- The speed of light in free space (or in vacuum) is: $c = \frac{1}{\sqrt{\mu_o \varepsilon_o}} = 3 \times 10^8\ m/s.$
- In lab, light is produced due to accelerated charged particles [charged particles executing SHM].

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4. Quantum theory: [Proposed by Einstein]

Light travels in the form of small packet of energy- called photons.

The photons carry energy and momentum along its direction of propagation (motion).

The energy of photon depends upon its frequency $[E = hf]$, and the intensity of photon depends upon its number. $[\boldsymbol{Intensity} = \frac{\boldsymbol{N\,h\,f}}{\boldsymbol{time \times Area}}]$. $N = number\ of\ photons$

- Quantum theory assumes photon as a particle.
- Quantum theory successfully explained the phenomena like: photoelectric effect, Compton effect, laser, etc.
- Quantum theory could not explain the phenomena like interference, diffraction, polarization.
  [Interference and diffraction could be explained by Huygens' wave theory]
  [Polarization could be explained by electromagnetic wave theory]

Remember!!!

- ✓ *Huygens assumed that light wave is a mechanical (and longitudinal) wave.*
- ✓ *Later, Maxwell proposed that light is not a mechanical wave, but it is an electromagnetic wave.*

5. Dual nature of light: [Proposed by De- Broglie]

Light possesses dual nature. Light can behave as a wave as well as a particle.

The wavelength of wave associated with photon particle is: $\boldsymbol{\lambda = \frac{h}{mc}}$

Here, $\boldsymbol{m = \frac{hf}{c^2}}$ $is\ the\ mass\ of\ photon\ (dynamic\ mass)$

and $c = speed\ of\ photon.$

Some Basic Terms:

- **Physical optics [wave optics]:**

The branch of physics which deals about the study of light on the basis of its wave nature is called as physical optics.

According to Huygens, source of light sends out waves in all directions through a hypothetical medium (called ether).

Huygens' method is a geometrical method.

- **Wave- Front and Wavelets:**

Wavefront:

Wavefront is the locus (imaginary surface) of all adjacent vibrating particles of medium which are equidistant from the source of light and are vibrating in same phase.

Each point in a wavefront vibrating in same phase, which behave as a source of new smaller spherical wave are called as wavelets.