Chapter 02: The Structure of Matter
Bushong: Radiologic Science for Technologists: Physics, Biology, and Protection, 11th Edition

MULTIPLE CHOICE

1. The term "atom" was first used by the _____.
   a. Ethiopians
   b. British
   c. Greeks
   d. Romans

   ANS: C
   The term "atom" was first used by the Greeks

   DIF: Moderate REF: p. 27 OBJ: Relate the history of the term "atom."

2. The first person to describe an element as being composed of identical atoms was _____.
   a. J. J. Thomson
   b. John Dalton
   c. Dmitri Mendeleev
   d. Niels Bohr

   ANS: B
   The first person to describe an element as being composed of identical atoms was John Dalton.

   DIF: Moderate REF: p. 27
   OBJ: Name the first person to describe an element as being composed of identical atoms.

3. The smallest particle that has all the properties of an element is a(n) _____.
   a. neutron
   b. proton
   c. electron
   d. atom

   ANS: D
   The smallest particle that has all the properties of an element is an atom.

   DIF: Moderate REF: p. 28 OBJ: Define the atom.

4. The periodic table of the elements was developed by _____ in the late 19th century.
   a. Bohr
   b. Rutherford
   c. Mendeleev
   d. Roentgen

   ANS: C
   The Periodic Table was developed by Mendeleev.

DIF: Moderate REF: p. 28
OBJ: Name the person who developed the periodic table of the elements.

5. Rutherford's experiments in 1911 showed that the atom was composed of _____.
   a. electrons with well-defined orbits
   b. a nucleus with an electron cloud
   c. electrified plum pudding
   d. a ball of hooks and eyes

   ANS: C
   Rutherford's experiments in 1911 showed that the atom was composed of a nucleus with an electron cloud.

   DIF: Moderate REF: p. 29
   OBJ: Relate the history of the Rutherford model of the atom.

6. A positively charged nucleus surrounded by negatively charged electrons in well-defined orbits is the _____ model of the atom.
   a. Bohr
   b. Thomson
   c. Rutherford
   d. Dalton

   ANS: A
   A positively charged nucleus surrounded by negatively charged electrons in well-defined orbits is the Bohr model of the atom.

   DIF: Moderate REF: p. 29
   OBJ: Identify the structure of the Bohr model of the atom.

7. What are the fundamental particles of an atom?
   a. Quark, positron, negatron
   b. Nucleon, electron, proton
   c. Proton, neutron, quark
   d. Proton, electron, neutron

   ANS: D
   The fundamental particles of an atom are the proton, electron, and neutron.

   DIF: Easy REF: p. 29 OBJ: Identify the fundamental particles of an atom.

8. The chemical element is determined by the number of _____ in the atom.
   a. protons
   b. electrons
   c. neutrons
   d. nucleons

   ANS: A
   The chemical element is determined by the number of protons in the atom.

   DIF: Moderate REF: p. 30 OBJ: Describe how a chemical element is determined.

9. An atom in a normal state has an electrical charge of _____.
   a. one
   b. zero
   c. positive
   d. negative

   ANS: B
   An atom in a normal state has an electrical charge of zero.

   DIF: Moderate REF: p. 31
   OBJ: Describe the electrical charge of an atom in a normal state.

10. The binding energies, or energy levels, of electrons are represented by their _____.
    a. atomic numbers
    b. atomic mass units
    c. shells
    d. isotopes

    ANS: C
    The binding energies, or energy levels, of electrons are represented by their shells.

    DIF: Moderate REF: p. 31
    OBJ: Describe binding energies or energy levels of electrons.

11. When an atom has the same number of protons as another, but a different number of neutrons, it is called an _____.
    a. isomer
    b. isobar
    c. isotone
    d. isotope

    ANS: D
    When an atom has the same number of protons as another, but a different number of neutrons, it is called an isotope.

    DIF: Difficult REF: p. 34 OBJ: Describe an isotope.

