

***Biology: A Guide to the Natural World, 5e (Krogh)***

**Chapter 2 Fundamental Building Blocks: Chemistry, Water, and pH**

1) A measure of the quantity of matter in an object is known as:

- A) atoms.
- B) density.
- C) mass.
- D) energy.

Answer: C

Topic: Section 2.1

Skill: Knowledge/Comprehension

2) All the mass of an atom is considered to be in the:

- A) protons only.
- B) protons and neutrons.
- C) electrons only.
- D) protons, neutrons, and electrons.

Answer: B

Topic: Section 2.1

Skill: Knowledge/Comprehension

3) If a neutral atom has an atomic number of 10, then we know that it has:

- A) 10 neutrons.
- B) 10 protons.
- C) 10 electrons.
- D) 10 protons and 10 electrons.
- E) 10 protons, 10 electrons, and 10 neutrons.

Answer: D

Topic: Section 2.1

Skill: Application/Analysis

4) An atom whose atomic number is 10 has how many electrons in its outermost energy level?

- A) eight
- B) ten
- C) two
- D) three
- E) five

Answer: A

Topic: Section 2.1

Skill: Application/Analysis

5) Isotopes are atoms of the same element that differ in their:

- A) number of electrons.
- B) number of neutrons.
- C) number of protons.
- D) ionic charge.

Answer: B

Topic: Section 2.1

Skill: Knowledge/Comprehension

6) All the atoms of the same element will have the same:

- A) number of protons.
- B) number of neutrons.
- C) number of protons and neutrons.
- D) mass.

Answer: A

Topic: Section 2.1

Skill: Application/Analysis

7) From its atomic number of 10, you can predict that a neon atom:

- A) is not chemically reactive.
- B) has an unfilled outer shell.
- C) has 10 neutrons.
- D) can easily gain or lose electrons.

Answer: A

Topic: Section 2.1

Skill: Application/Analysis

8) Which of the following are found in the nucleus of an atom?

- A) protons
- B) neutrons
- C) electrons
- D) protons and neutrons
- E) protons, neutrons, and electrons

Answer: D

Topic: Section 2.1

Skill: Knowledge/Comprehension

9) An element with 22 protons, 22 neutrons, and 22 electrons would have an atomic number of:

- A) 44.
- B) 22.
- C) 66.
- D) 11.

Answer: B

Topic: Section 2.1

Skill: Application/Analysis

10) Chlorine has an atomic number of 17, and argon has an atomic number of 18. From this information alone, you can predict that:

- A) argon has more neutrons than chlorine.
- B) argon is more chemically reactive than chlorine.
- C) argon will more readily ionize than chlorine.
- D) chlorine is more chemically reactive than argon.
- E) chlorine has more neutrons than argon.

Answer: D

Topic: Section 2.1

Skill: Application/Analysis

11) What is it about carbon-12, carbon-13, and carbon-14 that makes them all carbon?

- A) They all have the number of protons plus neutrons that is characteristic of carbon.
- B) They all have the number of protons that is characteristic of carbon.
- C) They all have the number of neutrons that is characteristic of carbon.
- D) They all are radioactive.
- E) They all are elements.

Answer: B

Topic: Section 2.1

Skill: Application/Analysis

12) You have a substance and begin a set of experiments in which you break it down into other substances through chemical reactions. After a few successive reactions, you discover a set of products that can't be broken down further, no matter what type of chemical reaction you attempt. These substances are:

- A) protons.
- B) elements.
- C) neutrons.
- D) electrons.
- E) isotopes.

Answer: B

Topic: Section 2.1

Skill: Knowledge/Comprehension

13) Atoms with eight electrons in their outer shells tend to:

- A) form covalent bonds.
- B) form ionic bonds.
- C) be chemically reactive.
- D) be stable and unreactive.

Answer: D

Topic: Section 2.1

Skill: Knowledge/Comprehension

14) Which of the following results from the making of a bond?

- A) Atoms become more reactive.
- B) Molecules are broken down.
- C) Electrons are destroyed.
- D) Atoms become more stable.

Answer: D

Topic: Section 2.2

Skill: Knowledge/Comprehension

15) For an atom to be considered an ion:

- A) protons can outnumber neutrons.
- B) protons can outnumber electrons.
- C) neutrons can outnumber protons.
- D) protons equal electrons.

