6.2 (a) Wavelength (λ) and frequency (ν) are inversely proportional; the proportionality constant is the speed of light (c). $\nu = c/\lambda$.

(b) Light in the 210-230 nm range is in the ultraviolet region of the spectrum. These wavelengths are slightly shorter than the 400 nm short-wavelength boundary of the visible region.

6.6 Wavelength of (a) gamma rays < (d) yellow (visible) light < (e) red (visible) light < (b) 93.1 MHz FM (radio) waves < (c) 680 kHz or 0.680 MHz AM (radio) waves

6.10 $\nu = c/\lambda$; $\dfrac{2.998 \times 10^8\ \text{m}}{1\ \text{s}} \times \dfrac{1}{489\ \text{nm}} \times \dfrac{1\ \text{nm}}{1 \times 10^{-9}\ \text{m}} = 6.13 \times 10^{14}\ \text{s}^{-1}$

The laser emits visible light; the color is green to blue-green.

6.14 (a) $E = hc/\lambda = 6.626 \times 10^{-34}\ \text{J}\cdot\text{s} \times \dfrac{2.998 \times 10^8\ \text{m}}{1\ \text{s}} \times \dfrac{1}{3.80\ \text{mm}} \times \dfrac{1\ \text{mm}}{1 \times 10^{-3}\ \text{m}}$

$= 5.23 \times 10^{-23}\ \text{J}$

(b) $E = h\nu = 6.626 \times 10^{-34}\ \text{J}\cdot\text{s} \times \dfrac{80.5 \times 10^6}{1\ \text{s}} = 5.33 \times 10^{-26}\ \text{J}$

(c) $\nu = E/h = \dfrac{1.77 \times 10^{-19}\ \text{J}}{6.626 \times 10^{-34}\ \text{J}\cdot\text{s}} = 2.67 \times 10^{14}\ \text{s}^{-1}$

$\lambda = hc/E = 1.12 \times 10^{-6}$ m; the radiation is infrared but near the visible "edge."

6.26 (a) absorbed (b) emitted (c) absorbed.

6.28 (a) $\Delta E = -2.18 \times 10^{-18}\ \text{J}\left[\dfrac{1}{n_f^2} - \dfrac{1}{n_i^2}\right] = -2.18 \times 10^{-18}\ \text{J}\ (1/1 - 1/25) = -2.093 \times 10^{-18}$

$= -2.09 \times 10^{-18}\ \text{J}$

$\nu = E/h = \dfrac{2.093 \times 10^{-18}\ \text{J}}{6.626 \times 10^{-34}\ \text{J}\cdot\text{s}} = 3.158 \times 10^{15} = 3.16 \times 10^{15}\ \text{s}^{-1}$

$\lambda = c/\nu = \dfrac{2.998 \times 10^8\ \text{m}}{1\ \text{s}} \times \dfrac{1\ \text{s}}{3.158 \times 10^{15}} = 9.49 \times 10^{-8}\ \text{m}$

Since the sign of ΔE is negative, radiation is emitted.

6.34 $\lambda = h/mv$; change mass to kg and velocity to m/s

mass of muon = $206.8 \times 9.1094 \times 10^{-28}\ g \times \frac{1\ kg}{1000\ g} = 1.8838 \times 10^{-28} = 1.88 \times 10^{-28}\ kg$

$$\lambda = \frac{6.626 \times 10^{-34}\ kg \cdot m^2 \cdot s}{1\ s^2} \times \frac{1}{1.8838 \times 10^{-28}\ kg} \times \frac{1\ s}{8.85 \times 10^3\ m/s} = 3.97 \times 10^{-10}\ m$$
$$= 3.97\ Å$$

6.42 (a) For $n = 3$, there are 3 l values (2, 1, 0) and 9 m_l values ($l = 2$; $m_l = -2, -1, 0, 1, 2$; $l = 1$, $m_l = -1, 0, 1$; $l = 0$, $m_l = 0$).

(b) For $n = 5$, there are 5 l values (4, 3, 2, 1, 0) and 25 m_l values ($l = 4$, $m_l = -4$ to $+4$; $l = 3$, $m_l = -3$ to $+3$; $l = 2$, $m_l = -2$ to $+2$; $l = 1$, $m_l = -1$ to $+1$; $l = 0$, $= 0$).

In general, for each principle quantum number n there are n l -values and n^2 m_l-values. For each shell, there are n kinds of orbitals and n^2 total orbitals.

6.44 (a) 2, 1, 1; 2, 1, 0; 2, 1 -1

(b) 5, 2, 2; 5, 2, 1; 5, 2, 0; 5, 2, -1; 5, 2, -2

6.46 (a) permissible, 2p (b) forbidden, for $l = 0$, m_l can only equal 0

(c) permissible, 4d (d) forbidden, for n = 3, the largest l value is 2

6.60 (a) Al: $[Ne]3s^2 3p^1$ (b) Sc: $[Ar]4s^2 3d^1$ (c) Co: $[Ar]4s^2 3d^7$

(d) Br: $[Ar]4s^2 3d^{10} 4p^5$ (e) Ba: $[Xe]6s^2$ (f) Re: $[Xe]6s^2 4f^{14} 5d^5$

(g) Lu: $[Xe]6s^2 4f^{14} 5d^1$

6.66 Count the total number of electrons to assign the element.

(a) N: $[He]2s^2 2p^3$ (b) Se: $[Ar]4s^2 3d^{10} 4p^4$ (c) Rh: $[Kr]5s^2 4d^7$