

# Iannucci: Dental Radiography, 4<sup>th</sup> Edition

## Chapter 02: Radiation Physics

### Test Bank

#### MULTIPLE CHOICE

1. The fundamental unit of matter is the:
- A. Proton
  - B. Neutron
  - C. Electron
  - D. Atom

ANS: D

	Feedback
A	A proton is a subatomic particle; the fundamental unit of matter is the atom.
B	A neutron is a subatomic particle; the fundamental unit of matter is the atom.
C	An electron is a subatomic particle; the fundamental unit of matter is the atom.
D	The fundamental unit of matter is the atom.

PTS: 1

REF: Page 9, Atomic and Molecular Structure

2. The nucleus of an atom contains:
- A. Protons
  - B. Neutrons
  - C. Protons and neutrons
  - D. Electrons

ANS: C

	Feedback
A	The nucleus of an atom contains neutrons as well as protons.
B	The nucleus of an atom contains protons as well as neutrons.
C	The nucleus of an atom contains protons and neutrons.
D	The nucleus of an atom does not contain electrons; it contains protons and neutrons.

PTS: 1

REF: Page 9, Atomic and Molecular Structure

3. Which subatomic particle carries a negative electrical charge?
- A. Neutron
  - B. Proton
  - C. Electron
  - D. Nucleon

ANS: C

	Feedback
A	A neutron does not carry an electrical charge.
B	A proton carries a positive electrical charge.
C	An electron carries a negative electrical charge.

<b>D</b>	A nucleon carries a positive (proton) or no (neutron) electrical charge.
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PTS: 1

REF: Page 9, Atomic and Molecular Structure

4. Which of the following elements is the simplest atom, with an atomic number of 1?
- |             |             |
|-------------|-------------|
| A. Hydrogen | C. Nitrogen |
| B. Helium   | D. Oxygen   |

ANS: A

	Feedback
<b>A</b>	Hydrogen is the simplest atom; with a single proton, it has an atomic number of 1.
<b>B</b>	Helium has an atomic number of 2.
<b>C</b>	Nitrogen has an atomic number of 7.
<b>D</b>	Oxygen has an atomic number of 8.

PTS: 1

REF: Page 9, Atomic and Molecular Structure

5. Which of the following statements is *true* of orbits or shells in the atom?
- Protons travel around the nucleus in well-defined shells.
  - An atom contains innumerable shells.
  - The energy level within each shell is the same.
  - The K shell is closest to the nucleus and has the highest energy level.

ANS: C

	Feedback
<b>A</b>	Electrons travel around the nucleus in well-defined shells.
<b>B</b>	An atom contains a maximum of seven shells.
<b>C</b>	The energy level within each shell is the same.
<b>D</b>	The K shell is located closest to the nucleus and has the lowest energy level.

PTS: 1

REF: Page 9, Atomic and Molecular Structure

6. The binding energy or binding force of an electron is:
- Determined by the distance between the neutrons and protons within the nucleus.
  - Weaker for electrons located in outer shells than for inner shells.
  - Weaker for electrons located in inner shells than for outer shells.
  - Both a and c.

ANS: B

	Feedback
<b>A</b>	The binding energy or binding force of an electron is determined by the distance between the nucleus and the orbiting electron.
<b>B</b>	The binding energy or binding force of an electron is weaker for electrons located in outer shells than for inner shells.

<b>C</b>	The binding energy or binding force of an electron is stronger for electrons located in inner shells than for outer shells.
<b>D</b>	Neither a nor c is correct.

PTS: 1

REF: Page 10, Atomic and Molecular Structure

7. Which of the following statements is/are *true* of ionization?
- An atom that gains an electron will have a negative charge.
  - An atom that loses an electron will have a negative charge.
  - An atom that loses an electron will have a positive charge.
  - Both a and c.

ANS: D

	<b>Feedback</b>
<b>A</b>	This statement is true; however, choice c is also correct.
<b>B</b>	An atom that loses an electron will have a positive charge.
<b>C</b>	This statement is true; however, choice a is also correct.
<b>D</b>	An atom that gains an electron will have a negative charge, and an atom that loses an electron will have a positive charge.

PTS: 1

REF: Page 11, Ionization

8. An ion pair results when:
- A proton is removed from an atom.
  - An electron is removed from an atom.
  - A neutron is removed from an atom.
  - Two atoms share a pair of electrons.