Answer: B

Topic: Section 2.2

Skill: Knowledge/Comprehension

16) As the difference in the electronegativity between atoms forming a chemical bond increases, the:

- A) less polar the molecule.
- B) more polar the molecule.
- C) more stable the molecule.
- D) more symmetrical the molecule.

Answer: B

Topic: Section 2.2

Skill: Application/Analysis

17) A polar covalent bond results when:

- A) two atoms share electrons equally.
- B) two atoms of the same element are sharing electrons.
- C) one of the atoms sharing electrons is more electronegative than the other atom.
- D) two atoms sharing electrons are equally electronegative.

Answer: D

Topic: Section 2.2

Skill: Knowledge/Comprehension

18) An atom will react with other atoms only until:

- A) it has completely filled its outermost energy level.
- B) it has less stability.
- C) all of its inner orbitals have been filled.
- D) it forms four covalent bonds

Answer: A

Topic: Section 2.2

Skill: Knowledge/Comprehension

19) The naturally occurring helium atom is chemically inert because:

- A) its outermost shell is filled with electrons.
- B) its nucleus is filled with two neutrons.
- C) it has the most protons that it could ever carry.
- D) it has all of the shared electrons it could ever have.

Answer: A

Topic: Section 2.2

Skill: Knowledge/Comprehension

20) Nonpolar molecules develop when:

- A) shared electrons are not shared equally.
- B) both atoms have similar electronegativity.
- C) one atom is much more electronegative than the other.
- D) electrons are completely transferred from one atom to another.

Answer: B

Topic: Section 2.2

Skill: Knowledge/Comprehension

21) The number of atoms coming out of a chemical reaction must equal the number of atoms going into a chemical reaction. This follows the principle of:

- A) the law of conservation of energy.
- B) chemical bonding.
- C) atomic theory.
- D) the law of conservation of mass.

Answer: D

Topic: Section 2.2

Skill: Application/Analysis

22) Which of the following is true of chemical bonds?

- A) Atoms can achieve a higher energy state and less stability by forming bonds.
- B) Electrons are always shared.
- C) Electrons can be shared or completely transferred.
- D) Chemical bonds cannot occur between two identical atoms.

Answer: C

Topic: Section 2.2

Skill: Knowledge/Comprehension

23) Atoms form bonds to:

- A) fill their outer shells with neutrons.
- B) obtain an equal number of protons and electrons.
- C) fill their outer shells with electrons.
- D) fill their outer shells with protons.
- E) obtain an equal number of protons and neutrons.

Answer: C

Topic: Section 2.2

Skill: Knowledge/Comprehension

24) Two hydrogen atoms (atomic number 1) form a covalent bond. Which of the following is true?

- A) Both hydrogen atoms now have two electrons in their outer shell.
- B) Both hydrogen atoms now have two protons in their outer shell.
- C) One hydrogen atom now has zero protons in its outer shell, and the other has two.
- D) One hydrogen atom now has zero electrons in its outer shell, and the other has two.
- E) Each hydrogen atom still has one electron in its outer shell.

Answer: A

Topic: Section 2.2

Skill: Application/Analysis

25) Oxygen has six electrons in its second outer shell, and hydrogen has one. With how many hydrogen atoms will oxygen form covalent bonds?

- A) eight
- B) one
- C) two
- D) six
- E) three

Answer: C

Topic: Section 2.2

Skill: Application/Analysis

26) Which of the following would form the fewest covalent bonds?

- A) neon (eight electrons in the second shell)
- B) carbon (four electrons in the second shell)
- C) hydrogen (one electron in the first shell)
- D) oxygen (six electrons in the second shell)

Answer: A

Topic: Section 2.2

Skill: Application/Analysis

- 27) Water is a polar molecule because:
- A) oxygen is more electronegative than hydrogen.
  - B) hydrogen has more neutrons than oxygen.
  - C) oxygen has more electrons than hydrogen.
  - D) oxygen has more neutrons than hydrogen.
  - E) hydrogen is more electronegative than oxygen.

