

Problem 1

A photon with wavelength **3.8 nm** collides with an electron staying at rest. After the collision the wavelength of the photon increases twice. Find the speed and wavelength of electron after the collision.

Problem 2

An electron trapped in a small box with infinite boundaries is initially **in its ground** state. It then **absorbs a photon** which excites it to the first excited state. The wavelength of this photon is λ_0 . Then it absorbs another photon which excites it from the *first* to the *second* excited state. Express the wavelength of the second photon in terms of λ_0 .

Problem 3

An emission spectrum gives one of the lines in the Balmer series of the hydrogen atom at 410 nm. This wavelength results from a transition from an upper energy level to $n = 2$. What is the principal quantum number (n) of the upper level?

Problem 4

A particle is traveling through Earth's atmosphere at a speed of $0.750c$. To an earthbound observer, the distance it travels is 2.50 km. How far does the particle travel as viewed from the **particle's reference frame? (in which the particle is at rest!)**

Problem 5

A non-flat screen, older-style television display works by accelerating electrons over a short distance to relativistic speed, and then using electromagnetic fields to control where the electron beam strikes a fluorescent layer at the front of the tube.

Suppose the electrons travel at **6.0×10^7 m/s** through a distance of **0.200m** from the start of the beam to the screen.

- What is the time of travel of an electron in the **rest frame of the television set?** (S)
- What is the electron's time of travel in **its own rest frame?** (S')

Problem 6

The **half-life** of strontium-90, $^{90}_{38}\text{Sr}$, is 28.8 y. Find

- (a) its decay constant and
- (b) the initial activity of 1.00 g of the material.

Problem 7

In an ancient burial cave, your team of archaeologists discovers ancient wood furniture. Only **80%** of the original ^{14}C remains in the wood. How old is the furniture? ($t_{1/2}$ of ^{14}C = 5730 y.)