The Ideal Gas Law: \[ PV = nRT_A = N kT_A \]
and the inference that \( T_A \propto (KE) \) of average gas molecule, can be obtained by elementary considerations.

Take the container to be a cube \( < \) on each side.

Assume that each gas particle has speed \( v \) and all velocity directions equally probable.

1. Compute the force exerted by the particles hitting the Right side of the cube & Divide this Avg. Force by \( L^2 = \text{Area of Right Face} \) to obtain:

\[ P = \frac{F_{\text{AV}}}{L^2} \]

2. To compute \( F_{\text{AV}} \), consider one molecule of gas, which has a component \( v_x \) of +\( v_x \) as it hits the Right face. It rebounds elastically with a final component \( -v_x \) of velocity, \( -v_x \). Its x-component of momentum is changed by \( \Delta p_x = -2mv_x \xi + m\xi = 2mv_x \), and this requires an impulse, \( F_i \Delta t = -2mv_x \), where \( F_i \) is the force exerted by the wall on the \( i \)th molecule during the collision. (And the force on the face is \( F_i = +2mv_x \) by Newton III.)

3. Compute the rate, \( R \), at which molecules strike the right face, assuming that there are \( N \) molecules in the box. During a small interval \( \Delta t \), all of the molecules within \( v_x \Delta t \) of the right face which are travelling to the Right (as \( v_x \) are at any moment) will hit the face. Thus box \( R = \frac{N}{2} \frac{v_x \Delta t}{2} \) molecules hit the Right face during \( \Delta t \). [The fraction of such molecules is \( \frac{v_x \Delta t}{2} \).]

4. The average force on the right face during a small interval \( \Delta t \) is

\[ F_{\text{US}} = \frac{F_{i} \Delta t}{2} = \frac{2m v_x \xi}{\Delta t} \frac{N}{2} \frac{v_x \Delta t}{L} = \frac{N}{2} m v_x^2 \]

& The Pressure is

\[ P = \frac{F_{\text{US}}}{\Delta t} = \frac{N}{2} m v_x^2 = \frac{1}{3} N (m v_x^2) \]

\[ PV = N (m v_x^2) = kT_A \]

5. In this way \( kT_A = m v_x^2 = \frac{3}{2} \left( \frac{m (v_x^2 + v_y^2 + v_z^2)}{3} \right) = \frac{3}{2} (KE) \); Thus,

average \( (KE) \) of a molecule \( \overline{KE} = \frac{3}{2} kT_A \), the gas law follows.