

Campbell Biology, 10e (Reece)

Chapter 2 The Chemical Context of Life

1) About twenty-five of the ninety-two natural elements are known to be essential to life. Which four of these twenty-five elements make up approximately 96 percent of living matter?

- A) carbon, sodium, hydrogen, nitrogen
- B) carbon, oxygen, phosphorus, hydrogen
- C) oxygen, hydrogen, calcium, nitrogen
- D) carbon, hydrogen, nitrogen, oxygen

Answer: D

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.1

2) Trace elements are those required by an organism in only minute quantities. Which of the following is a trace element that is required by humans and other vertebrates, but not by other organisms such as bacteria or plants?

- A) calcium
- B) iodine
- C) sodium
- D) phosphorus

Answer: B

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.1

3) Which of the following statements is FALSE?

- A) Carbon, hydrogen, oxygen, and nitrogen are the most abundant elements of living matter.
- B) Some naturally occurring elements are toxic to organisms.
- C) All life requires the same essential elements.
- D) Iron is needed by all humans.

Answer: C

Bloom's Taxonomy: Application/Analysis

Section: 2.1

4) Which of the following are compounds?

- A) H₂O, O₂, and CH₄
- B) H₂O and O₂
- C) O₂ and CH₄
- D) H₂O and CH₄, but not O₂

Answer: D

Bloom's Taxonomy: Application/Analysis

Section: 2.1

5) Knowing the atomic mass of an element allows inferences about which of the following?

- A) the number of electrons in the element
- B) the number of protons in the element
- C) the number of protons plus neutrons in the element
- D) the number of protons plus electrons in the element

Answer: C

Bloom's Taxonomy: Application/Analysis

Section: 2.2

6) In what way are elements in the same column of the periodic table the same? They have the same number of _____.

- A) protons
- B) electrons when neutral
- C) electrons in their valence shells when neutral
- D) electron shells when neutral

Answer: C

Bloom's Taxonomy: Application/Analysis

Section: 2.2

7) Molybdenum has an atomic number of 42. Several common isotopes exist, with mass numbers from 92-100. Therefore, which of the following can be true?

- A) Molybdenum atoms can have between 50 and 58 neutrons.
- B) Molybdenum atoms can have between 50 and 58 protons.
- C) Molybdenum atoms can have between 50 and 58 electrons.
- D) Isotopes of molybdenum have different numbers of electrons.

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

8) Carbon-12 is the most common isotope of carbon and has a mass number of 12. However, the average atomic mass of carbon found on a periodic table is slightly more than 12 daltons. Why?

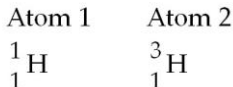
- A) The atomic mass does not include the mass of electrons.
- B) Some carbon atoms in nature have an extra proton.
- C) Some carbon atoms in nature have more neutrons.
- D) Some carbon atoms in nature have a different valence electron distribution.

Answer: C

Bloom's Taxonomy: Application/Analysis

Section: 2.2

9) Which of the following best describes the relationship between the atoms described below?



- A) They are isomers.
- B) They are isotopes.
- C) They contain 1 and 3 protons, respectively.
- D) They each contain only 1 neutron.

Answer: B

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

10) The atomic number of nitrogen is 7. Nitrogen-15 has a greater mass number than nitrogen-14 because the atomic nucleus of nitrogen-15 contains _____.

- A) 7 neutrons
- B) 8 neutrons
- C) 8 protons
- D) 15 protons

Answer: B

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

11) From its atomic number of 15, it is possible to predict that the phosphorus atom has _____.

- A) 5 neutrons, 5 protons, and 5 electrons
- B) 15 neutrons and 15 protons
- C) 8 electrons in its outermost electron shell
- D) 15 protons and 15 electrons

Answer: D

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

12) Fluorine has an atomic number of 9. Which of the following would you do to a neutral fluorine atom to complete its valence shell?

- A) add 1 electron
- B) add 2 electrons
- C) remove 1 electron
- D) Nothing. If fluorine is neutral, it has a complete valence shell.

Answer: A

Bloom's Taxonomy: Application/Analysis

Section: 2.2

13) Magnesium has an atomic number of 12. What is the most stable charge for a magnesium ion?



















- A) a +1 charge
- B) a +2 charge
- C) a -1 charge
- D) a -2 charge

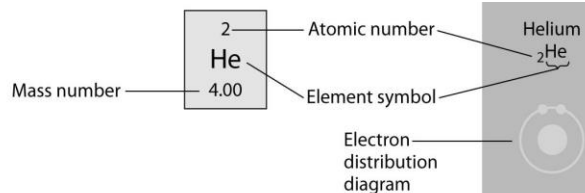
Answer: B

Bloom's Taxonomy: Application/Analysis

Section: 2.2

Refer to the following figure to answer the questions below.

