

1. The atomic number of an element refers to the number of _____ in an atom.
 - A) protons and neutrons
 - B) protons
 - C) electrons
 - D) neutrons
 - E) atomictrons

2. Which of the following statements concerning electrons is *false*?
 - A) Electrons orbit the nucleus of an atom in defined orbitals.
 - B) The outer shell of all atoms must contain eight electrons.
 - C) An atom may have more than one valence shell.
 - D) Electrons are negatively charged particles.
 - E) All of the above are true.

3. The element with which of the following atomic numbers would be most stable?
 - A) 1
 - B) 3
 - C) 12
 - D) 15
 - E) 18

4. What is the difference between an element and a molecule?
 - A) Molecules may be composed of different types of atoms, whereas elements are always composed of only one type of atom.
 - B) Molecules are composed of only one type of atom, whereas elements are composed of different types of atoms.
 - C) Molecules are elements.
 - D) Molecules always have larger atomic weights than elements.
 - E) Molecules do not have electrons, whereas elements do.

5. The strongest chemical bonds occur when
 - A) two atoms share electrons in a covalent bond.
 - B) two atoms share electrons in an ionic bond.
 - C) hydrogen bonds are formed.
 - D) van der Waals forces are in effect.
 - E) there are hydrophobic interactions.

6. You have discovered that a molecule is hydrophilic. What else do you know about this molecule?
- A) It cannot form hydrogen bonds.
 - B) It is a polar molecule.
 - C) It is a nonpolar molecule.
 - D) It has a partial positive region and a partial negative region.
 - E) Both b and d
7. The stability of the three-dimensional shape of many large molecules is dependent on
- A) covalent bonds.
 - B) ionic bonds.
 - C) hydrogen bonds.
 - D) van der Waals attractions.
 - E) hydrophobic interactions.
8. The molecular weight of glucose is 180. If you added 180 grams of glucose to a 0.5 liter of water, what would be the molarity of the resulting solution? (See Figure 2.2 for the periodic table.)
- A) 18
 - B) 1
 - C) 9
 - D) 2
 - E) 0.5
9. Why does ice float in water?
- A) Ice is less dense than water.
 - B) There are no hydrogen bonds in ice.
 - C) Ice is denser than water.
 - D) Water has a higher heat capacity than ice.
 - E) Ice has more covalent bonds than water.
10. Cola has a pH of 3; blood plasma has a pH of 7. The hydrogen ion concentration of cola is _____ than the hydrogen ion concentration of blood plasma.
- A) 4 times greater
 - B) 4 times smaller
 - C) 400 times greater
 - D) 10,000 times greater
 - E) 30,000 times greater

11. If solution A has a pH of 2 and solution B has a pH of 8, which of the following statements is true?
- A) A is basic and B is acidic.
 - B) A is acidic and B is basic.
 - C) A is a base and B is an acid.
 - D) A has a greater $[\text{OH}^-]$ than B.
 - E) None of the above
12. One mole of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) weighs
- A) 180 grams.
 - B) 42 atomic mass units.
 - C) 96 grams.
 - D) 342 grams.
 - E) 6.02 grams.
13. The role of a buffer is to
- A) allow the pH of a solution to vary widely.
 - B) make a solution basic.
 - C) maintain pH homeostasis.
 - D) disrupt pH homeostasis.
 - E) make a solution more acidic.
14. Which of the following statements about water is true?
- A) Water has a low heat of vaporization.
 - B) Water has a high specific heat.
 - C) When water freezes, it gains energy from the environment.
 - D) All of the above
 - E) None of the above
15. Which of the following statements about chemical reactions is true?
- A) The bonding partners of atoms remain constant.
 - B) All reactions release energy as they proceed.
 - C) The bonding partners of atoms change.
 - D) All reactions consume energy as they proceed.
 - E) None of the above
16. Calcium has an atomic number of 20. Draw structures for Ca and Ca^{2+} . What is the difference between these structures? Why is the most common ion of lithium Li^+ ?

