Section: Matter

1. What is matter?

2. What does mass mean?

PROPERTIES OF MATTER

3. What are two types of properties of matter?
   a. physical and atomic
   b. chemical and magnetic
   c. physical and chemical
   d. chemical and mental

4. What kind of properties can be observed without changing the composition of the substance?
   a. chemical
   b. physical
   c. magnetic
   d. atomic

5. Which of the following are all physical properties of matter?
   a. density, color, hardness
   b. density, reactions, hardness
   c. chemistry, freezing point, color
   d. lightness, electrons, boiling point

6. The properties that describe how a substance reacts with other substances to produce different substances are
   a. chemical properties.
   b. physical properties.
   c. magnetic properties.
   d. atomic properties.
7. When iron reacts with oxygen to form rust, the reaction is an example of a
   a. physical property of oxygen.
   b. magnetic property of oxygen.
   c. chemical property of iron.
   d. physical property of iron.

8. Which of the following is a chemical property of helium?
   a. Helium does not react with other substances but does form new substances.
   b. Helium reacts with other substances but does not form new substances.
   c. Helium reacts with other substances to form new substances.
   d. Helium does not react with other substances to form new substances.

9. A substance that cannot be broken down into simpler, stable substances by chemical means is
   a. an element.
   b. an atom.
   c. matter.
   d. mass.

10. What does each element have that can be used to identify it?
    a. a group of chemicals and atoms
    b. a group of compounds
    c. a characteristic set of physical and chemical properties
    d. a characteristic set of magnetic properties

11. About how many elements occur naturally on Earth?
    a. more than 1,000
    b. more than 90
    c. more than 900
    d. more than 9,000

12. About how many elements have been created in laboratories?
    a. about 36
    b. about 12
    c. about 60
    d. about 24

13. How many elements make up 98% of Earth’s crust?
    a. two
    b. four
    c. eight
    d. six
14. What is an atom?
   a. the smallest unit of an element
   b. the smallest unit of oxygen
   c. the smallest unit of matter
   d. the smallest unit in the universe

15. How many atoms lined up side by side would equal the thickness of a book page?
   a. about a hundred
   b. more than a million
   c. less than a hundred thousand
   d. less than a thousand

ATOMIC STRUCTURE

16. Atoms are made up of smaller parts called
   a. elemental particles.
   b. subatomic particles.
   c. material particles.
   d. energy particles.

17. What are the three major kinds of subatomic particles?
   a. matter, energy, elements
   b. atoms, elements, subtrons
   c. nucleus, positrons, magnitrons
   d. protons, electrons, neutrons

In the space provided, write the letter of the definition that best matches the term or phrase.

18. protons
   a. particles that have a negative charge
   b. particles that have no charge
   c. particles that have a positive charge

19. electrons
   a. particles that have a negative charge
   b. particles that have no charge
   c. particles that have a positive charge

20. neutrons

21. What is the nucleus of an atom?

22. Why does the nucleus of an atom have a positive charge?
23. How much of an atom’s mass does the nucleus make up?

__________________________________________________________________________

24. How much of an atom's volume does the nucleus make up?

__________________________________________________________________________

25. What makes up most of the volume of an atom?

__________________________________________________________________________

26. What is an electron cloud?

__________________________________________________________________________

27. Why are electrons attracted to the nucleus of an atom?

__________________________________________________________________________

28. What holds the electrons in an atom?

__________________________________________________________________________

ATOMIC NUMBER

29. What is the atomic number of an element?
   a. the number of neutrons in the nucleus of the atom
   b. the number of protons and neutrons in the nucleus of the atom
   c. the number of protons in the nucleus of the atom
   d. the number of electrons in the nucleus of an atom

30. An uncharged atom has an equal number of
   a. neutrons and electrons.
   b. protons and electrons.
   c. protons and neutrons.
   d. protons, electrons, and neutrons.

