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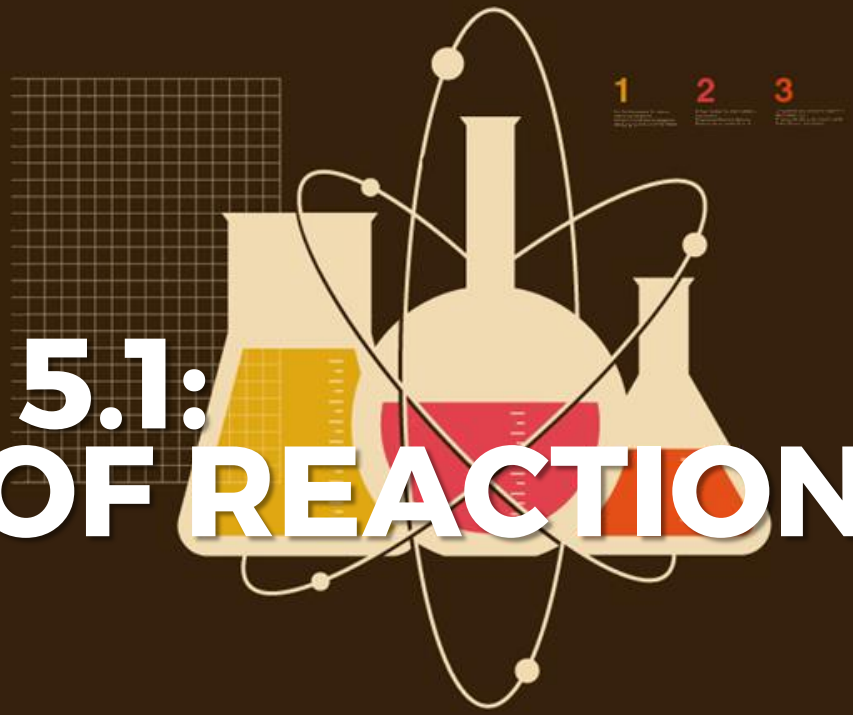


TOPIC 5.1: RATE OF REACTION

THE ABOUT

CHAPTER ANALYSIS

TIME

- Relatively okay chapter
- 5 key concepts

- Size of reactant particles
- Concentration of reactants
- Pressure applied
- Temperature of mixture
- Use of catalysts

EXAM

- Very much interlinked with Energy Changes
- Energy profile diagram is commonly tested

WEIGHTAGE

- Light overall weightage
- Constitute to **3%** of marks for past 5 year papers

KEY CONCEPT

CONDITIONS FOR SUCCESSFUL REACTION

RATE OF REACTION FACTORS

- Size of reactant particles
- Concentration of reactants
- Pressure applied
- Temperature of mixture
- Use of catalysts

2 CONDITIONS FOR EFFECTIVE COLLISION

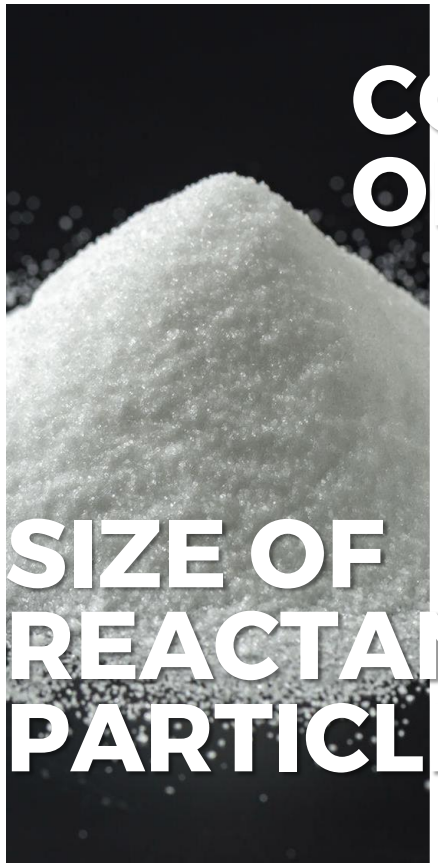
1) SUFFICIENT ENERGY
2) RIGHT ORIENTATION

