

## Chapter 02 The Chemistry of Life

### Multiple Choice Questions

1. The nucleus of an atom is composed of two subatomic particles, \_\_\_\_\_ and \_\_\_\_\_.
  - A. protons; neutrons
  - B. protons; electrons
  - C. neutrons; electrons
2. Atoms that bear a positive or negative charge are known as:
  - A. magnetic
  - B. electrically neutral
  - C. ions
  - D. lacking nuclei
3. The \_\_\_\_\_ of atoms determine how atoms will react with each other.
  - A. protons
  - B. neutrons
  - C. nuclei
  - D. electrons

4. In an atom, protons are always:
- A. equal to the electrons
  - B. never equal to the electrons
  - C. equal to the neutrons
  - D. combined with the electrons to calculate the atomic mass
5. The volume of space around a nucleus where an electron is most likely to be located is called the \_\_\_\_\_ of that electron.
- A. energy level
  - B. spin
  - C. pathway
  - D. orbital
6. Electrons possess energy of position, also known as \_\_\_\_\_ energy.
- A. kinetic
  - B. latent
  - C. potential
  - D. opposition
7. Most elements in nature exist as:
- A. solitary unreactive atoms
  - B. mixtures of different isotopes
  - C. mixtures of gases
  - D. mixtures of liquids

8. What is true about the half-life of  $^{14}\text{C}$ ?
- A. It takes 5,600 years for half of  $^{14}\text{C}$  to be converted to  $^{14}\text{N}$ .
  - B. The half-life never changes over time.
  - C. It can be employed in the radioisotopic dating of fossils.
  - D. All of these are correct.
9. When an electron is transferred from one atom to the next, and the two atoms are then electrically attracted to one another, the type of bond is a(n) \_\_\_\_\_ bond.
- A. hydrogen
  - B. covalent
  - C. kinetic
  - D. ionic
10. The type of bond that forms between two atoms when electrons are shared is a(n) \_\_\_\_\_ bond.
- A. hydrogen
  - B. covalent
  - C. kinetic
  - D. ionic
11. \_\_\_\_\_ bonds are needed for complex shapes of large organic molecules.
- A. Directional
  - B. Nondirectional
  - C. Stationary
  - D. Ionic
  - E. Covalent

12. What property of water is NOT attributable to hydrogen bonding between water molecules?

- A. Heat storage
- B. Ice formation
- C. Polarity
- D. Cohesion

13. A solution with a pH of 4 has \_\_\_\_\_ the concentration of  $H^+$  present compared to a solution with a pH of 5.

- A. 10 times
- B. 100 times
- C. 2 times
- D. 1000 times

14. The mass number of an atom is the:

- A. number of neutrons only.
- B. the number of electrons plus the number of protons.
- C. the number of protons only.
- D. the number of protons plus the number of neutrons.
- E. the number of electrons, plus the number of neutrons, plus the number of protons.

15. The atomic number of an atom is the:

- A. number of neutrons only
- B. number of electrons plus the number of protons
- C. number of protons only
- D. number of protons plus the number of neutrons
- E. number of electrons, plus the number of neutrons, plus the number of protons

16. The first shell in any atom contains one orbital which contains:

- A. 2 electrons
- B. 8 protons
- C. 8 electrons
- D. 4 neutrons
- E. 2 neutrons

17. The second shell in an atom contains \_\_\_\_\_ orbitals and holds up to \_\_\_\_\_ electrons.

- A. 4; 4
- B. 3; 2
- C. 4; 8
- D. 3; 8
- E. 8; 24

18. If an element has an atomic number of 6 and a mass number of 14, how many neutrons does it have?

- A. 6
- B. 14
- C. 7
- D. 8
- E. Impossible to determine

19. Which is *not* correct about water molecules?

- A. Hydrogen is more electronegative than oxygen.
- B. Water is a polar molecule.
- C. Covalent bonds exist within a water molecule.
- D. Hydrogen bonds exist between water molecules.
- E. Hydrogen bonds are weak bonds.

20. Which type of chemical bond exists within a water molecule?

- A. Hydrogen
- B. Ionic
- C. Covalent
- D. It depends on the temperature of the water.
- E. Weak

21. Water moving up into a paper towel is attributable to:

- A. heat storage
- B. high heat of vaporization
- C. electronegativity
- D. cohesion
- E. adhesion

22. The high surface tension of water that allows some insects to literally walk on water is due to:

- A. high heat of vaporization
- B. cohesion
- C. adhesion
- D. polar covalent bonds
- E. heat storage

23. Which statement is *incorrect* about acid rain?

- A. It comes from the tall stacks of coal-burning power plants.
- B. Its effects have been more devastating to the Southeast than the Northeast.
- C. Sulfuric acid in the atmosphere is carried back to earth with rain.
- D. It has resulted in lakes becoming devoid of life.
- E. In 1989, rain and snow in the Northeast often had a pH as low as 2.

