Extended Response

21.1 Planck and Quantum Nature of Light 67.

Some television tubes are CRTs. They use an approximately 30-kV accelerating potential to send electrons to the screen, where the electrons stimulate phosphors to emit the light that forms the pictures we watch. Would you expect X-rays also to be created? Explain.

a. No, because the full spectrum of EM radiation is not emitted at any temperature.
b. No, because the full spectrum of EM radiation is not emitted at certain temperatures.
c. Yes, because the full spectrum of EM radiation is emitted at any temperature.
d. Yes, because the full spectrum of EM radiation is emitted at certain temperatures.

68.

Consider an alternate reality in which Planck's constant is equal to 6.626 J • s. What effect would this have on the motion of a child on a playground swing?

a. The child would be able to swing at any speed.
b. The child would be able to swing at constant velocity.
c. The child could be released from the swing at any height.
d. The child could be released from the swing at only specific heights.

69.

What is the accelerating voltage of an X-ray tube that produces X-rays with the shortest wavelength of 0.0103 nm?

a. 1.21×10^{10} V
b. 2.4×10^{5} V
c. 3.0×10^{-33} V
d. 1.21×10^{5} V

70.

In a dental office, the person giving a dental x-ray examination leaves the room while the x-ray source is active. Dental office workers do not, however, take similar precautions against the bright lights of the exam room. Explain this difference.

a. Because x-ray photons carry much more energy than the photons of visible light, repeated exposure to x-rays can cause much more cumulative cell damage to the dental worker.
b. Because x-ray photons have a longer wavelength than the photons of visible light, repeated exposure to x-rays can cause much more cumulative cell damage to the dental worker.

c. Because x-ray photons have a lower frequency than the photons of visible light, repeated exposure to x-rays can cause much more cumulative cell damage to the dental worker.
d. Because x-ray photons are more massive than the photons of visible light, they penetrate more deeply into tissue, so repeated exposure to x-rays can cause much more cumulative cell damage to the dental worker.

21.2 Einstein and the Photoelectric Effect 71.

You and your lab partner increase the intensity of light shining on a metal surface. Predict the effect on the current that you are able to measure and explain your reasoning.

a. The observed current will increase because more electrons are moving through the material.
b. The observed current will increase because electrons are moving more quickly through the material.
c. The observed current will decrease because fewer electrons are moving through the material.
d. The observed current will decrease because electrons are moving more slowly through the material.

72.

Consider the emission spectrum of oxygen shown in the image. What can you conclude about the speed of the particles represented by the spectral lines?

a. The particles represented by the lines may have any speed between the lowest and highest energy on the spectrum.
b. The particles represented by the lines have discrete speeds corresponding to the spectral lines.
c. There exist particles with a speed equal to the average of the brightest orange line and brightest green line.
d. There exist particles with infinite speed based on this spectrum.

73.

A 500 nm photon of light strikes a semi-conductive surface with a binding energy of 2 eV. With what velocity will an electron be emitted from the semi-conductive surface?

a. 8.38×10^5 m/s
b. 9.33×10^5 m/s
c. 3×10^8 m/s
d. 4.11×10^5 m/s

74.

True or false—Treating food with ionizing radiation helps keep it from spoiling.

a. true
b. false

21.3 The Dual Nature of Light

75.

Explain how Compton scattering may have caused large scale disruptions to communications systems after atomic weapons were tested near Los Alamos?

a. The large numbers of neutrons released may have absorbed the energy of nearby electrons.
b. The large numbers of photons released may have dissipated some of their energy to nearby electrons.
c. The large numbers of neutrons released at high speeds may have caused nearby electrons to scatter.
d. The large numbers of photons released may have caused those photons and nearby electrons to increase in velocity and change directions.

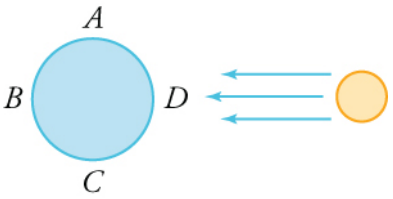
76.

Sunlight above the Earth's atmosphere has an intensity of 1.30 kW/m2 . If this is reflected straight back from a mirror that has only a small recoil, the light's momentum is exactly reversed, giving the mirror twice the incident momentum. If the mirror were attached to a solar sail craft, how fast would the craft be moving after 24 hr? Note—The average mass per square meter of the craft is 0.100 kg.

a. 8.67×10^{-5} m/s^2
b. 8.67×10^{-6} m/s^2
c. 94.2 m/s
d. 7.49 m/s

77.

Consider the counter-clockwise motion of LightSail-1 around Earth. When will the satellite move the fastest?



a. point A
b. point B
c. point C
d. point D

78.

What will happen to the interference pattern created by electrons when their velocities are increased?

a. There will be more zones of constructive interference and fewer zones of destructive interference.
b. There will be more zones of destructive interference and fewer zones of constructive interference.
c. There will be more zones of constructive and destructive interference.
d. There will be fewer zones of constructive and destructive interference.