

### 4.13: The Rate of Collisions between Unlike Gas Molecules

We define the collision frequency,  $\tilde{\nu}_{12}$ , as the number of collision per unit time between a single molecule of type 1 and any of the molecules of type 2 present in the same container. We find  $\tilde{\nu}_{12} = N_2 \pi \sigma_{12}^2 \langle v_{12} \rangle$ . If there are  $N_1$  molecules of type 1 present in a unit volume of the gas, the total number of collisions between type 1 molecules and type 2 molecules is  $N_1$  times greater. For clarity, let us refer to the total number of such collisions, per unit volume and per unit time, as the **collision rate**,  $\rho_{12}$ . We have

$$\rho_{12} = N_1 \tilde{\nu}_{12} = N_1 N_2 \pi \sigma_{12}^2 \langle v_{12} \rangle = N_1 N_2 \sigma_{12}^2 \left( \frac{8\pi kT}{\mu} \right)^{1/2}$$

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