### True / False Questions

24. Hydrogen bonds exist within a water molecule.

True   False

25. Nonpolar molecules are water soluble.

True   False

26. A solution of pH 3 is 100 times more acidic than a solution of pH 5.

True   False

## Fill in the Blank Questions

27. The number of protons in the nucleus of an atom is called the \_\_\_\_\_.

\_\_\_\_\_

28. Atomic mass refers to the numbers of \_\_\_\_\_ and \_\_\_\_\_ of an atom.

\_\_\_\_\_

29. Atoms that have the same number of protons but differ in their number of neutrons are \_\_\_\_\_.

\_\_\_\_\_

\_\_\_\_\_

30. Nonpolar compounds are said to be \_\_\_\_\_ because they shrink away from contact with water.

\_\_\_\_\_

31. When water ionizes, the negatively charged OH fragment is the \_\_\_\_\_ ion.

\_\_\_\_\_

32. We use the \_\_\_\_\_ scale to measure concentrations of hydrogen ions in a solution.

\_\_\_\_\_

33. A solution with a pH of 3 is said to be highly \_\_\_\_\_.

\_\_\_\_\_



34. Cells contain chemical substances called \_\_\_\_\_ that minimize changes in concentrations of  $H^+$  and  $OH^-$ .

\_\_\_\_\_

35. The chemical bond within a water molecule is a \_\_\_\_\_ bond.

\_\_\_\_\_

36. Due to hydrogen bonding, ice is \_\_\_\_\_ dense than water.

\_\_\_\_\_

37. A substance that increases the concentration of  $H^+$  is called a(n) \_\_\_\_\_.

\_\_\_\_\_

### Essay Questions

38. What are two of the characteristics of water that make it so important in living organisms?

39. What are some of the uses of radioactive isotopes?

40. Discuss the difference between covalent, ionic and hydrogen bonds.

41. What is acid rain and how does it affect forests and lakes?

42. Describe the structure of an atom, and include how the number of electrons in the outer shell will affect an atom's tendency to interact with other atoms.

## Chapter 02 The Chemistry of Life **Key**

### Multiple Choice Questions

1. The nucleus of an atom is composed of two subatomic particles, \_\_\_\_\_ and \_\_\_\_\_.

- A. protons; neutrons
- B. protons; electrons
- C. neutrons; electrons

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

2. Atoms that bear a positive or negative charge are known as:

- A. magnetic
- B. electrically neutral
- C. ions
- D. lacking nuclei

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.02  
Topic: Chemistry*

3. The \_\_\_\_\_ of atoms determine how atoms will react with each other.
- A. protons
  - B. neutrons
  - C. nuclei
  - D. electrons

*Bloom's Level: 2. Understand  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

4. In an atom, protons are always:
- A. equal to the electrons
  - B. never equal to the electrons
  - C. equal to the neutrons
  - D. combined with the electrons to calculate the atomic mass

*Bloom's Level: 2. Understand  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

5. The volume of space around a nucleus where an electron is most likely to be located is called the \_\_\_\_\_ of that electron.
- A. energy level
  - B. spin
  - C. pathway
  - D. orbital

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

6. Electrons possess energy of position, also known as \_\_\_\_\_ energy.

- A. kinetic
- B. latent
- C. potential
- D. opposition

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

7. Most elements in nature exist as:

- A. solitary unreactive atoms
- B. mixtures of different isotopes
- C. mixtures of gases
- D. mixtures of liquids

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.02  
Topic: Chemistry*

8. What is true about the half-life of  $^{14}\text{C}$ ?

- A. It takes 5,600 years for half of  $^{14}\text{C}$  to be converted to  $^{14}\text{N}$ .
- B. The half-life never changes over time.
- C. It can be employed in the radioisotopic dating of fossils.
- D. All of these are correct.

