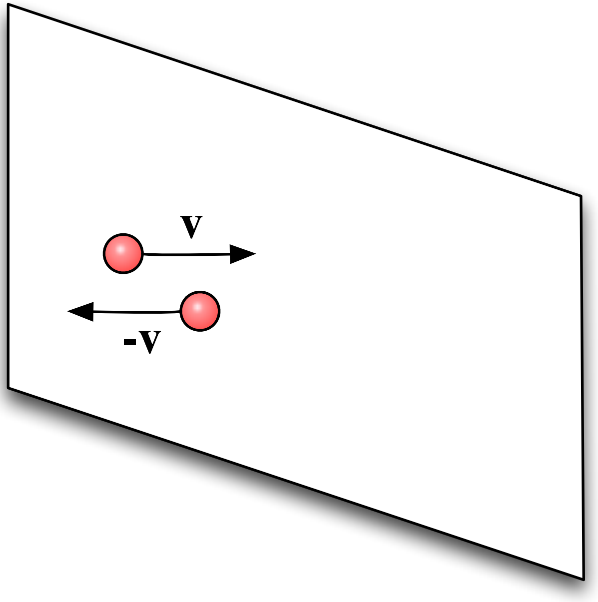
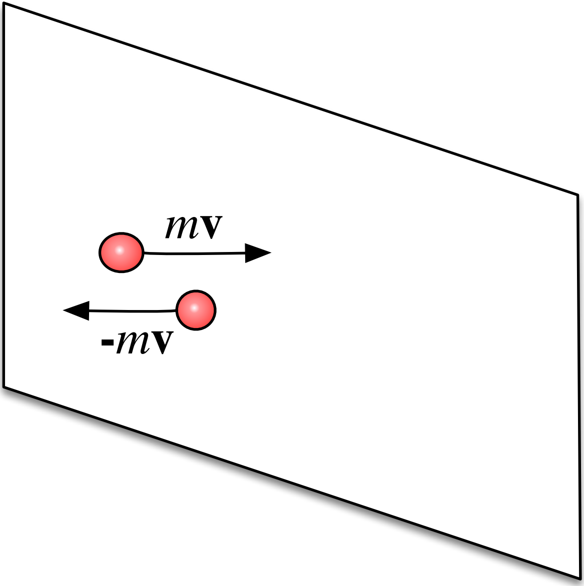
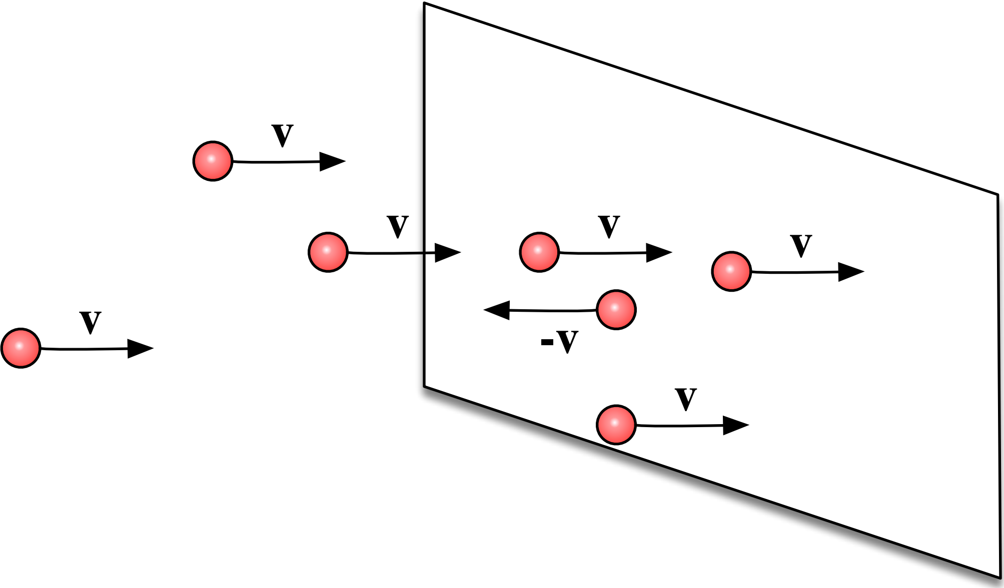
What is the change in velocity in this elastic collision?



