B. Oxygen  
**C.** Iron  
D. Nitrogen  
E. Carbon

Only six types of atoms—carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur— make up about 95% of the body weight of organisms.

2. Which six elements are the main components in living organisms?   
A. aluminum, magnesium, nitrogen, silicon, sodium, sulfur  
B. calcium, hydrogen, iron, potassium, sulfur, water  
**C.** carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur  
D. carbon dioxide, hydrogen, nitrogen, oxygen, phosphate, sulfate  
E. copper, iron, magnesium, sodium, water, zinc

Only six types of atoms—carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur— make up about 95% of the body weight of organisms.

 3. Which of the following is positively charged?   
A. Atomic mass  
B. Isotope  
**C.** Proton  
D. Neutron  
E. Electron

A proton is a subatomic particle with positive charge, located within the nucleus of an atom and has one atomic mass unit

4. Which of the following changes would cause an atom to become a different element?   
A. Increase the number of neutrons  
B. Increase the number of electrons  
**C.** Increase the number of protons  
D. Decrease the number of neutrons  
E. Decrease the number of electrons

All atoms of an element have the same number of protons.

5. A neutral atom of phosphorus was found to have an atomic number of 15 and a mass number of 31. What is the total number of electrons in this atom?   
A. 8  
**B.** 15  
C. 16  
D. 46  
E. 31

The atomic number not only tells you the number of protons, but it also tells you the number of electrons when the atom is electrically neutral.

6. A chemist found one atom with 9 protons, 8 neutrons and 7 electrons. Another atom has 8 protons, 9 neutrons and 10 electrons. Which of the following statements is correct?   
A. Both atoms are isotopes of the same element.  
B. Both atoms are chemically non-reactive and would not interact with other atoms.  
C. Both atoms have -2 electrical charge.  
D. Both atoms have fulfilled the octet rule.  
**E.** Both atoms have the same mass number.

All atoms of an element have the same number of protons. The mass number is the sum of the number of protons and the number of neutrons. The charge atom is determined by the number of electrons and protons. Atoms with 8 electrons filling the outer shell are following the octet rule.

7. The number of protons found in an atom is also known as:   
**A.** The atomic number  
B. The electron number  
C. The neutron number  
D. The atomic mass  
E. The isotope number

The atomic number is the number of protons in the nucleus of an atom

8. The identity of any atom can be determined by the   
A. number of neutrons  
B. atomic charge  
C. atomic mass  
**D.** number of protons  
E. number of electrons

The atomic number is the number of protons in the nucleus of an atom, which determines the identity of the atom.

9. Which of these describes the structure of an atom?   
A. Neutral protons and negative neutrons in the nucleus are surrounded by positive electrons.  
B. Negative protons and positive neutrons in the nucleus are surrounded by neutral electrons.  
C. Positive protons and negative electrons in the nucleus are surrounded by neutral neutrons.  
**D.** Positive protons and neutral neutrons in the nucleus are surrounded by negative electrons.  
E. Positive protons and negative neutrons in the nucleus are surrounded by neutral electrons.

Positively charged protons and uncharged neutrons are located within the nucleus of an atom. Negatively charged electrons move about the nucleus.

10. How is the mass number of an element determined?   
A. the number of neutrons plus the number of electrons  
B. the number of protons only  
C. the number of electrons only  
D. the number of protons plus the number of electrons  
**E.** the number of protons plus the number of neutrons

The mass number is the number of protons plus the number of neutrons in the nucleus.

11. Which of the following would be the biggest number of an atom?   
A. Electron number  
B. Neutron number  
**C.** Mass number  
D. Atomic number  
E. Proton number

The mass number of an atom depends on the number of protons and neutrons

12. When an element becomes a different isotope, what feature changes?   
A. valance number  
B. atomic charge  
C. atomic number  
D. proton number  
**E.** mass number

The isotopes of an element have the same number of protons, but they differ in atomic mass due to different numbers of neutrons.

13. How does two isotopes of the same element differ from each other?   
A. atomic number  
B. atomic charge  
C. number of protons  
D. number of electrons  
**E.** number of neutrons

The isotopes of an element have the same number of protons, but they differ in atomic mass due to different numbers of neutrons.

