

3. Three atoms in a crystal lattice oscillate with quantized energies given by:

$E_n = h\nu \left(n + \frac{1}{2} \right)$, where $n \geq 0$ is the quantum number. The total energy of the system is: $E_{total} = h\nu \left(n_1 + n_2 + n_3 + \frac{3}{2} \right)$ where n_1, n_2 , and n_3 are the quantum numbers of the three atoms.

It is observed that the total energy of the system is $\frac{9}{2}h\nu$. Determine the most likely configuration of the quantum numbers n_1, n_2 , and n_3 and the probability of obtaining this configuration.

4. The probability of finding a particle at position x is given by $f(x) = \frac{2x}{(1+x^2)^{3/2}}$, $x \geq 0$. Find the probability that x lies between 0 and 1. $P(0 \leq x \leq 1)$.

Homework Problem 2

1. In the kinetic theory of gases, gas molecules travel at different speeds, and the probability of finding a molecule with speed v is given as

$$p(v) dv = 4\pi \left(\frac{m}{2\pi k_B T} \right)^{3/2} v^2 e^{-\frac{mv^2}{2k_B T}} dv$$

Show that this probability distribution is normalized. You may use the following integral:

$$\int_0^\infty x^{2n} e^{-\alpha x^2} dx = \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{2^{n+1} \alpha^n} \sqrt{\frac{\pi}{\alpha}}$$