



Quiz # 2

Instructor: Ambresh Shivaji (**email:** ashivaji)

TA: Subhadip Ghosh (**email:** subhadipg)

1. Show that for a random variable x , $\langle x^2 \rangle \geq \langle x \rangle^2$.
2. What is the average thermal energy of an ideal gas of *linear* triatomic molecules kept at temperature T ? Explain your answer.
3. The **velocity distribution** of molecules in a gas is given by,

$$g(v_x) \propto e^{-mv_x^2/2k_B T}, \quad (1)$$

where, $g(v_x)dv_x$ gives fraction of molecules with velocities in between v_x and $v_x + dv_x$. Calculate $\langle v_x \rangle$, $\langle |v_x| \rangle$ and $\langle v_x^2 \rangle$.

4. The partition function for a classical ideal gas system in Grand Canonical Ensemble is given by

$$Z_G = \exp\left(\frac{V e^{\beta\mu}}{\lambda^3}\right); \quad \lambda = \sqrt{\frac{2\pi\hbar^2}{mk_B T}}. \quad (2)$$

Calculate pressure and derive the equation of state.

5. Calculate one particle partition function for a quantum mechanical system of spin-0 particles (non-interacting) kept in a 2-dimensional box of area A . You can assume that the temperature is large enough so that the energy levels form a continuum.