

2 Radiation Physics

CHAPTER REVIEW ANSWER KEY

Multiple Choice

1. d
Rationale: Of the choices given, the K shell electron is located closest to the nucleus and has the highest energy level and the greatest binding energy. The M, N, and L shell electrons are located farther from the nucleus.
2. b
Rationale: An electron is a negatively charged particle.
3. c
Rationales:
 - a. An ion is an atom that gains or loses an electron.
 - b. An ion pair is formed when an electron is removed from an atom.
 - c. A proton is a particle in the nucleus that carries a positive electrical charge.
4. b
Rationale: Ionization is described as the production of ions when an atom loses an electron.
5. b
Rationales:
 - a. Radiation is the propagation of energy through space in the form of waves or particles.
 - b. Ionization is the production of ions when an atom loses an electron.
 - c. Ionizing radiation is radiation that is capable of producing ions.
6. d
Rationale: Alpha particles, beta particles, and protons possess mass and are considered particulate radiation.
7. a
Rationale: Radar waves, microwaves, and x-rays are human-made or occur naturally and are arranged according to their energy level in the electromagnetic spectrum.
8. b
Rationale: *Wavelength* is defined as the distance between the crest of one wave and the crest of the next wave.
9. a
Rationale: X-rays travel at the speed of light.
10. b
Rationales:
 - a. X-rays and visible light are both forms of electromagnetic radiation.
 - b. X-rays have a shorter wavelength than visible light.
 - c. X-rays travel at the speed of light.

Identification

- | | |
|--------------------------|---------------------|
| 11. filament | 19. aluminum filter |
| 12. molybdenum cup | 20. lead collimator |
| 13. electron stream | 21. PID |
| 14. tungsten target | 22. tubehead seal |
| 15. copper sleeve | 23. x-ray tube |
| 16. vacuum | 24. oil |
| 17. x-ray beam | 25. unlead window |
| 18. leaded glass housing | 26. metal housing |

Multiple Choice

27. b
Rationales:
 a. The high-voltage circuit generates x-rays in the x-ray tube.
 c, d. The transformers either increase or decrease the voltage in an electrical circuit.
28. a
Rationale: The transformers either increase or decrease the voltage in an electrical circuit; the step-up transformer increases the incoming voltage to the level required.
29. c
Rationale:
 When the high-voltage circuit is activated, the voltage is increased, the filament heats up and thermionic emission occurs. The x-rays do not travel from the filament to the target until the exposure button is depressed.
30. b
Rationale: X-rays are produced at the anode that is the positive electrode inside the x-ray tube.
31. c
Rationale: Thermionic emission occurs at the cathode that is the negative electrode inside the x-ray tube.
32. a
Rationales:
 b. Characteristic radiation accounts for a very small part of x-rays produced in the dental x-ray machine.
 c, d. Compton scatter and coherent scatter do not occur at the anode.
33. b
Rationales:
 a. General radiation accounts for 70% of all energy produced at the anode.
 c, d. Compton scatter and coherent scatter do not occur at the anode.
34. a
Rationales:
 b. Radiation that is created when the primary beam interacts with matter is secondary radiation.
 c. Radiation that has been deflected from its path by the interaction with matter is scatter radiation.

Multiple Choice**(Continued)**

35. c

Rationale: Radiation that has been deflected from its path by the interaction with matter is scatter radiation.

36. b

Rationales:

- b. Coherent scatter accounts for 8% of the interactions of matter with the x-ray beam.
- c. The photoelectric effect accounts for 30% of the interactions of matter with the dental x-ray beam.

Identification

37. absorption

39. coherent scatter

38. Compton scatter

40. no interaction

Multiple Choice

41. b

Rationale: This diagram illustrates the x-ray photon colliding with an inner shell electron. The photon is absorbed (no scatter) and a photoelectron with a negative charge is produced (ionization). This diagram illustrates the photoelectric effect.

42. d

Rationale: This diagram illustrates the x-ray photon colliding with an outer shell electron, ejecting the electron from its orbit (scatter). The photon is scattered in a different direction at a lower energy level (ionization). This diagram illustrates Compton scatter.

43. c

Rationale: This diagram illustrates the x-ray photon being altered in its path (scatter); no loss of energy occurs and the photon remains unmodified (no ionization). This diagram illustrates coherent scatter.

44. a.

Rationale: This diagram illustrates the x-ray photon passing through an atom unchanged. Because no interaction has taken place, no scatter or ionization occurs.

Identification

45. D

47. A

46. A

48. D