ANS: B

	<b>Feedback</b>
<b>A</b>	An ion pair results when an electron is removed from an atom rather than a proton.
<b>B</b>	An ion pair results when an electron is removed from an atom.
<b>C</b>	An ion pair results when an electron is removed from an atom rather than a neutron.
<b>D</b>	An ion pair results when an electron is removed from an atom.

PTS: 1

REF: Page 11, Ionization

9. 1) *Radiation* is the emission and propagation of energy through space or a substance in the form of waves or particles. 2) *Radioactivity* can be defined as the process by which certain unstable atoms or elements undergo spontaneous disintegration, or decay, in an effort to attain a more balanced nuclear state.
- Both statements are true.
  - Both statements are false.
  - The first statement is true; the second statement is false.
  - The first statement is false; the second statement is true.

ANS: A

	Feedback
A	Both the statements about radiation and radioactivity are true.
B	Both statements are true.
C	Both statements are true.
D	Both statements are true.

PTS: 1

REF: Page 12, Radiation and Radioactivity

10. Radioactivity is:
- The emission and propagation of energy through space or a substance in the form of waves.
  - The emission and propagation of energy through space or a substance in the form of particles.
  - The process by which certain unstable atoms or elements undergo spontaneous disintegration, or decay, in an effort to attain a more balanced nuclear state.
  - The process by which certain unstable atoms or elements undergo spontaneous disintegration, or decay, in an effort to attain a less balanced nuclear state.

ANS: C

	Feedback
A	Radiation is the emission and propagation of energy through space or a substance in the form of waves or particles.
B	Radiation is the emission and propagation of energy through space or a substance in the form of waves or particles.
C	Radioactivity is the process by which certain unstable atoms or elements undergo spontaneous disintegration, or decay, in an effort to attain a more balanced nuclear state.
D	Radioactivity is the process by which certain unstable atoms or elements undergo spontaneous disintegration, or decay, in an effort to attain a more balanced nuclear state.

PTS: 1

REF: Page 12, Radiation and Radioactivity

11. Which of the following statements is/are *true* of ionizing radiation?
- It is radiation that is capable of producing ions by removing or adding an electron to an atom.
  - It is strictly an electromagnetic radiation and does not involve particles that have mass.
  - It may be classified as to whether it is particulate or electromagnetic radiation.
  - Both a and c.

ANS: D

	Feedback
A	This answer is true, but answer c is also true, making answer d the correct answer.

<b>B</b>	Ionizing radiation involves both particulate and electromagnetic radiation.
<b>C</b>	This answer is true, but answer a is also true, making answer d the correct answer.
<b>D</b>	Ionizing radiation is radiation that is capable of producing ions by removing or adding an electron to an atom, and it may be classified as to whether it is particulate or electromagnetic radiation.

PTS: 1 REF: Page 12, Ionizing Radiation

12. Particulate radiations:
- A. Are tiny particles of matter.
  - B. Do not possess mass.
  - C. Travel in curved lines at low speeds.
  - D. Do not transmit kinetic energy.

ANS: A

	<b>Feedback</b>
<b>A</b>	Particulate radiations are tiny particles of matter.
<b>B</b>	Particulate radiations do possess mass.
<b>C</b>	Particulate radiations travel in straight lines at high speeds.
<b>D</b>	Particulate radiations do transmit kinetic energy.

PTS: 1 REF: Page 12, Particulate Radiation

13. Cathode rays are derived from which of the following types of particulate radiation?
- A. Electrons
  - B. Alpha particles
  - C. Protons
  - D. Neutrons

ANS: A

	<b>Feedback</b>
<b>A</b>	Cathode rays are derived from electrons.
<b>B</b>	Alpha particles are emitted from the nuclei of heavy metals.
<b>C</b>	Protons are accelerated particles with a mass of 1 and a charge of +1.
<b>D</b>	Neutrons are accelerated particles with a mass of 1 and no electrical charge.

PTS: 1 REF: Page 12, Particulate Radiation

14. Which of the following types of particulate radiation are emitted from the nucleus of radioactive atoms?
- A. Alpha particles
  - B. Beta particles
  - C. Protons
  - D. Neutrons

ANS: B

	<b>Feedback</b>
<b>A</b>	Alpha particles are emitted from the nuclei of heavy metals.
<b>B</b>	Beta particles are emitted from the nucleus of radioactive atoms.
<b>C</b>	Protons are accelerated particles, specifically hydrogen nuclei, with a mass of 1 and a

	charge of +1.
<b>D</b>	Neutrons are accelerated particles with a mass of 1 and no electrical charge.

