

Chapter 01: Essential Concepts of Radiologic Science
Bushong: Radiologic Science for Technologists: Physics, Biology, and Protection, 11th Edition

MULTIPLE CHOICE

1. Matter is measured in _____.
- kilograms
 - joules
 - electron volts
 - rems

ANS: A

Matter is measured in kilograms.

DIF: Easy

REF: p. 3

OBJ: Recognize the unit

of measurement for matter.

2. Energy is measured in _____.
- kilograms
 - joules
 - electron volts
 - B or C

ANS: D

Energy is measured in joules or electron volts.

DIF: Moderate

REF: p. 4

OBJ: Recognize the unit of measurement for energy.

3. Atoms and molecules are the fundamental building blocks of _____.
- energy
 - radiation
 - matter
 - gravity

ANS: C

Atoms and molecules are the fundamental building blocks of matter.

DIF: Moderate

REF: p. 3

OBJ: List the fundamental building blocks of matter.

4. Ice and steam are examples of two forms of _____.
- matter
 - radiation
 - energy
 - work

ANS: A

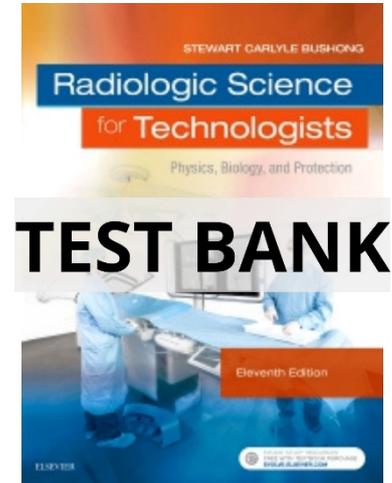
Ice and steam are examples of two forms of matter.

DIF: Difficult

REF: p. 4

OBJ: Describe states of matter.

5. The formula $E=mc^2$ is the basis for the theory that led to the development of _____.



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- a. x-rays
- b. electromagnetic radiation
- c. nuclear power
- d. cathode ray tubes

ANS: C

The formula $E=mc^2$ is the basis for the theory that led to the development of nuclear power.

DIF: Difficult REF: p. 5 OBJ: Understand the theory of energy-mass equivalence.

6. Radio waves, light, and x-rays are all examples of _____ energy.
- a. nuclear
 - b. thermal
 - c. electrical
 - d. electromagnetic

ANS: D

Electromagnetic energy includes radio waves, light, and x-rays as well as other parts of the spectrum.

DIF: Difficult REF: p. 4 OBJ: List types of electromagnetic energy.

7. A moving object has _____ energy.
- a. potential
 - b. kinetic
 - c. nuclear
 - d. electromagnetic

ANS: B

A moving object has kinetic energy.

DIF: Moderate REF: p. 4 OBJ: Identify various forms of energy.

8. What is the removal of an electron from an atom called?
- a. Ionization
 - b. Pair production
 - c. Irradiation
 - d. Electricity

ANS: A

The removal of an electron from an atom is called ionization.

DIF: Moderate REF: p. 5 OBJ: Understand ionization of matter.

9. Ionizing radiation is capable of removing _____ from atoms as it passes through the matter.
- a. neutrons
 - b. protons
 - c. electrons
 - d. ions

ANS: C

Ionizing radiation is capable of removing electrons from atoms as it passes through the matter.

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DIF: Moderate REF: p. 5

OBJ: Describe the process of ionization by ionizing radiation.

10. The energy of x-rays is _____.
- thermal
 - potential
 - kinetic
 - electromagnetic

ANS: D

X-rays are a form of electromagnetic energy.

DIF: Difficult

REF: p. 5

OBJ: List the category of energy of x-rays.

11. The biggest source of man-made ionizing radiation exposure to the public is _____.
- atomic fallout
 - diagnostic x-rays
 - smoke detectors
 - nuclear power plants

ANS: B

Medical x-ray exposure is the biggest source of man-made radiation.

DIF: Difficult

REF: p. 6

OBJ: Understand the relative intensity of ionizing radiation from various sources.

12. In the United States, we are exposed to _____ mR/year of ionizing radiation from the natural environment.
- 0–5
 - 5–20
 - 20–90
 - 100–300

ANS: C

We are exposed to 20–90 mR/yr of ionizing radiation from natural environmental sources in the United States.