*Bloom's Level: 2. Understand  
Johnson - Chapter 02  
Section: 02.02  
Topic: Chemistry*

9. When an electron is transferred from one atom to the next, and the two atoms are then electrically attracted to one another, the type of bond is a(n) \_\_\_\_\_ bond.
- A. hydrogen
  - B. covalent
  - C. kinetic
  - D.** ionic

*Bloom's Level: 2. Understand*  
*Johnson - Chapter 02*  
*Section: 02.03*  
*Topic: Chemistry*

10. The type of bond that forms between two atoms when electrons are shared is a(n) \_\_\_\_\_ bond.
- A. hydrogen
  - B.** covalent
  - C. kinetic
  - D. ionic

*Bloom's Level: 1. Remember*  
*Johnson - Chapter 02*  
*Section: 02.03*  
*Topic: Chemistry*

11. \_\_\_\_\_ bonds are needed for complex shapes of large organic molecules.
- A.** Directional
  - B. Nondirectional
  - C. Stationary
  - D. Ionic
  - E. Covalent

*Bloom's Level: 2. Understand*  
*Johnson - Chapter 02*

12. What property of water is NOT attributable to hydrogen bonding between water molecules?
- A. Heat storage
  - B. Ice formation
  - C. Polarity
  - D. Cohesion

*Bloom's Level: 3. Apply*  
*Johnson - Chapter 02*  
*Section: 02.04*  
*Topic: Chemistry*

13. A solution with a pH of 4 has \_\_\_\_\_ the concentration of  $H^+$  present compared to a solution with a pH of 5.
- A. 10 times
  - B. 100 times
  - C. 2 times
  - D. 1000 times

*Bloom's Level: 3. Apply*  
*Johnson - Chapter 02*  
*Section: 02.05*  
*Topic: Chemistry*

14. The mass number of an atom is the:
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  - B. the number of electrons plus the number of protons.
  - C. the number of protons only.
  - D. the number of protons plus the number of neutrons.
  - E. the number of electrons, plus the number of neutrons, plus the number of protons.

*Bloom's Level: 1. Remember*



15. The atomic number of an atom is the:
- A. number of neutrons only
  - B. number of electrons plus the number of protons
  - C. number of protons only
  - D. number of protons plus the number of neutrons
  - E. number of electrons, plus the number of neutrons, plus the number of protons

*Bloom's Level: 1. Remember*

*Johnson - Chapter 02*

*Section: 02.01*

*Topic: Chemistry*

16. The first shell in any atom contains one orbital which contains:
- A. 2 electrons
  - B. 8 protons
  - C. 8 electrons
  - D. 4 neutrons
  - E. 2 neutrons

*Bloom's Level: 1. Remember*

*Johnson - Chapter 02*

*Section: 02.01*

*Topic: Chemistry*

17. The second shell in an atom contains \_\_\_\_\_ orbitals and holds up to \_\_\_\_\_ electrons.
- A. 4; 4
  - B. 3; 2
  - C. 4; 8**
  - D. 3; 8
  - E. 8; 24

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

18. If an element has an atomic number of 6 and a mass number of 14, how many neutrons does it have?
- A. 6
  - B. 14
  - C. 7
  - D. 8**
  - E. Impossible to determine

*Bloom's Level: 2. Understand  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

19. Which is *not* correct about water molecules?
- A. Hydrogen is more electronegative than oxygen.**
  - B. Water is a polar molecule.
  - C. Covalent bonds exist within a water molecule.
  - D. Hydrogen bonds exist between water molecules.
  - E. Hydrogen bonds are weak bonds.

*Bloom's Level: 2. Understand*

20. Which type of chemical bond exists within a water molecule?

- A. Hydrogen
- B. Ionic
- C. Covalent
- D. It depends on the temperature of the water.
- E. Weak

*Bloom's Level: 2. Understand*

*Johnson - Chapter 02*

*Section: 02.04*

*Topic: Chemistry*

21. Water moving up into a paper towel is attributable to:

- A. heat storage
- B. high heat of vaporization
- C. electronegativity
- D. cohesion
- E. adhesion

*Bloom's Level: 2. Understand*

*Johnson - Chapter 02*

*Section: 02.04*

*Topic: Chemistry*

22. The high surface tension of water that allows some insects to literally walk on water is due to:
- A. high heat of vaporization
  - B. cohesion**
  - C. adhesion
  - D. polar covalent bonds
  - E. heat storage

*Bloom's Level: 2. Understand*  
*Johnson - Chapter 02*  
*Section: 02.04*  
*Topic: Chemistry*

23. Which statement is *incorrect* about acid rain?
- A. It comes from the tall stacks of coal-burning power plants.
  - B. Its effects have been more devastating to the Southeast than the Northeast.**
  - C. Sulfuric acid in the atmosphere is carried back to earth with rain.
  - D. It has resulted in lakes becoming devoid of life.
  - E. In 1989, rain and snow in the Northeast often had a pH as low as 2.