31. The atomic number of an uncharged atom is also equal to
   a. the number of its neutrons.
   b. the number of its subatomic particles.
   c. the number of its elements.
   d. the number of its electrons.
Directed Reading continued

____ 32. Elements on the periodic table are ordered according to
   a. their weight.
   b. their atomic numbers.
   c. their mass.
   d. their number of neutrons.

____ 33. The periodic table is a system for
   a. classifying neutrons.
   b. classifying chemicals.
   c. classifying elements.
   d. classifying matter.

____ 34. Elements in the same column on the periodic table have similar arrangements of what?
   a. electrons in their atoms
   b. protons in their atoms
   c. neutrons in their atoms
   d. positrons in their atoms

____ 35. Elements that have similar arrangements of electrons also have
   a. similar numbers of neutrons.
   b. similar chemical properties.
   c. similar elemental properties.
   d. similar physical properties.

ATOMIC MASS

____ 36. What is the mass number of an atom?
   a. the sum of its protons and electrons
   b. the sum of its protons, electrons, and neutrons
   c. the sum of its neutrons and electrons
   d. the sum of its protons and neutrons

____ 37. Since the mass of a subatomic particle is too small to be expressed easily in grams, what special unit is used?
   a. atomic matter unit (amu)
   b. elemental mass unit (emu)
   c. atomic mass unit (amu)
   d. subatomic mass unit (smu)

____ 38. Which subatomic particles each have an atomic mass unit close to 1?
   a. electrons and neutrons
   b. protons and neutrons
   c. protons and electrons
   d. electrons and positrons
____ 39. The mass of one proton is equal to the combined mass of how many electrons?
   a. less than 1  
   b. about 184  
   c. about 1,840  
   d. much more than 1,840

____ 40. When calculating an atom’s approximate mass, how is the mass of electrons figured?
   a. It is ignored.  
   b. It is figured at 1 over 1,840.  
   c. It is figured at 1 for every proton.  
   d. It is figured at 1,840 for every proton.

____ 41. Although all atoms of the same element contain the same number of protons, the number of its?
   a. neutrons may differ.  
   b. neutrons is always smaller.  
   c. positrons may differ.  
   d. electrons may differ.

____ 42. Which of the following is true of atoms of helium?
   a. All have two neutrons, but some have only one electron.  
   b. Most have two neutrons, but some have only one neutron.  
   c. Most have one proton, but some have only one neutron.  
   d. All have one neutron, but some have only one proton.

____ 43. An atom with the same number of protons as other atoms?
   a. has a different atomic number.  
   b. has no mass.  
   c. has no atomic number.  
   d. has the same atomic number.

44. What is an isotope?

45. How does a helium atom that has two neutrons compare with a helium atom that has only one neutron?
**Directed Reading continued**

46. Why do different isotopes of the same element have slightly different properties?

THE PERIODIC TABLE OF ELEMENTS

47. What is the atomic number of hydrogen?
   - a. 2
   - b. 3
   - c. 1
   - d. 6

48. What is the symbol of hydrogen?
   - a. C
   - b. H
   - c. He
   - d. 1

49. What is the atomic number of sodium?
   - a. 1
   - b. 6
   - c. 11
   - d. 0

50. What is the name of the element that has the symbol Ca?
   - a. Cesium
   - b. Californium
   - c. Cobalt
   - d. Calcium

51. What is the symbol of iron?
   - a. I
   - b. Ir
   - c. Fe
   - d. F
52. What is the atomic number of iron?
   a. 26
   b. 8
   c. 55
   d. 4

53. What is the symbol of uranium?
   a. Ur
   b. U
   c. Fe
   d. Um

54. What is the atomic number of uranium?
   a. 92
   b. 28
   c. 238
   d. 7

55. In the space provided, write the letter of the atomic number that matches the element on the periodic table.

   55. helium
   a. 8
   56. carbon
   b. 10
   57. nitrogen
   c. 6
   58. oxygen
   d. 16
   59. neon
   e. 13
   60. aluminum
   f. 2
   61. sulfur
   g. 17
   62. chlorine
   h. 7