First shell	<div>Hydrogen ${}_1\text{H}$</div> <div></div>	<div><div><div>2</div><div>He</div><div>4.00</div></div><div>Atomic number</div><div>Mass number</div><div>Element symbol</div></div> <div><div>Helium ${}_2\text{He}$</div><div>Electron distribution diagram</div><div></div></div>						
Second shell	<div>Lithium ${}_3\text{Li}$</div> <div></div>	<div>Beryllium ${}_4\text{Be}$</div> <div></div>	<div>Boron ${}_5\text{B}$</div> <div></div>	<div>Carbon ${}_6\text{C}$</div> <div></div>	<div>Nitrogen ${}_7\text{N}$</div> <div></div>	<div>Oxygen ${}_8\text{O}$</div> <div></div>	<div>Fluorine ${}_9\text{F}$</div> <div></div>	<div>Neon ${}_{10}\text{Ne}$</div> <div></div>
Third shell	<div>Sodium ${}_{11}\text{Na}$</div> <div></div>	<div>Magnesium ${}_{12}\text{Mg}$</div> <div></div>	<div>Aluminum ${}_{13}\text{Al}$</div> <div></div>	<div>Silicon ${}_{14}\text{Si}$</div> <div></div>	<div>Phosphorus ${}_{15}\text{P}$</div> <div></div>	<div>Sulfur ${}_{16}\text{S}$</div> <div></div>	<div>Chlorine ${}_{17}\text{Cl}$</div> <div></div>	<div>Argon ${}_{18}\text{Ar}$</div> <div></div>



14) Refer to the figure above (first three rows of the periodic table). What element has properties most similar to carbon?

- A) boron
- B) silicon
- C) nitrogen
- D) phosphorus

Answer: B

Bloom's Taxonomy: Synthesis/Evaluation

Section: 2.2

Atomic mass →	12	16	1	14	32	31
	C	O	H	N	S	P
Atomic number →	6	8	1	7	16	15

15) How many neutrons are present in the nucleus of a phosphorus-32 (^{32}P) atom (see the figure above)?

- A) 15
- B) 16
- C) 17
- D) 32

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

16) How many electrons will a single atom of sulfur with no charge and no bonds have in its valence shell (see the figure above)?

- A) 6
- B) 8
- C) 16
- D) 32

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

17) Based on electron configuration, which of the elements in the figure above would exhibit a chemical behavior most like that of oxygen?

- A) carbon
- B) nitrogen
- C) sulfur
- D) phosphorus

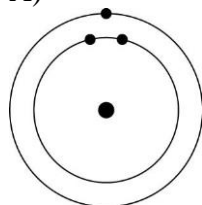
Answer: C

Bloom's Taxonomy: Application/Analysis

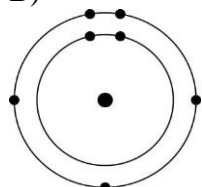
Section: 2.2

18) Which one of the atoms shown would be most likely to form a cation with a charge of +1?

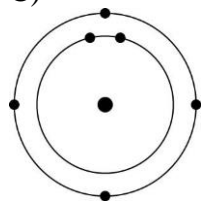
A)



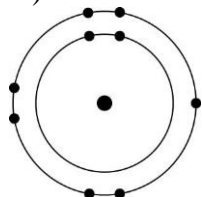
B)



C)



D)



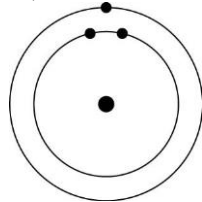
Answer: A

Bloom's Taxonomy: Application/Analysis

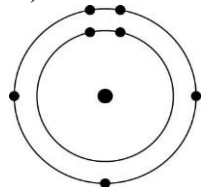
Section: 2.2

19) Which one of the atoms shown would be most likely to form an anion with a charge of -1?

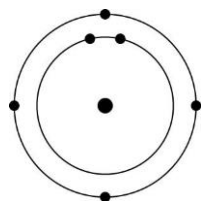
A)



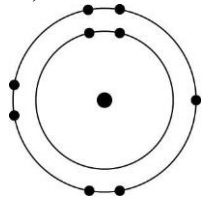
B)



C)



D)



Answer: D

Bloom's Taxonomy: Application/Analysis

Section: 2.2

20) Oxygen has an atomic number of 8 and most commonly, a mass number of 16. Thus, what is the atomic mass of an oxygen atom?

A) approximately 8 grams

B) approximately 8 daltons

C) approximately 16 grams

D) approximately 16 daltons

Answer: D

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

21) If you change the number of neutrons in an atom, you create ____.