What is the change in momentum of particle in this elastic collision?

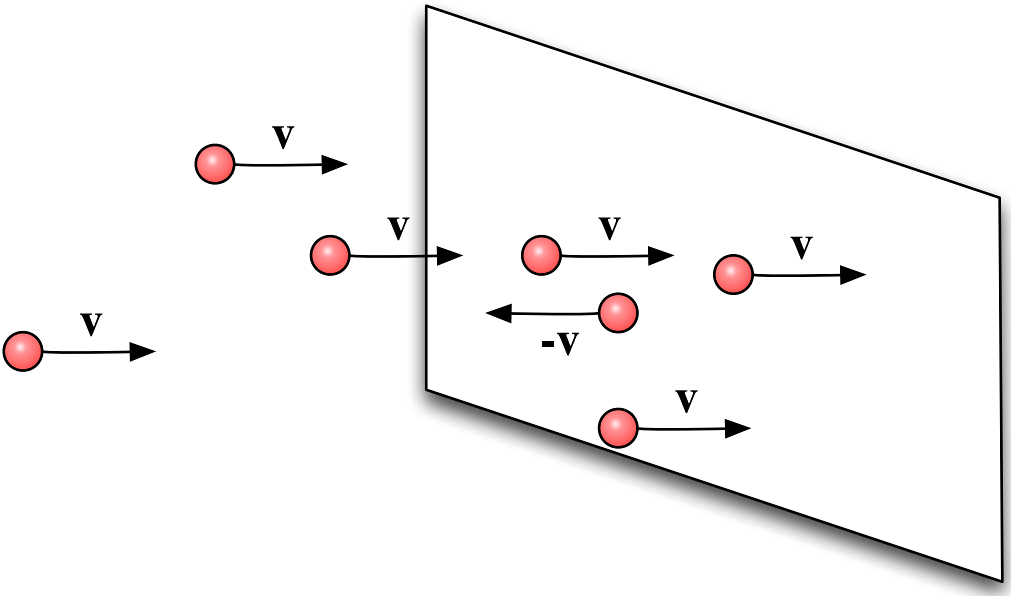


How many particles moving with velocity **v** will hit a wall in time Δt?



Only those close enough to the wall.

How many particles will hit a wall in time Δt?



Only those close enough to the wall.
And close enough is $d = \mathrm{v}\Delta t$.

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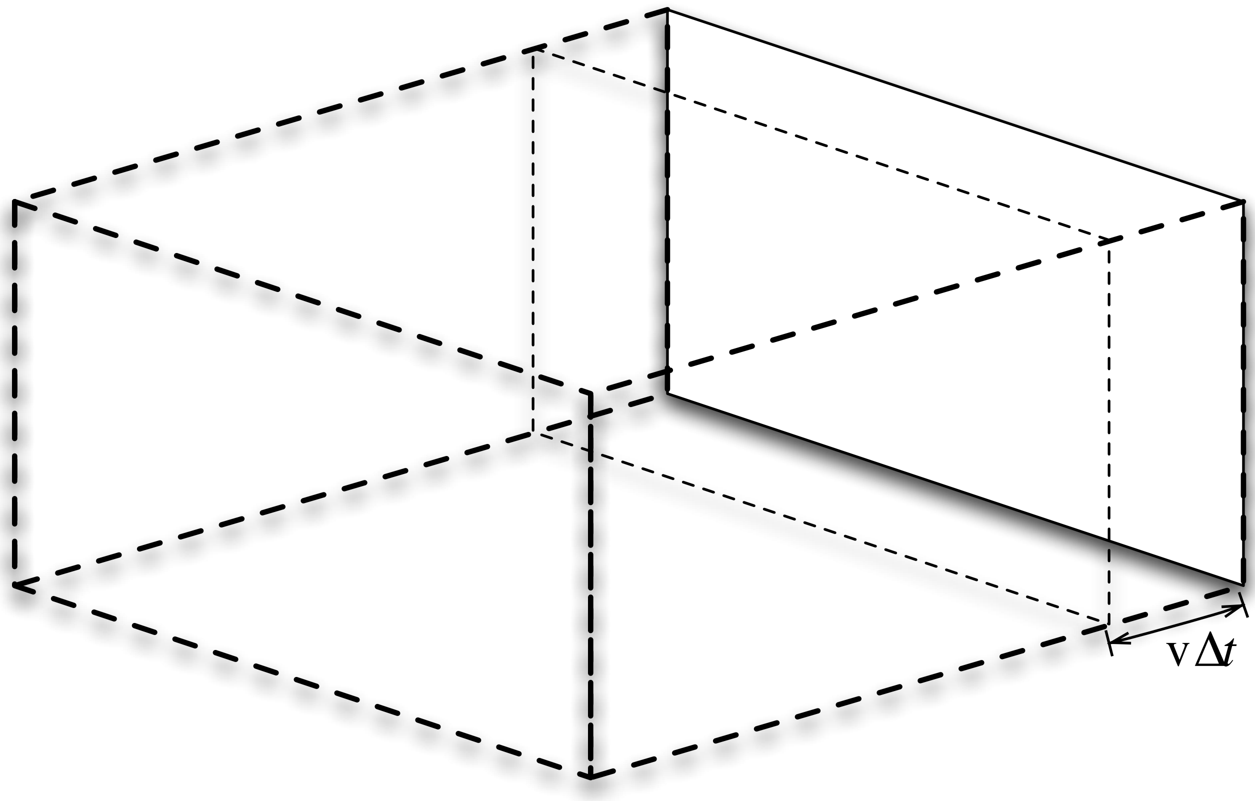

