TWELFTH EDITION

RADIOLOGIC SCIENCE FOR TECHNOLOGISTS

PHYSICS, BIOLOGY, AND PROTECTION
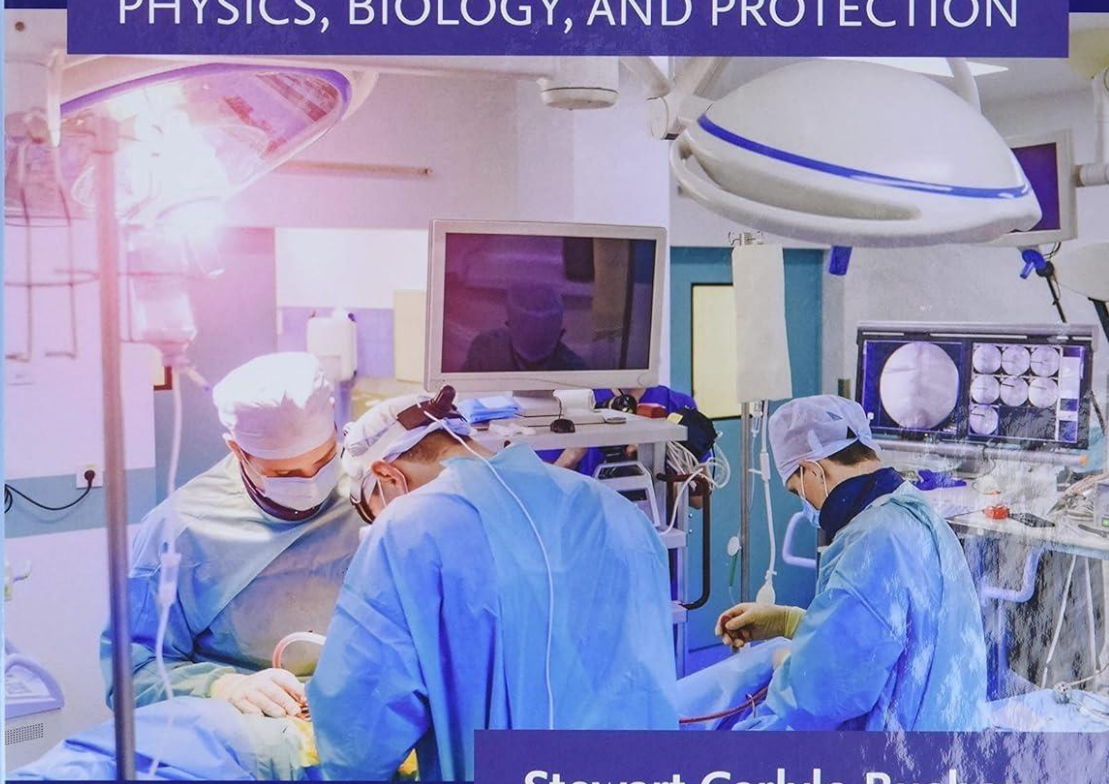
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ELSEVIER

TESTBANK

MULTIPLE CHOICE

1. Matter is measured in ._____
    a. kilograms
    b. joules
    c. electron volts
    d. rems

    <mark>ANS:</mark> A
    Matter is measured in kilograms.

2. Atoms and molecules are the fundamental building blocks of   .
    a. energy
    b. radiation
    c. matter
    d. gravity

    <mark>ANS:</mark> C
    Atoms and molecules are the fundamental building blocks of matter.

3. Ice and steam are examples of two forms of _____.
    a. matter
    b. radiation
    c. energy
    d. work

    <mark>ANS:</mark> A
    Ice and steam are examples of two forms of matter.

4. The formula $E = mc^2$ is the basis for the theory that led to the development of____. a.____ x-rays
    b. electromagnetic radiation
    c. nuclear power
    d. cathode ray tubes

    <mark>ANS:</mark> C
    The formula $E = mc^2$ is the basis for the theory that led to the development of nuclear power.

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

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

6. A moving object has energy.
   a. potential
   b. kinetic
   c. nuclear
   d. electromagnetic

B
A moving object has kinetic energy.

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

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

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

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

9. The energy of x-rays is _____._____
   a. thermal
   b. potential
   c. kinetic
   d. electromagnetic

D
X-rays are a form of electromagnetic energy.

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

B

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

11. In the United States, we are exposed to_____ mSv/year of ionizing radiation from the natural environment.
    a. 0 to 5
    b. 5 to 20
    c. 20 to 90

    d. 100 to 300

A

We are exposed to about 3 mSv/yr of ionizing radiation from natural environmental sources in the United States.

