Ch(3) : kinetic factors

I-Introduction

The rate of a chemical reaction depends mainly on the probability of contact between the particles of reactants.

The factors that affect on the distance between particles and on the velocity of particles are called kinetic factors.

The three main kinetic factors are :

The temperature of reaction system

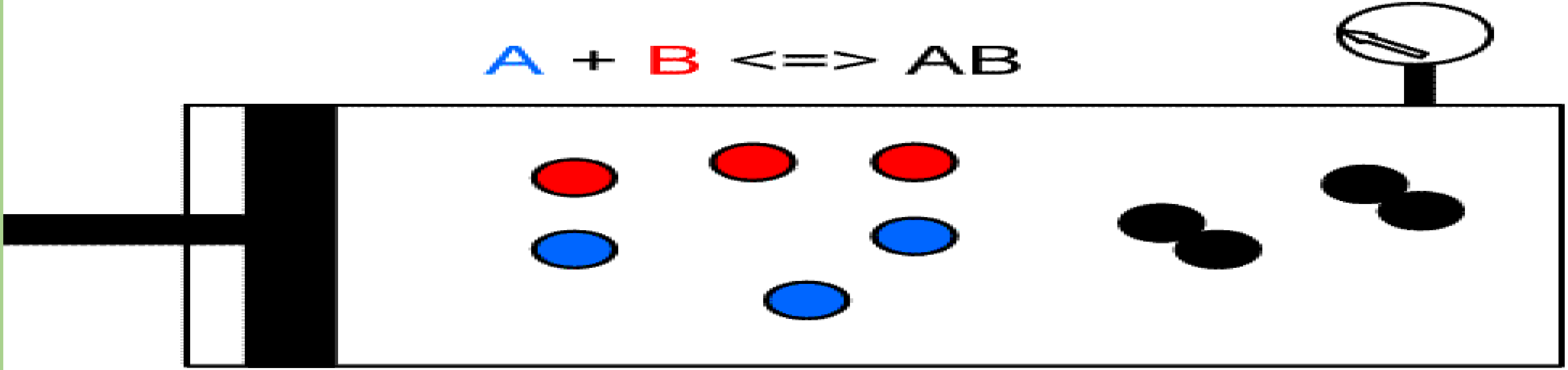
The concentrations of reactants

The presence of catalyst.

II- Effect of concentration of reactants

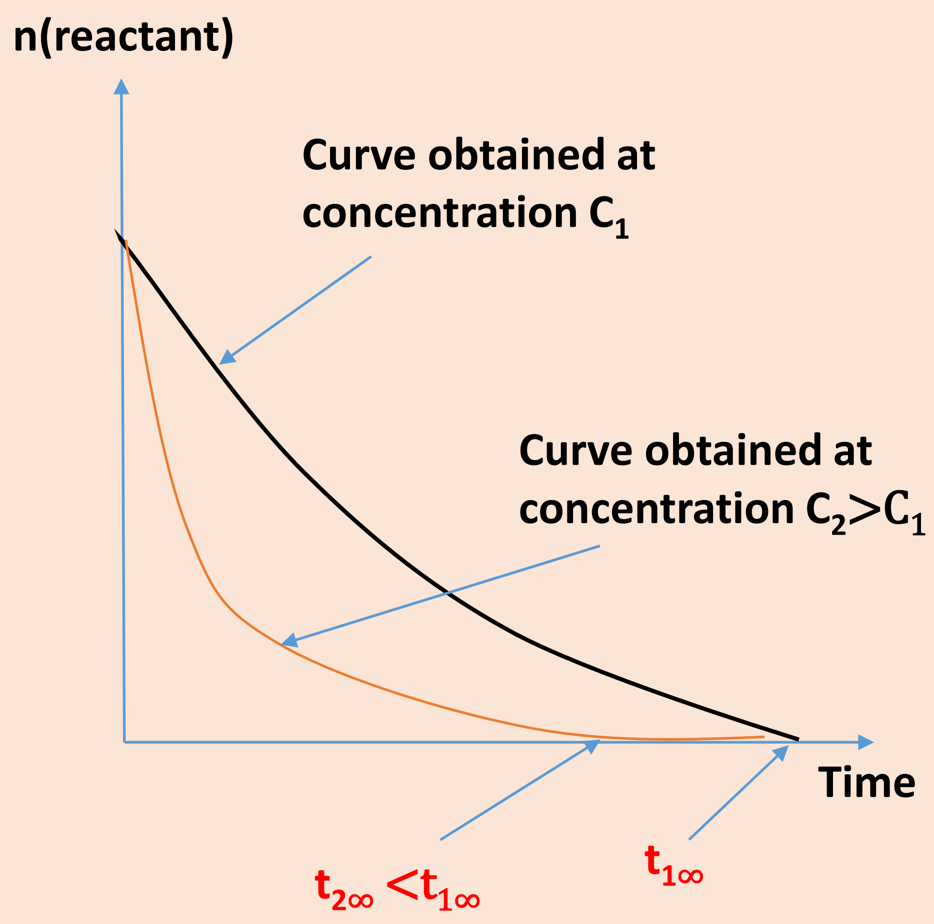
The rate of reaction depends on the initial concentration of reactants.