14. In order to determine if a patient has a tumor of the thyroid gland, which diagnostic procedure could be performed?   
A. patient drinks low levels of radioactive Iodine-131, then X-ray  
B. patient drinks high levels of radioactive Iodine-131, then PET scan  
C. inject low levels of radioactive glucose, then PET scan  
**D.** inject low levels of radioactive Thallium-201, then PET scan  
E. inject high levels of radioactive glucose, then Xray

A patient drinks low levels of radioactive Iodine-131, which concentrates in the thyroid gland. Then a X-ray of the thyroid glad can indicates the presence or absence of a tumor.

15. Although high doses of radiation are harmful to body cells, how can low levels of radioactive isotopes be used for medical benefit?   
A. to prevent ultraviolet damage from the sun  
B. to create enzyme drugs that work faster and better than normal  
C. to destroy aging and unwanted cells  
**D.** as tracers in imaging organs with Xrays and PET Scans  
E. to reduce obesity and diabetes in teenagers

A radioactive isotope can act as a tracer to detect molecular changes. Specific tracers can also be used in imaging the body's organs and tissues.

16.   This diagram shows that two oxygen atoms interact:   
A. to form one covalent bond.  
**B.** to form two covalent bonds.  
C. to form four covalent bonds.  
D. to form an ionic bond.  
E. to form hydrogen bonds.

A double covalent bond occurs when two atoms share two pairs of electrons.

17.   This diagram shows an atom of phosphorus. How many electrons are in the valence shell?   
A. 2  
B. 4  
**C.** 5  
D. 6  
E. 8

The number of electrons in an atom's outer shell, called the valence shell, determines its chemical reactivity.

18. Which factor determines whether an atom will be chemically reactive?   
A. the number of electrons in the inner shell  
**B.** the number of electrons in the outer shell  
C. the number of electron shells an atom has  
D. the ratio of protons to electrons  
E. the ratio of protons to neutrons

The number of electrons in an atom's outer shell, called the valence shell, determines its chemical reactivity.

19. A sulfur atom has 6 electrons in the outer electron shell. What will it most likely do?   
A. stay as a single atom in nature  
B. lose two electrons to another atom  
C. lose 6 neutrons to another atom  
D. nothing, as this is a very stable atom  
**E.** gain two electrons from another atom

Most atoms obey the octet rule: They will give up, accept, or share electrons in order to have eight electrons in the outer shell.

20. When the number of protons does not equal the number of electrons, the atom is called   
A. an isotope  
B. an octet  
**C.** an ion  
D. a compound  
E. a valance

An ion is an atom with a net charge, due to loss or gain of electron(s).

21. If a neutral oxygen atom gains two electrons from another atom, then the overall charge of this oxygen atom will become   
A. unknownm, as you need to know how many protons are present  
**B.** -2  
C. +2  
D. 2 more than its original mass number  
E. 0

The oxygen atom now has two more electrons than it has protons, therefore, it has a net charge of -2.

22. Which ions found specifically in bones and teeth are important in muscle contractions and nerve conduction?   
A. Potassium  
B. Bicarbonate  
**C.** Calcium  
D. Chloride  
E. Sodium

Calcium is found in bones and teeth, important in muscle contraction and nerve conduction

23. Which bond results from the sharing of electrons?   
A. An octet bond  
**B.** A covalent bond  
C. A valance bond  
D. An ionic bond  
E. An isotope bond

A covalent bond occurs when two atoms share electrons.

24. Which bond occurs between a positive-charged atom and a negative-charged atom?   
A. adhesive interaction  
B. hydrophobic interaction  
C. hydrogen bond  
D. covalent bond  
**E.** ionic bond

Ionic compounds are held together by an ionic bond, which is an attraction between negatively and positively charged ions.

25. This diagram shows the interaction of a sodium ion and a chlorine ion. What is this interaction?   
A. The sodium atom gives up one proton.  
B. The chlorine atom gives up one neutron.  
C. The sodium atom gives up one neutron.  
D. The chlorine atom gives up one electron.  
**E.** The sodium atom gives up one electron.

After the sodium atom donates one electron to the chlorine atom, each atom would have eight electrons in the outer shell. The sodium atom would then have a net charge of +1 and the chlorine atom has a net charge of -1.  


