Problems

21.1 Planck and Quantum Nature of Light 22.

How many X-ray photons per second are created by an X-ray tube that produces a flux of X-rays having a power of 1.00 W? Assume the average energy per photon is 75.0 keV.

a. 8.33×10^{15} photons
b. 9.1×10^{7} photons
c. 9.1×10^{8} photons
d. 8.33×10^{13} photons

23.

What is the frequency of a photon produced in a CRT using a 25.0-kV accelerating potential? This is similar to the layout as in older color television sets.

a. 6.04×10^{-48} Hz
b. 2.77×10^{-48} Hz
c. 3.02×10^{18} Hz
d. 6.04×10^{18} Hz

21.2 Einstein and the Photoelectric Effect 24.

What is the binding energy in eV of electrons in magnesium, if the longest-wavelength photon that can eject electrons is 337 nm?

a. 7.44×10^{-19} J
b. 7.44×10^{-49} J
c. 5.90×10^{-17} J
d. 5.90×10^{-19} J

25.

Photoelectrons from a material with a binding energy of 2.71 eV are ejected by 420-nm photons. Once ejected, how long does it take these electrons to travel 2.50 cm to a detection device?

a. 8.5×10^{-6} s
b. 3.5×10^{-7} s
c. 43.5×10^{-9} s
d. 8.5×10^{-8} s

21.3 The Dual Nature of Light 26.

What is the momentum of a 0.0100-nm-wavelength photon that could detect details of an atom?

a. 6.626×10^{-27} kg m/s
b. 6.626×10^{-32} kg m/s
c. 6.626×10^{-34} kg m/s

d. 6.626×10^{-23} kg m/s

27.

The momentum of light is exactly reversed when reflected straight back from a mirror, assuming negligible recoil of the mirror. Thus the change in momentum is twice the initial photon momentum. Suppose light of intensity 1.00 kW/m2 reflectsfrom a mirror of area 2.00 m2 each second. Using the most general form of Newton's second law, what is the force on the mirror?

a. 1.33×10^{-5} N
b. 1.33×10^{-6} N
c. 1.33×10^{-7} N
d. 1.33×10^{-8} N