

# "ENZYMES"

Enzymes are commonly proteinaceous substances which are capable of catalysing chemical reactions of biological origin without themselves undergoing any change. Therefore, they are called Biocatalyst.

Term Enzyme was coined by Kuhne.

Enzyme was discovered and isolated by Buchner.

Enzymes are synthesized by living cells.

\* All most all enzymes are protein. There are nucleic acids that behave like enzymes. These are called Ribozymes.

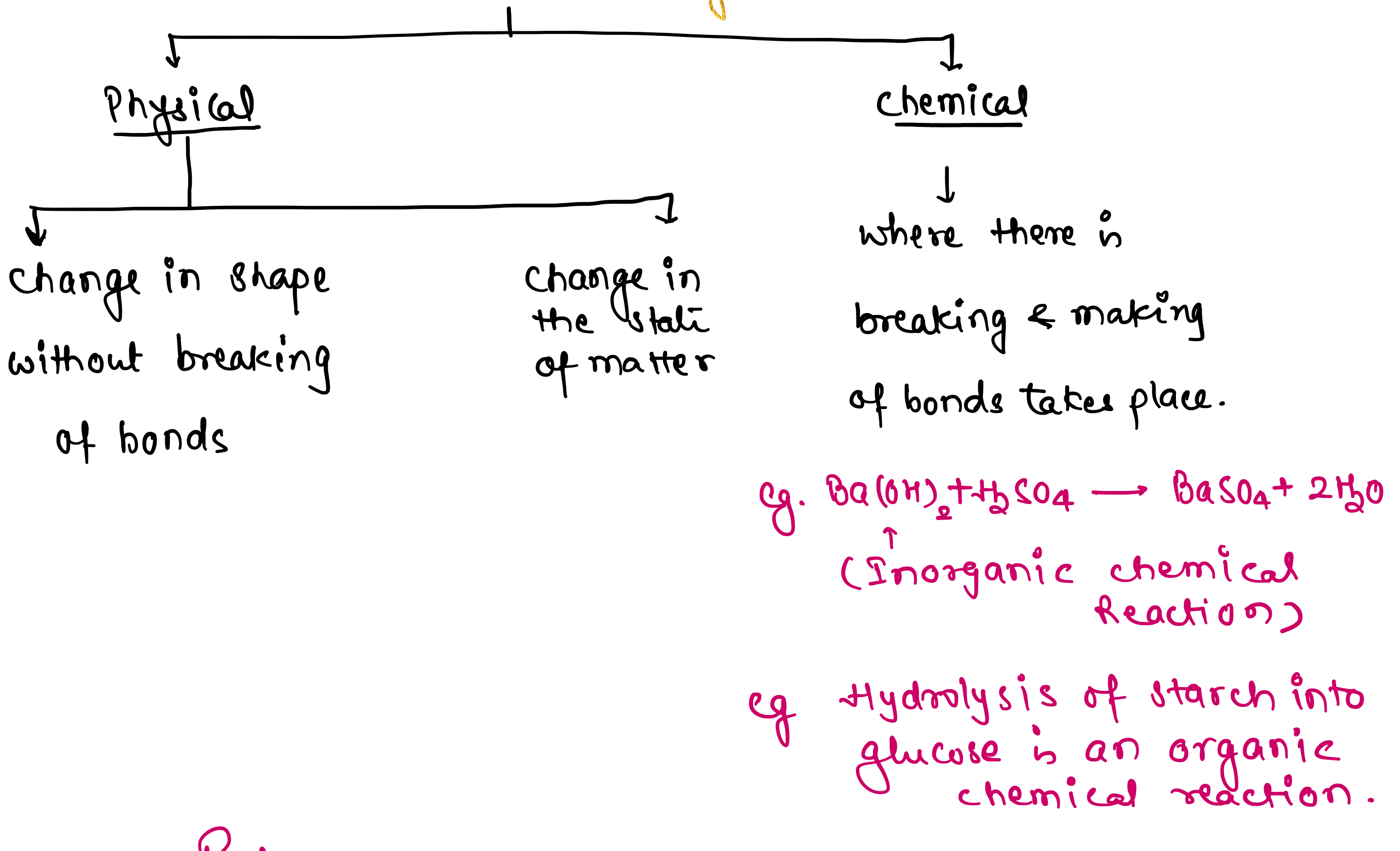
\* Enzyme have 1°, 2° & 3° structures.