26. This diagram shows the interaction of a sodium ion and a chlorine ion. After this interaction, what is the result?   
A. The sodium atom will have a negative charge and the chlorine atom will have a positive charge.  
**B.** Both atoms will be stable with 8 electrons in their outermost electron shells.  
C. The sodium atom will have a total of 11 electrons and the chlorine atom will have 17 electrons.  
D. The sodium atom will have a total of 12 electrons and the chlorine atom will have 18 electrons.  
E. A polar covalent bond will be formed.

After the sodium atom donates one electron to the chlorine atom, each atom would have eight electrons in the outer shell. The sodium atom would then have a net charge of +1 and the chlorine atom has a net charge of -1.  


27. Which chemical bond results from the equal sharing of electrons between two atoms?   
A. Polar  
B. Ionic  
C. Hydrogen  
D. Adhesive  
**E.** Nonpolar

A nonpolar covalent bond occurs when the sharing of electrons between atoms is fairly equal

28. When there in an unequal sharing of electrons between two atoms, what will be the result?   
A. an electronegative molecule, such as calcium ion.  
B. an ionic compound, such as salt.  
C. a hydrophobic molecule, such as fat.  
D. a nonpolar molecule, such as methane.  
**E.** a polar molecule, such as water.

A polar covalent bond occurs when the sharing of electrons between atoms is unequal, and results in a polar molecule.

29.      
What type of chemical bond occurs specifically between one hydrogen atom and one oxygen atom in a water molecule?   
**A.** a hydrogen bond  
B. an ionic bond  
C. a polar covalent bond  
D. a nonpolar covalent bond

In a water molecule, the sharing of electrons between oxygen and each hydrogen is not completely equal. The unequal sharing of electrons in a covalent bond creates a polar covalent bond.

30. Which interaction causes water molecules to attract other water molecules?   
A. ionic bond  
**B.** hydrogen bond  
C. adhesive interaction  
D. covalent bond  
E. hydrophobic interaction

The polarity of water molecules causes the hydrogen atoms in one molecule to be attracted to the oxygen atoms in other water molecules.

31.   In a DNA molecule, the polar "G" nucleotide on one strand always bonds with the polar "C" nucleotide on the other strand. Due to the thousands of \_\_\_\_\_ that hold the two strands together, DNA molecules are stable for thousands of years.   
A. ionic bonds  
B. hydrophobic interactions  
C. covalent bonds  
**D.** hydrogen bonds  
E. adhesive interactions

Hydrogen bonds hold the two strands of DNA together. When DNA makes a copy of itself, each hydrogen bond breaks easily, allowing the DNA to unzip. On the other hand, the hydrogen bonds, acting together, add stability to the DNA molecule. Figure 10.2

32. Which term describes the tendency of water molecules to cling to other water molecules?   
A. Adhesion  
B. Nonpolar  
C. Electronegativity  
**D.** Cohesion  
E. Polar

Water molecules exhibit cohesion when they stick together.

33. When bath salt crystals dissolve in water, which chemical interactions in the salt crystals are being dissociated by the water molecules?   
A. polar covalent bonds  
B. nonpolar covalent bonds  
C. hydrophobic interactions  
**D.** ionic bonds  
E. hydrogen bonds

When ionic salts are put into water, the negative ends of the water molecules are attracted to the sodium ions, and the positive ends of the water molecules are attracted to the chloride ions. This causes the sodium ions and the chloride ions to dissociate (separate) as it dissolves in water.

34.   In this diagram of a blood vessel, the interaction marked "A" is between a water molecule and the wall of the blood vessel. Which term describes the tendency of water molecules to cling to the blood vessel and prevents the liquid from flowing backward?   
**A.** Adhesion  
B. Electronegativity  
C. Buffering  
D. Hydrophobicity  
E. Cohesion

Cohesion keeps the water column from breaking apart, and adhesion of water molecules to vessel walls prevents the water column from falling backward.

35.   In this diagram of a blood vessel, the interaction marked **"B"** is between two water molecules in blood. What is this interaction that allows blood to flow in one direction?   
A. Electronegativity  
B. Buffering  
C. Hydrophobicity  
**D.** Cohesion  
E. Adhesion

Cohesion of water molecules permit blood to flow, and adhesion of water molecules to vessel walls prevents the water column from falling backward.

