Ques.

The temperature of an ideal gas in 3-dimensions is 300 K. The corresponding de-Broglie wavelength of the electron approximately at 300 K, is :

[m_e = mass of electron = 9×10^{-31} kg, h = Planck constant = $6.6 \times 6.6 \times 10^{-34}$ Js, k_B = Boltzmann constant = 1.38×10^{-23} JK^{-1}]

Given, Planck's constant, h = 6.6 × 10^{-34} Js

Boltzmann constant, k_B = 1.38 × 10^{-23} J/K

Mass of an electron, m_e = 9 × 10^{-31} kg

Temperature of an ideal gas, T = 300 K

As we know that, de-Broglie wavelength,

$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}$ .... (i)

Here, E is the kinetic energy,

$E = \frac{3K_BT}{2}$

Substituting value of E in Eq. (i), we get

$\lambda = \frac{h}{\sqrt{3mK_BT}}$

Substituting the given values in the above equation, we get

$\lambda = \frac{6.6\times10^{-34}}{\sqrt{3\times9\times10^{-31}\times1.38\times10^{-23}\times300}}$

= 6.26 nm

∴ The corresponding de-Broglie wavelength of an electron approximately at 300 K is 6.26 nm.