

CHAPTER 6-PROBLEM SET

1. A diode laser emits at a wavelength of 987 nm. **(a)** In what portion of the electromagnetic spectrum is this radiation found? **(b)** All of its output energy is absorbed in a detector that measures a total energy of 0.52 J over a period of 32 s. How many photons per second are being emitted by the laser?
2. Place the following transitions of the hydrogen atom in order from shortest to longest wavelength of the photon emitted: $n = 5$ to $n = 3$, $n = 4$ to $n = 2$, $n = 7$ to $n = 4$, and $n = 3$ to $n = 2$.
3. Use the de Broglie relationship to determine the wavelengths of the following objects: **(a)** an 85-kg person skiing at 50 km/hr, **(b)** a 10.0-g bullet fired at 250 m/s, **(c)** a lithium atom moving at 2.5×10^5 m/s, **(d)** an ozone (O_3) molecule in the upper atmosphere moving at 550 m/s.
4. **(a)** For $n = 4$, what are the possible values of l ? **(b)** For $l = 2$, what are the possible values of m_l ? **(c)** If m_l is 2, what are the possible values for l ?
5. What is the maximum number of electrons in an atom that can have the following quantum numbers? **(a)** $n = 3$, $m_l = -2$; **(b)** $n = 4$, $l = 3$; **(c)** $n = 5$, $l = 3$, $m_l = 2$, **(d)** $n = 4$, $l = 1$, $m_l = 0$.
6. Identify the group of elements that corresponds to each of the following generalized electron configurations and indicate the number of unpaired electrons for each:
(a) [noble gas] ns^2np^5
(b) [noble gas] $ns^2(n-1)d^2$
(c) [noble gas] $ns^2(n-1)d^{10}np^1$
(d) [noble gas] $ns^2(n-2)f^6$
7. The rays of the Sun that cause tanning and burning are in the ultraviolet portion of the electromagnetic spectrum. These rays are categorized by wavelength. So-called UV-A radiation has wavelengths in the range of 320–380 nm, whereas UV-B radiation has wavelengths in the range of 290–320 nm. **(a)** Calculate the frequency of light that has a wavelength of 320 nm. **(b)** Calculate the energy of a mole of 320-nm photons. **(c)** Which are more energetic, photons of UV-A radiation or photons of UV-B radiation? **(d)** The UV-B radiation from the Sun is considered a greater cause of sunburn in humans than is UV-A radiation. Is this observation consistent with your answer to part (c)?