Answer: A

Topic: Section 2.2

Skill: Application/Analysis

- 28) What is the difference between an ionic and covalent bond?
- A) In an ionic bond, one atom accepts electrons from the other; in a covalent bond, a pair of atoms share electrons.
  - B) In an ionic bond, one atom has more electronegativity than the other; in a covalent bond, the atoms have the same electronegativity.
  - C) Ionic bonding involves the inner electron shells; covalent bonding involves the valence electron shell.
  - D) Ionic bonds form between atoms of different elements; covalent bonds form between atoms of the same element.

Answer: A

Topic: Section 2.3

Skill: Knowledge/Comprehension

- 29) The ionic bond of sodium chloride is formed as a result of:
- A) sodium and chlorine sharing electrons.
  - B) both sodium and chlorine losing electrons.
  - C) sodium gaining an electron from chlorine.
  - D) sodium giving up an electron to chlorine.
  - E) sodium giving up a proton to chlorine.

Answer: D

Topic: Section 2.3

Skill: Application/Analysis

- 30) Potassium has one electron in its fourth shell, and chlorine has seven electrons in its third shell. Which of the following is most likely to be true?
- A) Chlorine will give an electron to potassium to form an ionic bond.
  - B) Potassium will give an electron to chlorine to form an ionic bond.
  - C) The two atoms will share the electron unequally in a polar covalent bond.
  - D) The two atoms will share an electron equally in a nonpolar covalent bond.

Answer: B

Topic: Section 2.3

Skill: Application/Analysis

31) An atom becomes an ion when:

- A) it gains or loses neutrons.
- B) it forms a covalent bond.
- C) it gains or loses electrons.
- D) hydrogen ions are shared.
- E) it gains or loses protons.

Answer: C

Topic: Section 2.3

Skill: Knowledge/Comprehension

32) Sodium chloride (NaCl) crystals (table salt) form as a result of:

- A) covalent bonding.
- B) hydrogen bonding.
- C) being chemically stable.
- D) the attraction of oppositely charged particles for each other.

Answer: D

Topic: Section 2.3

Skill: Knowledge/Comprehension

33) Hydrogen bonds are very important in the functional shape of:

- A) proteins.
- B) sugars.
- C) fats.
- D) nucleic acids.
- E) proteins and nucleic acids.

Answer: E

Topic: Section 2.4

Skill: Knowledge/Comprehension

34) In a bottle of water, hydrogen bonding occurs between the hydrogen of one atom and a/an:

- A) hydrogen atom in the same molecule.
- B) oxygen atom in a different molecule.
- C) oxygen atom in the same water molecule.
- D) hydrogen atom in a different molecule.

Answer: B

Topic: Section 2.4

Skill: Knowledge/Comprehension



35) In hydrogen bonding, hydrogen nearly always pairs with:

- A) another hydrogen.
- B) carbon.
- C) oxygen or nitrogen.
- D) sodium or chlorine.

Answer: C

Topic: Section 2.4

Skill: Knowledge/Comprehension

36) In what ways are hydrogen bonds and ionic bonds similar?

- A) Both are based on attraction between atoms that carry differences in electrical charge.
- B) Both involve an even sharing of electrons between atoms.
- C) Both are based on attraction between two atoms where each carries a positive charge.
- D) Both are based on repulsion between atoms that carry differences in electrical charge.
- E) Both are based on attraction between two atoms where each carries a negative charge.

Answer: A

Topic: Section 2.4

Skill: Application/Analysis

37) Molecules of water stick to each other because:

- A) hydrogen bonds form between the hydrogen atom of one molecule and the oxygen atom of another molecule.
- B) water molecules are nonpolar, and nonpolar molecules stick together.
- C) hydrogen bonds form between the hydrogen atom of one molecule and a hydrogen atom of another molecule.
- D) covalent bonds form between the hydrogen atom of one molecule and the oxygen atom of another molecule.

Answer: A

Topic: Section 2.4

Skill: Knowledge/Comprehension

38) When sodium chloride dissolves in water, the sodium and chloride ions are pulled into solution by:

- A) ionic bonds that form between the ions and the water molecules.
- B) the attraction of the sodium ions to the negatively charged oxygen, and the attraction of the chloride ions to the two positively charged hydrogens of the water molecules.
- C) the attraction of the sodium ions to the positively charged oxygen, and the attraction of the chloride ions to the two negatively charged hydrogens of the water molecules.
- D) covalent bonds that form between the ions and the water molecules.

