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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) H_2O, O_2, and CH_4
B) H_2O and O_2
C) O_2 and CH_4
D) H_2O and CH_4, but not O_2
Answer: D
Bloom's Taxonomy: Application/Analysis
Section: 2.1

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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

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

Atom 1	Atom 2
$^{1}_{1}H$	$^{3}_{1}H$

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 valance shell.
Answer: A
Bloom's Taxonomy: Application/Analysis
Section: 2.2

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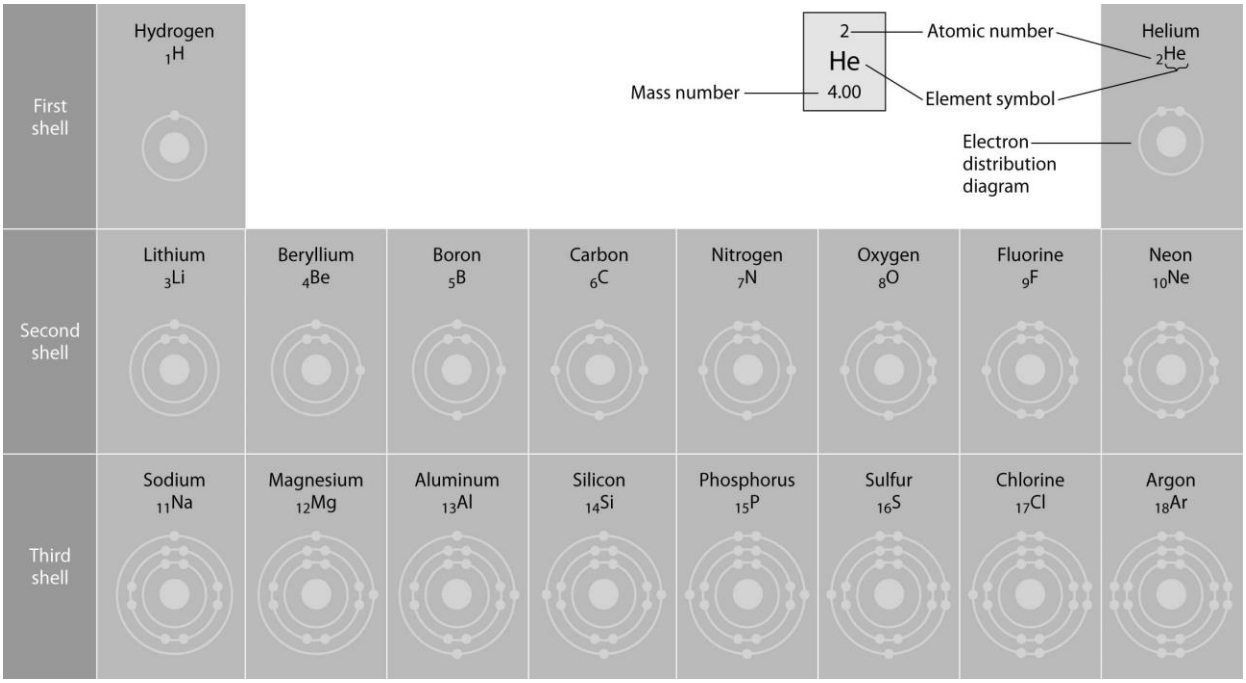
13) Magnesium has an atomic number of 12. What is the most stable charge for a magnesium ion?
A) a +1 charge
B) a +2 charge
C) a -1 charge
D) a -2 charge
Answer: B
Bloom's Taxonomy: Application/Analysis
Section: 2.2

Refer to the following figure to answer the questions below.



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

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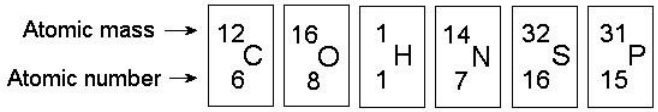

15) How many neutrons are present in the nucleus of a phosphorus-32 (^{32}P) atom (see the figure above)?
A) 15
B) 16
C) 17
D) 32
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

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
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Section: 2.2

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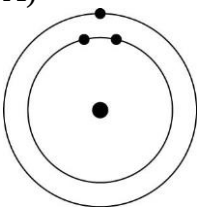
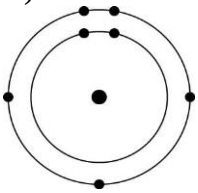
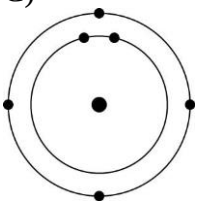
18) Which one of the atoms shown would be most likely to form a cation with a charge of +1?
A)



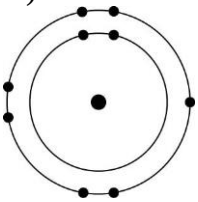
B)



C)



D)



Answer: A
Bloom's Taxonomy: Application/Analysis
Section: 2.2

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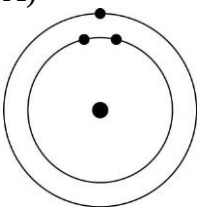
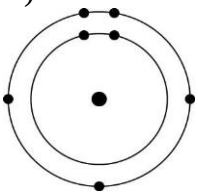
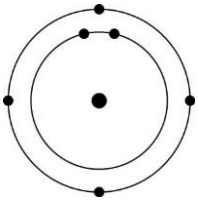
19) Which one of the atoms shown would be most likely to form an anion with a charge of -1?
A)



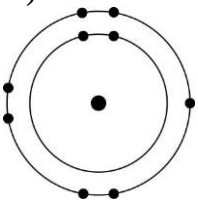
B)



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
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Section: 2.2

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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

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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 (NH_3)?
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

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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) $MgCl_2$
C) Mg_2Cl
D) $MgCl_3$
Answer: B
Bloom's Taxonomy: Application/Analysis
Section: 2.3

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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

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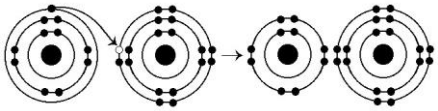
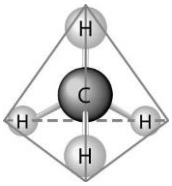


38) What results from the chemical reaction illustrated above? The reactants have no charge.
A) a cation with a net charge of +1 and an anion with a net charge of +1
B) a cation with a net charge of -1 and an anion with a net charge of -1
C) a cation with a net charge of -1 and an anion with a net charge 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

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42) How many electrons are involved in a double covalent bond?
A) one
B) two
C) three
D) four
Answer: D
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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

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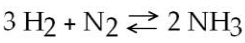
51) Which of the following is true for this reaction?



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

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