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.

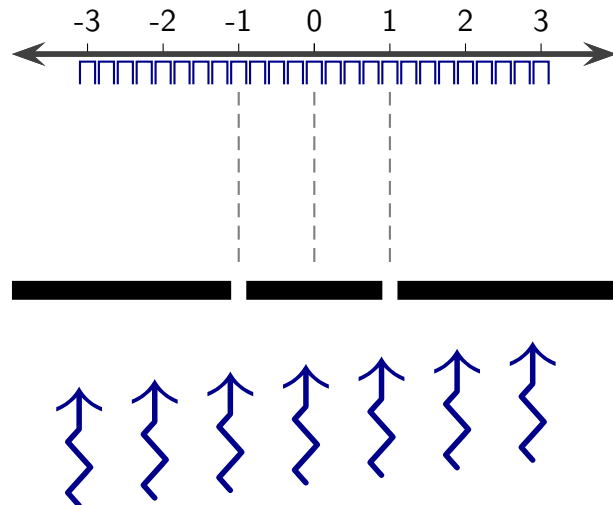Which of the following is true of the scattering at at $30°$ angle?

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.

Overlapping Waves from a Double Slit

Light

Barrier

Screen

Light Intensity
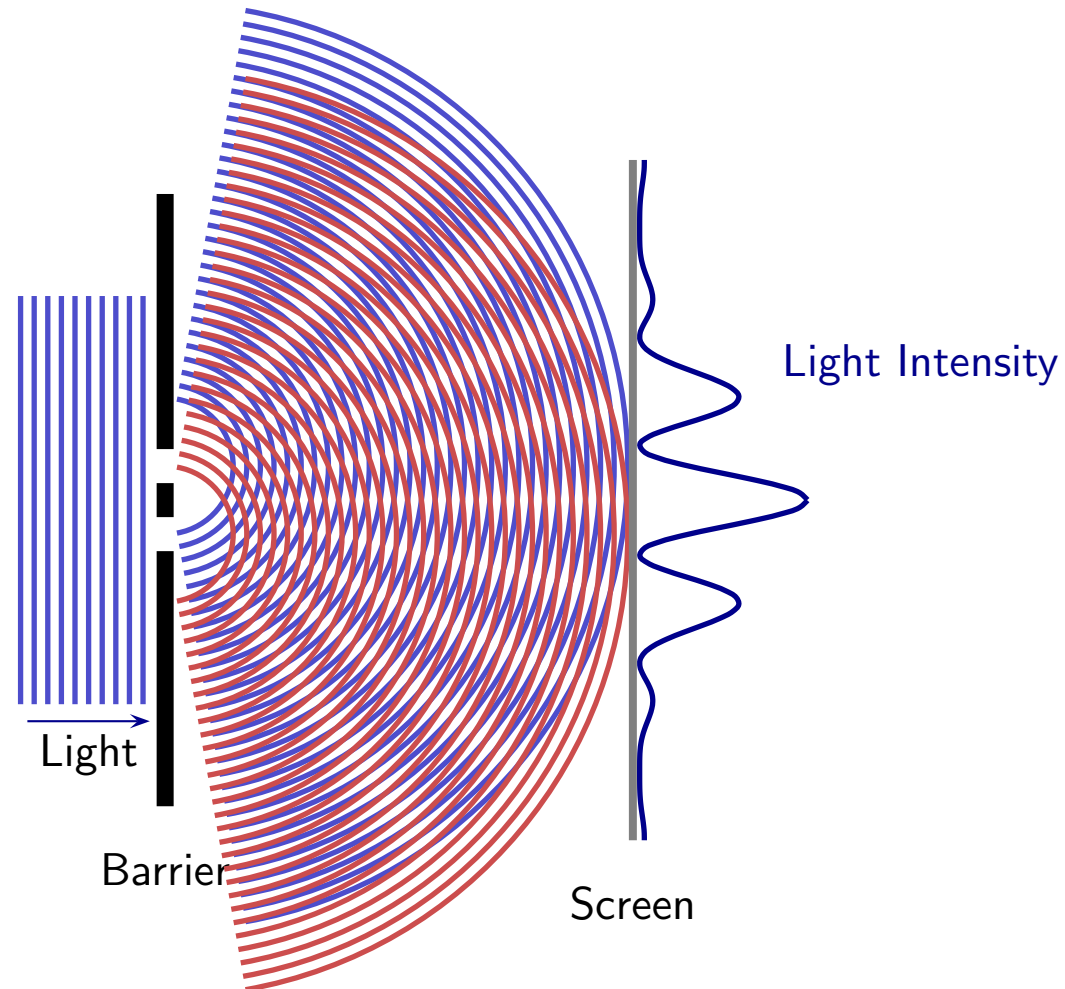
Question 3

Light consisting of photons is incident on a double slit. The screen consists of a collection of photon detectors, each ideally with zero width. A stream of photons is fired toward the barrier.

Which of the following is true about the detectors at which photons could possibly arrive?

1. Only at that at "0".

2. Only at those at "-1" and "1".

3. Only at that at "-1", "1" and "0".

4. Photons could arrive at most of the detectors.

5. None of the above.