Answer: B

Topic: Section 2.6

Skill: Knowledge/Comprehension

39) Hydrophobic molecules tend to be \_\_\_\_\_ by water.

- A) repelled
- B) absorbed
- C) mixed
- D) attracted

Answer: A

Topic: Section 2.6

Skill: Knowledge/Comprehension

40) You mix sugar in water and stir until it's completely dissolved. In this system, the water is the \_\_\_\_\_, the sugar is the \_\_\_\_\_, and the end result is a \_\_\_\_\_.

- A) solute; solution; solvent
- B) solute; solvent; solution
- C) solvent; solution; solute
- D) solution; solvent; solute
- E) solvent; solute; solution

Answer: E

Topic: Section 2.6

Skill: Knowledge/Comprehension

41) You shake up a bottle of vinegar and oil dressing to mix it each time you use it. The reason you need to do this is that:

- A) oil is hydrophobic and won't dissolve in vinegar, so the oil and vinegar separate upon standing.
- B) vinegar and oil are oppositely charged, and opposites attract.
- C) fat molecules are too large to dissolve in water.
- D) vinegar has an acidic pH and is neutralized when mixed with oil.

Answer: A

Topic: Section 2.6

Skill: Application/Analysis

42) The high specific heat and surface tension of water are a result of:

- A) ionic bonds.
- B) covalent bonds within the water molecules.
- C) the size of water molecules.
- D) hydrogen bonding between water molecules.
- E) covalent bonds between water molecules.

Answer: D

Topic: Section 2.6

Skill: Knowledge/Comprehension

43) As an acid mixes in water:

- A) the number of hydroxide ions will increase.
- B) the number of hydrogen ions will increase.
- C) the pH remains at 7.
- D) it becomes buffered.

Answer: B

Topic: Section 2.7

Skill: Knowledge/Comprehension

44) Buffering systems work to maintain pH within normal limits by:

- A) adding hydrogen ions when conditions becomes too acidic.
- B) adding hydroxide ions when conditions become too basic.
- C) removing hydrogen ions when conditions become too acidic and adding hydrogen ions when conditions become too basic.
- D) adding hydrogen ions when conditions become too acidic and removing hydrogen ions when conditions become too basic.

Answer: C

Topic: Section 2.7

Skill: Application/Analysis

45) An atom always contains the same number of protons as neutrons.

Answer: FALSE

Topic: Section 2.1

Skill: Knowledge/Comprehension

46) Neutrons are negatively charged.

Answer: FALSE

Topic: Section 2.1

Skill: Knowledge/Comprehension

47) Anything that occupies space and has mass is energy.

Answer: FALSE

Topic: Section 2.1

Skill: Knowledge/Comprehension

48) An element can't be broken down into another form of pure matter.

Answer: TRUE

Topic: Section 2.1

Skill: Knowledge/Comprehension

49) The number of neutrons in the nucleus of an atom gives it a unique chemical nature.

Answer: FALSE

Topic: Section 2.1

Skill: Knowledge/Comprehension

50) Isotopes differ from each other in the number of protons that they possess.

Answer: FALSE

Topic: Section 2.1

Skill: Knowledge/Comprehension

51) Atoms are electrically neutral.

Answer: TRUE

Topic: Section 2.1

Skill: Knowledge/Comprehension

52) The electrons of an atom contribute significantly to the mass of an atom.

Answer: FALSE

Topic: Section 2.1

Skill: Knowledge/Comprehension

53) Chemical reactions involve only the outermost electrons of an atom.

Answer: TRUE

Topic: Section 2.2

Skill: Knowledge/Comprehension

54) Ionic bonds occur through a sharing of electrons.

Answer: FALSE

Topic: Section 2.3

Skill: Knowledge/Comprehension

55) Acids release hydrogen ions into aqueous solutions.