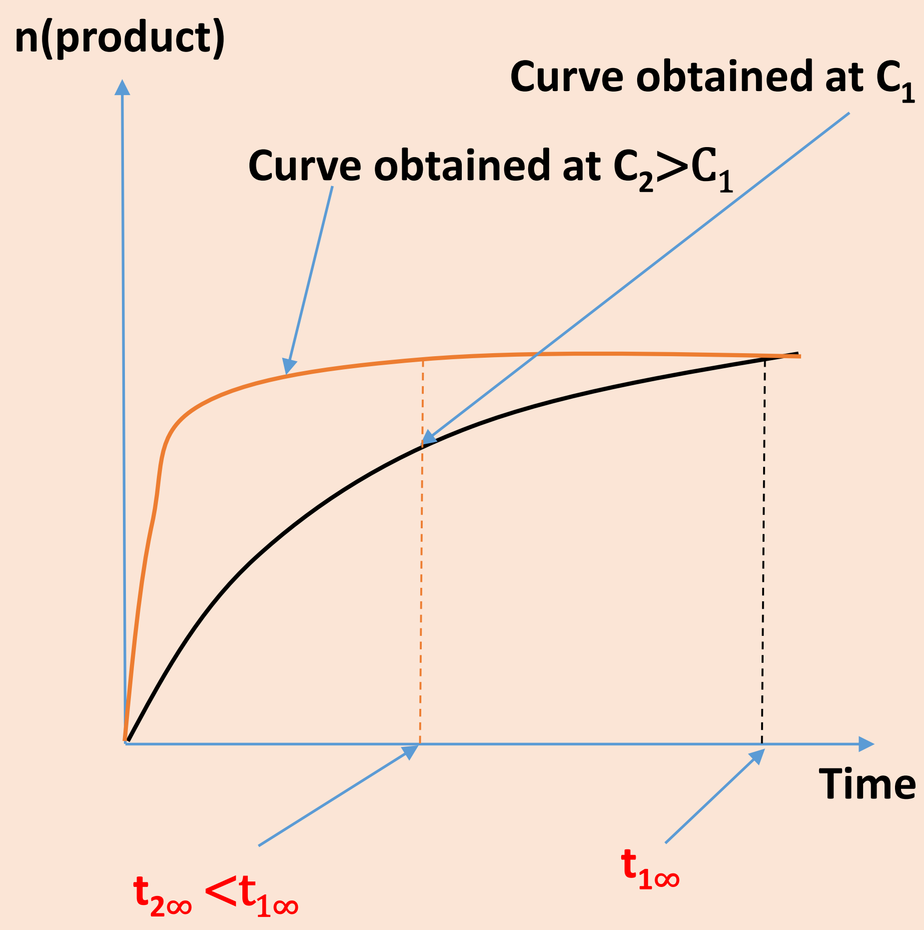
As concentration of reactants increases → **The rate of reaction increases**



As volume ↓, the concentration of reactants↑ and the rate will increase.

