

Exercise 1

Show that the angle ϕ by which the electron is scattered is related to the scattering angle θ of the photon by

$$\cot \frac{\theta}{2} = \left(1 + \frac{\lambda_c}{\lambda_0} \right) \tan \phi$$

Exercise 2

Is Compton effect easier to observe with I.R., visible, UV or X-rays ? In a Compton scattering experiment the scattered electron moves in the same direction as that of the incident photon. In which direction does the photon scatter ?

(Answer : X-rays, 180° .)

Exercise 3

A 200 MeV photon strikes a stationary proton (rest mass 931 MeV) and is back scattered. Find the kinetic energy of the proton after the scattering.

(Ans. 60 MeV)

Exercise 4

A photon of wavelength 6000 nm scatters from an electron at rest. The electron recoils with an energy of 60 keV. Calculate the energy of the scattered photon and the angle through it is scattered.

(Ans. 147 keV, 91.3°)

Exercise 5

A photon scatters from a proton, initially at rest. After the collision, the proton is found to scatter at an angle of 30° with the original direction of the incident photon with a kinetic energy of 100 MeV. Find (i) the initial energy of the photon and (ii) the angle through it is scattered

[**Hints** : The rest mass of proton is 938 MeV. Total energy of a relativistic particle is $\sqrt{p^2c^2 + m^2c^4}$. Use these to determine momentum of the scattered proton. Use momentum and energy conservation. Answer (i) 329 MeV (ii) 104° .]

Exercise 6

Find the smallest energy that a photon can have in order to be able to transfer half of its energy to an electron at rest (rest mass of an electron is 0.5 Mev)

(Ans. 0.256 Mev)

Exercise 7

A photon has the same wavelength as the Compton wavelength of an electron. What is the energy of the photon in eV ?

(Ans. 0.51 MeV)