# Chapter 7 Practice Worksheet

(no polyelectronic atoms or trends)

Key

1. An FM radio station has a frequency of 88.9 MHz (1 MHz = $10^6$ Hz, or cycles per second). What is the wavelength of this radiation in meters?

$\lambda = \frac{c}{\nu} = \frac{2.998 \times 10^8 \text{ m/s}}{88.9 \times 10^6 \frac{1}{s}} = 3.37 \text{ m}$

2. The most prominent line in the spectrum of neon is found at 865.438 nm. Other lines are found at 837.761 nm, 878.062 nm, 878.438 nm, and 1885.387 nm.
   (a) Which of these lines represents the most energetic light? smallest $\lambda$ = highest $\nu$ = Highest Energy. $E = h\nu$
   (b) What is the frequency of the most prominent line? What is the energy of one photon of this wavelength?

$\nu = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m/s}}{865.438 \times 10^{-9} \text{ m}} = 3.469 \times 10^{14} \text{ Hz}$ or $3.469 \times 10^{14} \frac{1}{s}$

$E = h\nu$

$E = (6.626 \times 10^{-34} \text{ J s})(3.469 \times 10^{14} \frac{1}{s})$

$E = 2.295 \times 10^{-19} \text{ J}$

3. Calculate the wavelength (in nanometers) associated with a 1.0 x $10^2$ g golf ball moving at 30. m/s (about 67 mph). How fast must the ball travel to have a wavelength of 5.6 x $10^{-3}$ nm?

$\lambda = \frac{h}{m\nu} = \frac{6.626 \times 10^{-19} \text{ J s}}{(0.10 \text{ kg})(30 \frac{m}{s})} = 2.2 \times 10^{-34} \text{ m}$

$\nu = \frac{h}{m\lambda} = \frac{6.626 \times 10^{-34} \text{ J s}}{(0.10 \text{ kg})(5.6 \times 10^{-3} \text{ nm})(\frac{1 \text{ m}}{10^9 \text{ nm}})} = 1.2 \times 10^{-21} \frac{m}{s}$

4. Calculate the energy of an electron in the n=2 energy level of hydrogen. Calculate the energy of an electron in the n=3 energy level. What is the difference in energy of these two levels? If a photon of light had this energy, what would its wavelength be?

$E = -2.178 \times 10^{-18} \text{ J} \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$E = -2.178 \times 10^{-18} \text{ J} (0.1389) = 3.025 \times 10^{-19} \text{ J}$

$\lambda = \frac{hc}{E} = \frac{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \frac{m}{s})}{3.025 \times 10^{-19} \text{ J}} = 6.567 \times 10^{-7} \text{ m}$

5. Rank the following orbitals in the H atom in order of increasing energy: 3s, 2s, 2p, 4s, 3p, 1s, and 3d.

1s, 2s, 2p, 3s, 3p, 4s, 3d

6. How many orbitals in an atom can have the following quantum number or designation?

a) 3p 3

b) 4p 3

c) $4p_x$ 1

d) 6d 5

e) 5d 5

f) 5f 7

g) $n = 5$

h) 7s

7. When n = 3, l can have values of 2, 1 and 0.
   For the 3d orbital, l has a value of 2.

   When n = 4, l can have values of 3, 2, 1, 0.
   For the 4p orbital, l has a value of 1.

   When n = 2, l can have values of 1, 0.
   For the 2s orbital, l has a value of 0