# *Essentials of The Living World 5th edition George Johnson Test Bank*

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# 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

Protons are positively charged while neutrons are electrically neutral. Please see section 02.01.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.01 Describe the basic structure of an atom in terms of three subatomic particles.*
*Section: 02.01*
*Topic: Atomic Structure*

2. Atoms that bear a positive or negative charge are known as
A. magnetic.
B. electrically neutral.
**C.** ions.
D. lacking nuclei.

Ions have gained or lost electrons. Please see section 02.02.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.02.01 Differentiate between a cation and an anion.*
*Section: 02.02*
*Topic: Atomic Structure*
*Topic: Chemical Bonds*


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

Electrons govern interactions since they are the atomic particles which form the bonds. Please see section 02.01.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.02 Explain why electrons determine the chemical behavior of atoms.*
*Section: 02.01*
*Topic: Atomic Structure*

4. In a neutral atom in terms of the number of subatomic particles, protons are always
**A.** equal to the electrons.
B. close to the electrons.
C. equal to the neutrons.
D. combined with the electrons to calculate the atomic mass.

Please see section 02.01. Electrical neutrality means that there must be equal numbers of electrons and protons.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.01.01 Describe the basic structure of an atom in terms of three subatomic particles.*
*Section: 02.01*
*Topic: Atomic Structure*


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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

Please see section 02.01. Electron orbitals combine when covalent bonds form.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.03 Explain how electrons carry energy.*
*Section: 02.01*
*Topic: Atomic Structure*

6. Electrons possess energy of position, also known as _____ energy.
A. kinetic
B. latent
**C.** potential
D. opposition

Potential energy is stored in a thing which has a particular position. Please see section 02.01.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.03 Explain how electrons carry energy.*
*Section: 02.01*
*Topic: Atomic Structure*

7. Most elements in nature exist as
A. solitary unreactive atoms.
**B.** mixtures of different isotopes.
C. mixtures of gases.
D. mixtures of liquids.

For example, carbon exists in nature as a mixture of three isotopes. Please see section 02.02.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.02.02 Differentiate between an ion and an isotope.*
*Section: 02.02*
*Topic: Atomic Structure*


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8. What is true about $^{14}C$?
A. It is an ion.
B. It is the most common form of carbon.
**C.** It can be employed in the radioisotopic dating of fossils.
D. It has 6 neutrons.

Carbon-14 spontaneously breaks down, releasing radiation. Please see section 02.02.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.02.02 Differentiate between an ion and an isotope.*
*Section: 02.02*
*Topic: Atomic Structure*

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

Please see section 02.03. Ionic bonds involve atoms or molecules with full charges.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.03.01 Define a chemical bond and describe the three principal kinds.*
*Section: 02.03*
*Topic: Chemical Bonds*


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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

Please see section 02.03. Covalent bonds involve shared electrons, even if not all atoms share equally.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.03.03 Explain why most chemical bonds in organisms are covalent bonds, and distinguish between polar and nonpolar covalent bonds.*
*Section: 02.03*
*Topic: Chemical Bonds*

11. Strong, _____ bonds are needed for the building of complex biological molecules.

**A.** directional
B. nondirectional
C. stationary
D. ionic
E. None of the answer choices is correct.

Please see section 02.03. Organic molecules can take a wide range of shapes, allowing a wide range of functions.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.03.03 Explain why most chemical bonds in organisms are covalent bonds, and distinguish between polar and nonpolar covalent bonds.*
*Section: 02.03*
*Topic: Chemical Bonds*


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12. What property of water comes from something other than hydrogen bonding?
A. Heat storage
B. Ice formation
**C.** Polarity
D. Cohesion

Review section 02.04. Polarity is due to differences in electronegativity between atoms.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.04.05 Explain why oil will not dissolve in water.*
*Section: 02.04*
*Topic: Properties of Water*

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

Please see section 02.05. pH units are logarithmic. A difference of one pH unit means a tenfold concentration difference.

*Bloom's Level: 3. Apply*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*


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14. The mass number of an atom is the
A. the 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.

