

Question 1

In the “down conversion” process light of one wavelength is incident on a special type of crystal. Sometimes when a photon is incident on the crystal it is absorbed and two photons are emitted from the crystal. The energy of the crystal returns to its value before the interaction. Let f_{inc} be the frequency of the incident photon and $f_{\text{em } 1}$, $f_{\text{em } 2}$ be those of the emitted photons.

Which of the following is possible?

1. $f_{\text{em } 1} = f_{\text{em } 2} = f_{\text{inc}}$.
2. $f_{\text{em } 1} = f_{\text{em } 2} > f_{\text{inc}}$.
3. $f_{\text{em } 1} = f_{\text{em } 2} < f_{\text{inc}}$.
4. $f_{\text{em } 1} > f_{\text{inc}}$ and $f_{\text{em } 2} < f_{\text{inc}}$.
5. All of these.
6. Only options 3, 4.

Question 2

The Compton effect could be carried out by scattering X-rays off electrons or off an atom. The only difference in the analysis is that the electron mass would be replaced by the atom mass.

Which of the following is true of the scattering at at 30° angle?

1. The wavelength shift would be the same for either the electron case or the atom case.
2. The wavelength shift would be larger for the electron case than the atom case.
3. The wavelength shift would be smaller for the electron case than the atom case.