\* In 3° structure, the back bone of the protein chain folds upon itself, the chain criss-crosses itself and hence, many crevices or pocket are made. One such pocket is the 'Active site'.

\* Active site of an enzyme is a crevice or pocket into which the substrate fits. Thus enzyme through their active site, catalyse reactions at a high rate.

\* All enzymes are Globular proteins.

## Chemical Reactions :-



$$\text{Rate (Physical or chemical process)} = \frac{\Delta P}{\Delta t} \quad [\text{amount of product formed per unit time}]$$

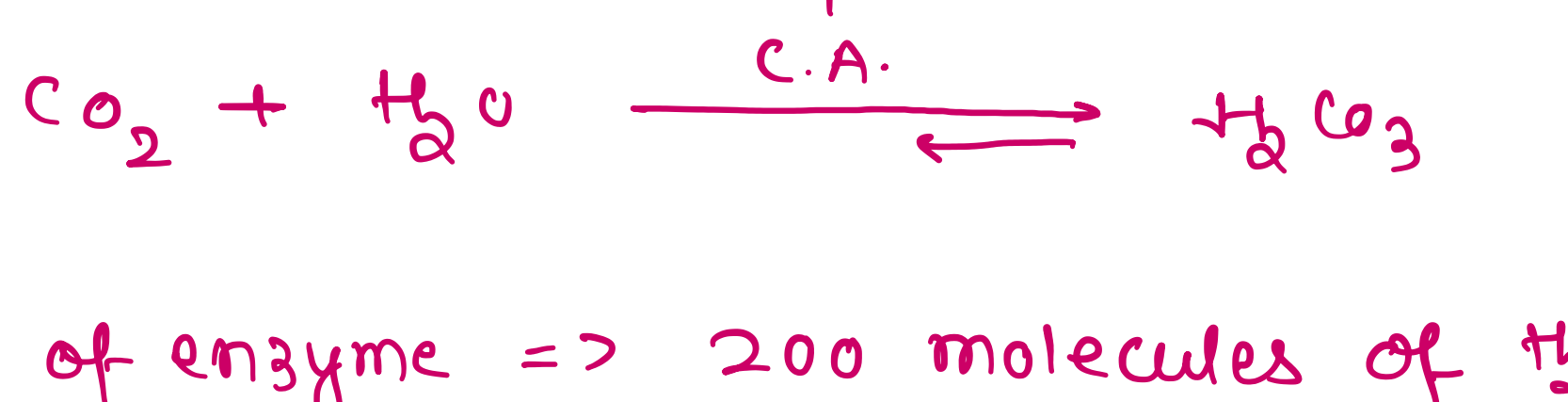
Rate can also be called as velocity if the direction is specified.

This Rate (either of physical or chemical process) is affected by temp. among other factors.

\* A general rule of thumb is that rate doubles or less by half for every 10°C change in either direction.

Catalysed reactions proceed at rates vastly higher than that of uncatalysed ones.

for example :-



In absence of enzyme => 200 molecules of  $\text{H}_2\text{CO}_3$  being formed in an hour.

In presence of carbonic anhydrase enzyme =>

6,00,000 molecules formed per second.

Here enzyme accelerated the rate by \*\*\* 10 million times

\* A multistep chemical reaction, when each of the steps is catalysed by the same enzyme complex or different enzymes is called a Metabolic pathway.

for eg. Glucose → 2 pyruvic acid

Metabolic pathway in which 10 different enzyme catalysed metabolic reaction.

\* In our skeletal muscle, under anaerobic condition, lactic acid is formed.