PTS: 1 REF: Page 12, Particulate Radiation

15. Electromagnetic radiations:

- A. Are entirely man-made.                      C. Are a form of particulate radiation.  
 B. Include x-rays and visible light.        D. Have mass.

ANS: B

	<b>Feedback</b>
<b>A</b>	Electromagnetic radiations are man-made or occur naturally.
<b>B</b>	Electromagnetic radiations include x-rays and visible light.
<b>C</b>	Electromagnetic radiations are not a form of particulate radiation.
<b>D</b>	Electromagnetic radiations do not have mass.

PTS: 1 REF: Page 12, Electromagnetic Radiation

16. Which of the following forms of electromagnetic radiation are capable of ionization?

- A. Radio waves                                      C. Ultraviolet light  
 B. Visible light                                      D. X-rays

ANS: D

	<b>Feedback</b>
<b>A</b>	Radio waves are not capable of ionization.
<b>B</b>	Visible light is not capable of ionization.
<b>C</b>	Ultraviolet light is not capable of ionization.
<b>D</b>	Of the forms of electromagnetic radiation listed, only x-rays are capable of ionization.

PTS: 1 REF: Page 14, X-Radiation

17. Photons are:

- A. Bundles of energy with mass and weight.  
 B. Bundles of energy that travel at the speed of sound.  
 C. A component of the particle concept of electromagnetic radiation.  
 D. A component of the wave concept of electromagnetic radiation.

ANS: C

	<b>Feedback</b>
<b>A</b>	Photons are bundles of energy without mass or weight.
<b>B</b>	Photons are bundles of energy that travel at the speed of light.
<b>C</b>	Photons are a component of the particle concept of electromagnetic radiation.
<b>D</b>	Photons are a component of the wave concept of electromagnetic radiation.

PTS: 1 REF: Page 12, Electromagnetic Radiation

18. Which of the following statements is *true* of the wave concept of electromagnetic radiation?
- A. *Wavelength* refers to the speed of the wave.
  - B. *Velocity* refers to the number of wavelengths that pass a given point in a certain amount of time.
  - C. *Frequency* is defined as the distance between the crest of one wave and the crest of the next.
  - D. Frequency and wavelength are inversely related.

ANS: D

	Feedback
A	Velocity refers to the speed of the wave.
B	Frequency refers to the number of wavelengths that pass a given point in a certain amount of time.
C	Wavelength is defined as the distance between the crest of one wave and the crest of the next.
D	Frequency and wavelength are inversely related; if the frequency of the wave is high, the wavelength will be short, and if the frequency is low, the wavelength will be long.

PTS: 1 REF: Page 13, Electromagnetic Radiation

19. Which of the following forms of electromagnetic radiation has the shortest wavelength?
- A. Radio wave
  - B. Television wave
  - C. Radar wave
  - D. Dental x-ray wave

ANS: D

	Feedback
A	A radio wave has a wavelength as long as 100 meters.
B	A television wave has a wavelength of approximately 1 meter.
C	A radar wave has a wavelength of 1/100 of a meter.
D	The dental x-ray wave has a wavelength of 0.1 nanometer, or 0.0000000001 meter.

PTS: 1 REF: Page 13, Electromagnetic Radiation

20. Which of the following components of the x-ray machine would have an indicator light for the on-off switch and an indicator light for the exposure button?
- A. X-ray tube
  - B. X-ray tubehead
  - C. The control panel
  - D. The extension arm

ANS: C

	Feedback
A	The control panel has the indicator lights, rather than the x-ray tube.

<b>B</b>	The control panel has the indicator lights, rather than the x-ray tubehead.
<b>C</b>	The control panel has an indicator light for the on-off switch and an indicator light for the exposure button.
<b>D</b>	The control panel has the indicator lights, rather than the extension arm.