Please see section 02.01. Atomic number is the number of large particles in the nucleus of an atom of an element.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.01 Describe the basic structure of an atom in terms of three subatomic particles.*
*Section: 02.01*
*Topic: Atomic Structure*

15. The atomic number of an atom is the
A. the 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.

Please see section 02.01. Atomic number is never more than mass number.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.01 Describe the basic structure of an atom in terms of three subatomic particles.*
*Section: 02.01*
*Topic: Atomic Structure*


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16. The first shell in any atom contains one orbital which may contain as many as
**A.** 2 electrons.
B. 8 protons.
C. 8 electrons.
D. 4 neutrons.
E. 2 neutrons.

Please see section 02.01. The possible number of electrons per atom is determined by the number of protons, and the number per shell is determined by how far it is from the nucleus.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.03 Explain how electrons carry energy.*
*Section: 02.01*
*Topic: Atomic Structure*

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

Orbitals hold two electrons each. Please see section 02.01.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.01.03 Explain how electrons carry energy.*
*Section: 02.01*
*Topic: Atomic Structure*


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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.

Please see sections 02.01 and 02.02. The difference between mass number and atomic number is the number of neutrons.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.01.01 Describe the basic structure of an atom in terms of three subatomic particles.*
*Learning Outcome: 02.02.02 Differentiate between an ion and an isotope.*
*Section: 02.01*
*Section: 02.02*
*Topic: Atomic Structure*

19. If you were grading an exam about water, which statement would lose points?
**A.** Hydrogens have partial negative charges.
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 relatively weak bonds.

Please see section 02.03. Hydrogen atoms in water molecules have partial positive charges.

*Bloom's Level: 3. Apply*
*Learning Outcome: 02.03.04 Predict which molecules will form hydrogen bonds with each other.*
*Section: 02.03*
*Topic: Properties of Water*


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20. Which type of chemical substance lowers the $H^+$ concentration in a solution?
A. Ice
B. Acid
**C.** Base
D. Buffer
E. Hydrogen ion

Please see section 02.05. Base and acid are, in some sense, opposites.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*

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.

Please see section 02.04. Adhesion is the property of water sticking to other polar substances.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.04.04 Distinguish cohesion from adhesion.*
*Section: 02.04*


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22. If you wanted to stop an insect from walking on water, you would need to add something to the water to stop
A. high heat of vaporization.
**B.** cohesion.
C. adhesion.
D. polar covalent bonds.
E. heat storage.

Please see section 02.04. Cohesion is due to water molecules sticking together as a result of hydrogen bonding.

*Bloom's Level: 4. Analyze*
*Learning Outcome: 02.04.04 Distinguish cohesion from adhesion.*
*Section: 02.04*
*Topic: Properties of Water*

**True / False Questions**

23. Buffers always release $H^+$ ions into solution to stabilize pH.
**FALSE**

Please see section 02.05. Buffers act to minimize changes in pH, which sometimes involves releasing hydrogen ions into solution but other times involves taking up hydrogen ions from the solution.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*


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24. Nonpolar molecules are water soluble.
**FALSE**

Please see section 02.04. Nonpolar molecules are hydrophobic, or "water fearing."

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.04.05 Explain why oil will not dissolve in water.*
*Section: 02.04*
*Topic: Properties of Water*

## Fill in the Blank Questions

25. The number of protons in the nucleus of an atom is called the _____.
**atomic number**

Please see section 02.01. Atomic number is always the same as or less than atomic mass.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.01.01 Describe the basic structure of an atom in terms of three subatomic particles.*
*Section: 02.01*
*Topic: Atomic Structure*

26. If you wanted to change the atomic mass of an atom, you would have to alter either the number of _____ or the number of _____.
**protons, neutrons**

Atomic mass is the sum of the numbers of protons and neutrons in an atomic nucleus. Please see section 02.01.

*Bloom's Level: 3. Apply*
*Learning Outcome: 02.01.01 Describe the basic structure of an atom in terms of three subatomic particles.*
*Section: 02.01*
*Topic: Atomic Structure*


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27. If you were helping a professor with an experiment in which different forms of carbon were to be used, you would go the storeroom to find different _____.
**isotopes**

Please see section 02.02. Carbon occurs in nature in three isotopes, which are forms of carbon differing in weight but not in how they form bonds.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.02.02 Differentiate between an ion and an isotope.*
*Section: 02.02*
*Topic: Atomic Structure*

28. You are chemically analyzing a new compound. It does not dissolve well in water, so you write down that it is _____.
**hydrophobic**

Please see section 02.04. "Hydrophobic" means "water fearing."