63. Why does the periodic table use an average atomic mass for each element?

   ____________________________________________

64. What does average atomic mass mean?

   ____________________________________________
65. How many naturally occurring isotopes of hydrogen are there?

66. Why does each isotope of hydrogen have a mass number different from the others?

67. How can you determine the average atomic mass of hydrogen?

68. What is the average atomic mass of hydrogen, as noted in the periodic table?

VALENCE ELECTRONS AND PERIODIC PROPERTIES

69. Elements are arranged in columns on the period table based on what?
   a. similarities in their physical properties
   b. similarities in their chemical properties
   c. differences in their physical properties
   d. differences in their chemical properties

70. What are columns called on the periodic table?
   a. properties
   b. rows
   c. valences
   d. groups

71. The number of outermost electrons in an atom’s electron cloud largely determine an atom’s
   a. chemical properties.
   b. physical properties.
   c. magnetic properties.
   d. atomic properties.

72. What are the outermost electrons in an atom’s electron cloud called?
   a. atomic electrons
   b. nuclear electrons
   c. valence electrons
   d. periodic electrons
____ 73. Within each group on the periodic table, the atoms of each element generally have
   a. the same physical properties.
   b. different chemical properties.
   c. the same number of valence atoms.
   d. the same atomic numbers.

____ 74. How many valence electrons do atoms of elements in Groups 3–12 have?
   a. 3 or more
   b. 2 or more
   c. only 1
   d. 1 or 2

75. In groups 13–18 on the periodic table, what is the number of valence electrons in each atom?

76. What is true of an atom that has 8 valence electrons?

77. What is true of elements whose atoms have 1, 2, or 3 valence electrons?

78. What is the main difference between metals and nonmetals?
Section: Combinations of Atoms

1. What is true of the elements found in Earth’s crust?
   a. They usually occur in pure form.
   b. They generally occur in combination with other elements.
   c. They usually do not occur in combination with other elements.
   d. They generally occur in pure form, but in combination with other elements.

2. What is a compound?
   a. a substance made of two or more elements joined by chemical bonds between the atoms of those elements
   b. a substance made of a single element joined by chemical bonds between the atoms of that element
   c. a substance made of thousands of elements joined by chemical bonds between the atoms of those elements
   d. a substance made of two or more subatomic particles joined by physical bonds

3. The properties of a compound are
   a. the same as those of the elements that make up the compound.
   b. physically similar to the elements of the compound.
   c. chemically similar to the elements of the compound.
   d. different from those of the elements that make up the compound.

Molecules

4. The smallest unit of matter that can exist by itself and retain all of a substance’s chemical properties is a(n)
   a. mixture.
   b. atom.
   c. molecule.
   d. element.

5. In a molecule of two or more atoms, how are the atoms connected?
   a. The atoms are chemically bonded together.
   b. Magnetism connects the atoms.
   c. The atoms are physically mixed.
   d. Electrostatic energy bonds the atoms together.
6. Molecules that are made up of only two atoms are called
   a. subatomic particles.
   b. diatomic molecules.
   c. isotopes.
   d. chemical formulas.

7. What does O₂ mean?
   a. It means a diatomic molecule with 2 parts.
   b. It means an oxygen compound with 2 parts.
   c. It means a mixture of 2 parts oxygen.
   d. O is the symbol for oxygen; the subscript 2 is the number of oxygen atoms bonded together.

CHEMICAL FORMULAS

8. In any compound, the elements that make up the compound
   a. occur in different relative proportions.
   b. occur in the same relative proportions.
   c. do not occur in measurable proportions.
   d. do not occur in the same relative proportions.

9. What is a chemical formula?
   a. a combination of letters and numbers that shows which elements make up a compound
   b. the numbers used to show how many chemical and physical bonds a molecule has
   c. a combination of subscripts and letters that shows which electrons make up a mixture
   d. the letters used to show how many chemical and physical bonds a molecule has

10. What does the chemical formula H₂O mean?
    a. Each water molecule has one atom of hydrogen and one atom of oxygen.
    b. Each water molecule has one atom of hydrogen and two atoms of oxygen.
    c. Each water molecule has two atoms of hydrogen and two atoms of oxygen.
    d. Each water molecule has two atoms of hydrogen and one atom of oxygen.