PTS: 1 REF: Page 14, Control Panel

21. Which component of the x-ray tubehead absorbs heat created by the production of x-rays?
- A. Metal housing
  - B. Insulating oil
  - C. Aluminum discs
  - D. Lead collimator

ANS: B

	Feedback
<b>A</b>	The metal housing protects the x-ray tube and grounds the high-voltage components.
<b>B</b>	Insulating oil absorbs heat created by the production of x-rays.
<b>C</b>	Aluminum discs filter out nonpenetrating, longer-wavelength x-rays.
<b>D</b>	The lead collimator restricts the size of the x-ray beam.

PTS: 1 REF: Page 14, Tubehead

22. Which component of the tubehead aims and shapes the x-ray beam?
- A. Metal housing
  - B. Tubehead seal
  - C. Aluminum discs
  - D. Position-indicating device

ANS: D

	Feedback
<b>A</b>	The metal housing protects the x-ray tube and grounds the high-voltage components.
<b>B</b>	The tubehead seal seals the oil in the tubehead and acts as a filter to the x-ray beam.
<b>C</b>	Aluminum discs filter out the nonpenetrating, longer-wavelength x-rays.
<b>D</b>	The position-indicating device aims and shapes the x-ray beam.

PTS: 1 REF: Page 15, Tubehead

23. Within the x-ray tube, electrons are generated by the:
- A. Tungsten filament in the cathode.
  - B. Tungsten filament in the anode.
  - C. Molybdenum cup.
  - D. Copper stem.

ANS: A

	Feedback
<b>A</b>	Within the x-ray tube, electrons are generated by the tungsten filament in the cathode.
<b>B</b>	Within the x-ray tube, electrons are generated by the tungsten filament in the cathode.
<b>C</b>	The molybdenum cup focuses the electrons into a narrow beam and directs the beam across the tube toward the tungsten target of the anode.



<b>D</b>	The copper stem functions to dissipate heat away from the tungsten target.
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PTS: 1                      REF: Page 16, Cathode

24. The purpose of the anode is to:
- A. Produce electrons when heated.
  - B. Convert electrons into x-ray photons.
  - C. Absorb heat created by the production of x-rays.
  - D. Filter out nonpenetrating, longer-wavelength x-rays.

ANS: B

<b>Feedback</b>	
<b>A</b>	The purpose of the cathode is to produce electrons when heated.
<b>B</b>	The purpose of the anode is to convert electrons into x-ray photons.
<b>C</b>	The purpose of insulating oil is to absorb heat created by the production of x-rays.
<b>D</b>	The purpose of aluminum discs is to filter out nonpenetrating, longer-wavelength x-rays.

PTS: 1                      REF: Page 16, Anode

25. \_\_\_\_ is the measurement of the number of electrons moving through a conductor.
- A. Alternating current
  - B. Direct current
  - C. Amperage
  - D. Voltage

ANS: C

<b>Feedback</b>	
<b>A</b>	Alternating current describes a current in which the electrons flow in two opposite directions.
<b>B</b>	Direct current describes a current in which the electrons flow in one direction through a conductor.
<b>C</b>	Amperage is the measurement of the number of electrons moving through a conductor.
<b>D</b>	Voltage is the measurement of electrical force that causes electrons to move from a negative pole to a positive one.

PTS: 1                      REF: Page 17, Electricity and Electrical Currents

26. Which transformer in the x-ray machine is used to increase the voltage from the incoming 110- or 220-line voltage to the 65,000 to 100,000 volts required?
- A. Step-down transformer
  - B. Step-up transformer
  - C. Autotransformer
  - D. Both a and c

ANS: B

<b>Feedback</b>	
<b>A</b>	A step-down transformer is used to decrease the voltage from the incoming 110- or 220-

	line voltage to the 3 to 5 volts required.
<b>B</b>	The step-up transformer is used to increase the voltage to the 65,000 to 100,000 volts required.
<b>C</b>	An autotransformer serves as a voltage compensator that corrects for minor fluctuations in the current.
<b>D</b>	Neither a nor c is correct.

PTS: 1 REF: Page 17, Transformers

27. Thermionic emission of electrons occurs at the:
- A. Tungsten filament in the anode.
  - B. Tungsten filament in the cathode.
  - C. Copper stem.
  - D. Molybdenum cup.

ANS: B

Feedback	
<b>A</b>	Thermionic emission of electrons occurs at the tungsten filament in the cathode.
<b>B</b>	Thermionic emission of electrons occurs at the tungsten filament in the cathode.
<b>C</b>	Thermionic emission of electrons occurs at the tungsten filament in the cathode; the copper stem functions as a heat sink for the tungsten target.
<b>D</b>	Thermionic emission of electrons occurs at the tungsten filament in the cathode; the molybdenum cup focuses the electrons into a narrow beam.