If we change the concentration of one reactant from C_1 to C_2 ($C_2 > C_1$), the kinetic curves of reactants and of products will change as the following :





Note

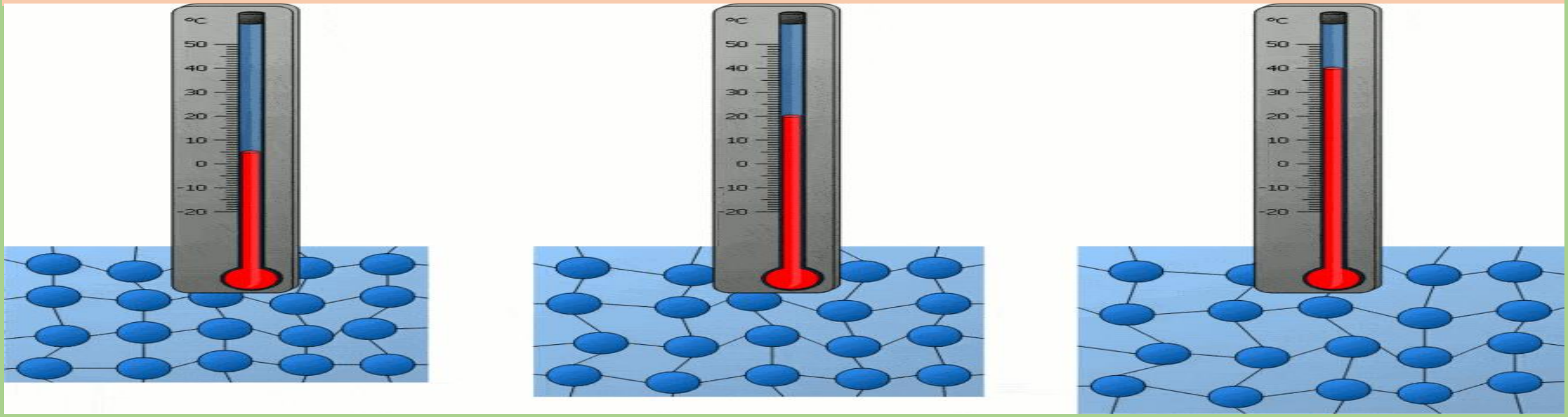
If we change the concentration of the limiting reactant, the maximum value in the kinetic curves of products will change.

If we change the concentration of the excess reactant, the maximum value in the kinetic curves of products remains without change since the maximum value depends only on the limiting reactant.