11. In a chemical formula, what does a subscript that follows the symbol for a element indicate?
    a. half the number of atoms of that element in the molecule
    b. the number of atoms of that element in the molecule
    c. double the number of atoms of that element in the molecule
    d. the number of molecules of that element in an atom
12. How do elements and compounds form new compounds?
   a. by being heated and melting together
   b. by combining through physical reactions
   c. by combining through chemical reactions
   d. by dividing through chemical reactions

13. What is a chemical equation?
   a. a formula that describes the physical reaction of elements and compounds combining to form new compounds
   b. a formula that describes the chemical reaction of elements that do not combine to form new compounds
   c. a formula that describes the chemical reaction of elements and compounds combining to form new compounds
   d. a formula that describes the physical reaction of compounds that do not combine to form new compounds

14. In a chemical equation, what is shown on the left-hand side of the arrow?
   a. the reactions
   b. the products
   c. the molecules
   d. the reactants

15. In a chemical equation, what is shown on the right-hand side of the arrow?
   a. the reactions
   b. the products
   c. the molecules
   d. the reactants

16. What does the arrow in a chemical reaction mean?
   a. “gives” or “yields”
   b. “gives” and “takes”
   c. “takes” or “yields”
   d. “takes” or “makes”

17. Explain the equation \( \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \).

18. When is a chemical equation balanced?

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19. Why can you not change chemical formulas to balance an equation?

20. What are coefficients?

21. In the equation CH₄ + 2O₂ → CO₂ + 2H₂O, what is the coefficient in 2H₂O? How is the coefficient used?

22. In the equation CH₄ + 2O₂ → CO₂ + 2H₂O, how is the coefficient in 2O₂ used?

CHEMICAL BONDS

23. What are chemical bonds?
   a. the forces that hold the molecules in atoms together
   b. the forces that hold the subatomic particles within molecules together with other molecules
   c. the forces that hold the subatomic particles in atoms within molecules together
   d. the forces that hold the atoms within molecules together

24. Chemical bonds form because of
   a. the transmutation of energy.
   b. the attraction between positive and negative charges.
   c. the change of matter into energy.
   d. positive and negative charges repelling each other.
### Directed Reading continued

_____ 25. How do atoms form chemical bonds?
  a. by combining protons
  b. by either transferring or sharing neutrons
  c. by either transferring or sharing valence electrons
  d. by either combining or rearranging valence electrons

_____ 26. What is the result of variations in the forces that hold molecules together?
  a. a wide range of physical and chemical properties
  b. a wide range of behavioral difficulties
  c. a narrow range of physical and chemical properties
  d. virtually nothing

_____ 27. When scientists study the interactions of atoms, what can they predict?
  a. how long it takes for chemical bonds to form
  b. how subatomic particles will split apart to form other atoms
  c. which kinds of atoms will form chemical bonds together
  d. the weather

_____ 28. How many valence electrons can a hydrogen atom have?
  a. 1
  b. 2
  c. 3
  d. 4

_____ 29. How can hydrogen reach a more chemically unreactive state?
  a. by splitting
  b. by fusing
  c. by giving up or accepting another proton
  d. by giving up or accepting another electron

_____ 30. What happens when an electron is transferred from one atom to another?
  a. Only the atom that accepts the electron becomes charged; the other becomes neutral.
  b. Only the atom that gave up the electron becomes charged; the other becomes neutral.
  c. Both atoms lose their charge.
  d. Both atoms become charged.

