de-Broglie Hypothesis:- According to the de-Broglie every object which possess mass and velocity behaves both as particle and as wave.
or light have dual nature that is particle nature as well as wave nature.

Light

Particle
(experiment to confirm)
Photoelectric effect
Compton effect

Wave
(experiment to confirm)
Interference
Diffraction
Polarisation

de-Broglie Equation:-

According to the Planck's Quantum theory energy of the photon is given by

$$E = h\nu \quad \text{--- (1)}$$

According to the Einstein's mass energy relation

$$E = mc^2 \quad \text{--- (2)}$$

from equation (1) and (2)

$$h\nu = mc^2$$

$$\nu = \frac{c}{\lambda}$$

$$\frac{h\cancel{c}}{\lambda} = m c^{\cancel{2}}$$

$$\frac{h}{\lambda} = mc$$

$$\boxed{\lambda = \frac{h}{mc}} \Rightarrow \lambda = \frac{h}{\text{mass} \times \text{velocity}}$$

for particle (matter-wave)

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

$$\boxed{\lambda = \frac{h}{p}}$$

$\lambda \rightarrow$ wave length

$h \rightarrow$ Planck's constant.

$p \rightarrow$ Momentum.

The wavelength of moving particle is inversly proportional to its momentum, and hence inversly proportional to its mass.

Comparison: Let us consider a ball of mass $m = 100g$ and $v = 100$ m/sec, $h = 6.626 \times 10^{-34}$ J sec.

Then $\lambda = \frac{h}{mv}$

$$\lambda = \frac{6.626 \times 10^{-34}}{100 \times 10^{-3} \times 100}$$

$$\boxed{\lambda = 6.626 \times 10^{-35} \text{ m}}$$

The wavelength is very small we can not measure this wavelength.

Let us consider an electron whose mass is $m = 9.1 \times 10^{-31}$ kg and $v = 100$ m/sec.

$$\lambda = \frac{6.626 \times 10^{-34}}{9.1 \times 10^{-31} \times 100}$$

$$\boxed{\lambda = 7.3 \times 10^{-6} \text{ m}}$$ which is measurable.

Therefore matter have dual nature.

de-Broglie wavelength in terms of Kinetic energy.

consider a particle of mass 'm' moving with velocity v.

Now Kinetic energy of the particle is given as.

$$E = \frac{1}{2} m v^2$$

$$E = \frac{m^2 v^2}{2m}$$

$$E = \frac{p^2}{2m} \quad (\because p = mv)$$

$$p^2 = 2mE$$

$$p = \sqrt{2mE}$$

$$\lambda = \frac{h}{p}$$

$$\boxed{\lambda = \frac{h}{\sqrt{2mE}}}$$

If a charge 'q' is accelerated through a potential difference 'V' Volt from the rest then the Kinetic energy

$$E = qV$$

$$\boxed{\lambda = \frac{h}{\sqrt{2mqV}}}$$

This is the wavelength of an accelerated charge particle.