Multiple Choice

21.1 Planck and Quantum Nature of Light 29.

A perfect blackbody is a perfect absorber of energy transferred by what method?

a. conduction
b. convection
c. induction
d. radiation

30.

Which of the following is a physical entity that is quantized?

a. electric charge of an ion
b. frequency of a sound
c. speed of a car

31.

Find the energy in joules of photons of radio waves that leave an FM station that has a 90.0-MHz broadcast frequency.

a. 1.8×10^{-25} J
b. 1.11×10^{-25} J
c. 7.1×10^{-43} J
d. 5.96×10^{-26} J

32.

Which region of the electromagnetic spectrum will provide photons of the least energy?

a. infrared light
b. radio waves
c. ultraviolet light
d. X-rays

33.

A hot, black coffee mug is sitting on a kitchen table in a dark room. Because it cannot be seen, one assumes that it is not emitting energy in the form of light. Explain the fallacy in this logic.

a. Not all heat is in the form of light energy.
b. Not all light energy falls in the visible portion of the electromagnetic spectrum.
c. All heat is in the form of light energy.
d. All light energy falls in the visible portion of the electromagnetic spectrum.

34.

Given two stars of equivalent size, which will have a greater temperature: a red dwarf or a yellow dwarf? Explain. Note—Our sun is considered a yellow dwarf.

a. a yellow dwarf, because yellow light has lower frequency
b. a red dwarf, because red light has lower frequency
c. a red dwarf, because red light has higher frequency
d. a yellow dwarf, because yellow light has higher frequency

21.2 Einstein and the Photoelectric Effect 35.

What is a quantum of light called?

a. electron
b. neutron
c. photon
d. proton

36.

Classical physics explains many aspects of electromagnetic radiation. Which of the following observations is consistent with the classical model?

a. Immediate ejection of electrons upon exposure of a material to light.
b. Exposure to light causes an electrical response in many materials.
c. The speed of ejected electrons is independent of light intensity.
d. Electrical activity from a given material requires a specific frequency of light.

37.

If 5\,\text{eV} of energy is supplied to an electron with a binding energy of 2.3\,\text{eV}, with what kinetic energy will the electron be launched?

a. 2.3\,\text{eV}
b. 7.3\,\text{eV}
c. 11.5\,\text{eV}
d. \text{2.7}\,\text{eV}

38.

Which of the following terms translates to *light-producing voltage*?

a. photoelectric
b. quantum mechanics
c. photoconductive
d. photovoltaic

39.

Why is high frequency EM radiation considered more dangerous than long wavelength EM radiation?

a. Long wavelength EM radiation photons carry less energy and therefore have greater ability to disrupt materials through the photoelectric effect.
b. Long wavelength EM radiation photons carry more energy and therefore have greater ability to disrupt materials through the photoelectric effect.
c. High frequency EM radiation photons carry less energy and therefore have lower ability to disrupt materials through the photoelectric effect.
d. High frequency EM radiation photons carry more energy and therefore have greater ability to disrupt materials through the photoelectric effect.

40.

Why are UV, X-rays, and gamma rays considered ionizing radiation?

a. UV, X-rays, and gamma rays are capable of ejecting photons from a surface.
b. UV, X-rays, and gamma rays are capable of ejecting neutrons from a surface.
c. UV, X-rays, and gamma rays are capable of ejecting protons from a surface.
d. UV, X-rays, and gamma rays are capable of ejecting electrons from a surface.

21.3 The Dual Nature of Light 41.

What two particles interact in Compton scattering?

a. photon and electron
b. proton and electron
c. neutron and electron
d. proton and neutron

42.

What is the momentum of a 500-nm photon?

a. 8.35×10^{-26} kg m/s
b. 3.31×10^{-40} kg m/s
c. 7.55×10^{26} kg m/s
d. 1.33×10^{-27} kg m/s

43.

The conservation of what fundamental physics principle is behind the technology of solar sails?

a. charge
b. mass
c. momentum
d. angular momentum

44.

Terms like frequency, amplitude, and period are tied to what component of wave-particle duality?

a. neither the particle nor the wave model of light
b. both the particle and wave models of light
c. the particle model of light
d. the wave model of light

45.

Why was it beneficial for Compton to scatter electrons using X-rays and not another region of light like microwaves?

a. because X-rays are more penetrating than microwaves
b. because X-rays have lower frequency than microwaves
c. because microwaves have shorter wavelengths than X-rays
d. because X-rays have shorter wavelength than microwaves