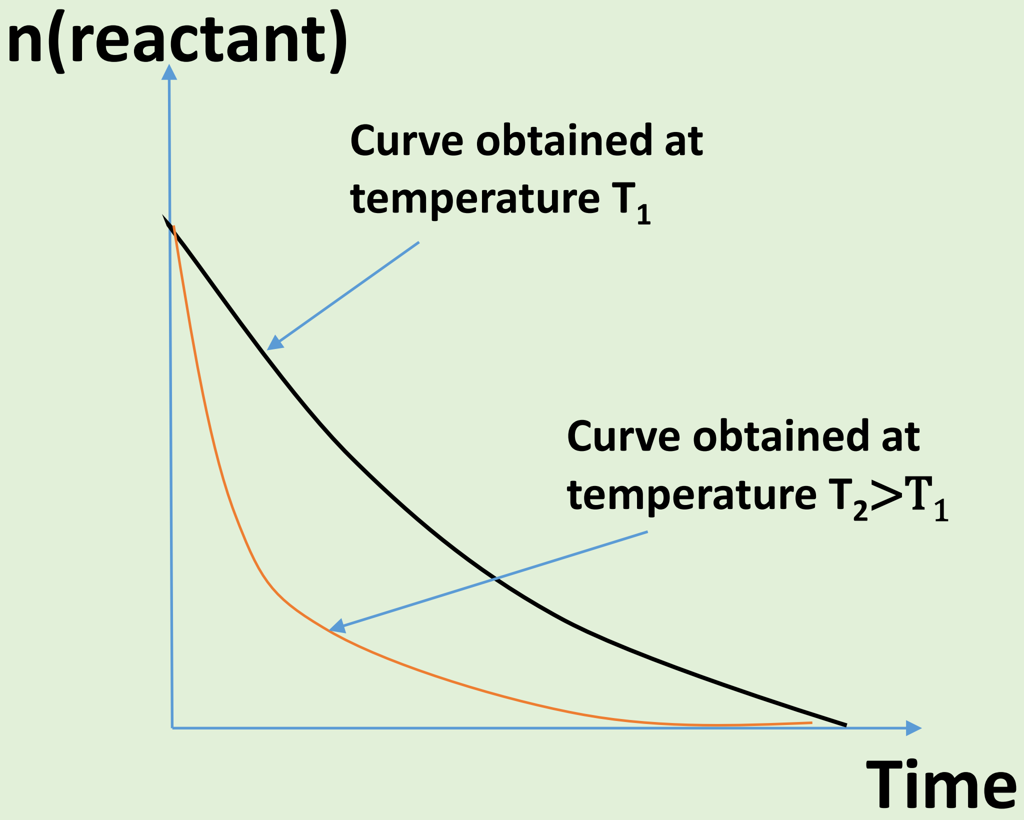
III- Effect of temperature

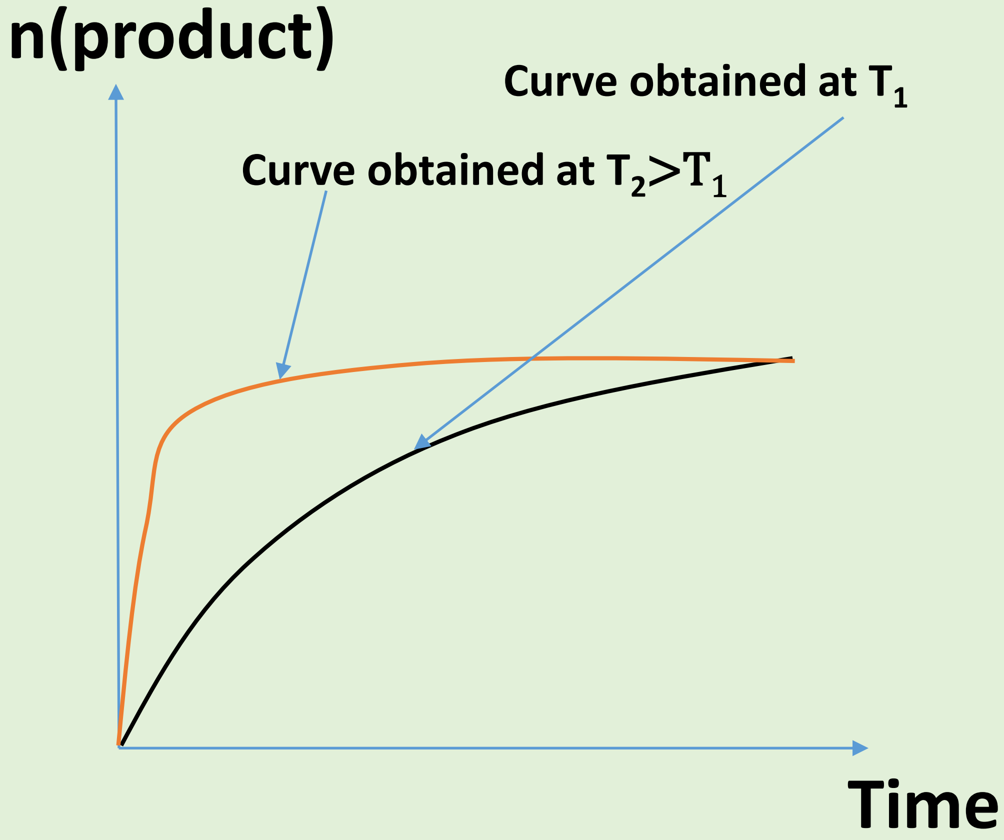
The temperature is a kinetic factor that accelerates the reaction to reach its final state faster without change in the final state of the reaction (the yield of reaction remains without change).

