<u>Homework Set #14 Solutions</u> (12/8 - 12/12):

Chapter 23: **Questions** 24, 37, 55 **Exercises** 13, 20, 23

Questions:

24. The electric force provides the centripetal force for the electrons to orbit the nucleus. This is analogous to the Moon orbiting the Earth.

37. The number of photoelectrons emitted from the surface per unit of time depends on the intensity of the incident light.

55. The wavelengths of X-rays are about the size of atoms.

Exercises:

13. $L = \dfrac{nh}{2\pi} = \dfrac{(1)\left(6.63\times10^{-34}\ \mathrm{J\cdot s}\right)}{2\pi} = 1.06\times10^{-34}\ \mathrm{J\cdot s}$

20. $f = \dfrac{E}{h} = \dfrac{13.6\ \mathrm{eV}}{6.63\times10^{-34}\ \mathrm{J\cdot s}}\left[\dfrac{1.6\times10^{-19}\ \mathrm{J}}{1\ \mathrm{eV}}\right] = 3.28\times10^{15}\ \mathrm{Hz}$; above

23. $E = hf = \left(6.33\times10^{-34}\ \mathrm{J\cdot s}\right)\left(2\times10^{18}\ \mathrm{Hz}\right) = 1.33\times10^{-15}\ \mathrm{J} = 8.29\mathrm{keV}$

Chapter 24: **Questions** 1, 6 **Exercises** 1, 7

Questions:

1. The successes included accounting for the stability of atoms, the numerical values for the wavelengths of spectral lines in hydrogen and hydrogenlike atoms, and the general features of the periodic table. Bohr’s model failed in that it could not explain why accelerating electrons didn’t radiate, the spectral lines in non-hydrogenlike atoms, the splitting of spectral lines into two or more lines, the relative intensities of the spectral lines, the details of the periodic table including the capacity of each shell, and the lack of relativistic effects.

6. If a wire loop had a standing wave pattern with three anti-nodes, the second anti-node would have to be moving in the opposite direction to both the first and the third anti-nodes at all times. Therefore, the first and third anti-nodes would have to be moving in the same direction. But, because it is a loop, the first and third anti-nodes are adjacent making this motion impossible.

Exercises:

1. $\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}\ \text{J} \cdot \text{s}}{(1000\ \text{kg})(30\ \text{m/s})} = 2.21 \times 10^{-38}\ \text{m}$

7. $v = \frac{6.63 \times 10^{-34}\ \text{J} \cdot \text{s}}{(9.11 \times 10^{-31}\ \text{kg})(10^{-10}\ \text{m})} = 7.28 \times 10^{6}\ \text{m/s}$