Answer: TRUE

Topic: Section 2.7

Skill: Knowledge/Comprehension

*Match the following.*

- A) positive charge
- B) outer electrons
- C) ionic bond
- D) no electric charge
- E) hydrogen bond
- F) nonpolar covalent bond
- G) negative charge
- H) polar covalent bond

56) Protons

Topic: Section 2.1

Skill: Knowledge/Comprehension

57) Neutrons

Topic: Section 2.1

Skill: Knowledge/Comprehension

58) Electrons

Topic: Section 2.1

Skill: Knowledge/Comprehension

59) Results from an unequal sharing of shared electrons

Topic: Section 2.2

Skill: Knowledge/Comprehension

60) Results from an equal sharing of electrons

Topic: Section 2.2

Skill: Knowledge/Comprehension

61) Are involved in chemical reactions

Topic: Section 2.2

Skill: Knowledge/Comprehension

62) Results from electrons being transferred from one atom to another

Topic: Section 2.3

Skill: Knowledge/Comprehension

63) Explains the attraction of water molecules for each other

Topic: Section 2.4

Skill: Knowledge/Comprehension

Answers: 56) A 57) D 58) G 59) H 60) F 61) B 62) C 63) E

64) \_\_\_\_\_ orbit around the nucleus of an atom.

Answer: Electrons

Topic: Section 2.1

Skill: Knowledge/Comprehension

65) A single covalent chemical bond represents a sharing of \_\_\_\_\_ electrons between two atoms.

Answer: two

Topic: Section 2.2

Skill: Knowledge/Comprehension

66) Water molecules are uncharged and \_\_\_\_\_.

Answer: polar

Topic: Section 2.2

Skill: Knowledge/Comprehension

67) Hydrogen bonds may form between oxygen of one water molecule and \_\_\_\_\_ of another water molecule.

Answer: hydrogen

Topic: Section 2.4

Skill: Knowledge/Comprehension

68) A signal molecule will \_\_\_\_\_ to a receptor if the molecules' shapes match, similar to a key in a lock.

Answer: bind

Topic: Section 2.5

Skill: Knowledge/Comprehension

69) It takes more energy to raise the temperature of water than of alcohol because water has a higher \_\_\_\_\_.

Answer: specific heat

Topic: Section 2.6

Skill: Application/Analysis

70) A(n) \_\_\_\_\_ has a higher pH than a(n) \_\_\_\_\_.

Answer: base; acid

Topic: Section 2.7

Skill: Knowledge/Comprehension

71) Which elements make up the majority of the human body?

Answer: Carbon, oxygen, and hydrogen make up the majority of the human body.

Topic: Section 2.1

Skill: Knowledge/Comprehension

72) What are the three most important subatomic particles in an atom called? Which one is involved in forming chemical bonds?

Answer: Protons, neutrons, and electrons are the three most important subatomic particles. Only electrons are involved in chemical bonding.

Topic: Section 2.1

Skill: Knowledge/Comprehension

73) What is chemical bonding? Explain the differences between covalent and ionic bonding.

Answer: Atoms react if they need electrons to complete their outer orbitals. Covalent bonding results from sharing of electrons between two atoms, whereas ionic bonding results when one atom transfers electrons to the other atom.

Topic: Section 2.2

Skill: Knowledge/Comprehension

74) Explain how a polar molecule, such as water, can have a difference in electrical charge but is also electrically neutral.

Answer: Because the electronegativity of oxygen and hydrogen is so different, oxygen keeps shared electrons more around its nucleus than does the hydrogen in water, creating an electrical imbalance. Because each atom of the water molecule at some time has its outermost energy level full, the water molecule is electrically neutral.

Topic: Section 2.2

Skill: Knowledge/Comprehension

75) How are ions formed? Why do ionic compounds readily dissolve in water?

Answer: Ions are formed when one atom completely transfers one or more electrons to another atom. Because ionic compounds are made up of oppositely charged ions, water molecules readily dissociate them from each other, dissolving the ionic compound.

Topic: Section 2.3

Skill: Knowledge/Comprehension

76) Temperatures on the Earth are moderated by the presence of so much water on the planet. Using your understanding of water's temperature-moderating abilities, predict what would happen to temperatures in the tropical and temperate regions if the oceans were made of alcohol instead of water. (Hint: Water has a higher specific heat than alcohol.)

Answer: Water's high specific heat means it is very effective at absorbing heat in hot regions and releasing a lot of heat in cooler regions, thus preventing hot regions from getting too hot and cooler regions from getting too cold. Alcohol could not absorb or release as much heat, so hot regions would be much hotter and cooler regions would be much colder.

