Milestone: Keeping Time: Homework 8

Due: 6 November 2020

1 Electromagnetic waves

The speed of a wave is always defined via

$$\text{speed} = \frac{\text{distance traveled}}{\text{time taken to travel}}.$$

All electromagnetic waves travel (in a vacuum or air) with speed 3.0×10^8 meters per second.

a) Determine the distance an electromagnetic wave travels in $2.0\,\text{ms} = 2.0 \times 10^{-3}\,\text{s}$.

b) Determine how long it takes an electromagnetic wave to travel a distance of 100 meters (roughly 100 yards).

2 Frequency of light waves

A red light wave has frequency $4.3 \times 10^{14}\,\text{Hz}$.

a) Determine how many crests of the wave enter your eye every second.

b) Determine how many crests of the wave enter your eye every minute.

3 Visible light spectrum

Find a source (something like Wikipedia would be fine in this case) that lists the range of visible light spectrum. Order the basic colors in the spectrum in order of increasing frequency.

4 Electromagnetic spectrum

There exists a large variety of electromagnetic waves, distinguished amongst themselves by their frequencies. Find a source (something like Wikipedia would be fine in this case) that lists the different types of electromagnetic waves across the frequency spectrum. Select three types of electromagnetic wave and describe how each is useful in your everyday life.

5 Atomic structure

The "Build an Atom" animation allows you to construct models of various atoms. This can be found at https://phet.colorado.edu/en/simulation/build-an-atom Open the link and run the animation. Open the "Atom" tab and ensure that all the boxes, including Stabel/Unstable are checked.

a) By adding protons, construct the Oxygen atom. Then add neutrons and electrons so that the atom is stable and the Net Charge meter reads zero. How many protons, neutrons and electrons does this atom have?

b) Repeat this for Neon.

6 Quantum theory and atoms

The early quantum theory of atoms was developed by Bohr. This is the theory as described in class and also in Chapter 14 of Barnett.

a) In this version of quantum theory, if the electron stays in one energy (orbital) state, does it produce electromagnetic radiation as it orbits?

b) Suppose that the electron is in one energy (orbital) state. Explain what the electron has to do in order to emit electromagnetic radiation (for example, light).