**Chemistry and Water Study Guide**

**Elements**Although all of the substances in the universe are chemically diverse, they all have one thing in common: They’re all made up of elements. Elements, by definition, are substances that cannot be broken down into simpler substances by chemical means. There are 92 naturally occurring elements found in nature.

**Subatomic particles**

1. If you break down an element into smaller pieces, you’ll eventually come to an **atom.** Define atom:

2. Atoms are the building blocks of the physical world. Within atoms, there are even smaller subatomic particles called **protons, neutrons, and electrons.** In your own words describe the atomic structure of an atom and the interactions of the subatomic particles.

3. Contrast the terms atomic mass and atomic number.

4. Draw and label a diagram of a carbon atom, include the subatomic particles:

**The essential elements of Life**5. There are about 18 elements which are involved in living cells. Identify the following 14, include protons, neutrons, and electrons:

H= O= N= Na= Ca= Cl= Fe= C=

Mg= I= P= S= K= Cu=

6. What are isotopes?

7. What do you call unstable isotopes?

8. Identify are radioisotopes use for?

9. What determines interactions between atoms?

10. What are valence electrons? Why are valence electrons important?

11. How many electrons do stable elements have?

12. Define compound:

13. You’ll sometimes find that a compound has different properties from those of its elements. For instance, hydrogen and oxygen exist in nature as gases. Yet when they combine to make water, they often pass into a liquid state. When hydrogen atoms get together with oxygen atoms to form water, we’ve got a chemical **reaction.** Write out the chemical reaction for the above reaction: **Label the reactants and the products**.

14. The atoms of a compound are held together by **chemical bonds**, which may be ionic bonds, covalent bonds, or hydrogen bonds. Define the following terms and give examples of each:

1. ionic bond
2. covalent bond
3. nonpolar covalent bond
4. polar covalent bond
5. hydrogen bond

15. If there is a covalent bond in which 2 pairs of electrons are EQUALLY shared, that bond is...  
A. Polar single B. Polar double  
C. Non-polar single D. Non-polar double

16. What is a covalent bond in which electrons are equally shared?  
A. Polar B. Non-Polar  
C. Both D. Neither

17. What is a covalent bond in which electrons are unequally shared?  
A. Polar B. Non-Polar  
C. Both D. Neither

What are the van der Waals attraction?

***The Acids and Bases***

18. Water is important because most reactions occur in watery solutions. Reactions are also influenced by whether the solution in which they occur is **acidic, basic, or neutral.** What makes a solution acidic or basic?

19. Describe is the difference between acidity and alkalinity?

20. The acidity and alkalinity of a solution can be measured using a **pH scale.** Draw and label a pH scale ranging from 0 to 14, include what pH’s are considered acids, what pH’s are considered bases, what pH is neutral, and where the following would fall on the pH scale: concentrated nitric acid, stomach acid, lemon juice, cola drinks, vinegar, black coffee, distilled water, blood, seawater, laundry bleach, ammonia, oven cleaner, and drain cleaner***.***

21. How does a buffer work? Propose where would a buffer be needed?

**WATER: THE VERSATILE MOLECULE**

22. Define the following words

Hydrogen bond

Hydrophilic

Hydrophobic

23. How much of your body weight consists of water? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

24. Draw and label a diagram of water:

25. Explain why water is a polar molecule, include partial charges both negative and positive.

26. Define hydrogen bond and is it a strong or weak bond?

27. Draw and label a diagram of six water molecules engaging in hydrogen bonds. Hint: start with a central water molecule and work outward.

28. Determine why it is important that ice floats?

29. When is water the densest? What events can this lead to?

30. Label the following as hydrophilic or hydrophobic

a. paper

b. wax

c. table salt

d. sugar

31. If heat is added to the hydrogen bonds, predict what would happen to the bonds and the water molecules. Explain why would that happen?

32. Hydrogen bonds are not actually bonds, but strong intermolecular forces that act in a bond-like way. It’s this property that makes water a great solvent- it can dissolve many kinds of substances. The hydrogen bonds that hold water molecules contribute to a number of special properties. Describe and explain the significance to life, the following properties that water has to do hydrogen bonding:

1. cohesive forces
2. cohesion
3. adhesion
4. capillary action
5. heat capacity
6. ice density
7. universal solvent

33. Many mammals control their body temperature by sweating. Which property of water is most directly responsible for the ability of sweat to lower body temperature? Describe how this process occurs.

34. Explain each of the following in terms of the properties of water. You are not limited to the three properties discussed in the previous question (32).

1. the role of water as a medium for the metabolic processes of cells
2. the ability of water to moderate temperature within living organisms and in organisms’ environments
3. the movement of water from the roots to the leaves of plants

35. In agricultural areas, farmers pay close attention to the weather forecast. Right before a predicted overnight freeze, farmers spray water on crops to protect the plants. Use the properties of water to explain how this method works. Be sure to mention why hydrogen bonds are responsible for this phenomenon.