As temperature increases → **The rate of reaction increases**



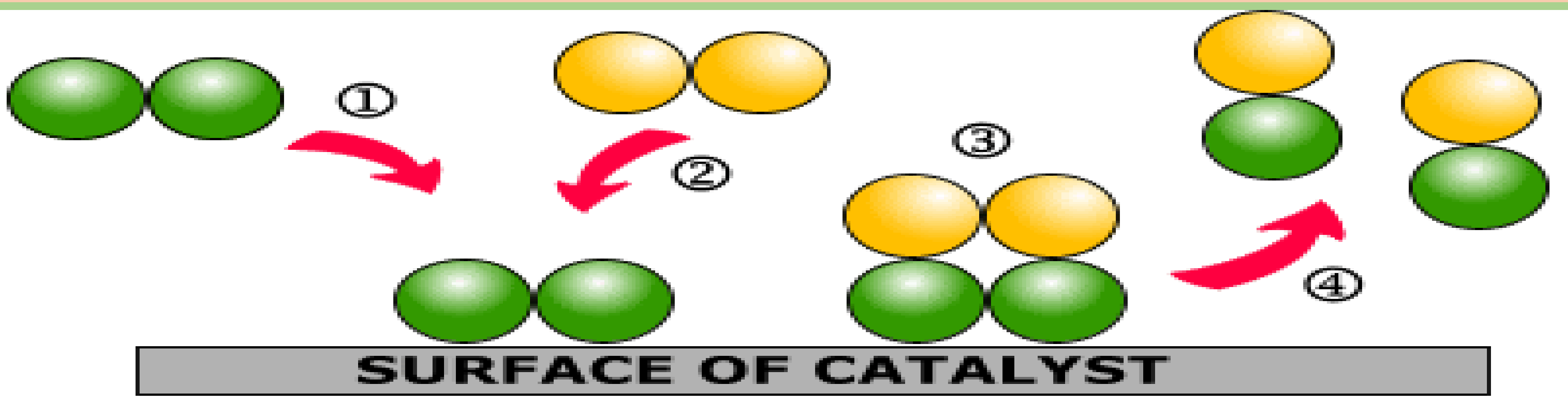
If we change the temperature of the reaction system from T_1 to T_2 ($T_2 > T_1$), the kinetic curves will change as the following :





IV- Effect of catalyst

The same as temperature, the catalyst is a kinetic factor that accelerate the reaction without change in the final state.



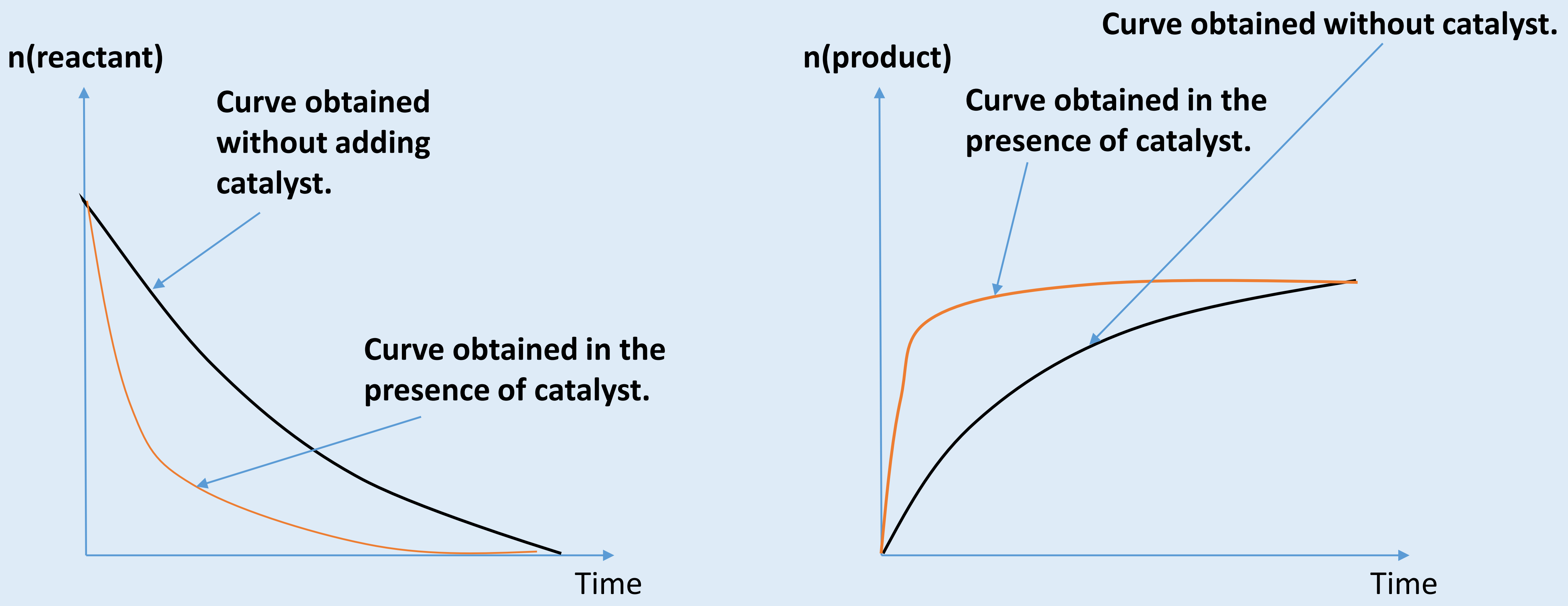
① One of the reactants approaches the catalyst's surface and settles onto an active site - ADSORPTION

