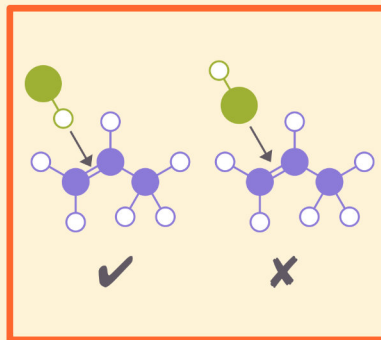


HIGHLIGHTS

- An introduction to the non-mathematical aspects of Collision Theory.
- This ignores that the model was based on gases and treated molecules as hard balls.
- The three requirements for a reaction:
 - The molecules must collide.
 - A successful collision occurs if the molecules have sufficient energy (activation energy).
 - A successful collision occurs if the molecules have the correct orientation.
- A reaction can be accelerated by:
 - Increasing the concentration.
 - Heating it.
 - Adding a catalyst.
- It isn't always a good idea to speed up a reaction!



Rates of reactions, and reaction kinetics, is a topic often skipped over by organic chemists. It is mentioned in the discussion of the classic substitution reactions (S_N1 & S_N2), and as a vague concept in catalysis (catalysts speed up reactions), but it otherwise left to physical chemists to teach. This is a mistake (interpret that statement however you want!). An understanding of the rate of a reaction, and the kinetics of a reaction (without going into mathematical detail) is very useful for a synthetic chemist. How fast a reaction occurs is important in biology, environmental science, and many other disciplines. Here is a muddled overview (I have never taught this subject so I'm a little rusty and don't have any of the normal 'lecturer's tricks/insights' that I hopefully do for other topics).

This is the first of two summaries & looks at the simple ideas behind of collision theory.

CHEMISTRY CLASSICS

RATES OF REACTION I

COLLISION THEORY (AN ORGANIC CHEMIST'S SIMPLIFICATION)



© gjr for makingmolecules.com
This handout is shared under a
Creative Commons Attribution-
NonCommercial-ShareAlike
BY-NC-ND-SA 4.0 licence.



A rough guide to collision theory

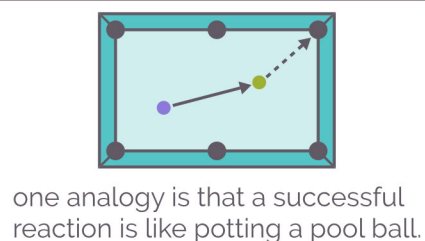
1. Collision theory & a successful reaction

Collision theory states that a reaction only occurs if two molecules collide with sufficient energy to overcome the activation barrier and have the correct orientation. The theory was originally for gases and treats molecules as hard spheres but organic chemists still use this as a starting point when discussing rates of reaction in solution.

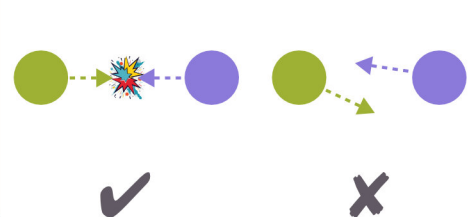
a chemical reaction



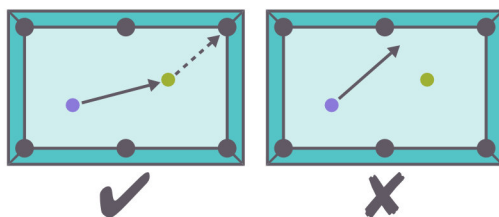
a reaction only occurs when the following criteria are met:



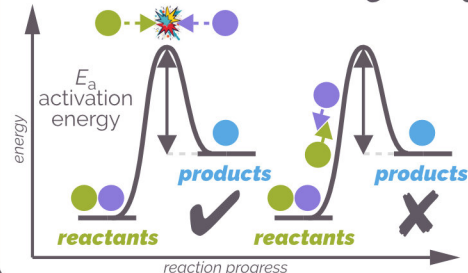
the reactants must **collide**



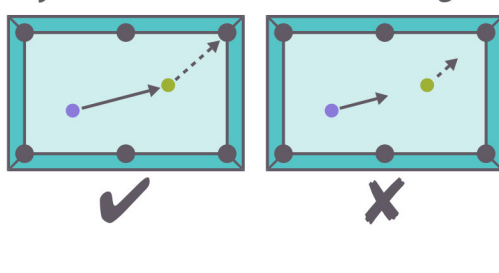
you must **hit the ball!**



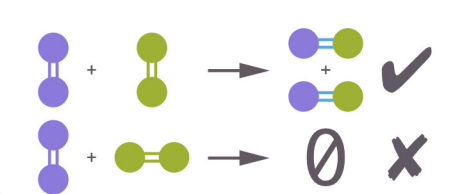
the reactants must have **enough energy**