- A) a cation
- B) an anion
- C) an isotope
- D) a different element

Answer: C

Bloom's Taxonomy: Application/Analysis

Section: 2.2

22) Can the atomic mass of an element vary?

- A) No, it is fixed. If it changes at all then you have formed a different element.
- B) Yes. Adding or losing electrons will substantially change the atomic mass.
- C) Yes. Adding or losing protons will change the atomic mass without forming a different element.
- D) Yes. Adding or losing neutrons will change the atomic mass without forming a different element.

Answer: D

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

23) Which of the following is the best description of an atom's physical structure?

- A) An atom is a solid mass of material.
- B) The particles that form an atom are equidistant from each other.
- C) Atoms are little bubbles of space with mass concentrated at the center of the bubble.
- D) Atoms are little bubbles of space with mass concentrated on the outside surface of the bubble.

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.2

24) A salamander relies on hydrogen bonding to stick to various surfaces. Therefore, a salamander would have the greatest difficulty clinging to a ____.

- A) slightly damp surface
- B) surface of hydrocarbons
- C) surface of mostly carbon-oxygen bonds
- D) surface of mostly carbon-nitrogen bonds

Answer: B

Bloom's Taxonomy: Synthesis/Evaluation

Section: 2.3

25) A covalent chemical bond is one in which _____.

- A) electrons are removed from one atom and transferred to another atom so that the two atoms become oppositely charged
- B) protons and neutrons are shared by two atoms so as to satisfy the requirements of both atoms
- C) outer-shell electrons of two atoms are shared so as to satisfactorily fill their respective orbitals
- D) outer-shell electrons of one atom are transferred to fill the inner electron shell of another atom

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

26) What is the maximum number of covalent bonds that an oxygen atom with atomic number 8 can make with hydrogen?

- A) 1
- B) 2
- C) 4
- D) 6

Answer: B

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

27) Nitrogen (N) is more electronegative than hydrogen (H). Which of the following is a correct statement about the atoms in ammonia (NH₃)?

- A) Each hydrogen atom has a partial positive charge; the nitrogen atom has a partial negative charge.
- B) Ammonia has an overall positive charge.
- C) Ammonia has an overall negative charge.
- D) The nitrogen atom has a partial positive charge; each hydrogen atom has a partial negative charge.

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

28) Bonds between two atoms that are equally electronegative are _____.

- A) hydrogen bonds
- B) polar covalent bonds
- C) nonpolar covalent bonds
- D) ionic bonds

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

29) What results from an unequal sharing of electrons between atoms?

- A) a nonpolar covalent bond
- B) a polar covalent bond
- C) an ionic bond
- D) a hydrophobic interaction

Answer: B

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

30) A covalent bond is likely to be polar when _____.

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

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

31) What is the difference between covalent bonds and ionic bonds?

- A) Covalent bonds involve the sharing of pairs of electrons between atoms; ionic bonds involve the sharing of single electrons between atoms.
- B) Covalent bonds involve the sharing of electrons between atoms; ionic bonds involve the electrical attraction between charged atoms.
- C) Covalent bonds involve the sharing of electrons between atoms; ionic bonds involve the sharing of protons between charged atoms.
- D) Covalent bonds involve the transfer of electrons between charged atoms; ionic bonds involve the sharing of electrons between atoms.

Answer: B

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

32) The atomic number of chlorine is 17. The atomic number of magnesium is 12. What is the formula for magnesium chloride?

- A) MgCl
- B) MgCl₂
- C) Mg₂Cl
- D) MgCl₃

Answer: B

Bloom's Taxonomy: Application/Analysis

Section: 2.3

33) How many electron pairs are shared between carbon atoms in a molecule that has the formula C_2H_4 ?

- A) 1
- B) 2
- C) 3
- D) 4

Answer: B

Bloom's Taxonomy: Application/Analysis

Section: 2.3

34) Which bond or interaction would be difficult to disrupt when compounds are put into water?

- A) covalent bonds between carbon atoms
- B) hydrogen bonds
- C) ionic bonds
- D) ionic and hydrogen bonds

Answer: A

Bloom's Taxonomy: Application/Analysis

Section: 2.3

35) Water molecules are attracted to one another by _____.

- A) nonpolar covalent bonds
- B) ionic bonds
- C) hydrogen bonds
- D) hydrophobic interactions

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

36) Van der Waals interactions may result when _____.

- A) electrons are not symmetrically distributed in a molecule
- B) molecules held by ionic bonds react with water
- C) two polar covalent bonds react
- D) a hydrogen atom loses an electron

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

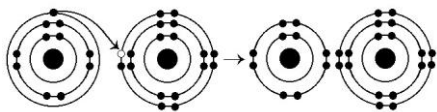
37) What is the maximum number of hydrogen atoms that can be covalently bonded in a molecule containing two carbon atoms?

