Equipartition of Energy

calculate averages

$\bar{v}_x = 0 \; ; \; v_y, v_z$

$\overline{v_x^2} = \int v_x^2 \, dw_{v_x} \, dw_{v_y} \, dw_{v_z}$

$\overline{v_x^2} = \int v_x^2 \, dw_{v_x} \, dw_{v_y} \, dw_{v_z}$

$= \left(\frac{\beta m}{2\pi}\right)^{3/2} \int v_x^2 e^{-\frac{\beta m}{2}(v_x^2+v_y^2+v_z^2)}$

$= \left(\frac{\beta m}{2\pi}\right)^{1/2} \int v_x^2 e^{-\frac{\beta m}{2} v_x^2} \, dv_x$

$\overline{v_x^2} = \frac{k_B T}{m}$

$\overline{v^2} = \overline{v_x^2} + \overline{v_y^2} + \overline{v_z^2} = \frac{3 k_B T}{m}$

$\overline{K} = \frac{1}{2} m \overline{v^2} = \frac{3}{2} k_B T$

$U = 0$

$E = N \frac{3}{2} k_B T \; ; \; N = \#\,\text{part}$

$C_V = \left(\frac{\partial E}{\partial T}\right)_N = \frac{3}{2} k_B$

$\frac{1}{2} k_B T$ of energy per degree of freedom