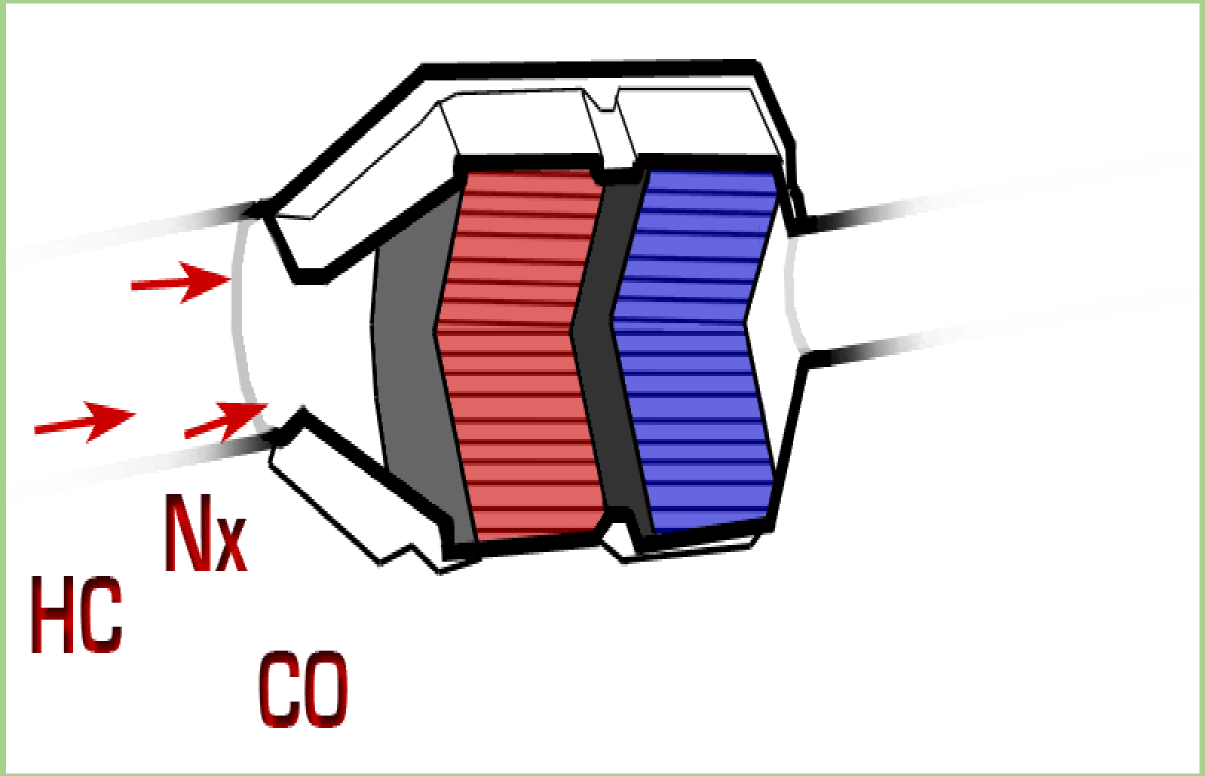
② Another reactant approaches the catalyst