12. Today, radiology is considered to be a(n) _____occupation.
    a. safe
    b. unsafe
    c. dangerous
    d. high-risk

A

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

13. _____is a special quantity of radiologic science.
    a. Mass
    b. Velocity
    c. Radioactivity
    d. Momentum

C

Radioactivity is a special quantity of radiologic science.

14. 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

B

ALARA means As Low As Reasonably Achievable.

15. Computed tomography was developed in the_____.
    a. 1890s
    b. 1920s
    c. 1970s
    d. 1990s

C
Computed tomography was developed in the 1970s.

16. Filtration is used to____._____
    a. absorb low-energy x-rays
    b. remove high-energy x-rays
    c. restrict the useful beam to the body part imaged
    d. fabricate gonadal shields

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

TRUE/FALSE

1. Mass is the quantity of matter as described by its energy equivalence.

    T
    Mass is the quantity of matter as described by its energy equivalence.

2. Radiation is the removal of an electron from an atom.

    F
    Ionization is the removal of an electron from an atom.

3. Radiology emerged as a medical specialty because of the Snook transformer and the Crookes x-ray tube.

    F
    Radiology emerged as a medical specialty because of the Snook transformer and the Coolidge x-ray tube.

Chapter 02: Basic Physics Primer Bushong: Radiologic Science for Technologists, 12th Edition

MULTIPLE CHOICE

1. The basic quantities measured in mechanics are ____,____ __, and ___. _____
    a. volume; length; meters
    b. mass; length; time
    c. radioactivity; dose; exposure
    d. meters; kilos; seconds

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

2. An example of a derived quantity in mechanical physics is a _____
   a. meter
   b. second
   c. dose
   d. volume

   D
   Volume is a derived unit.

3. Exposure is measured in units of_____._____
   a. becquerel
   b. sieverts
   c. meters
   d. grays

   D
   Exposure is measured in units of grays.

4. What is the decimal equivalent of the proper fraction 4/1000?
   a. 0004
   b. 004
   c. 04
   d. 4

   B
   The decimal equivalent of the proper fraction 4/1000 is .004.

5. What is the decimal equivalent of the improper fraction 289/74?
   a. 390
   b. 3.90
   c. 39.0
   d. 390.0

   B
   The decimal equivalent of the improper fraction 289/74 is 3.90.

6. The first step to expressing a number in scientific notation is to _____.
   a. round up to the nearest 1000
   b. round down to the nearest 1000
   c. write the number in decimal form
   d. write the number as a fraction

   C
   The first step to expressing a number in scientific notation is to write the number in decimal form.

7. What is 6080 in exponential form?
   a. $6080.0 \ \square \ 10^4$

b. 608.0 $\square$ 10^4

c. 6.080 $\square$ 10^3

d. 6080 $\square$ 10^3

C

The number 6080 in exponential form is 6.080 $\square$ 10^3

8. Graphs are typically based on two axes; a____and a__. a.____y-axis; z-axis

b. oblique; horizontal

c. x-axis; y-axis

d. vertical; oblique

C

Most graphs are based on two axes: a horizontal or x-axis and a vertical or y-axis.

9. In radiologic science, all of the following are special quantities, except:

a. exposure.

b. distance.

c. dose.

d. effective dose.

B

In radiologic science, special quantities are those of exposure, dose, effective dose, and radioactivity.

10. The SI unit of velocity is____.____

a. meters per second

b. miles per hour

c. meters per millisecond

d. kilometers per second

C

Units of velocity in SI are meters per second (m/s).

11. Mass density should be reported in which units?

a. Coulomb/kilogram

b. Newtons per square meter

c. Kilograms per cubic meter

d. Kilograms per square meter

C

Mass density should be reported with units of kilograms per cubic meter (kg/m^3).

12. An object at rest will   if no outside forces are applied.

a. stay at rest

b. decrease mass

c. increase velocity
d. decrease velocity

ANS: A

An object at rest will stay at rest if no outside forces are applied.

13. Which of the following explains the difference between speed and velocity?
    a. One has motion, and the other does not.
    b. One involves acceleration, and the other does not.
    c. One involves time, and the other does not.
    d. One has direction, and the other does not.

ANS: B

Velocity includes acceleration and speed does not. Speed is the rate at which an object covers distance.

14. For every action, there is an equal and opposite reaction, this describes which Newton's law?
    a. Newton's first law of motion
    b. Newton's second law of motion
    c. Newton's third law of motion
    d. Newton's law of inertia

ANS: C

Newton's third law of motion states that for every action, there is an equal and opposite reaction.

15. Work is the product of and distance.
    a. force
    b. gravity
    c. acceleration
    d. motion

ANS: A

Work is the product of force and distance.

16. The transfer of heat by the emission of infrared radiation is . a. electric radiation
    b. magnetic energy
    c. mechanical energy
    d. thermal radiation

ANS: D

Thermal radiation is the transfer of heat by the emission of infrared radiation.