12. When atoms of various elements combine, they form _____.
    a. isotopes
    b. compounds
    c. molecules
    d. ions

    ANS: C
    When atoms of various elements combine, they form molecules.

    DIF: Moderate REF: p. 36 OBJ: Describe a molecule.

13. An atom that loses or gains one or more electrons is a(n) _____.
    a. ion
    b. molecule

c. isotope
d. isomer

ANS: A
An atom that loses or gains one or more electrons is an ion.

DIF: Moderate REF: p. 31 OBJ: Define an ion.

14. The maximum number of electrons that can exist in an electron shell is calculated with the formula _____.
a. 2n
b. $2n^2$
c. 2/n
d. $2/n^2$

ANS: B
The number of electrons in an electron shell is calculated with the formula $2n^2$.

DIF: Difficult REF: p. 32
OBJ: Identify the formula for the maximum number of electrons that can exist in an electron shell.

15. A neutral atom has the same number of _____ and electrons.
a. quarks
b. neutrinos
c. neutrons
d. protons

ANS: D
A neutral atom has the same number of protons and electrons.

DIF: Easy REF: p. 34
OBJ: Identify the formula for the maximum number of electrons that can exist in an electron shell.

16. The innermost electron shell is symbolized by the letter _____.
a. J
b. K
c. L
d. M

ANS: B
The innermost electron shell is symbolized by the letter K.

DIF: Moderate REF: p. 32
OBJ: Recognize the symbol for the innermost electron shell.

17. The shell number of an atom is called the _____.
a. alpha particle
b. chemical element
c. principal quantum number
d. half-life number

ANS: C
The shell number of an atom is called the principal quantum number.

DIF: Moderate REF: p. 32 OBJ: Define the shell number of an atom.

18. The atomic number of an element is symbolized by the letter _____.
    a. A
    b. X
    c. Z
    d. n

    ANS: C
    The atomic number of an element is symbolized by the letter Z.

    DIF: Moderate REF: p. 34
    OBJ: Identify symbol for the atomic number of an element.

19. Aluminum has an atomic number of 13. How many protons does it have?
    a. 13
    b. 26
    c. 27
    d. None of the above

    ANS: A
    The atomic number equals the number of protons in an atom.

    DIF: Moderate REF: p. 34
    OBJ: Identify the number of protons on an atom based on its atomic number.

20. Two identical atoms which exist at different energy states are called _____.
    a. isotopes
    b. isomers
    c. isotones
    d. isobars

    ANS: B
    Two identical atoms which exist at different energy states are called isomers.

    DIF: Moderate REF: p. 36 OBJ: Define an isomer.

21. The atomic number of molybdenum is 42 and the atomic mass number is 98. How many neutrons does it have?
    a. 42
    b. 98
    c. 21
    d. 56

    ANS: D
    The number of neutrons is equal to A–Z.

    DIF: Difficult REF: p. 36
    OBJ: Identify the number of neutrons in an atom based on its atomic number and atomic mass number.

22. A chemical compound is any quantity of _____.

a. one type of atom
b. one type of molecule
c. two types of molecules
d. two or more types of atoms

ANS: B
A chemical compound is any quantity of one type of molecule.

DIF: Difficult REF: p. 36 OBJ: Describe a compound.

23. During beta emission, an atom releases _____.
a. electrons
b. positrons
c. protons
d. neutrons

ANS: A
During beta emission, an atom releases electrons.

DIF: Moderate REF: p. 37 OBJ: Describe beta emission.

24. The only difference between x-rays and gamma rays is their _____.
a. energy
b. size
c. origin
d. name

ANS: C
The only difference between x-rays and gamma rays is their origin.

DIF: Moderate REF: p. 42
OBJ: Explain the difference between x-rays and gamma rays.

25. The _____ is the least penetrating form of ionizing radiation.
a. beta particle
b. x-ray
c. gamma ray
d. alpha particle

ANS: D
The alpha particle is the least penetrating form of ionizing radiation.

DIF: Moderate REF: p. 41
OBJ: Name the least penetrating form of ionizing radiation.