③ Re-arrangement of electrons takes place - REACTION

④ The products are released from the surface - DESORPTION

If we add a catalyst to the reaction system, the kinetic curves will change as the following :



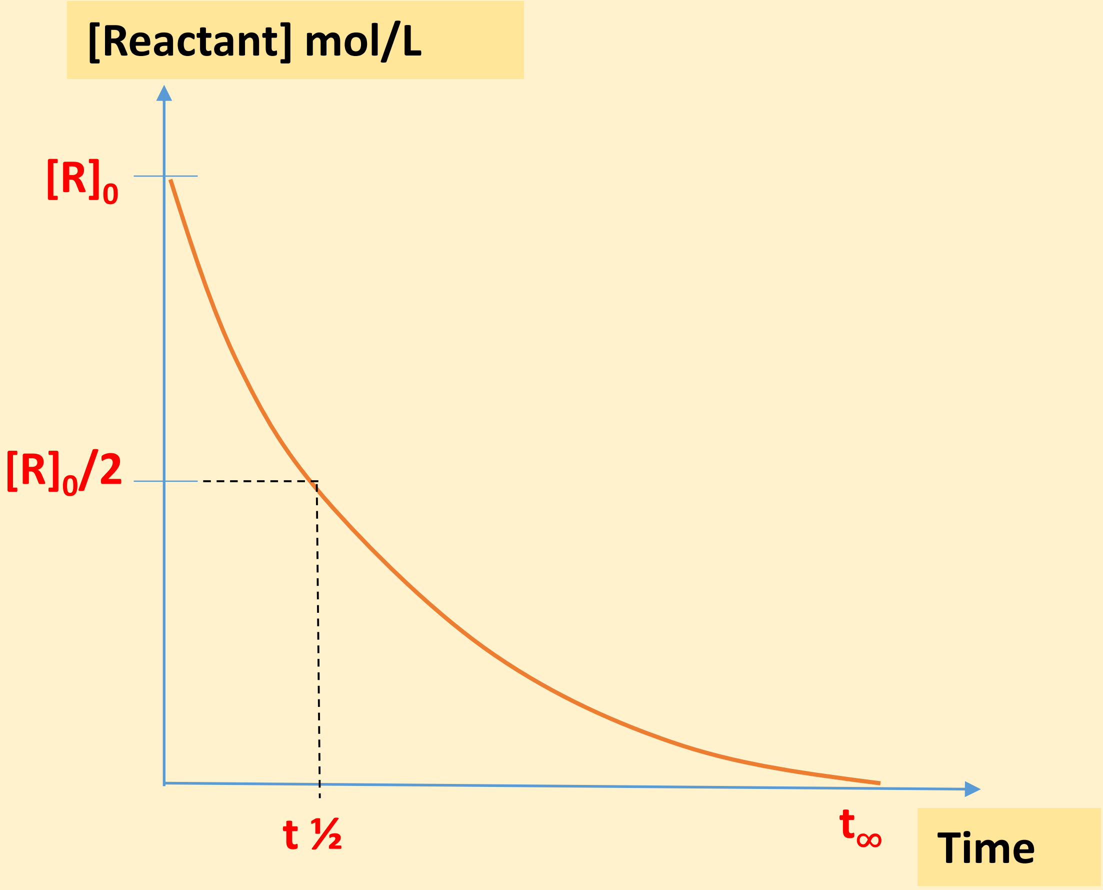

Nx
HC
CO

V- Half- life time of the reaction (t ½)

The half-life time t ½ of a reaction is the time required for the reactant concentration (or number of moles) to decrease to the half of its initial value.