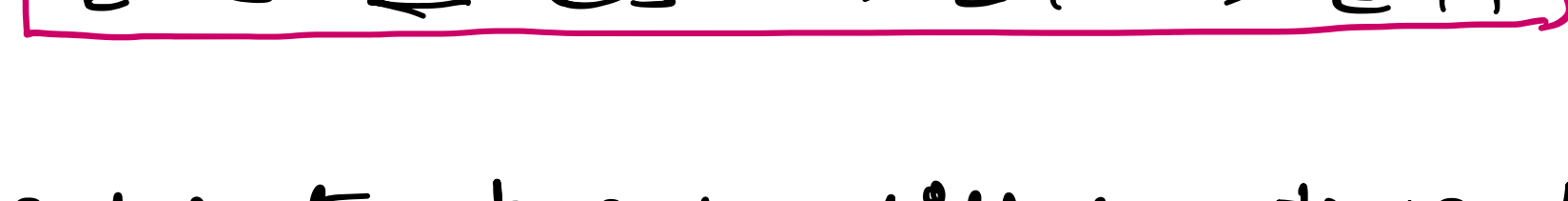
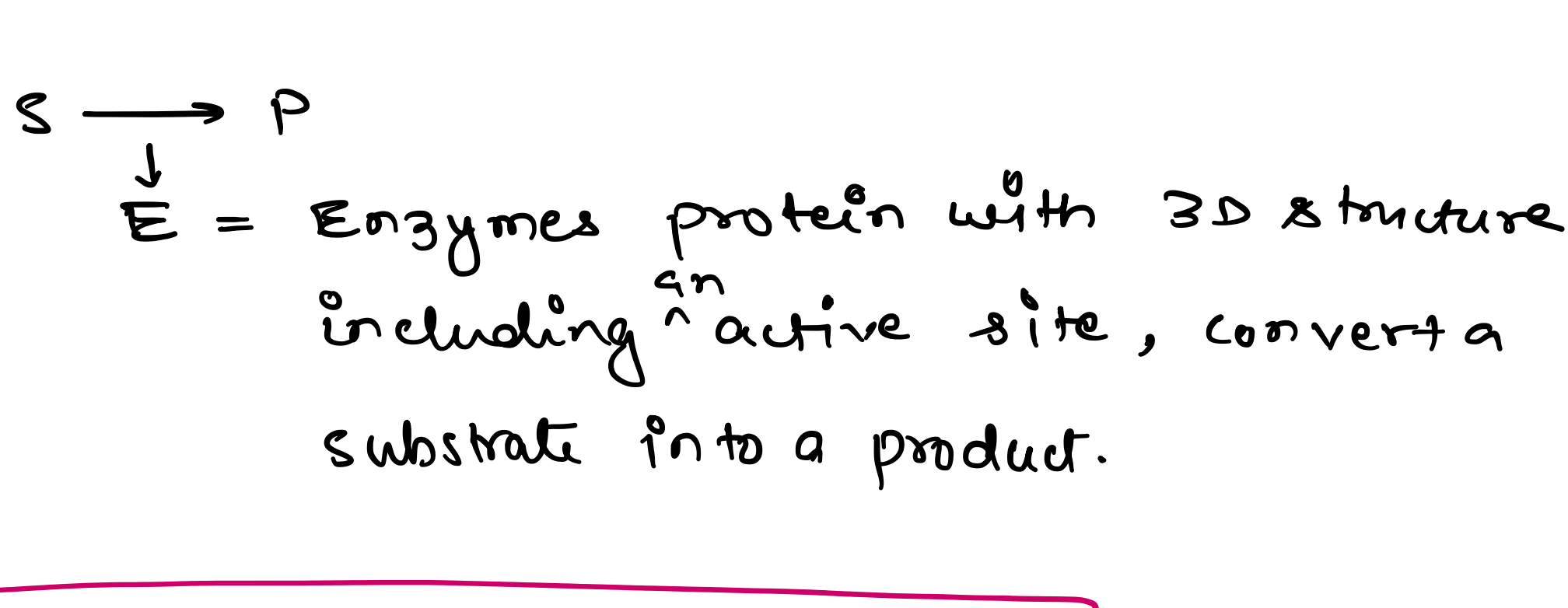