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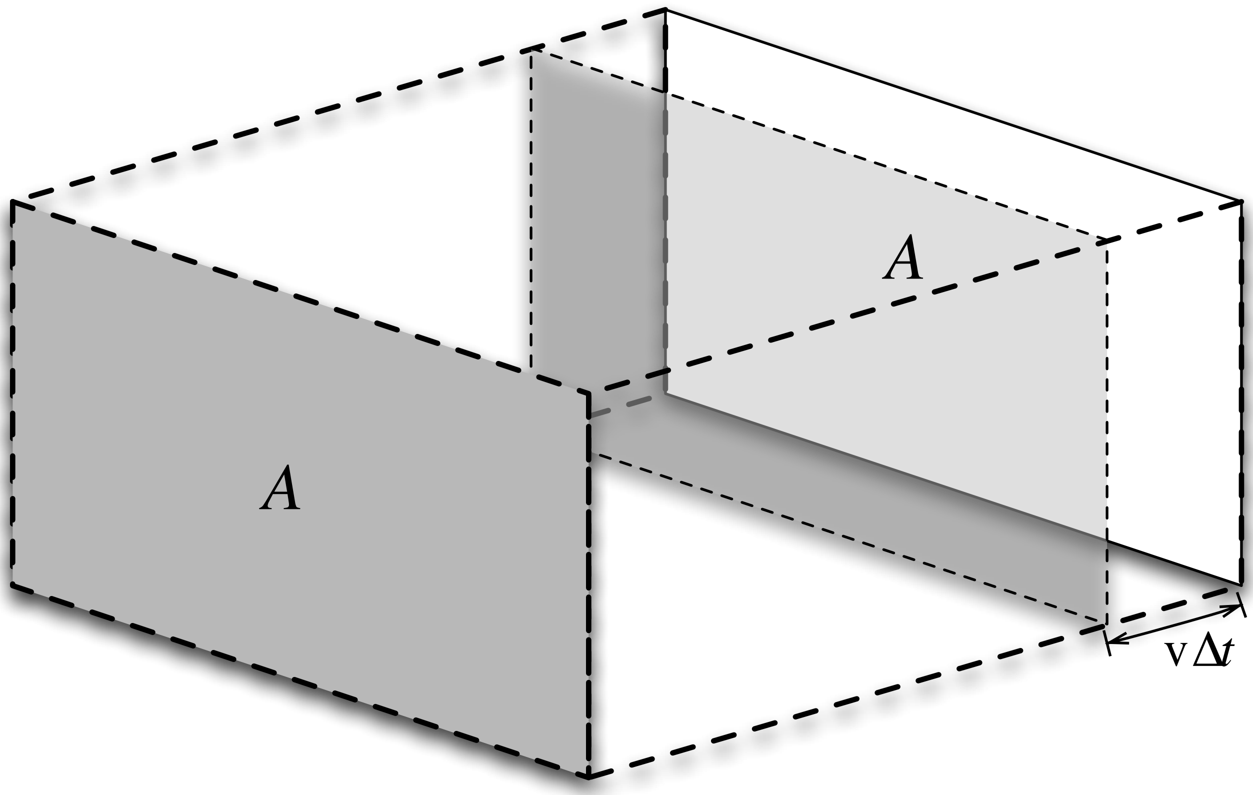
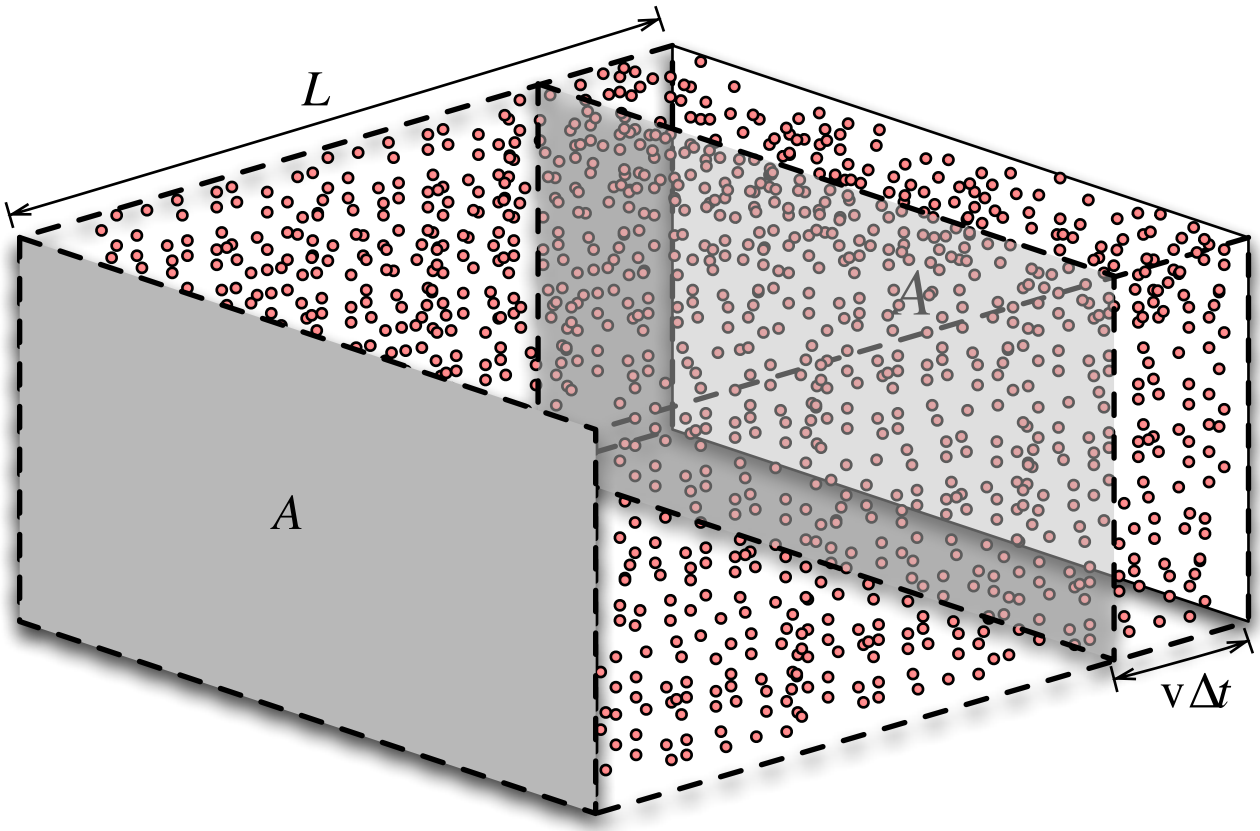