$[R]_{t1/2} = [R]_0/2$

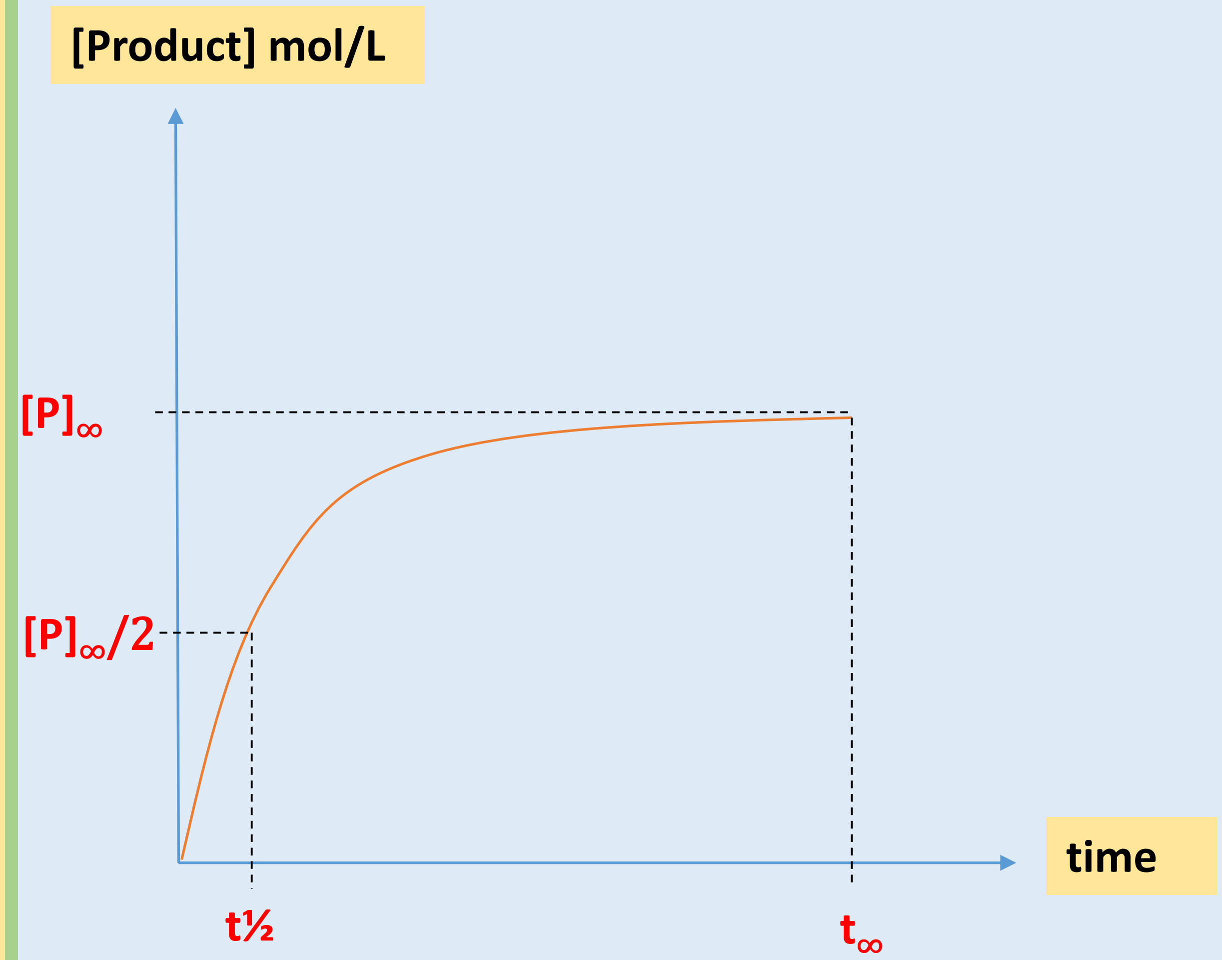
The time corresponding to $[R]_0/2$ is called the half life time of the reaction.



If the mixture of reactants is not stoichiometric, the half-life time is defined with respect to the limiting reactant.

The half life time can be defined also with respect to a product (P).

for example if the maximum concentration of the product $[P]_\infty$ is determined, then $[P]_{t1/2} = [P]_\infty /2$ and the time corresponding to $[P]_{t1/2}$ is the half life time of the reaction.



The half life time is used to compare the speed of two different reactions or to compare the rate of a reaction at two different conditions.

The reaction has the less half life time is faster.

Note

$$t_{1/2} < t_{\infty}/2$$