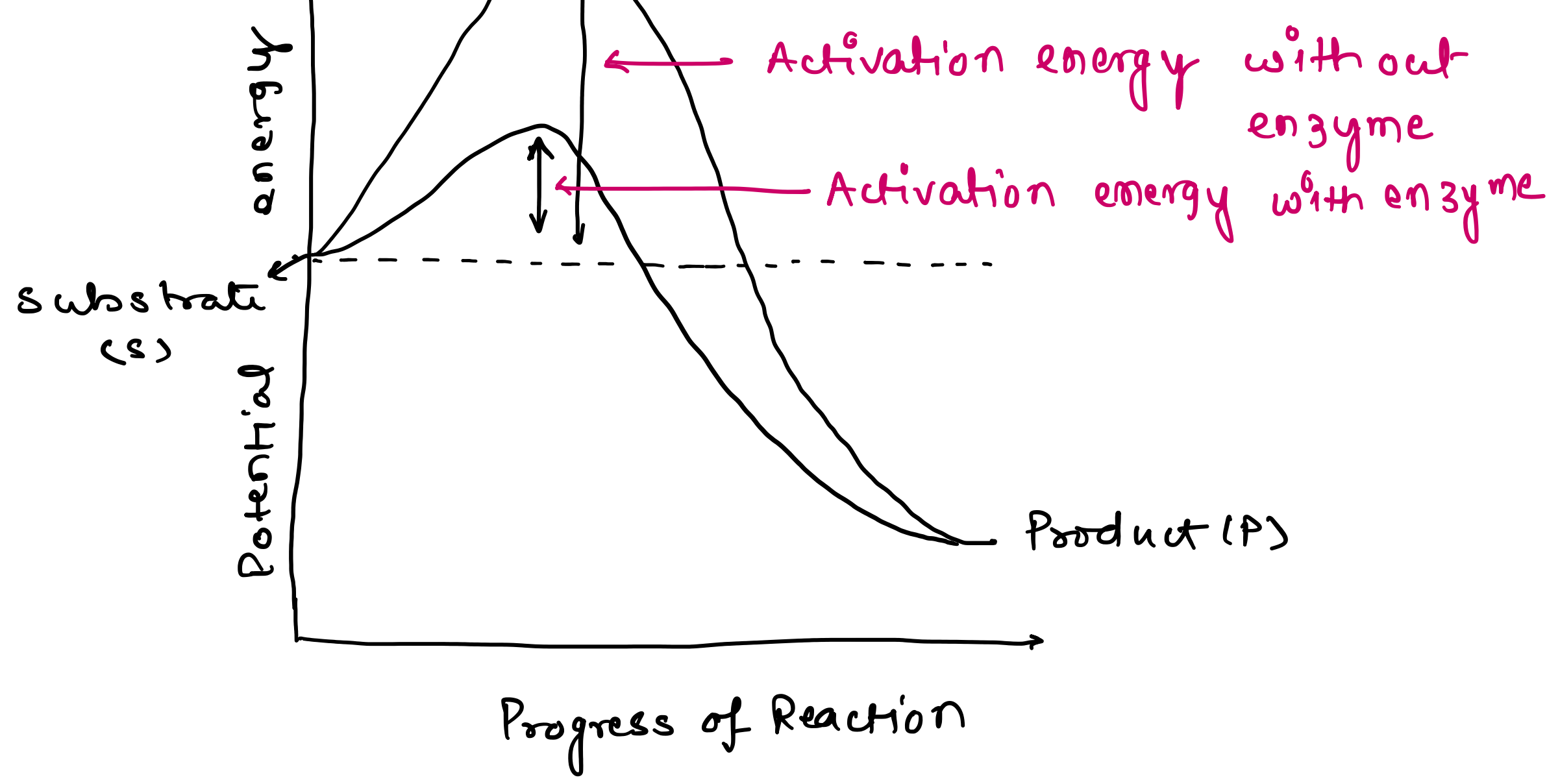
\* Under normal aerobic condition, pyruvic acid is formed