Only those close enough to the wall.
And close enough is $d = \text{v}\Delta t$.

How many particles are in the entire box?
Let's call that number N.
That's N particles in volume AL.

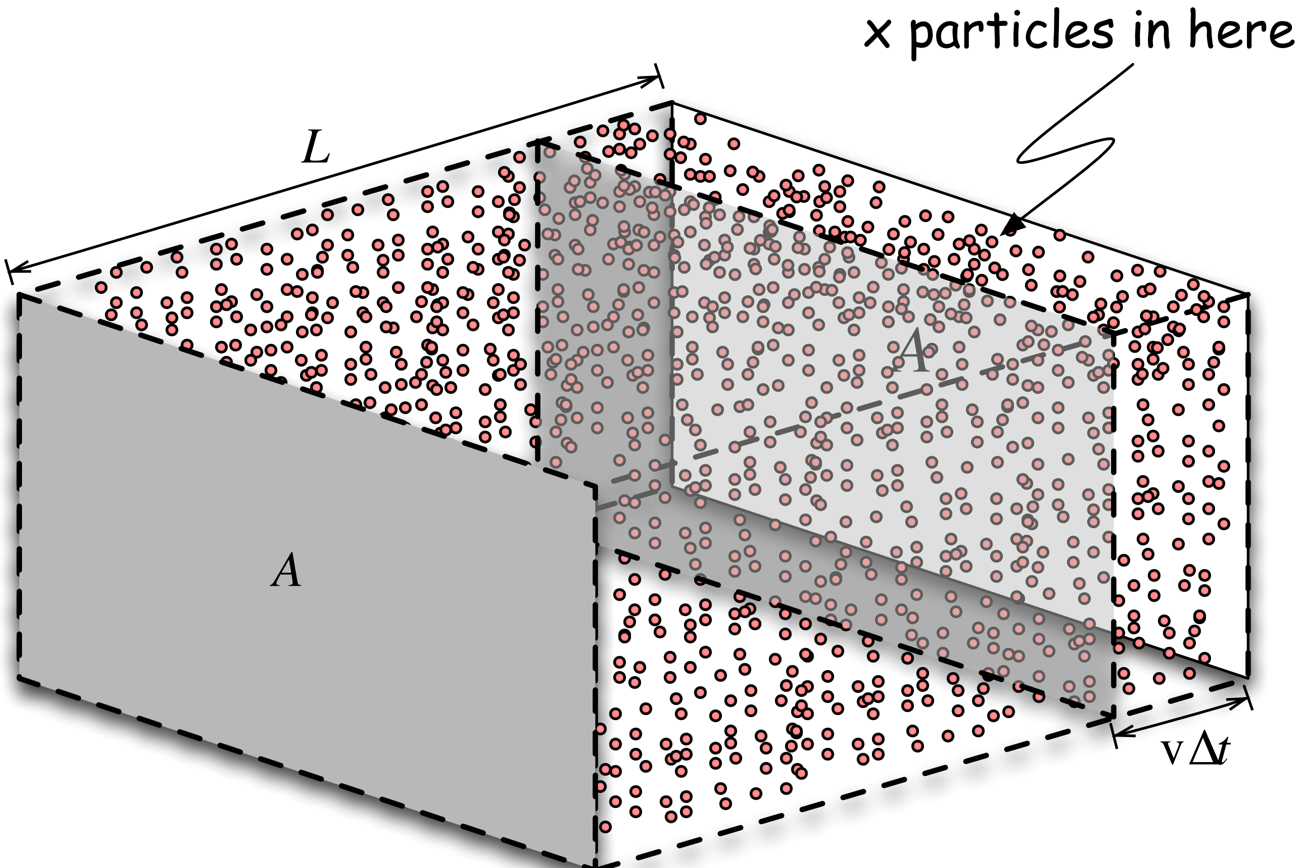


How many are close enough to the wall to hit it in time Δt?
Let's call that number x.
That's x particles in volume $A(\mathrm{v}\Delta t)$.

N particles are in the entire volume.

x particles are in the volume which is close enough for particles to hit the wall in time Δt.

