***Campbell Biology, 11e* (Urry)**
Chapter 2 The Chemical Context of Life

2.1 Multiple-Choice Questions

1) About 25 of the 92 natural elements are known to be essential to life. Which 4 of these 25 elements make up approximately 96% 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 TRUE?
A) Carbon, hydrogen, oxygen, and calcium 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) A patient suffering from a goiter should not consume seafood.
Answer: B
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

5) Atoms have no electric charge because they have _____.
A) uncharged neutrons in their nuclei
B) an equal number of protons and neutrons
C) an equal number of protons and electrons
D) an equal number of charged and uncharged subatomic particles
Answer: C
Bloom's Taxonomy: Application/Analysis
Section: 2.2

6) An ion with six protons, seven neutrons, and a charge of 2+ has an atomic number of _____.
A) four
B) five
C) six
D) seven
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. 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-14 has the same _____.
A) atomic number and atomic mass as carbon-12
B) atomic number and thus number of neutrons as carbon-13
C) atomic mass as both carbon-12 and carbon-13
D) number of protons but more neutrons than carbon-12
Answer: D
Bloom's Taxonomy: Application/Analysis
Section: 2.2

9) A(n) _____ has charge but negligible mass, whereas a(n) _____ has mass but no charge.
A) proton; neutron
B) neutron; proton
C) neutron; electron
D) electron; neutron
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

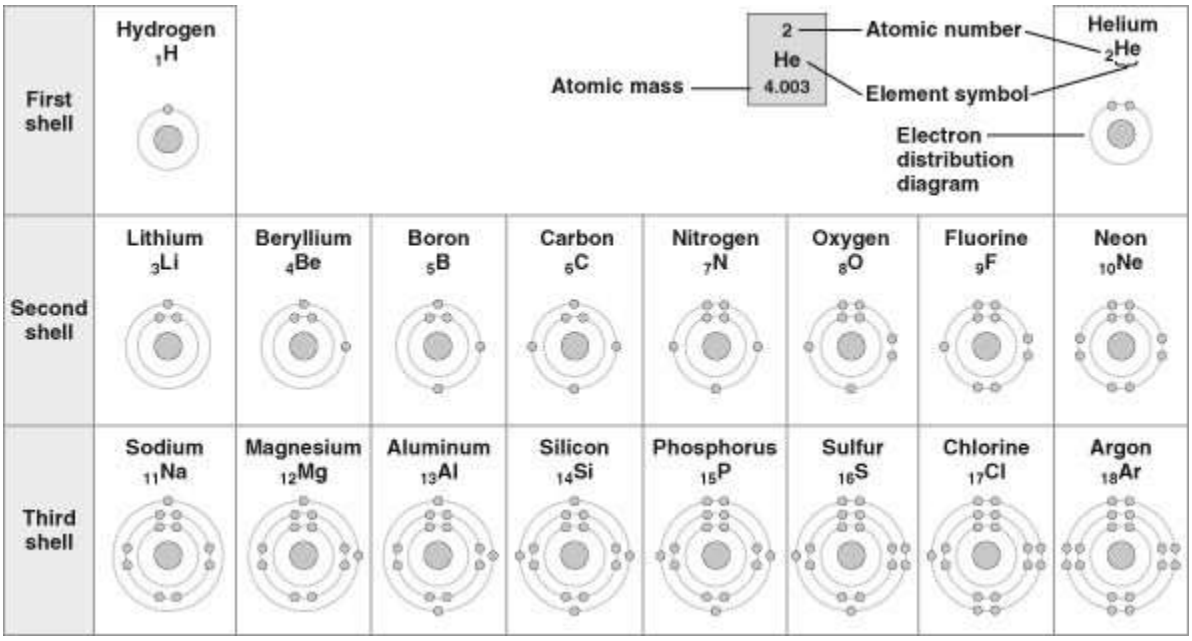
10) The atomic number of nitrogen is 7. Nitrogen-15 has a greater mass number than nitrogen-14 because the atomic nucleus of nitrogen-15 contains _____.
A) 7 neutrons
B) 8 neutrons
C) 8 protons
D) 15 protons
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

11) The left to right order of elements in the periodic table is based on their _____.
A) atomic mass
B) atomic number
C) electric charge of the atom
D) the number of neutrons
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