Topic: Section 2.6

Skill: Synthesis/Evaluation

77) Oil spills in the ocean are often treated with chemical dispersants. These materials are similar to detergents in that the molecules have both hydrophilic and hydrophobic portions. Based on this, predict what will happen when chemical dispersants are used to treat oil spills.

Answer: The dispersant molecules have a hydrophobic portion that will dissolve in the oil and a hydrophilic portion that will dissolve in the water. This will cause the oil to be broken up into small droplets suspended in the water.

Topic: Section 2.6

Skill: Synthesis/Evaluation

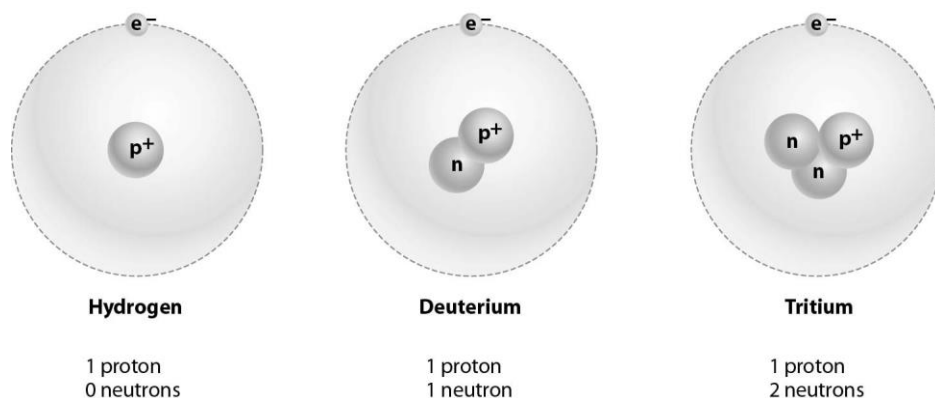
78) You have been having trouble with acid indigestion recently. You buy some milk of magnesia, an antacid, from the drug store to relieve your indigestion. Milk of magnesia is a mixture of magnesium hydroxide in water. What makes milk of magnesia a good antacid? If you could chemically analyze your stomach fluids, what would you find before and after taking the antacid?

Answer: Magnesium hydroxide provides hydroxide ions, which will neutralize the acidity by removing hydrogen ions. Stomach fluids will have a low pH before taking the antacid and a higher pH afterward.

Topic: Section 2.7

Skill: Application/Analysis

*Refer to the figure below, and then answer the question that follows.*



79) Hydrogen, deuterium, and tritium are considered the same element because:

- A) their mass is about the same.
- B) they can form ions easily.
- C) they have the same number of protons.

Answer: C

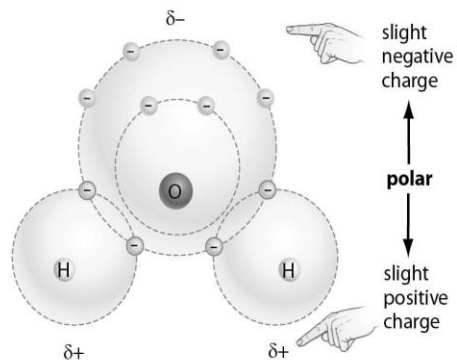
Topic: Section 2.1

Skill: Knowledge/Comprehension

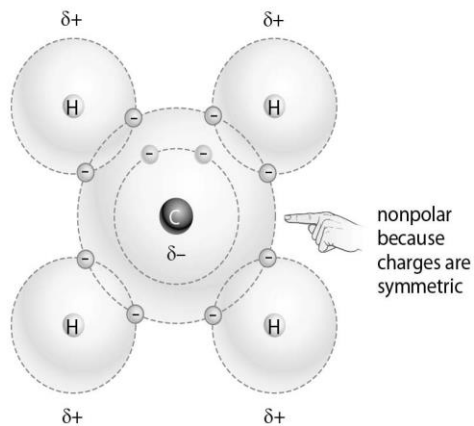


Refer to the figure below, and then answer the question that follows.

(a) Polar water molecule



(b) Nonpolar methane molecule



80) Which of the following molecules is most likely to bind to an ion, and why?

