

PHY 251 Fall 2009: homework problem set 3, due PHY 251 drop box in room A-129 by noon on Friday, Sep. 25.

1. A proton with a kinetic energy of 10 GeV collides with an antiproton at rest. They annihilate each other, and produce two identical-energy gamma rays (very energetic photons) that come out at angles θ above and below, respectively, the direction of the proton's motion. Calculate the energy E and momentum p of the gamma rays, and the angle θ .
2. A atom of the radioactive isotope of carbon ^{14}C (mass 14.003 242 amu, where 1 amu=931.494 MeV/ c^2) decays into an electron (mass 0.000 549 amu) and a singly ionized ^{14}N atom (mass 14.003 074 – 0.000 549 amu). If the ^{14}C atom were at rest, and no other particles were involved, calculate the total energy released by this decay, and the energy and momentum of the electron and ^{14}N atoms after the decay.
3. Do Serway problem 3.6.
4. Look up the overall luminous efficiency of a 100 W incandescent light bulb on Wikipedia. Assume that the power emitted as visible light is all emitted at $\lambda = 500$ nm. How many photons per second does this light bulb emit?
5. The photocurrent produced from a metal target by $\lambda = 220$ nm light is driven to zero by a retarding potential of 3.05 Volts. What's the work function of the metal?
6. Photons of wavelength 440 nm are incident on a metal. Ejected electrons are then directed into a region with a 1.5×10^{-5} Tesla magnetic field, where their trajectory is bent into a circular arc with a radius of 15 cm. Find the work function of the metal.
7. Some 2.00 MeV gamma rays are incident on a target. At what angle will 0.50 MeV Compton scattered photons be observed?
8. A 10 keV photon is Compton scattered through an angle of 20° . What's the energy of the scattered photon? (Think of how to calculate it accurately).
9. If the maximum energy given to an electron during Compton scattering is 20 keV, what is the wavelength of the incident photon?
10. A 120 keV photon undergoes Compton scattering at an angle of 50° . Find the energy of the scattered photon, and the energy and angle of the recoil electron.