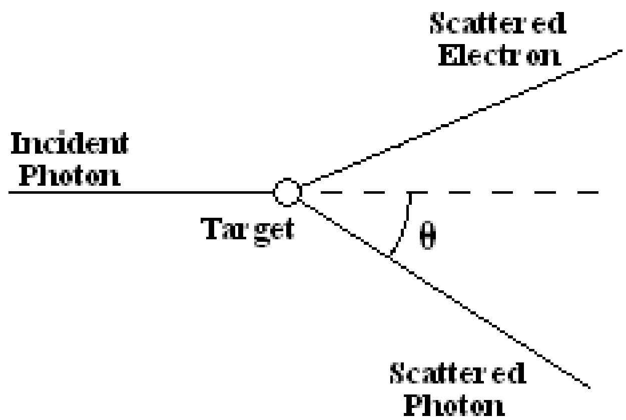
Compton Scattering

Physicist Arthur Holly Compton won the 1927 Nobel Prize in Physics for observing that a light "wave", after colliding with a free electron, gained energy. This observation could not be explained by modeling light as a wave, but instead by modeling light as a particle that we call a photon. Thus, Compton's observation was fundamental in suggesting wave-particle duality. Consider the setup below, where a photon of wavelength λ hits an electron (target) of mass m_e, and where the scattered photon heads off at an angle of θ. Derive a formula for the wavelength of the scattered photon in terms of λ, θ, m_e, and any fundamental constants you think you need.



Some possibly useful information:

$$E = \frac{hc}{\lambda}$$

where E is energy, $h = 6.63 \times 10^{-34} J * sec$ is Planck's constant, c is the speed of light, and λ is wavelength.

$$E^2 = c^2p^2 + m^2c^4$$

where p is [the magnitude of] momentum and m is mass. By the way, for particles that are moving slowly compared to the speed of light, the usual $KE = \frac{1}{2}mv^2$ is a good estimate.