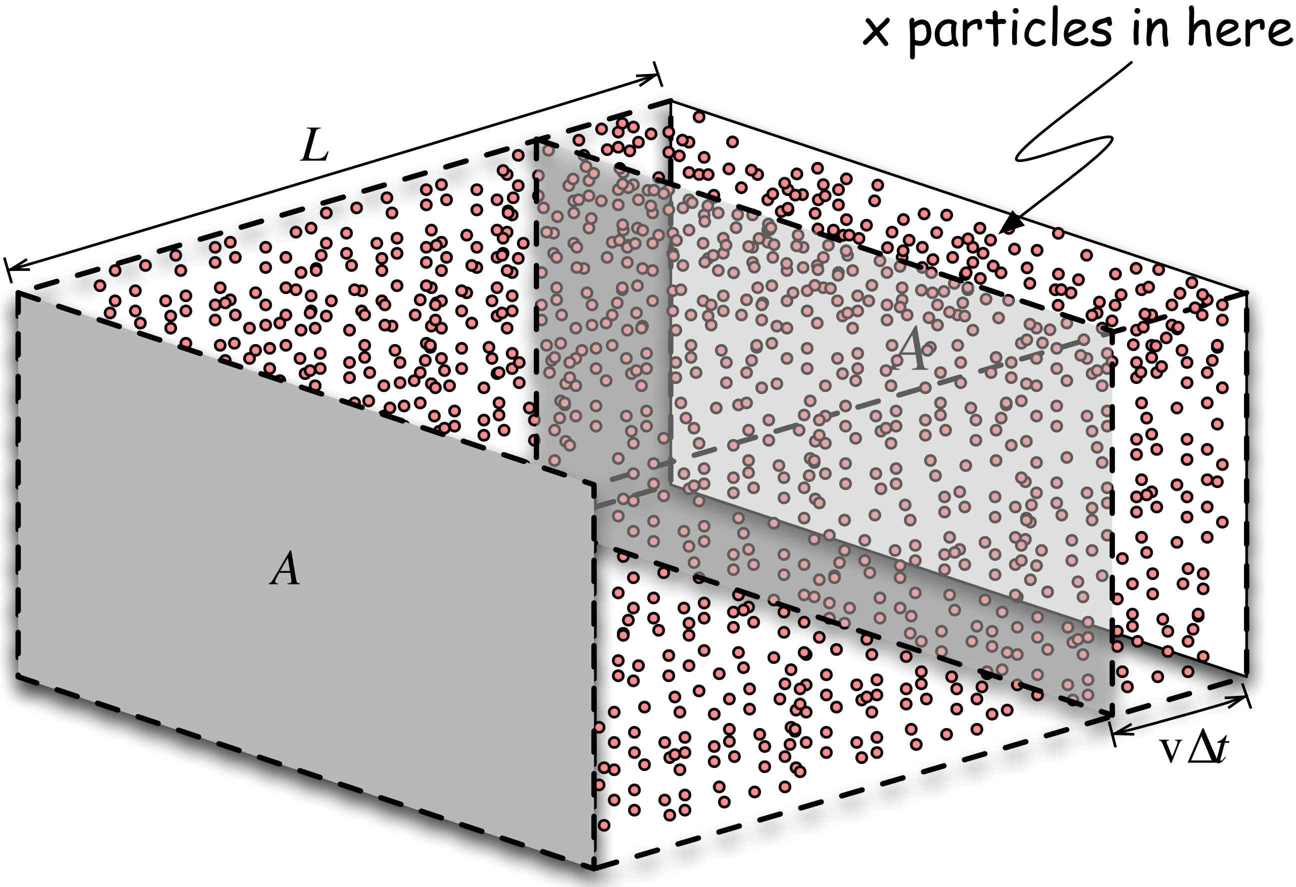
The number of particles per unit volume is the same for both the entire volume and the smaller volume.



$$\frac{N}{AL} = \frac{x}{A(v\Delta t)} \qquad \frac{N}{V} = \frac{x}{A(v\Delta t)}$$

x particles are in the volume that is close enough for particles to hit the wall in time Δt.

