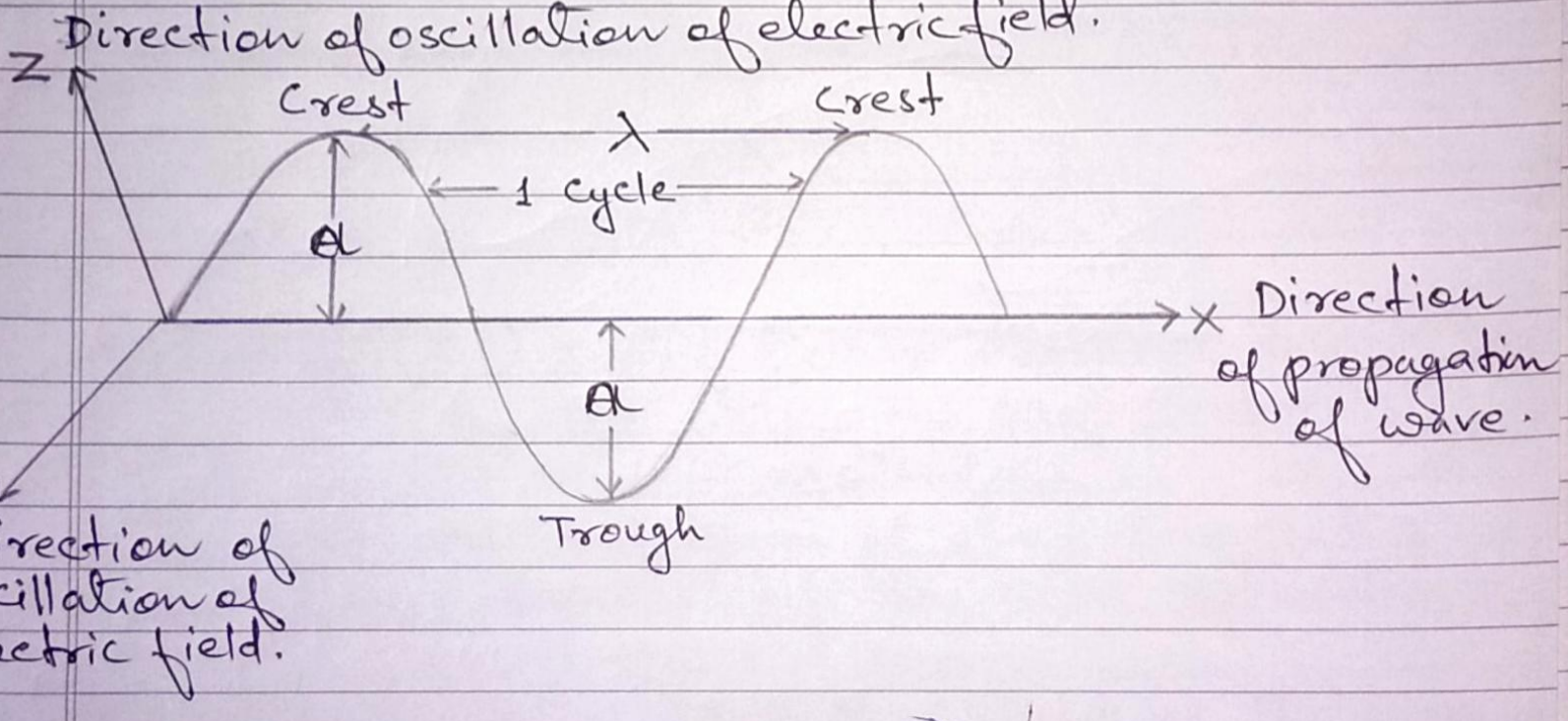
Electromagnetic radiation

James Maxwell suggested that, when electrically charge particle moves under acceleration, alternating electrical and magnetic fields are produced and transmitted. These fields are transmitted in the forms of waves called electromagnetic waves or electromagnetic radiation.

The oscillating electric and magnetic fields produced by oscillating charged particles are perpendicular to each other and both are perpendicular to the direction of propagation of the wave.



There are many types of electromagnetic raditions. These are characterised by properties like wavelength (λ) and frequency (ν)

Wavelength (λ) - Distance between two consecutive crests or two consecutive troughs. Unit - m, cm etc.

Frequency (ν) - Number of vibrations made by an electromagnetic radition per second. Unit - s^{-1} or Hz

Wave number ($\bar{\nu}$) - Number of waves of an electromagnetic radiation present in per unit length (per cm) is called wave number. It is reciprocal of wavelength. i.e,

$$\bar{\nu} = \frac{1}{\lambda}$$

Unit - m^{-1}, cm^{-1} etc.

Velocity (c) - The linear distance travelled by the wave in one second
unit - ms^{-1} or cms^{-1}.

In vaccum all types of electromagnetic radiations travel at the same speed. i.e;

$$c = 3 \times 10^8 \, ms^{-1}.$$

Amplitude (a) - ~~It is~~ the hight of the crest or depth of the trough.

Electromagnetic radiations have dual character i.e, having wave nature as well as particle character. Particle nature of electromagnetic radiation was explained by quantum theory.

Quantum theory - This theory was given by Max. Planck and later extended by Einstein. ~~According~~ According to this theory.

1. Electromagnetic radiations are composed of small packets of energy called 'quanta' ~~photons~~ Small packets of light are called 'photons'
2. Energy of electromagnetic radiations is emitted or absorbed in the form of quanta.
3. Energy of a quantum is propotional to its frequency and is expressed by the equation.

$$E = h\nu \quad \text{——— (1)}$$

where,

E = Energy of quantum.

h = Planck's constant.

$= 6.626 \times 10^{-34}$ Js

ν = Frequency of ~~quantum~~ radiation.

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4. Energy of quantum of radiation is inversely proportional to its wave length and is expressed by the equation.

$$E = \frac{hc}{\lambda} \quad \text{---(2)}$$

5. Where, c = Velocity of light in vacuum.
$= 3 \times 10^8 \, m\,s^{-1}$
λ = wavelength of radiation.

5. From eqn (1) and (2) we get.

$$h\nu = \frac{hc}{\lambda}$$

$$\therefore \nu = \frac{c}{\lambda} \quad \text{---(3)}$$