12) A neutral atom has two, eight, eight electrons in its first, second, and third energy levels. This information _____.
A) does not tell us about the atomic number of the element
B) does not tell us about the chemical properties of the element
C) does not tell us about the atomic mass of the element
D) does not tell us about the size of the element
Answer: C
Bloom's Taxonomy: Application/Analysis
Section: 2.2

13) In a chemical reaction, the element ^{13}Al will most preferably _____.
A) lose three electrons and become positively charged
B) gain five electrons and become negatively charged
C) lose five electrons and become positively charged
D) gain three electrons and become positively charged
Answer: A
Bloom's Taxonomy: Application/Analysis
Section: 2.2

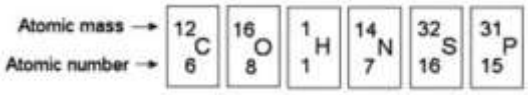
Refer to the following figure (first three rows of the periodic table) to answer the questions below.



14) What element does not prefer to react with other elements?
A) hydrogen
B) helium
C) beryllium
D) both hydrogen and beryllium
Answer: B
Bloom's Taxonomy: Synthesis/Evaluation
Section: 2.2

15) Which pair of elements would likely have similar valency and thus similar chemical behavior?
A) nitrogen and phosphorus
B) carbon and nitrogen
C) sodium and chlorine
D) hydrogen and helium
Answer: A
Bloom's Taxonomy: Application/Analysis
Section: 2.2

Refer to the following figure to answer the questions below.



16) How many electrons are present in a Phosphorus 3+ atom?
A) 16
B) 12
C) 19
D) 34
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

17) How many electrons will a single atom of sulfur with no charge and no bonds have in its valence shell?
A) 6
B) 8
C) 16
D) 32
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

18) 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

19) Elements ^{72}Zn, ^{75}As, and ^{74}Ge have the _____.
A) same number of protons
B) same number of protons and electrons
C) same number of neutrons
D) same number of neutrons and electrons
Answer: C
Bloom's Taxonomy: Synthesis/Evaluation
Section: 2.2

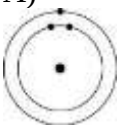
20) Can the atomic mass of an element vary?
A) No, it is fixed; otherwise a new element will be formed.
B) Yes. Adding or losing electrons will substantially change the atomic mass.
C) Yes. Adding or losing protons will change the atomic mass without forming a different element.
D) Yes. Adding or losing neutrons will change the atomic mass without forming a different element.
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

21) 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

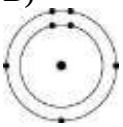
22) When are atoms most stable?
A) when they have the fewest possible valence electrons
B) when they have the maximum number of unpaired electrons
C) when all of the electron orbitals in the valence shell are filled
D) when all electrons are paired
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.2

23) 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

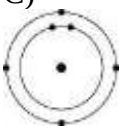
24) Which one of the atoms shown would be most likely to form a cation with a charge of +1?
A)



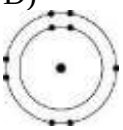
B)



C)

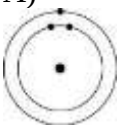


D)

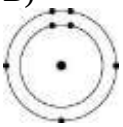


Answer: A
Bloom's Taxonomy: Application/Analysis
Section: 2.3

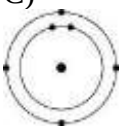
25) Which one of the atoms shown would be most likely to form an anion with a charge of -1?
A)



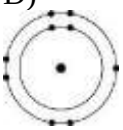
B)



C)



D)



Answer: D
Bloom's Taxonomy: Application/Analysis
Section: 2.3

26) 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

27) 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

28) 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

29) 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

30) In the following structure where A and B represent two different elements, the valency of A is _____ and B is _____.

A) one; three
B) one; five
C) three; five
D) eight; eight
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.3

31) 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 of the same elements
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.3

32) 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

33) 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

34) How many electron pairs are shared between carbon atoms in a molecule that has the formula C_2H_4?
A) one
B) two
C) three
D) four
Answer: B
Bloom's Taxonomy: Application/Analysis
Section: 2.3

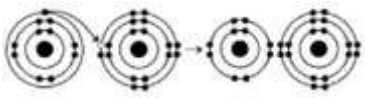
35) Which bond or interaction would be difficult to disrupt when compounds are put into water?
A) covalent bonds between carbon atoms
B) hydrogen bonds
C) ionic bonds
D) ionic and hydrogen bonds
Answer: A
Bloom's Taxonomy: Application/Analysis
Section: 2.3

36) Which of the following is broken when water evaporates?
A) nonpolar covalent bonds
B) ionic bonds
C) hydrogen bonds
D) polar covalent bonds
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.3

37) 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

38) What is the maximum number of hydrogen atoms that can be covalently bonded in a molecule containing two carbon atoms?
A) two
B) four
C) six
D) eight
Answer: C
Bloom's Taxonomy: Application/Analysis
Section: 2.3

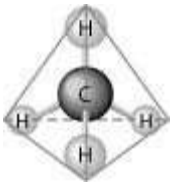
Refer to the following figure to answer the questions below.



