CHAPTER 2

Multiple Choice

1. b. Water is a form of matter. Heat, light, electricity, and x-radiation are forms of energy.
2. d. The innermost shell is the K shell, followed by the L shell, and so on, up to a maximum of seven shells.
3. c. Only radiation that produces ions is termed ionizing radiation.
4. a. Electromagnetic radiations have no electrical charge.
5. d. X-rays travel in divergent lines.
6. b. Roentgen is a traditional unit of measurement.
7. a. While the rad is the unit for measuring absorbed dose in traditional units, the gray is the unit used by the SI system.
8. d. Background radiation refers to that radiation which is always present in the environment. The sources of background radiation include cosmic rays from outer space, terrestrial radiations from the earth, and naturally occurring radionuclides which we inadvertently inhale or ingest.
9. b. Velocity is a measure of the speed of travel.
10. c. The majority of x-rays produced by dental x-ray machines are formed by general/bremsstrahlung radiation which is produced when electrons are accelerated across the tube head and abruptly stop against the tungsten target.
11. d. Radiation is defined as the emission and movement of energy through space in the form of electromagnetic radiation (x- and gamma rays) or particulate radiation (alpha and beta particles).

12. d. A molecule is the smallest particle of a substance that retains the properties of that substance.

13. b. Radiation is defined as the emission and movement of energy through space in the form of electromagnetic radiation (x- and gamma rays) or particulate radiation (alpha and beta particles).

14. c. Frequency is a measure of the number of waves that pass a given point per unit of time.

15. c. The Compton effect causes x-rays to be scattered in all directions.

16. b. Absorbed dose is the traditional unit of measure referring to the amount of energy deposited in tissues by any type of radiation.

17. b. Sievert is the Système International unit for measuring dose equivalent.

18. c. The sievert is the Système International unit and the rem is the traditional unit of measurement for the comparison of biological effects.

19. b. "Dose equivalent" is defined as the product of the absorbed dose multiplied by a biological-effect qualifying or weighting factor. The Système International unit for measuring the dose equivalent is the sievert (Sv).

20. a. Wavelength is the distance between two similar points on two successive waves. The shorter the wavelength, the more penetrating the radiation.

<u>True/False</u>

1. False. Energy is the ability to do work and overcome resistance. Energy is produced whenever the state of matter is altered.

2. True. If an atom is split, the resulting particles do not retain the full properties of the element.

3. False. Electrons have a negative charge and are constantly orbiting the nucleus. Protons are the component of an atom that have a positive charge.

4. True. There may be as many as seven shells in an atom. The innermost level is the K shell, followed by the L shell, and so on.

5. True. Dental x-rays involve the use of electromagnetic radiation and not unstable radioactive isotopes.

6. False. X-rays travel at the speed of light (186,000 miles per second).

7. False. Wavelength and frequency are inversely related. When the wavelength is long, the frequency is low. When the wavelength is short, the frequency is high.

8. False. Dental x-rays have no effect on the atoms they interact with, so the irradiated materials are not made radioactive.

9. True. When an x-ray imparts all of its energy to an orbital electron of an atom, the x-ray vanishes.

10. True. Part of the energy of a dental x-ray is transferred to an orbital electron and a new, weaker x-ray is formed that scatters in a different direction, possibly even a direction opposite to the original x-ray.

11. False. The number of protons in the nucleus of an element determines its atomic number.

12. True. Background radiation is defined as ionizing radiation that is always present in our environment and includes cosmic rays from outer space, naturally occurring radiation from the earth, and radiation from radioactive materials.

13. False. Binding energy is the internal energy within the atom that holds its components together.

14. True. The number of protons in the nucleus of an element determines its atomic number.

15. True. Secondary radiation is radiation that travels in a direction opposite that of the original x-ray.

16. True. The majority of x-rays produced by dental x-ray machines are formed by general/bremsstrahlung radiation.

17. False. The electromagnetic spectrum arranges energy types by wavelengths.

18. True. Hard radiation refers to x-radiation with extremely short wavelengths indicative of high energy.

19. True. Any radiation that produces ions is called "ionizing radiation."

20. True. Electromagnetic radiations display two seemingly contradictory properties. It is believed to move through space as both a particle and a wave.

Short Answer

1. Matter. The world consists of matter and energy. Matter makes up anything we can see, touch, and recognize.

2. Protons. Positively charged protons and neutral neutrons make up the nucleus of atoms.

3. Ions. The number of protons (positive charges) in an atom normally equals the number of electrons (negative charges). When an electron is removed from a neutral atom, it loses electrical neutrality and becomes an ion.

4. Radioactivity. Unstable, radioactive isotopes try to regain nuclear stability through the release of energy.

5. Photons. The particle (or quantum) theory assumes that electromagnetic radiations are particles or quanta. These particles are called “photons.”

6. Velocity. “Velocity” is the term for the speed of a wave of electromagnetic energy.

7. Hard radiation. Useful wavelengths in diagnostic dental radiography range from 0.1 to 0.5 Angstrom and are called “hard radiation” because they have sufficient penetrating power to expose dental radiographs.

8. No. X-rays travel at the speed of light and cease to exit the tube head within a fraction of a second after releasing the exposure button.

9. Background. Those living on the Colorado plateau receive additional background radiation due to the increased cosmic radiation at the higher altitude and enhanced terrestrial radiation from higher concentrations of radionuclides like uranium in the soil.

10. 100. The gray is the unit in the SI system that is replacing the rad unit in the traditional system. They both measure absorbed dose.