DIF: Difficult

REF: p. 6

OBJ: Understand the amount of natural environmental ionizing radiation to which the public is exposed in the United States.

13. The basic quantities measured in mechanics are _____, _____, and _____.
- volume, length, meters
 - mass, length, time
 - radioactivity, dose, exposure
 - meters, kilos, seconds

ANS: B

The basic quantities measured in mechanics are mass, length, and time.

DIF: Easy

REF: p. 12

OBJ: List the basic quantities measured in mechanics.

14. An example of a derived quantity in mechanical physics is a _____.

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- a. meter
- b. second
- c. dose
- d. volume

ANS: D

Volume is a derived unit.

DIF: Moderate REF: p. 12 OBJ: Recognize an example of a derived quantity.

15. _____ is a special quantity of radiologic science.

- a. Mass
- b. Velocity
- c. Radioactivity
- d. Momentum

ANS: C

Radioactivity is a special quantity of radiologic science.

DIF: Easy REF: p. 14

OBJ: Recognize radioactivity as a special quantity of radiologic science.

16. Exposure is measured in units of _____.

- a. becquerel
- b. sieverts
- c. meters
- d. grays

ANS: D

Exposure is measured in units of grays.

DIF: Moderate REF: p. 14 OBJ: Understand units of radiation measurement.

17. Today, radiology is considered to be a(n) _____ occupation.

- a. safe
- b. unsafe
- c. dangerous
- d. high-risk

ANS: A

Today, radiology is considered to be a safe occupation because of effective radiation protection practices.

DIF: Moderate REF: p. 10 OBJ: Understand the risk of an occupation in radiology.

18. What does ALARA mean?

- a. All Level Alert Radiation Accident
- b. As Low As Reasonably Achievable
- c. Always Leave A Restricted Area
- d. As Low As Regulations Allow

ANS: B

ALARA means As Low As Reasonably Achievable.

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DIF: Moderate REF: p. 10 OBJ: Understand the meaning of ALARA.

19. Computed tomography was developed in the _____.
- 1890s
 - 1920s
 - 1970s
 - 1990s

ANS: C

Computed tomography was developed in the 1970s.

DIF: Moderate REF: p. 10
OBJ: Relate history of the development of computed tomography.

20. Filtration is used to _____.
- absorb low-energy x-rays
 - remove high-energy x-rays
 - restrict the useful beam to the body part imaged
 - fabricate gonadal shields

ANS: A

Filtration is used to absorb low-energy x-rays.

DIF: Moderate REF: p. 12
OBJ: Relate history of the development of computed tomography.

Chapter 02: The Structure of Matter

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MULTIPLE CHOICE

1. The term “atom” was first used by the _____.
- Ethiopians
 - British
 - Greeks
 - 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 _____.
- J. J. Thomson
 - John Dalton
 - Dmitri Mendeleev
 - Niels Bohr

ANS: B

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

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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) _____.
- neutron
 - proton
 - electron
 - 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.
- Bohr
 - Rutherford
 - Mendeleev
 - 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 _____.
- electrons with well-defined orbits
 - a nucleus with an electron cloud
 - electrified plum pudding
 - 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.
- Bohr
 - Thomson
 - Rutherford
 - 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?
- Quark, positron, negatron
 - Nucleon, electron, proton
 - Proton, neutron, quark
 - 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.
- protons
 - electrons
 - neutrons
 - 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 _____.
- one
 - zero
 - positive
 - 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 _____.
- atomic numbers
 - atomic mass units
 - shells
 - 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 _____.
- isomer
 - isobar
 - isotone
 - isotope

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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 _____.
- isotopes
 - compounds
 - molecules
 - 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) _____.
- ion
 - molecule
 - isotope
 - 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 _____.
- $2n$
 - $2n^2$
 - $2/n$
 - $2/n^2$

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.
- quarks
 - neutrinos
 - neutrons
 - 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 _____.

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- 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.

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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?
- 42
 - 98
 - 21
 - 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 _____.
- one type of atom
 - one type of molecule
 - two types of molecules
 - 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 _____.
- electrons
 - positrons
 - protons
 - 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 _____.
- energy
 - size
 - origin
 - 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.
- beta particle
 - x-ray