

Chapter 01: Radiation and Its Discovery

Fauber: Radiographic Imaging and Exposure, 5th Edition

MULTIPLE CHOICE

1. When were x-rays discovered?
 - a. October 8, 1985
 - b. November 8, 1895
 - c. January 23, 1896
 - d. August 15, 1902

ANS: B

X-rays were discovered by Wilhelm Conrad Roentgen on November 8, 1895.

REF: p.1

2. What type of tube was Roentgen working with in his lab when x-rays were discovered?
 - a. Crookes tube
 - b. Fluorescent tube
 - c. High-vacuum tube
 - d. Wurzburg tube

ANS: A

Roentgen was working with a low-vacuum tube known as a Crookes tube.

REF: p.2

3. Which of the following terms could be defined as the instantaneous production of light only during an interaction between a type of energy and some element or compound?
 - a. Phosphorescence
 - b. Afterglow
 - c. Glowing
 - d. Fluorescence

ANS: D

Fluorescence is the instantaneous emission of light from a material due to the interaction with some type of energy.

REF: p.2

4. Barium platinocyanide was the:
 - a. type of dark paper Roentgen used to darken his laboratory.
 - b. material Roentgen used to produce the first radiograph of his wife's hand.
 - c. metal used to produce the low-vacuum tube.
 - d. fluorescent material that glowed when the tube was energized.

ANS: D

A piece of paper coated with barium platinocyanide glowed each time Roentgen energized his tube.

REF: p.2

5. The first radiograph produced by Roentgen, of his wife's hand, required an exposure time of:
- 15 s.
 - 150 s.
 - 15 min.
 - 150 min.

ANS: C

It took a 15-min exposure time to produce the first radiograph.

REF: p.3

6. The letter x in x -ray is the symbol for:
- electricity.
 - the unknown.
 - penetrating.
 - discovery.

ANS: B

The letter x represents the mathematical symbol of the unknown.

REF: p.3

7. The first Nobel Prize for physics was received in 1901 by:
- Marie Curie.
 - William Crookes.
 - Wilhelm Roentgen.
 - Albert Einstein.

ANS: C

Wilhelm Roentgen received the first Nobel Prize for physics in 1901.

REF: p.4

8. X-rays were at one time called:
- Becquerel rays.
 - Roentgen rays.
 - Z-rays.
 - none of the above.

ANS: B

X-rays were at one time called Roentgen rays.

REF: p.4

9. Erythema, an early sign of biologic damage due to x-ray exposure, is:
- reddening of the skin.
 - a malignant tumor.
 - a chromosomal change.
 - one of the most serious effects of x-ray exposure.

ANS: A

Erythema is reddening and burning of the skin, an early and less serious effect of exposure to large doses of x-radiation.

REF: p.5

10. X-rays have which of the following properties?
- Electrical
 - Magnetic
 - Chemical
 - A and B
 - A and C

ANS: D

X-rays, a type of electromagnetic radiation, have both electrical and magnetic properties.

REF: p.5

11. The distance between two successive crests of a sine wave is known as:
- an angstrom.
 - frequency.
 - the Greek letter *nu*.
 - wavelength

ANS: D

The distance between two successive crests or troughs of a sine wave is the measure of its wavelength.

REF: p.6

12. X-rays used in radiography have wavelengths that are measured in:
- angstroms.
 - millimeters.
 - centimeters.
 - hertz.

ANS: A

X-rays in the range used in radiography have wavelengths that are so short that they are measured in angstroms.

REF: p.6

13. The frequency of a wave is the number of waves passing a given point per given unit of time. Frequency is measured in:
- angstroms.
 - hertz.
 - inches.
 - eV.

ANS: B

The unit of frequency is hertz. The frequency of x-rays in the radiography range varies from about 3×10^{19} to 3×10^{18} Hz.

REF: p.6

14. Which of the following is a correct description of the relationship between the wavelength and frequency of the x-ray photon?
- Wavelength and frequency are directly proportional.
 - Wavelength and frequency are inversely related by the square root of lambda.
 - Frequency and wavelength are inversely related.
 - Wavelength and frequency have no relationship to each other.

ANS: C

Wavelength and frequency are inversely related; as one increases, the other decreases.

REF: p.6

15. A _____ is a small, discrete bundle of energy.
- phaser
 - quark
 - photon
 - mesion

ANS: C

A photon, or quantum, is a small, discrete bundle of energy.

REF: p.7

16. The speed of light is:
- 3×10^8 meters per second
 - 3×10^8 miles per second
 - 186,000 miles per second
 - A and B
 - A and C

ANS: E

The speed of light can be described as either 3×10^8 meters per second or 186,000 miles per second.

REF: p.8

17. When first developed, the branch of medicine using x-rays was called:
- radiology.
 - radiography.
 - roentgenology.
 - imaging sciences.

ANS: C

What we now call *radiology* was first called *roentgenology*.

REF: p.4

18. The electrical energy applied to an x-ray tube will be transformed to:
- heat.
 - light.

- c. x-rays.
- d. A and B.
- e. A and C.

ANS: E

The electrical energy applied to the x-ray tube will be transformed into heat (primarily) and x-rays.

REF: p.5

19. The Greek symbol lambda (λ) represents the x-ray's:
- a. wavelength.
 - b. speed.
 - c. frequency.
 - d. quantity.

ANS: A

Lambda (λ) is the Greek symbol that represents wavelength.