- A) 2
- B) 4
- C) 6
- D) 8

Answer: C

Bloom's Taxonomy: Application/Analysis

Section: 2.3



38) What results from the chemical reaction illustrated above? The reactants have no charge.

- A) a cation with a net charge of +1 and an anion with a net charge of +1
- B) a cation with a net charge of -1 and an anion with a net charge of -1
- C) a cation with a net charge of -1 and an anion with a net charge of +1
- D) a cation with a net charge of +1 and an anion with a net charge of -1

Answer: D

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

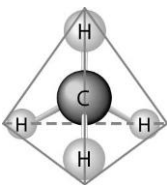
39) What is the atomic number of the cation formed in the reaction illustrated above?

- A) 8
- B) 10
- C) 11
- D) 16

Answer: C

Bloom's Taxonomy: Application/Analysis

Section: 2.3



40) What causes the shape of the molecule shown above?

- A) the shape of the 2 *p* orbitals in the carbon atom
- B) the shape of the 1 *s* orbital in the carbon atom
- C) the shape of the *sp*³ hybrid orbitals of the electrons shared between the carbon and hydrogen atoms
- D) hydrogen bonding configurations between the carbon and hydrogen atoms

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

41) How many electrons are involved in a single covalent bond?

- A) one
- B) two
- C) three
- D) four

Answer: B

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

42) How many electrons are involved in a double covalent bond?

- A) one
- B) two
- C) three
- D) four

Answer: D

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

43) If an atom has a charge of +1, which of the following must be true?

- A) It has two more protons than neutrons.
- B) It has the same number of protons as electrons.
- C) It has one more electron than it does protons.
- D) It has one more proton than it does electrons.

Answer: D

Bloom's Taxonomy: Application/Analysis

Section: 2.3

44) Elements found on the left side of the periodic table contain outer shells that are _____; these elements tend to form _____ in solution.

- A) almost empty; cations
- B) almost empty; anions
- C) almost full; cations
- D) almost full; anions

Answer: A

Bloom's Taxonomy: Application/Analysis

Section: 2.3

45) An atom has four electrons in its valence shell. What types of covalent bonds is it capable of forming?

- A) single, double, or triple
- B) single and double only
- C) single bonds only
- D) double bonds only

Answer: A

Bloom's Taxonomy: Application/Analysis

Section: 2.3

46) When are atoms most stable?

- A) when they have the fewest possible valence electrons
- B) when they have the maximum number of unpaired electrons
- C) when all of the electron orbitals in the valence shell are filled
- D) when all electrons are paired

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

47) When the atoms involved in a covalent bond have the same electronegativity, what type of bond results?

- A) an ionic bond
- B) a hydrogen bond
- C) a nonpolar covalent bond
- D) a polar covalent bond

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

48) Nitrogen (N) normally forms three covalent bonds with a valence of 5. However, ammonium has four covalent bonds, each to a different hydrogen (H) atom (H has a valence of 1). What do you predict to be the charge on ammonium?

- A) +1
- B) -1
- C) +2
- D) -2

Answer: A

Bloom's Taxonomy: Application/Analysis

Section: 2.3

49) You need to write down information about a molecule, but need to indicate only the type and number of atoms it contains. Which representation would work best?

- A) molecular formula
- B) structural formula
- C) ball-and-stick model
- D) space-filling model

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

50) You need to represent a molecule to best illustrate the relative sizes of the atoms involved and their interrelationships. Which representation would work best?

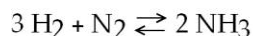
- A) molecular formula
- B) structural formula
- C) ball-and-stick model
- D) space-filling model

Answer: D

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.3

51) Which of the following is true for this reaction?



- A) The reaction is nonreversible.
- B) Hydrogen and nitrogen are the reactants of the reverse reaction.
- C) Ammonia is being formed and decomposed simultaneously.
- D) Only the forward or reverse reactions can occur at one time.

Answer: C

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.4

52) Which of the following correctly describes all chemical equilibrium?

- A) Forward and reverse reactions continue with no net effect on the concentrations of the reactants and products.
- B) Concentrations of products are higher than the concentrations of the reactants.
- C) There are equal concentrations of products and reactants while forward and reverse reactions continue.
- D) There are equal concentrations of reactants and products, and the reactions have stopped.

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.4

53) Which of the following correctly describes a reaction that has reached chemical equilibrium?

- A) The rate of the forward reaction is equal to the rate of the reverse reaction.
- B) All of the reactants have been converted to the products of the reaction.
- C) All of the products have been converted to the reactants of the reaction.
- D) Both the forward and the reverse reactions have stopped, with no net effect on the concentration of the reactants and the products.

Answer: A

Bloom's Taxonomy: Knowledge/Comprehension

Section: 2.4