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.04.05 Explain why oil will not dissolve in water.*
*Section: 02.04*
*Topic: Properties of Water*

29. When water ionizes, the negatively charged OH fragment is the _____ ion.
**hydroxide**

Please see section 02.05. Besides hydroxide, water produces a proton for the other ion when it ionizes.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*
*Topic: Properties of Water*


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30. We use the _____ scale to measure concentrations of hydrogen ions in a solution.
**pH**

Please see section 02.05. pH ranges from strongly acidic to strongly basic.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*
*Topic: Properties of Water*

31. A solution with a pH of 3 is said to be highly _____.
**acidic**

Please see section 02.05. Examples of acids include lemon juice and stomach acid.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*

32. The doctor prescribes a medicine to help stop wide fluctuations in stomach acid which have been causing you pain. The doctor has probably prescribed a _____.
**buffer**

Please see section 02.05. Buffers help to minimize changes in pH.

*Bloom's Level: 4. Analyze*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*


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33. The chemical bond within a water molecule is a _____ bond.
**covalent**

Atoms within a water molecule share electrons, so the bonds formed are covalent. Please see section 02.03.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.03.03 Explain why most chemical bonds in organisms are covalent bonds, and distinguish between polar and nonpolar covalent bonds.*
*Section: 02.03*
*Topic: Chemical Bonds*
*Topic: Properties of Water*

34. Due to _____ bonding, ice is less dense than water.
**hydrogen**

Fish in cold lakes are saved in the winter by the lower density of water ice since water ice then floats, rather than sinking and crushing the fish. Please see section 02.04.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.04.02 Explain why ice floats.*
*Section: 02.04*
*Topic: Properties of Water*

35. A substance that increases the concentration of $H^+$ is a(n) _____.
**acid**

Please see section 02.05. Acids release protons, lowering pH.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.05.01 Define pH, and predict the change in hydrogen ion concentration represented by a difference of 1 on the pH scale.*
*Section: 02.05*
*Topic: Acids and Bases*
*Topic: Properties of Water*


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## Essay Questions

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

Water makes up the majority of most living things and is the solvent of life. Water is a polar molecule and can form hydrogen bonds. These two characteristics are responsible for the properties of high polarity, high heat of vaporization, low ice density, and cohesion. Please see section 02.04.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.04.01 Explain why water heats up so slowly.*
*Section: 02.04*
*Topic: Properties of Water*

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

Will vary, but should include medical tests and fossil dating. Please see section 02.02.

*Bloom's Level: 1. Remember*
*Learning Outcome: 02.02.02 Differentiate between an ion and an isotope.*
*Section: 02.02*
*Topic: Atomic Structure*

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

Please see section 02.03. The various important kinds of bonds vary in bond strength and the way electrons are shared.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.03.01 Define a chemical bond and describe the three principal kinds.*
*Section: 02.03*
*Topic: Chemical Bonds*


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39. Describe van der Waals forces and how they play a role in biological molecules.

Please see section 02.04. van der Waals interactions are too weak to be bonds but are still critical for some biological structures.

*Bloom's Level: 2. Understand*
*Learning Outcome: 02.03.05 Distinguish between a chemical bond and van der Waals interactions.*
*Section: 02.03*
*Topic: Chemical Bonds*

**True / False Questions**

40. If you wanted to design a solvent to replace water in a living thing, you would want to avoid hydrogen bonds so that the fluid would be effective at cooling when the organism sweated.
**FALSE**

Please see section 02.04. The hydrogen bonds in water are what makes it effective in cooling organisms as they sweat.

*Bloom's Level: 4. Analyze*
*Learning Outcome: 02.04.03 Explain why sweating cools you.*
*Section: 02.04*
*Topic: Properties of Water*

41. Two hydrophobic molecules in a cell membrane would form a hydrogen bond.
**TRUE**

Please see section 02.03. Hydrophobic molecules cannot form hydrogen bonds since they lack polar atoms.

*Bloom's Level: 4. Analyze*
*Learning Outcome: 02.03.04 Predict which molecules will form hydrogen bonds with each other.*
*Section: 02.03*
*Topic: Chemical Bonds*


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