REF: p.6

20. An angstrom (\AA) is equal to:
- a. 10^{-1} meter
 - b. 10^{-10} meter
 - c. 10^{-1} foot
 - d. 10^{-10} foot

ANS: B

One angstrom is equal to 10^{-10} meter.

REF: p.6

21. X-rays used in radiography have wavelengths ranging from 0.1 to:
- a. 0.01 \AA .
 - b. 1 \AA .
 - c. 10 \AA .
 - d. 100 \AA .

ANS: B

X-rays used in radiography have wavelengths ranging from 0.1 to 1 \AA .

REF: p.6

22. X-rays used in radiography have wavelengths ranging from 3×10^{19} to:
- a. 3×10^8 Hz.
 - b. 3×10^{-10} Hz.
 - c. 3×10^{10} Hz.
 - d. 3×10^{18} Hz.

ANS: D

X-rays used in radiography have wavelengths ranging from 3×10^{19} to 3×10^{18} Hz.

REF: p.6

23. In the formula $c = \lambda\nu$, c represents:
- frequency.
 - the speed of light.
 - wavelength.
 - kinetic energy.

ANS: B

In this formula, c represents the speed of light.

REF: p.6

24. In the formula $c = \lambda\nu$, ν represents:
- frequency.
 - the speed of light.
 - wavelength.
 - kinetic energy.

ANS: A

In this formula, ν represents frequency.

REF: p.6

25. The energy of an individual x-ray photon is measured in:
- frequency.
 - wavelength.
 - kilovolts peak (kVp).
 - electron volts (eV).

ANS: D

X-ray photon energy is measured in electron volts (eV).

REF: p.7

26. An x-ray beam that has photons with many different energies is:
- homogenous.
 - monoenergetic.
 - heterogeneous.
 - never found.

ANS: C

A heterogeneous x-ray beam consists of photons with many different energies.

REF: p.8

27. X-rays can:
- penetrate the human body.
 - be absorbed in the human body.
 - change direction in the human body.
 - A and B only.
 - all of the above.

ANS: E

X-rays can penetrate, be absorbed in, or change direction (due to scattering) in the human body.

REF: p.9

28. In conjunction with ALARA, which of the following cardinal principles help to minimize radiation exposure?

- I. Time—Increase time exposed to ionizing radiation
- II. Time—Decrease time exposed to ionizing radiation
- III. Distance—Increase distance from ionizing radiation
- IV. Distance—Decrease distance from ionizing radiation
- V. Shielding—Maximize use of shielding from ionizing radiation

- a. I, III, and V
- b. I, IV, and V
- c. II, III, and V
- d. II, IV, and V

ANS: C

The cardinal principles include decreasing time exposed to ionizing radiation, increasing distance from ionizing radiation, and maximizing use of shielding from ionizing radiation.

REF: p.9

TRUE/FALSE

1. X-rays are invisible.

ANS: T

A characteristic of x-rays is that they are invisible.

REF: p.9

2. X-rays carry a negative charge that causes ionization.

ANS: F

X-rays are electrically neutral.

REF: p.9

3. X-ray photons travel at the speed of light in a vacuum.

ANS: T

In a vacuum, x-rays will travel at the speed of light.

REF: p.9

4. X-ray photons are capable of traveling around corners.

ANS: F

X-rays travel in straight lines, so they are unable to travel around corners.

REF: p.9

5. Chemical changes may occur as a result of exposure to ionizing radiation.

ANS: T

Chemical changes, such as in radiographic or photographic film, occur as a result of exposure to ionizing radiation.

REF: p.9

6. X-rays will change direction in the presence of a strong magnetic field.

ANS: F

X-rays do not respond to a magnetic field.

REF: p.8

7. X-rays produce a slight tingling sensation when they enter the body.

ANS: F

X-rays cannot be felt.

REF: p.8

8. X-rays cannot be focused with a lens.

ANS: T

Unlike visible light, it is not possible to focus x-rays with a lens.

REF: p.9

9. X-rays are able to interact with certain materials and produce light energy.

ANS: T

Certain materials will fluoresce, or produce light energy, when stimulated by x-rays.

REF: p.9

10. It is impossible for x-rays to interact with matter and produce secondary radiation.

ANS: F

Secondary radiation is often produced as a result of x-rays interacting with matter.

REF: p.9

11. X-rays can produce ionization of atoms making up cells, causing damage.

ANS: T

A major reason that unnecessary exposure must be avoided is that x-rays can ionize atoms and cause damage.

REF: p.9

12. Since Roentgen's discovery in the late nineteenth century, we have learned an enormous amount about the properties of x-rays.

ANS: F

Roentgen's original work on the characteristics of x-rays was so thorough that very little has been learned about their properties since.

REF: p.12

13. It is the radiographer's responsibility to minimize the radiation dose to the patient, to themselves, and to others in accordance with the **As Low As Reasonably Achievable** (ALARA) principle.

ANS: T

It is the radiographer's responsibility to minimize the radiation dose to the patient, to themselves, and to others in accordance with the **As Low As Reasonably Achievable** (ALARA) principle.

REF: p.12

14. Screening for pregnancy is an important task for minimizing unnecessary exposure to a developing fetus.

ANS: T

Screening for pregnancy is an important task for minimizing unnecessary exposure to a developing fetus.

REF: p.12