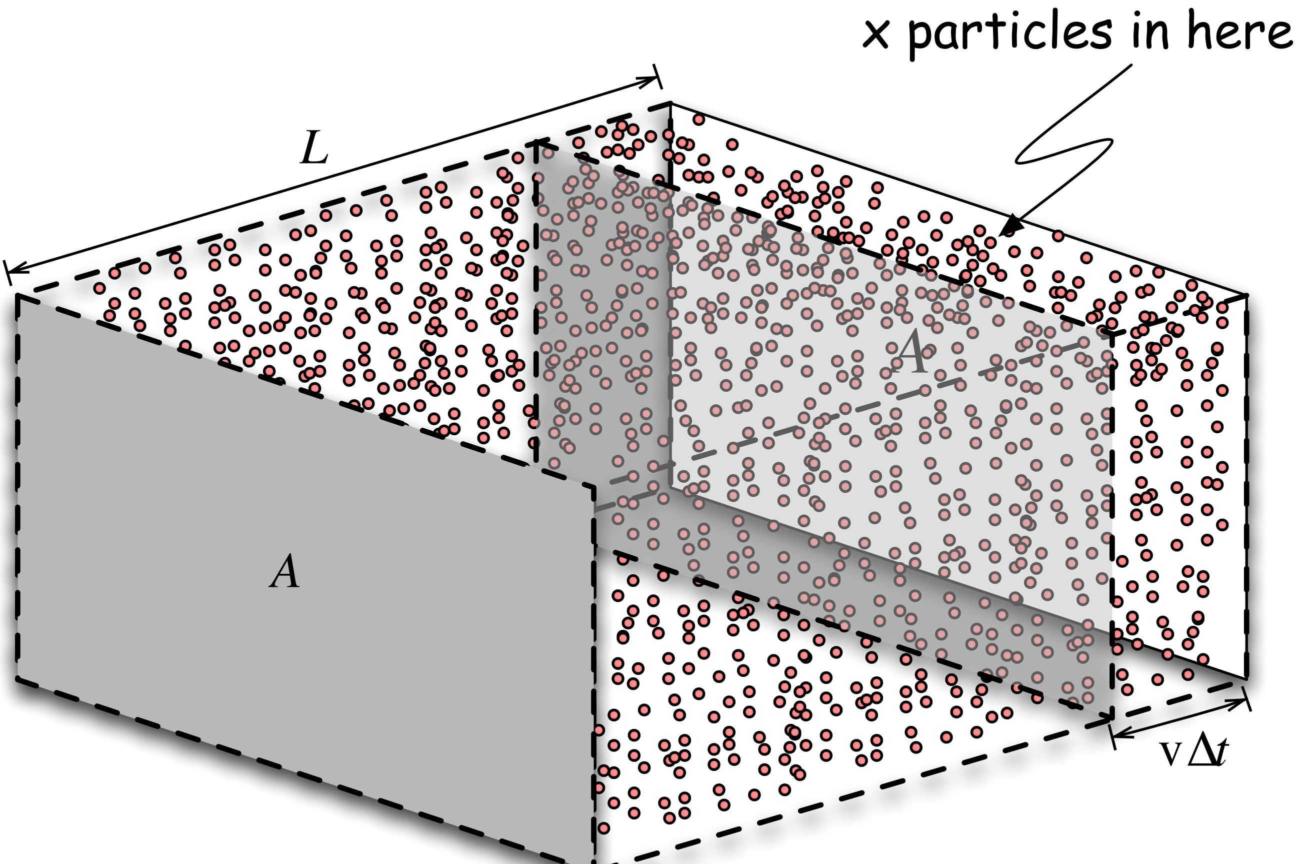
$$x = \frac{N}{V} A(v\Delta t)$$



But how many particles in that little volume will actually hit the wall. They are close enough, but not all of them are actually moving *toward* the wall. We will now rely on statistics. There are 6 directions for a molecule to move in. (Can you imagine them?) One of those directions is toward the wall. So, on the average, 1/6 of the x particles will actually hit the wall in time Δt.

x particles are in the volume which is close enough for particles to hit the wall in time Δt. Only 1/6 of those are heading toward the wall.