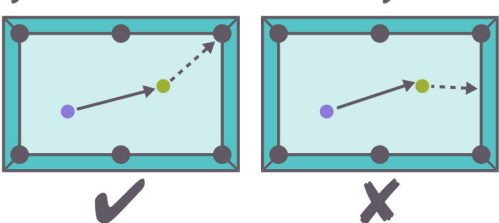
you must **hit the ball hard enough**



the reactants must collide with the **correct orientation**



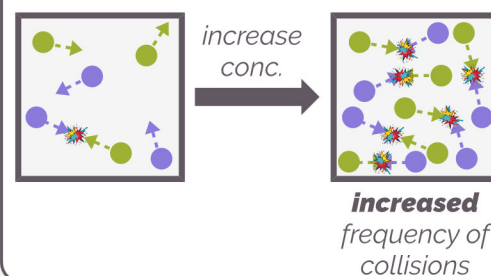
you must **hit the ball correctly** (the difficult bit!)



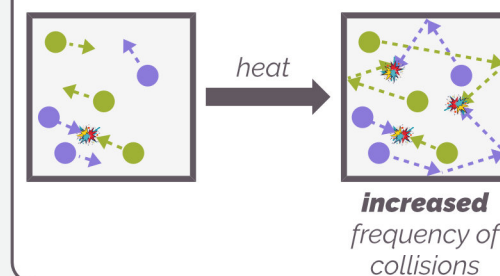
2. Increasing the rate of reaction

In collision theory, the rate of a reaction is related to the frequency of successful collisions. The higher the frequency, the faster the reaction. The goal is to increase the frequency of collisions or the number of molecules with sufficient energy to react (both approaches increase the frequency of successful collisions).

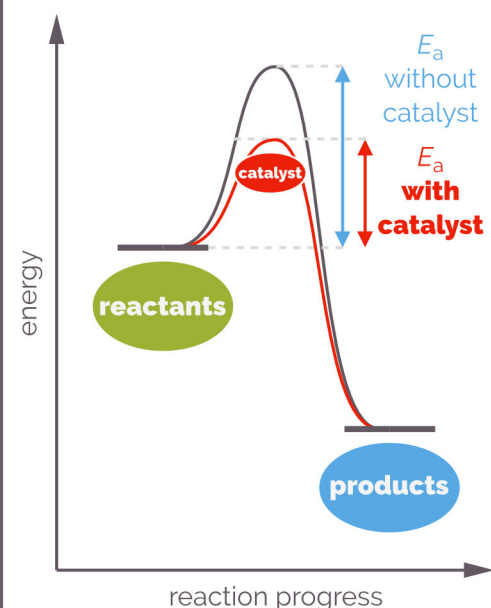
1. Increase concentration



2. Increase temperature (1)

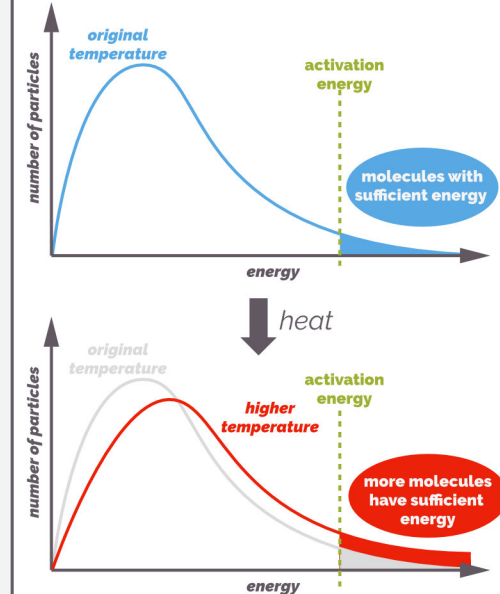


4. Addition of catalyst



more molecules with sufficient energy
higher frequency of successful collisions

3. Increase temperature (2)



more molecules with sufficient energy
higher frequency of successful collisions