17. What heat transfer takes place when you burn your finger by touching a hot iron?
    a. Conduction
    b. Convection
    c. Radiation
    d. Electromagnetic

ANS: A

Conduction is the transfer of heat through a material or by touching.

18. What heat transfer takes place when water is boiled?
    a. Conduction
    b. Convection
    c. Radiation
    d. Electromagnetic

ANS: B

Convection is the mechanical transfer of —hot‖ molecules in a gas or liquid from one place to another.

19. What are the two cryogens used in Magnetic resonance imaging with a superconducting magnet?
    a. Gaseous helium and gaseous nitrogen
    b. Liquid helium and gaseous nitrogen
    c. Gaseous helium and liquid helium
    d. Liquid helium and liquid nitrogen

ANS: D

Liquid nitrogen and liquid helium are the two cryogens that are used in magnetic resonance imaging with a superconducting magnet.

20. When you stretch a rubber band, you are storing _ energy. a. kinetic
    b. potential
    c. thermal
    d. radiant

ANS: B

Potential energy is the stored energy of position or configuration.

Chapter 03: The Structure of Matter Bushong: Radiologic Science for Technologists, 12th 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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

12. When atoms of various elements combine, they form ._____
    a. isotopes

b. compounds

c. molecules

d. ions

C

When atoms of various elements combine, they form molecules.

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

   a. ion

   b. molecule

   c. isotope

   d. isomer

A

An atom that loses or gains one or more electrons is 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. $2/n^2$

B

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

15. A neutral atom has the same number of_____and electrons.

   a. quarks

   b. neutrinos

   c. neutrons

   d. protons

D

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

16. The innermost electron shell is symbolized by the letter_____.

   a. J

   b. K

   c. L

   d. M

B

The innermost electron shell is symbolized by the letter K.

17. The shell number of an atom is called the _____.

   a. alpha particle

   b. chemical element

   c. principal quantum number

   d. half-life number

C

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

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

    C

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

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

    A

    The atomic number equals the number of protons in an atom.

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

    B

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

Chapter 04: Electromagnetic Energy Bushong: Radiologic Science for Technologists, 12th Edition

___

MULTIPLE CHOICE

1. The four properties of photons are____,_____ ,_____and____._____
   a. size; shape; spin; mass
   b. frequency; mass; amplitude; wavelength
   c. frequency; wavelength; velocity; amplitude
   d. refraction; velocity; spin; amplitude

   C

   The properties of photons are frequency, wavelength, velocity, and amplitude.

2. The smallest quantity of any type of electromagnetic radiation is a(n) _____.
   a. photon
   b. electron

c. neutrino
d. quark

ANS: A

The smallest quantity of any type of electromagnetic radiation is a photon.

3. What is the velocity of all electromagnetic radiation?
   a. $8 \square 10^3$ m/s
   b. $2 \square 10^8$ m/s
   c. $3 \square 10^8$ m/s
   d. $4 \square 10^3$ m/s

ANS: C

The velocity of all electromagnetic radiation is $3 \square 10^8$ m/s.

4. The rate of rise and fall of a sine wave is called its___._____
   a. amplitude
   b. frequency
   c. wavelength
   d. velocity

ANS: B

The rate of rise and fall of a sine wave is called its frequency.

5. A hertz (Hz) is equal to cycle(s) per second.
   a. 103
   b. 102
   c. 10
   d. 1

ANS: D

A hertz is equal to 1 cycle per second.

6. What is the electromagnetic wave equation?
   a. $c = f\square$
   b. $c = f/\square$
   c. $c = fv$
   d. $c = f - \square$

ANS: A

The wave equation is $c = f\square$.

7. The _____ of electromagnetic radiation is constant.
   a. amplitude
   b. velocity
   c. frequency
   d. wavelength

B

The velocity of electromagnetic radiation is constant.

8. If the wavelength of a beam of electromagnetic radiation increases by a factor of 2, then its frequency must _____.
   a. double
   b. increase four times
   c. decrease by half
   d. remain constant

C

If the wavelength of a beam of electromagnetic radiation increases by a factor of 2, then its

frequency must decrease by half.

9. The intensity of radiation _____ in the _____ object from the source.

proportion to the square of the distance of

   a. increases; direct
   b. decreases; direct
   c. increases; inverse
   d. decreases; inverse

D

The intensity of radiation decreases in inverse proportion to the square of the distance of the object from the source.

10. The reduction of radiation intensity due to scattering and absorption is called_____. a. reflection
    b. refraction
    c. attenuation
    d. dispersion

C

The reduction of radiation intensity due to scattering and absorption is called attenuation.