17. Nitrogen atoms can form triple bonds with each other. What is a triple bond? How many electrons are shared between two N atoms?

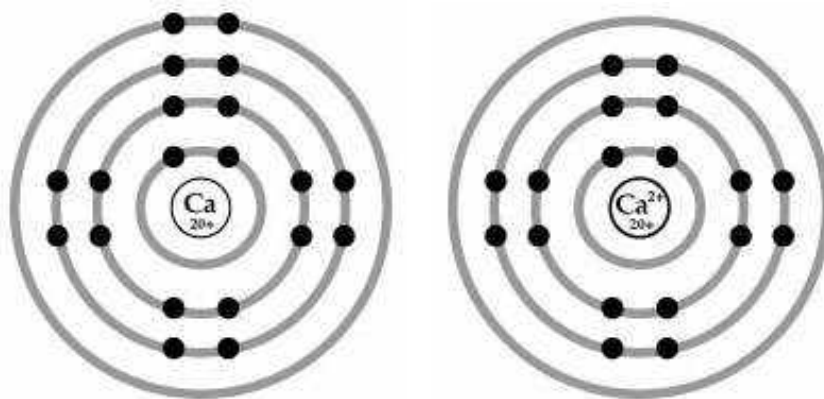
18. Water is a polar molecule. This property contributes to cohesion and surface tension. Draw six water molecules. In your drawing, indicate how hydrogen bonding between molecules contributes to cohesion and surface tension. (Be sure to include appropriate covalent bonds in each molecule.)

19. Rank the following solutions in order from the most acidic to the most basic: lemon juice, pH = 2; Mylanta, pH = 10; Sprite, pH = 3; drain cleaner, pH = 15; seawater, pH = 8. Of the preceding, which has the highest concentration of H^+ ions? Which has the lowest concentration of H^+ ions?

20. If you have 12 moles of a substance, how many molecules do you have of that substance? Suppose the substance has a molecular weight of 342. How many grams of that substance would you have to dissolve in a liter of water to make a 12 *M* solution?

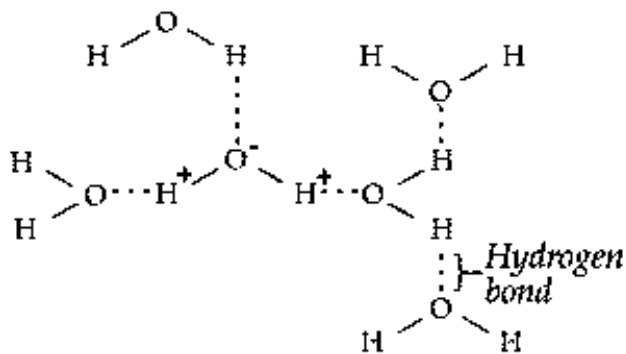
Answer Key

1. B
2. B
3. E
4. A
5. A
6. E
7. C
8. D
9. A
10. D
11. B
12. A
13. C
14. B
15. C
- 16.



The difference between these structures is that calcium (Ca) has two electrons in its outer shell. Calcium ion (Ca²⁺) has lost its two outer electrons and therefore has a positive charge of 2 because it has two more protons than electrons. Lithium has only one electron in its outer shell; when that electron is lost, the ion gains a positive charge of only 1.

17. Three pairs of electrons are shared between two N atoms in a triple bond.
- 18.



The partially positive hydrogens of one water molecule are attracted to the partially negative oxygens of another molecule of water. This attraction tends to cause water molecules to “stick” together, creating surface tension.

19. Lemon juice, pH = 2 (highest concentration of H⁺ ions); Sprite, pH = 3; seawater, pH = 8; Mylanta, pH = 10; drain cleaner, pH = 15 (lowest concentration of H⁺ ions).
20. You would multiply Avogadro's number (6.02×10^{23}) times 12 to determine the number of molecules. This gives you 7.224×10^{24} molecules of this substance. A 12 M solution would be made by multiplying the formula weight of the molecule times 12 and adding that many grams of the substance to one liter of water. The formula weight of this molecule is 342, so you would need 4104 g.