36. Certain insects, such as a water strider, can walk across the surface of a pond. Which property of water allows this?   
**A.** Water molecules are able to stick to other water molecules.  
B. Frozen water is less dense than liquid water.  
C. Water can dissolve polar and ionic compounds.  
D. Water molecules are able to stick to other non-water molecules.  
E. Water repels hydrophobic materials.

Hydrogen bonding is responsible for cohesion of water molecules, and causes water to have a high surface tension.

37. Which of the following statements does not apply to the properties of water?   
**A.** High bond strength  
B. High heat of vaporization  
C. High adhesion  
D. High cohesion  
E. High surface tension

Due to hydrogen bonding between water molecules, water (1) is cohesive and adhesive, (2) changes temperature slowly, (3) dissolves other polar substances, and (4) expands as it freezes.

38. Which of the following is not a use of water by living organisms?   
A. External transportation for chemicals  
B. Help exchange heat  
C. Adds in homeostasis  
**D.** Provides nutrients for metabolism  
E. Provides a medium for movement

A watery environment supports and protects cells while providing an external transport system for chemicals. Homeostasis is also assisted by the ability of water to absorb and give off heat in a way that prevents rapid temperature changes.

39. An unknown solution is poured into a beaker containing water and is stirred vigorously. After a few minutes, the scientist observes that the two liquids are not mixing. Based on this observation, what conclusion can the scientist make?   
A. The unknown solution is covalent.  
B. The unknown solution is hydrophilic.  
C. The unknown solution is adhesive.  
D. The unknown solution is ionic.  
**E.** The unknown solution is hydrophobic.

Hydrophilic molecules (ionized and/or polar, such as salts) attract water. Hydrophobic molecules (nonionized and nonpolar, such as gasoline) do not attract water.

40. When you mix sugar into your coffee, the sugar dissolves in the liquid. This shows that sugar molecules are   
**A.** hydrophilic.  
B. cohesive.  
C. hydrophobic.  
D. covalent.  
E. neither hydrophobic nor hydrophilic.

Hydrophilic molecules (ionized salts or polar sugars) attract water molecules, can be dissolved in water and carried through organisms in blood vessels/plant tubes.

41. A chemist mixes a substance into a beaker of water. The substance does not dissolve in the water. Most likely, the substance is   
**A.** hydrophobic.  
B. hydrogen-bonded to water.  
C. covalent.  
D. ionic.  
E. hydrophilic.

Nonionized and nonpolar molecules that cannot attract water are said to be hydrophobic. Gasoline contains nonpolar molecules, and therefore it does not mix with water and is hydrophobic.

42. When water is mixed with a salt in a beaker, the salt would be considered:   
A. the solvent  
**B.** the solute  
C. the solution  
D. the buffer  
E. the ion

A solution contains both a solute, usually a solid, and a solvent, usually a liquid.

43. When you add sugar to your coffee, the sugar is the \_\_\_ and the coffee is the \_\_.   
A. buffer, solvent  
B. solute, buffer  
**C.** solute, solvent  
D. solvent, solute  
E. solvent, solution

A solution contains both a solute, usually a solid, and a solvent, usually a liquid.

44. What type of molecules can attach to water molecules?   
A. Ionic  
B. Adhesive  
C. Covalent  
D. Hydrophobic  
**E.** Hydrophilic

Molecules that can attract water are hydrophilic.

45. Which of the following statements is not true about ice?   
A. It freezes from top to bottom  
B. It is less dense than liquid water  
C. It floats in water  
**D.** It is denser than liquid water  
E. It insulates and slows down the freezing of water below

Water is more dense at 4°C than it is at 0°C. Water expands when it freezes.

46. In a solution, if the hydroxide ion concentration exceeds the hydrogen ion concentration the solution is considered to be:   
A. A solute  
**B.** A base  
C. An acid  
D. Neutral  
E. A buffer

A pH above 7 is basic because [OH-], hydroxide concentration, is greater than [H+], the hydrogen concentration.