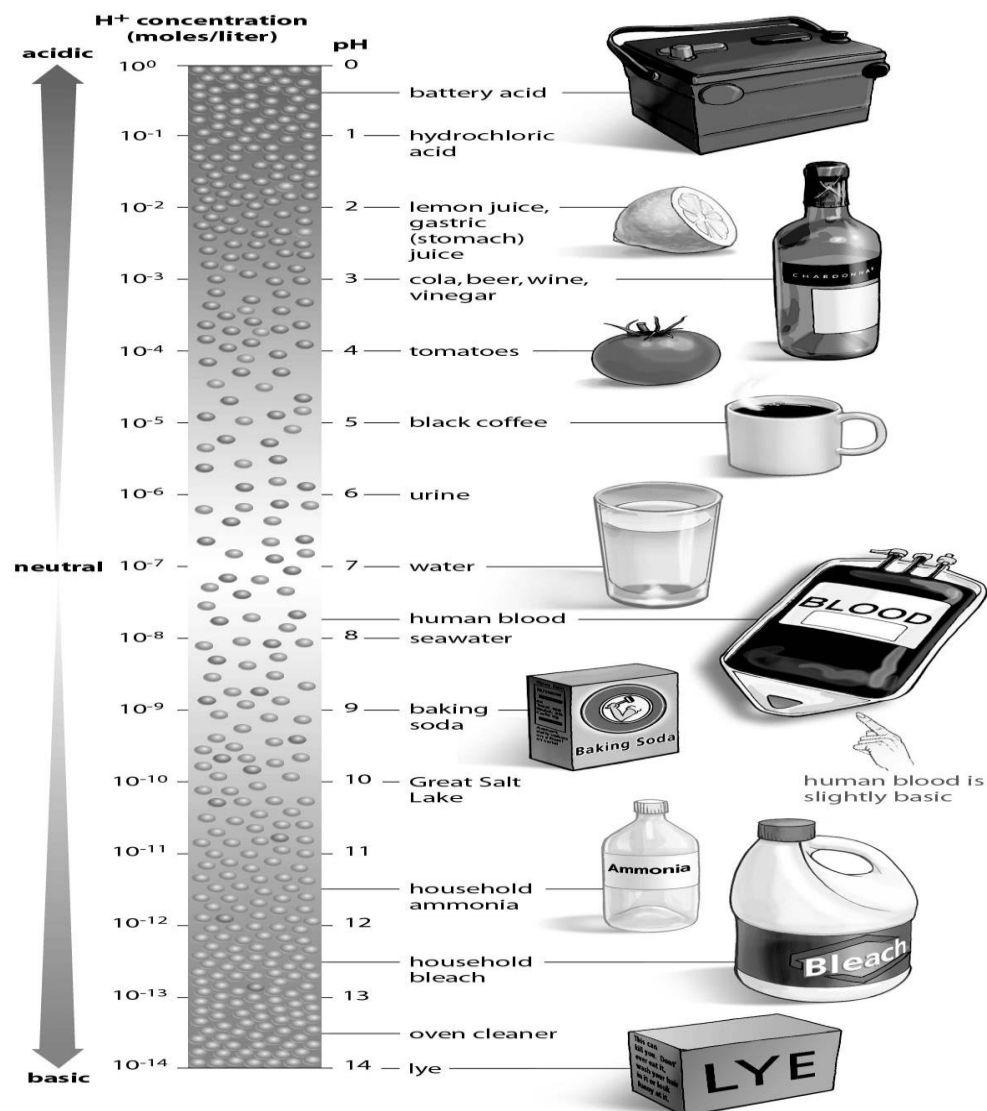
- A) Molecule A, because it has electrical charges that will attract an ion
- B) Molecule B, because it has four hydrogen atoms on the exterior of the molecule
- C) Molecule A, because any molecule with oxygen is able to bind to an ion
- D) Molecule B, because it has a carbon at in the center of the molecule

Answer: A

Topic: Section 2.3

Skill: Application/Analysis

Refer to the figure below, and then answer the question that follows.



81) You are working in a chemistry lab, and your lab partner knocks over a beaker of hydrochloric acid. You alert your laboratory instructor, and he immediately pours another solution over the spill to neutralize the acid. Using the figure as a guide, what did your instructor pour onto the acid to neutralize it?

- A) water
- B) baking soda
- C) lemon juice
- D) coffee

Answer: B

Topic: Section 2.7

Skill: Knowledge/Comprehension