\* In yeast, during fermentation same pathway leads to production of ethanol (alcohol)

## Difference between Inorganic catalyst & Enzymes.

Inorganic Catalyst	Enzymes
* Inorganic in nature	* mostly proteinaceous in nature
* It work in non-living or physical world	* It originate in biological world
* They work efficiently at high temp & high pressure	* enzyme get damaged at high temp (eg say above 40°C)
	✓ enzymes isolated from organism who normally live under extremely high temperature (eg hot vents and sulphur springs), are stable and retain their catalytic power even at high temperature (upto 80°-90°C)
	* Thermal stability is important quality of enzyme isolated from thermophilic organisms.

\* How do enzyme brings about such high rates of chemical conversions.



\* Substrate has to diffuse towards the 'active site'.

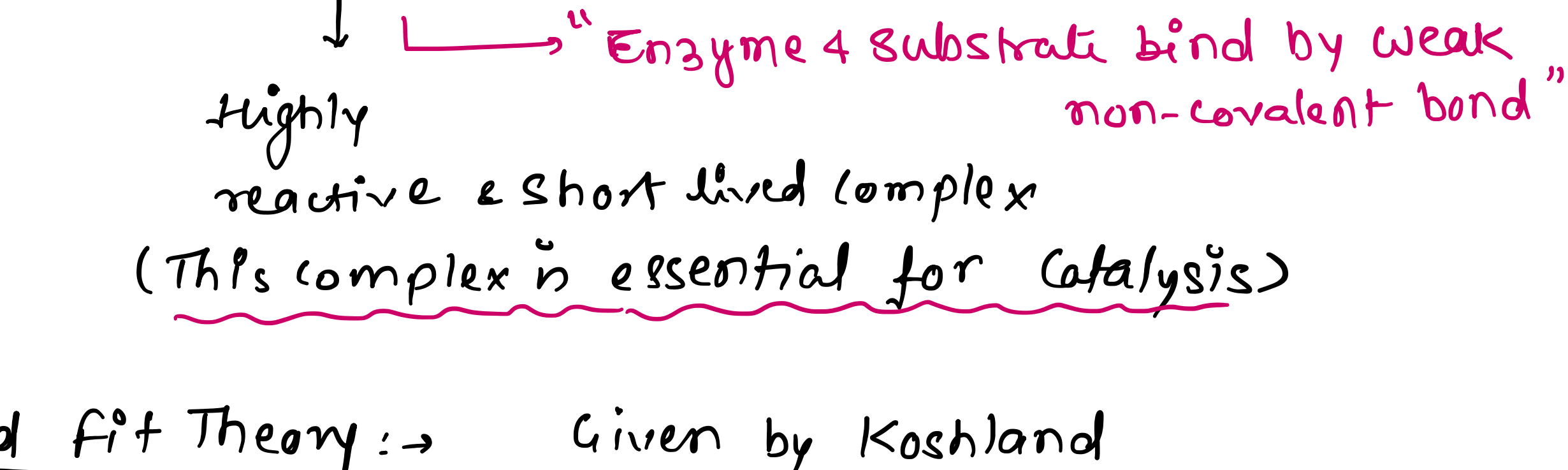
\*\* Enzymes eventually bring down Energy barrier making the transition of 'S' to 'P' more easy.

It lowers down the energy of activation.

## Nature of Enzyme Action :-

\* There are two hypothesis by which enzymes are supposed to bring about chemical reaction

(1) Lock & key Hypothesis :- Given by Emil Fischer



(2) Induced fit Theory :- Given by Koshland

The catalytic cycle of an enzyme action can be described in the following steps

- (1) First, the substrate binds to the active site of the enzyme, fitting into the active site
- (2) The binding of the substrate induces the enzyme to alter its shape, fitting more tightly around the substrate
- (3) The active site of the enzyme, now in close proximity of the substrate breaks the chemical bond of the substrate and the new enzyme product complex is formed
- (4) The enzyme releases the products of the reaction and the free enzyme is ready to bind to another molecule of the substrate and run through the catalytic cycle once again.