CL7_Q1. What are matter waves? State De-Broglie hypothesis.

Answer

Waves associated with material particles in motion are called matter waves or de-Broglie waves.
De-Broglie in his study, assuming that what is true with energy (X- ray/light) is also true with matter and put forward a hypothesis stating that like light, matter also has a wave-particle dual nature. He proposed that all particles in motion behave as waves. This is known as de-Broglie hypothesis.

The wavelength of a moving particle is given by

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

Where *h* is the Planck's constant and *p* is the momentum of moving particles.

CL7_Q2. Why is the wave nature of matter not apparent for macroscopic particles?

Answer

According to de-Broglie hypothesis a moving body is associated with matter waves and the wavelength of the waves is given by

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

Where 'v' is the velocity with which the body moves.
As the mass 'm' of the body increases, the wavelength tends to be insignificant. Therefore, the wavelength associated with macroscopic bodies become insignificant in comparison to the size of the bodies themselves even at very low velocities. Because of the smaller magnitude of Planck's constant h, the wavelength λ will be significant only in the case of micro-particles.

CL7_Q3. The mass of the oxygen molecule is 5.4×10^{-26} kg. If this molecule moves with a speed of 500 m/s, calculate the de-Broglie wavelength associated with the molecule?

Answer

Given: Mass of the oxygen molecule m= 5.4×10^{-26} kg

V= 500 m/s

We know that the de-Broglie wavelength is given by

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

$$\lambda = \frac{6.626 \times 10^{-34}}{5.4 \times 10^{-26} \times 500}$$

$$\lambda = 2.45 \times 10^{-11} m$$