47. Hydrochloric acid is classified as an acid because   
**A.** it dissociates to release hydrogen ions.  
B. it absorbs excess hydroxide ions from the solution.  
C. it dissociates to release hydroxide ions.  
D. it absorbs excess hydrogen ions from the solution.  
E. it dissociates to release both hydrogen ions and hydroxide ions.

Hydrochloric acid (HCl) is an important inorganic acid that dissociates to release hydrogen ions and chlorine ions.

48. After lye (a strong base) is added to water,   
A. there would be a huge decrease in hydroxide ions in the water.  
B. there would be a huge increase in hydrogen ions in the water.  
**C.** there would be a huge increase in hydroxide ions in the water.  
D. there would be a huge increase in both hydrogen ions and hydroxide ions.  
E. there would be a huge decrease in hydrogen ions in the water.

If sodium hydroxide, also known as lye or caustic soda, is added to a beaker of water, the number of hydroxide ions increases

49. What type of solution has a pH of 8.2?   
A. neutral  
B. ionic  
**C.** base  
D. acid  
E. buffer

A pH below 7 is an acidic solution. A pH above 7 is a basic solution.

50. Limewater with a pH of 12.4 should be classified as a   
**A.** strong base  
B. weak acid  
C. strong acid  
D. buffer  
E. weak base

A pH below 7 is an acidic solution. A pH above 7 is a basic solution.

51. Lemon Juice has a pH of 2.3 and should be classified as a   
A. strong base  
B. buffering solution  
C. weak base  
**D.** strong acid  
E. weak acid

A pH below 7 is an acidic solution. A pH above 7 is a basic solution.

52. A solution which resists pH changes is   
**A.** A buffer  
B. An acid  
C. A base  
D. Hydrophilic  
E. Hydrophobic

A buffer resists changes in pH.

53. Alkalosis, cramping, and irritability can occur when our blood pH rises above 7.45. Acidosis, seizures, coma and death can occur when our blood pH falls below pH 7.35. To prevent these conditions, our blood usually has chemicals which   
A. can produce more water molecules  
B. keep pH at neutral state  
C. can take up excess hydroxide ions  
D. can take up both excess hydrogen ions and excess hydroxide ions  
**E.** can take up excess hydrogen ions

Normally, buffers take up excess hydrogen ions (H+) or hydroxide ions (OH-), thus preventing alkalosis and acidosis.

54. A chemistry student measures the pH of a solution as 7.1. The student adds five milliliters of an acid to the solution and finds that the pH of the solution is still 7.1. What conclusion could be made from these observations?   
A. The original solution was weakly acidic.  
B. The original solution was weakly basic.  
**C.** The original solution was buffered.  
D. The original solution was strongly basic.  
E. The original solution was strongly acidic.

A buffer resists changes in pH. A buffer can take up excess hydrogen ions (H+) or excess hydroxide ions (OH-) in the solution.

**True / False Questions**

55. Neutrons have a negative charge.   
**FALSE**

The subatomic particles are positively charged protons, uncharged neutrons, and negatively charged electrons.

56. In the orbital shells of electrons, the outer shell has a higher energy level than the inner shell and can hold eight electrons.   
**TRUE**

Each electron lower level is filled with electrons before the next higher level contains any electrons. The first shell (closest to the nucleus) can contain two electrons, thereafter, each additional shell can contain eight electrons.

57. Radioactive isotopes can be used as tracers to detect molecular changes.   
**TRUE**

A radioactive isotope can act as a tracer to detect molecular changes.

58. The bond which results from a transfer of electrons from one atom to another is called an ionic bond.   
**TRUE**

An ionic bond occurs when electrons are transferred from one atom to another.

59. When the concentration of hydrogen ions is greater than the concentration of hydroxide ions the solution is considered an acid.   
**TRUE**

Acids have Excess Hydrogen Ions.

60. Out of covalent, ionic, and hydrogen, the hydrogen bond is the strongest.   
**FALSE**

A hydrogen bond is weaker than an ionic or covalent bond.

61. Two or more different elements bonded together is called an isotope.   
**FALSE**

When atoms of two or more elements bond together in fixed proportions, the product is called a compound. A molecule is the smallest part of a compound that still has the properties of that compound.

62. The attraction of an atom for the electrons in a covalent bond is called electronegativity.   
**TRUE**

The ability of an atom to attract electrons in a covalent bond is called its electronegativity.