PTS: 1 REF: Page 17, Page 18, Production of Dental X-Rays

28. Approximately what percentage of the kinetic energy of the electrons is converted to x-rays at the anode?
- A. Less than 1%
  - B. 25%
  - C. 50%
  - D. 100%

ANS: A

Feedback	
<b>A</b>	Less than 1% of the kinetic energy of the electrons is converted to x-rays at the anode.
<b>B</b>	25% is incorrect; less than 1% of the kinetic energy of the electrons is converted to x-rays at the anode.
<b>C</b>	50% is incorrect; less than 1% of the kinetic energy of the electrons is converted to x-rays at the anode.
<b>D</b>	100% is incorrect; less than 1% of the kinetic energy of the electrons is converted to x-rays at the anode.

PTS: 1 REF: Page 18, Production of Dental X-Rays

29. The lead collimator:
- A. Carries away the heat produced during the production of x-rays.
  - B. Permits a small number of x-rays to exit from the x-ray tube.
  - C. Filters the longer-wavelength x-rays from the beam.

D. Restricts the size of the x-ray beam.

ANS: D

	Feedback
A	The copper stem carries away the heat produced during the production of x-rays.
B	The unleaded glass window portion of the tube permits a small number of x-rays to exit from the x-ray tube.
C	The aluminum disc filters the longer-wavelength x-rays from the beam.
D	The lead collimator restricts the size of the x-ray beam.

PTS: 1

REF: Page 18, Production of Dental X-Rays

30. Which of the following statements is *true* of general radiation?

- A. It is also known as braking (bremsstrahlung) radiation.
- B. It is also known as characteristic radiation.
- C. It is the source of the majority of x-rays that are produced.
- D. Both a and c.

ANS: D

	Feedback
A	This statement is true, but choice c is also correct.
B	This statement is not true; general radiation is not the same as characteristic radiation.
C	This statement is true, but choice a is also correct.
D	General radiation is also known as braking (bremsstrahlung) radiation, and it is the source of the majority of x-rays produced.

PTS: 1

REF: Page 18, General Radiation

31. Which form of the x-ray beam is most detrimental to the patient and operator?

- A. Primary radiation
- B. Secondary radiation
- C. Scatter radiation
- D. Useful beam

ANS: C

	Feedback
A	Primary radiation is the penetrating x-ray beam produced at the target of the anode.
B	Secondary radiation is created when the primary beam interacts with matter.
C	Scatter radiation is the most detrimental to the patient and operator.
D	The useful beam is another term for primary radiation.

PTS: 1

REF: Page 19, Definitions of X-Radiation

32. Which is the most common possibility when an x-ray photon interacts with matter?

- A. No interaction
- B. Absorption or photoelectric effect
- C. Compton scatter
- D. Coherent scatter

ANS: C

Feedback	
<b>A</b>	No interaction means the photon passed through matter without any interaction.
<b>B</b>	Absorption (photoelectric effect) accounts for 30% of the interactions with matter of the dental x-ray beam.
<b>C</b>	Compton scatter accounts for 62% of the interactions with matter that occur in diagnostic radiography.
<b>D</b>	Coherent scatter accounts for only 8% of the interactions with matter of the dental x-ray beam.

PTS: 1 REF: Page 20, Compton Scatter

33. Which of the following four possibilities that can occur when an x-ray photon interacts with matter is responsible for producing densities on film that make dental radiography possible?
- A. No interaction
  - B. Absorption or photoelectric effect
  - C. Compton scatter
  - D. Coherent scatter

ANS: A

Feedback	
<b>A</b>	X-ray photons that pass through a patient without interaction are responsible for producing the densities on film that make dental radiography possible.
<b>B</b>	Absorption or photoelectric effect is incorrect; x-ray photons that pass through a patient without interaction are responsible for producing densities on film that make dental radiography possible.
<b>C</b>	Compton scatter is incorrect; x-ray photons that pass through a patient without interaction are responsible for producing densities on film that make dental radiography possible.
<b>D</b>	Coherent scatter is incorrect; x-ray photons that pass through a patient without interaction are responsible for producing densities on film that make dental radiography possible.

PTS: 1 REF: Page 20, No Interaction