39) What results from the chemical reaction in the illustration? 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

40) What is the atomic number of the cation formed in the reaction in the illustration?
A) 8
B) 10
C) 11
D) 16
Answer: C
Bloom's Taxonomy: Application/Analysis
Section: 2.3

Refer to the following figure to answer the questions below.



41) What causes the shape of the molecule shown?
A) the shape of the two *p* orbitals in the carbon atom
B) the shape of the one *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

42) How many electrons are involved in a triple covalent bond?
A) 3
B) 6
C) 9
D) 12
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.3

43) Based on electron configuration, which of the elements in the figure 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

44) 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

45) 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

46) 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

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 five. However, ammonium has four covalent bonds, each to a different hydrogen (H) atom (H has a valence of one). 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 are asked to indicate the type and number of atoms in a molecule. 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) How is a single covalent bond formed?
A) Two atoms share two pairs of electrons.
B) Two atoms share two electrons.
C) Two atoms share one electron.
D) One atom loses a pair of electrons to the other.
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.3

Refer to the following figure to answer the questions below.

$3H_2 + N_2 \rightleftharpoons 2NH_3$

51) Which of the following is true for the 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 factors will increase the rate of reaction in the forward direction?
A) addition of nitrogen
B) addition of ammonia
C) addition of hydrogen
D) addition of both nitrogen and hydrogen
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Section: 2.4

53) Which of the following correctly describes *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

2.2 Student Edition End-of-Chapter Questions

1) In the term *trace element*, the adjective *trace* means that
A) the element is required in very small amounts.
B) the element can be used as a label to trace atoms through an organism's metabolism.
C) the element is very rare on Earth.
D) the element enhances health but is not essential for the organism's long-term survival.
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension

2) Compared with ^{31}P, the radioactive isotope ^{32}P has
A) a different atomic number.
B) one more proton.
C) one more electron.
D) one more neutron.
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension

3) The reactivity of an atom arises from
A) the average distance of the outermost electron shell from the nucleus.
B) the existence of unpaired electrons in the valence shell.
C) the sum of the potential energies of all the electron shells.
D) the potential energy of the valence shell.
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension

4) Which statement is true of all atoms that are anions?
A) The atom has more electrons than protons.
B) The atom has more protons than electrons.
C) The atom has fewer protons than does a neutral atom of the same element.
D) The atom has more neutrons than protons.
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension

5) Which of the following statements correctly describes any chemical reaction that has reached equilibrium?
A) The concentrations of products and reactants are equal.
B) The reaction is now irreversible.
C) Both forward and reverse reactions have halted.
D) The rates of the forward and reverse reactions are equal.
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension

6) We can represent atoms by listing the number of protons, neutrons, and electrons—for example, $2p^+$, $2n^0$, $2e^-$ for helium. Which of the following represents the ^{18}O isotope of oxygen?
A) $7p^+$, $2n^0$, $9e^-$
B) $8p^+$, $10n^0$, $8e^-$
C) $9p^+$, $9n^0$, $9e^-$
D) $10p^+$, $8n^0$, $9e^-$
Answer: B
Bloom's Taxonomy: Application/Analysis

7) The atomic number of sulfur is 16. Sulfur combines with hydrogen by covalent bonding to form a compound, hydrogen sulfide. Based on the number of valence electrons in a sulfur atom, predict the molecular formula of the compound.
A) HS
B) HS_2
C) H_2S
D) H_4S
Answer: C
Bloom's Taxonomy: Application/Analysis

8) What coefficients must be placed in the following blanks so that all atoms are accounted for in the products?

$C_6H_{12}O_6 \rightarrow$ _____ C_2H_6O + _____ CO_2

A) 2; 1
B) 3; 1
C) 1; 3
D) 2; 2
Answer: D
Bloom's Taxonomy: Application/Analysis