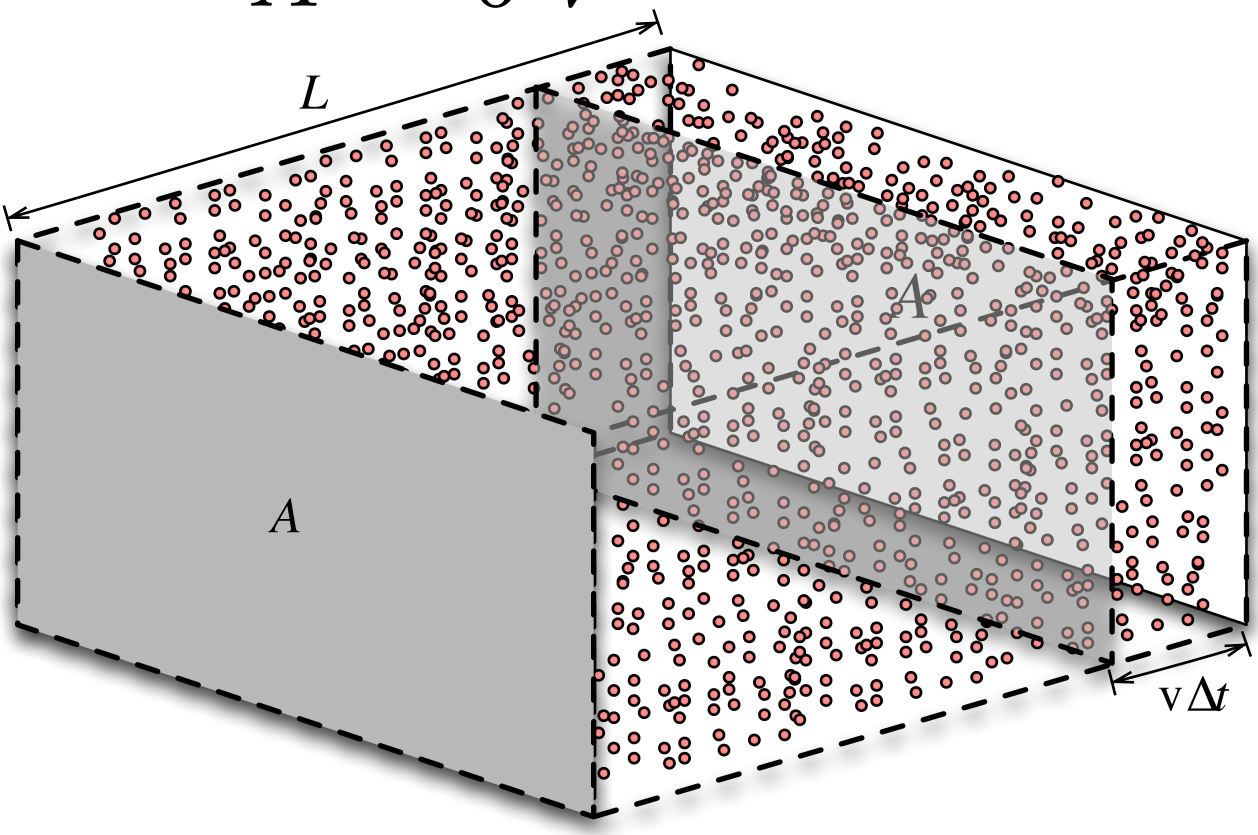
We will use the symbol n for the number of particles that actually hit the wall in time Δt:



$$n = \frac{1}{6}\frac{N}{V}A(v\Delta t)$$

$$F\Delta t = \frac{1}{6}\frac{N}{V}A(v\Delta t)(2mv)$$

$$\frac{F}{A} = \frac{1}{6}\frac{N}{V}(v)(2mv)$$



$$P = \frac{1}{3}\frac{N}{V}(mv^2)$$

$$P = \frac{1}{3}\frac{N}{V}(mv^2)$$

$$P = \frac{2}{3}\frac{N}{V}\left(\frac{1}{2}mv^2\right)$$

$$PV = \frac{2}{3}N\left(\frac{1}{2}mv^2\right)$$

$$PV = nRT \qquad\qquad PV = NkT$$

$$NkT = \frac{2}{3}N\left(\frac{1}{2}mv^2\right)$$

$$\frac{3}{2}kT = \frac{1}{2}mv^2$$