*Bloom's Level: 2. Understand*  
*Johnson - Chapter 02*  
*Section: 02.05*  
*Topic: Chemistry*

### True / False Questions

24. Hydrogen bonds exist within a water molecule.

**FALSE**

*Bloom's Level: 1. Remember*  
*Johnson - Chapter 02*  
*Section: 02.04*

25. Nonpolar molecules are water soluble.

FALSE

*Bloom's Level: 2. Understand  
Johnson - Chapter 02  
Section: 02.03  
Topic: Chemistry*

26. A solution of pH 3 is 100 times more acidic than a solution of pH 5.

TRUE

*Bloom's Level: 2. Understand  
Johnson - Chapter 02  
Section: 02.05  
Topic: Chemistry*

### Fill in the Blank Questions

27. The number of protons in the nucleus of an atom is called the \_\_\_\_\_.

atomic number

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

28. Atomic mass refers to the numbers of \_\_\_\_\_ and \_\_\_\_\_ of an atom.

protons, neutrons

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.01  
Topic: Chemistry*

29. Atoms that have the same number of protons but differ in their number of neutrons are \_\_\_\_\_.

isotopes

*Bloom's Level: 2. Understand*

*Johnson - Chapter 02*

*Section: 02.02*

*Topic: Chemistry*

30. Nonpolar compounds are said to be \_\_\_\_\_ because they shrink away from contact with water.

hydrophobic

*Bloom's Level: 1. Remember*

*Johnson - Chapter 02*

*Section: 02.03*

*Topic: Chemistry*

31. When water ionizes, the negatively charged OH fragment is the \_\_\_\_\_ ion.

hydroxide

*Bloom's Level: 1. Remember*

*Johnson - Chapter 02*

*Section: 02.05*

*Topic: Chemistry*

32. We use the \_\_\_\_\_ scale to measure concentrations of hydrogen ions in a solution.

pH

*Bloom's Level: 1. Remember*

*Johnson - Chapter 02*

*Section: 02.05*

*Topic: Chemistry*

33. A solution with a pH of 3 is said to be highly \_\_\_\_\_.

acidic

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.05  
Topic: Chemistry*

34. Cells contain chemical substances called \_\_\_\_\_ that minimize changes in concentrations of  $H^+$  and  $OH^-$ .

buffers

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.05  
Topic: Chemistry*

35. The chemical bond within a water molecule is a \_\_\_\_\_ bond.

covalent

*Bloom's Level: 1. Remember  
Johnson - Chapter 02  
Section: 02.04  
Topic: Chemistry*

36. Due to hydrogen bonding, ice is \_\_\_\_\_ dense than water.

less

*Bloom's Level: 2. Understand  
Johnson - Chapter 02  
Section: 02.04  
Topic: Chemistry*

37. A substance that increases the concentration of  $H^+$  is called a(n) \_\_\_\_\_.

acid

*Bloom's Level: 1. Remember*

## Essay Questions

38. What are two of the characteristics of water that make it so important in living organisms?

Water is a polar molecule, and can form hydrogen bonds. These two characteristics are responsible for the properties of high polarity, heat-storing ability, high heat of vaporization, low density of ice, and cohesion.

*Bloom's Level: 2. Understand*

*Johnson - Chapter 02*

*Section: 02.04*

*Topic: Chemistry*

39. What are some of the uses of radioactive isotopes?

Will vary, but should include medical tests and fossil dating.

*Bloom's Level: 3. Apply*

*Johnson - Chapter 02*

*Section: 02.02*

*Topic: Chemistry*



40. Discuss the difference between covalent, ionic and hydrogen bonds.

Covalent bonds involve sharing electrons between atoms. Ionic bonds occur when oppositely charged ions are attracted to each other. Hydrogen bonds occur when polar molecules are attracted by opposite partial charges on different molecules.

*Bloom's Level: 2. Understand*  
*Johnson - Chapter 02*  
*Section: 02.03*  
*Topic: Chemistry*

41. What is acid rain and how does it affect forests and lakes?

Will vary, but should include the emissions of coal-burning power plants and the effect of sulfuric acid on the pH of rain and snow. Also, answers should include acid rain's effect on biodiversity, forests, and lakes.

*Bloom's Level: 2. Understand*  
*Johnson - Chapter 02*  
*Section: 02.05*  
*Topic: Chemistry*

42. Describe the structure of an atom, and include how the number of electrons in the outer shell will affect an atom's tendency to interact with other atoms.

Atoms contain protons (positively charged), and neutrons (neutral) in their nucleus. Electrons are in electron shells around the nucleus. Each orbital holds a maximum of 2 electrons and atoms try to fill their outer shells with electrons.

*Bloom's Level: 2. Understand*  
*Johnson - Chapter 02*  
*Section: 02.01*  
*Topic: Chemistry*



Chapter 02 The Chemistry of Life **Summary**

<u>Category</u>	<u># of Questions</u>
Bloom's Level: 1. Remember	20
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Johnson - Chapter 02	42
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Section: 02.03	6
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