_____ 31. What is an ion?
  a. an atom or molecule that has a neutral charge
  b. an atom or molecule that carries a negative or positive charge
  c. an atom that has at least one extra neutron
  d. an atom that has at least one extra proton
32. How many electrons do neutral sodium atoms have?
   a. 1
   b. 11
   c. 8
   d. 2

33. How many valence electrons does a sodium atom have?
   a. 8
   b. 11
   c. 1
   d. 2

34. If a neutral sodium atom loses its outermost electron, how many electrons are now in its outermost electron cloud?
   a. 8
   b. 2
   c. 11
   d. 1

35. When an atom gives up an electron and no longer has a balance between positive and negative charges, what does it become?
   a. a molecule
   b. an isotope
   c. neutral
   d. an ion

36. When a sodium atom releases its valence electron, what does it become?
   a. a proton
   b. a sodium isotope
   c. a positive sodium ion
   d. a negative sodium ion

37. If a neutral chlorine atom accepts an electron, what happens?
   a. It now has 8 valence electrons, and it becomes a chemically unstable, positively charged chloride ion.
   b. It now has 7 valence electrons, and it becomes a chemically unstable, negatively charged chloride ion.
   c. It now has 8 valence electrons, and it becomes a chemically stable, negatively charged chloride ion.
   d. It now has 7 valence electrons, and it becomes a chemically stable, positively charged chloride ion.
38. What is an ionic bond?
   a. the force between charged ions that results from neutron transfer between atoms
   b. the opposing force between uncharged ions
   c. the attractive force between ions with the same charge
   d. the attractive force between oppositely charged ions

39. An ionic compound is formed through the transfer of
   a. electrons.
   b. protons.
   c. neutrons.
   d. energy.

40. When are most ionic compounds formed?
   a. when electrons are transferred between atoms of metallic elements
   b. when neutrons are transferred between atoms of metallic and nonmetallic elements
   c. when electrons are transferred between atoms of metallic and nonmetallic elements
   d. when electrons are transferred between atoms of nonmetallic elements

41. Sodium chloride is composed of
   a. negatively charged sodium ions and positively charged chloride ions.
   b. positively charged sodium ions and negatively charged chloride ions.
   c. positively charged sodium ions and chloride ions.
   d. negatively charged sodium ions and chloride ions.

42. What is a covalent bond?

43. If atoms are sharing electrons, what happens to the positive nucleus of each atom?
44. What force keeps atoms that share electrons joined?

45. What is a covalent compound?

46. How do two atoms of hydrogen combine with one atom of oxygen to form a water molecule?

47. Why would atoms that are covalently bonded not share electrons equally?

48. What is a polar covalent bond?

49. Explain how water is an example of a molecule that forms because of polar covalent bonds.
50. What is caused by a water molecule’s slightly negative charge at its oxygen end and the slightly positive charge at its hydrogen end?

MIXTURES

51. What is a mixture?
   a. a combination of five or more substances that are not chemically combined
   b. a combination of two or more substances that are chemically combined
   c. a combination of two or more substances that are not chemically combined
   d. a combination of 10 or more substances that are chemically combined

52. The substances that make up a mixture
   a. keep their individual properties.
   b. lose their individual properties.
   c. combine chemically.
   d. lose their individual chemical properties.

53. Unlike a compound, a mixture
   a. can be separated into its parts by chemical means.
   b. cannot be separated into its parts by physical means.
   c. cannot be separated into its parts by chemical means.
   d. can be separated into its parts by physical means.

54. To separate a mixture of powdered sulfur, S, and iron, Fe, filings, you can
   a. use chemical means.
   b. use a magnet to attract the iron.
   c. add more chemicals.
   d. pick out the sulfur by hand.

55. What are heterogeneous mixtures?
   a. three or more substances that are uniformly distributed
   b. two or more substances that are not uniformly distributed
   c. three or more substances that cannot be separated by physical means
   d. two or more substances that can be separated by physical means
56. What rock is an example of a heterogeneous mixture of minerals?
   a. limestone  
   b. feldspar  
   c. quartz  
   d. granite

57. What is a homogeneous mixture?

58. What is a homogeneous mixture of two or more substances uniformly dispersed throughout the mixture?

59. What is dissolved in the solution known as sea water?

60. What is happening in sea water on a molecular level, in terms of positive and negative charges?

61. What is an alloy?