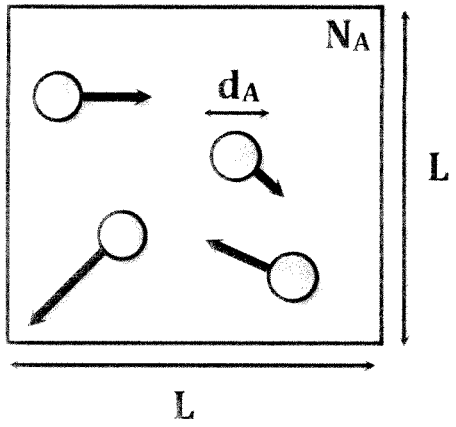
Name KEY gtID# _____

ChBE 4300(A) – Kinetics and Reactor Design

School of Chemical & Biomolecular Engineering
Georgia Institute of Technology
Spring 2014

Quiz #2 – January 31st, 2014
Closed Book, 10 minutes

Consider N_A identical molecules of diameter d_A moving on a square surface with sides of length L. In other words, these molecules are moving in a 2-D plane.



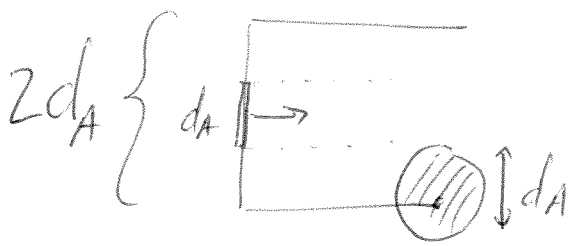
The collision frequency, Z_{AA}, for this situation in molecular units takes the form:

$$Z_{AA} = A * v_{rel,2D} * B$$

By analogy to lecture (3-D) and PS#2 (1-D), what are the missing terms labeled *A* and *B*? These should be simple mathematical expressions that contain the variables given in the problem and any necessary constants. Assume L is large enough that the molecules rarely collide with the edge of the surface.

Hint: Ensure your equation yields units of collisions/area-time.

Need collision "rectangle"



$A = J_{2D} = 2d_A$

↑ cross-section in 2-D

Also, need "area density"

$B = \left(\frac{N_A}{L^2}\right)\left(\frac{N_A}{L^2}\right)$

$B = \frac{N_A^2}{L^4}$