

9.16: The Rate Constant for a Gas-Phase Chemical Reaction May Depend on the Orientations of the Colliding Molecules

In the previous section, the simple hard-sphere model for collisions was modified to take into account the fact that not every collision of particles occurred with sufficient energy to result in a reaction. The line of centers model assumed that all colliding particles were spheres, yet we know that this is definitely not the case. Thus, we need to modify the collision model to factor in the orientation of non-spherical particles. Figure 9.16.1 shows an example of properly oriented particles and an example of improperly oriented molecules.

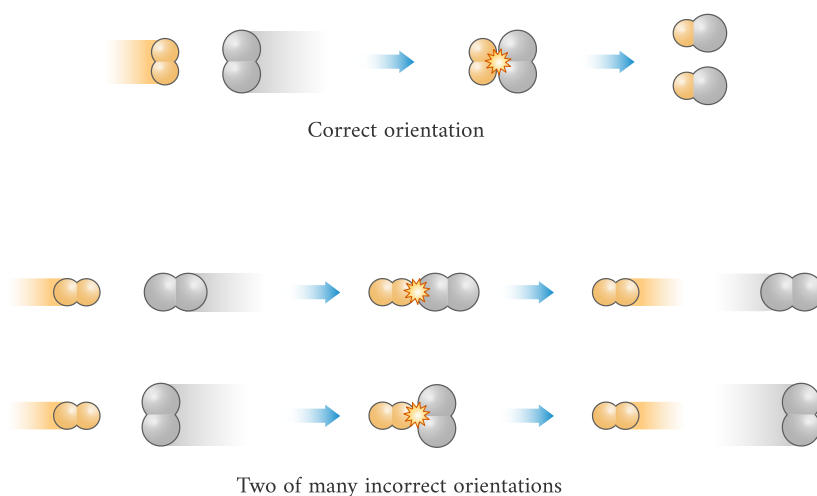


Figure 9.16.1: (top) Molecules colliding with the correct orientation that leads to a successful reaction. (bottom) Molecules colliding in two of the many incorrect orientations that do not lead to a reaction. (CC BY-NC; Ümit Kaya via LibreTexts)

Because proper orientation of colliding molecules is necessary, the hard-sphere collision model overestimates the number of effective collisions. This is one of the factors that leads an incorrect value for A estimated by the hard-sphere collision model.

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