11. The intensity of radiation on an object is reduced with distance because the radiation

    _____ .
    a. reduces its velocity
    b. increases in wavelength
    c. loses its energy
    d. is spread out over a greater area

D

The intensity of radiation on an object is reduced with distance because the radiation is spread out over a greater area.

12. If the intensity of light from a flashlight is 4 millilumens (mlm) at a distance of 3 feet, what will the intensity be at 6 feet? a.   0.4 millilumens
    b. 1 millilumen
    c. 2 millilumens
    d. 16 millilumens

    ANS: B
    If the intensity of light from a flashlight is 4 millilumens (mlm) at a distance of 3 feet using the inverse square law, it will be 1 millilumen at 6 feet.

13. The diagnostic range of x-ray energy is_____._____
    a. 30 to 150 kVp
    b. 200 to 300 kVp
    c. 300 to 1000 kVp
    d. over 1 MV

    ANS: A
    The diagnostic range of x-ray energy is 30 to 150 kVp.

14. The energy of a photon is directly proportional to its .
    a. amplitude
    b. frequency
    c. velocity
    d. wavelength

    ANS: B
    The energy of a photon is directly proportional to its frequency.

15. The mass equivalent of a 100 KeV photon of radiation can be calculated using the__.____
    a. inverse square formula
    b. equivalent Planck equation
    c. relativity formula
    d. Planck quantum equation

    ANS: C
    The mass equivalent of a 100 KeV photon of radiation can be calculated using the relativity formula.

16. X-rays are usually identified by their .
    a. energy
    b. velocity
    c. wavelength
    d. hertz

    ANS: A
    X-rays are usually identified by their energy.

17. The lowest energy range of the electromagnetic spectrum is .
    a. sound waves
    b. radio waves
    c. gamma rays
    d. microwaves

    ANS: B
    The lowest energy range on the electromagnetic spectrum is radio waves.

18. Gamma rays are produced in the_____ of the atom.
    a. outer electron shell
    b. inner electron shell
    c. nucleus
    d. K-shell

    ANS: C
    Gamma rays are produced in the nucleus of the atom.

19. Photons tend to interact with matter   their wavelength.
    a. equal in size to
    b. larger in size than
    c. smaller in size than
    d. unequal in size to

    ANS: A
    Photons tend to interact with matter equal in size to their wavelength.

20. Photons with the highest frequencies have the.
    a. highest velocity
    b. lowest energy
    c. longest wavelengths
    d. shortest wavelengths

    ANS: D
    Photons with the highest frequencies have the shortest wavelengths.

Chapter 05: Electricity, Magnetism, and Electromagnetism Bushong: Radiologic Science for Technologists, 12th Edition

MULTIPLE CHOICE

1. The smallest unit of electrical charge is the___._____
   a. electron
   b. proton
   c. neutron
   d. neutrino

The smallest unit of electrical charge is the electron.

2. Electrification occurs through the movement of_____._____
   a. protons only
   b. protons and electrons
   c. electrons only
   d. electrons and neutrons

Electrification occurs only through the movement of electrons.

3. Like charges___and unlike charges ___._____
   a. repel; repel
   b. attract; attract
   c. attract; repel
   d. repel; attract

Like charges repel and unlike charges attract.

4. Electrostatic force is__proportional to the distance between charges, and _____ proportional to the product of the charges. a. directly; inversely
   b. inversely; directly
   c. inversely; inversely
   d. directly; directly

Electrostatic force is inversely proportional to the distance between charges, and directly proportional to the product of the charges.

5. The charges on an electrified object are distributed _____.
   a. in the center of the object
   b. on the side nearest the charge
   c. on the topside of the object
   d. evenly throughout the object

The charges on an electrified object are distributed evenly throughout.

6. On the surface of an electrified object, the charges concentrate on the_____._____

a. top side

b. underside

c. sharpest curvatures

d. smoothest curvatures

On the surface of an electrified object, the charges concentrate on the sharpest curvature.

7. A_____ is a source of direct current.

a. wall socket

b. battery

c. generator

d. spark

A battery is a source of direct current.

8. What is the unit of electric potential?

a. Watt

b. Amp

c. Volt

d. Ohm

The unit of electric potential is the volt.

9. An electric potential applied to a conductor produces a(n) _____.

a. electric current

b. magnetic field

c. electric insulator and conductor

d. electric current and a magnetic field

D

When an electric potential is applied to a conductor, both an electric current and a magnetic field are produced.

10. An alternating (AC) current is represented by a   line.

a. sinusoidal

b. horizontal

c. vertical

d. descending

A

An alternating (AC) current is represented by a sinusoidal line.

11. A_____ uses direct current.

a. hair dryer

b. toaster

c. microwave

d. flashlight

D

A flashlight is battery operated, and batteries use direct current.

12. Alternating current is produced by a _____.

a. battery