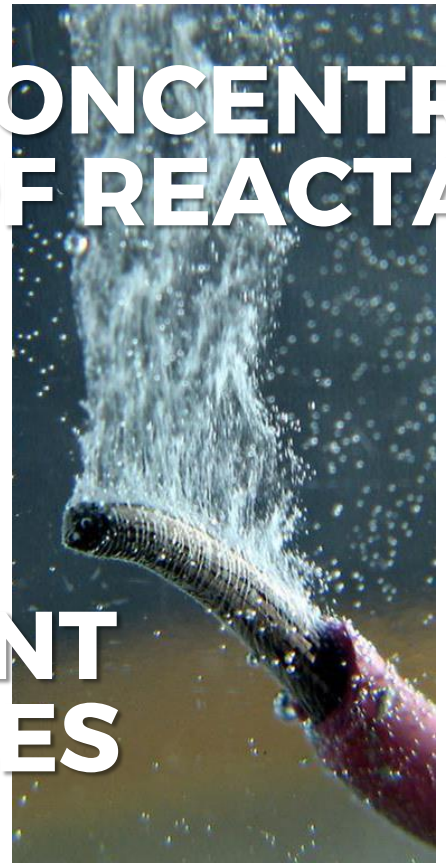
Reactions occur when there are **effective collisions** between reacting particles.

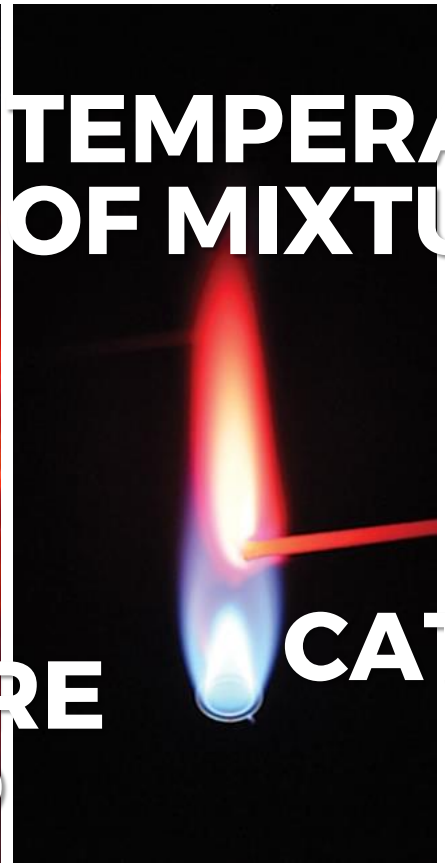
In an effective collision, reactants would need to collide with sufficient energy and in the right orientation to form products.

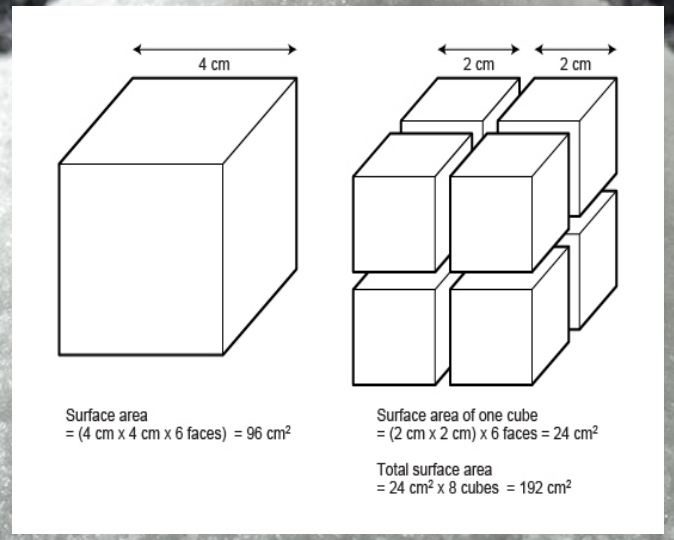
Both conditions have to be fulfilled before an effective collision takes place and products can be formed.

5 FACTORS THAT AFFECT RATE OF REACTION







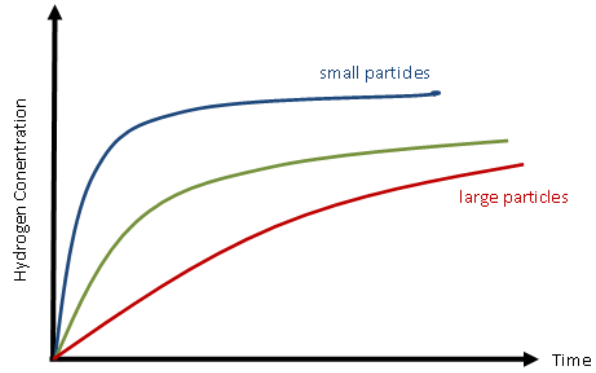


SIZE OF REACTANT PARTICLES

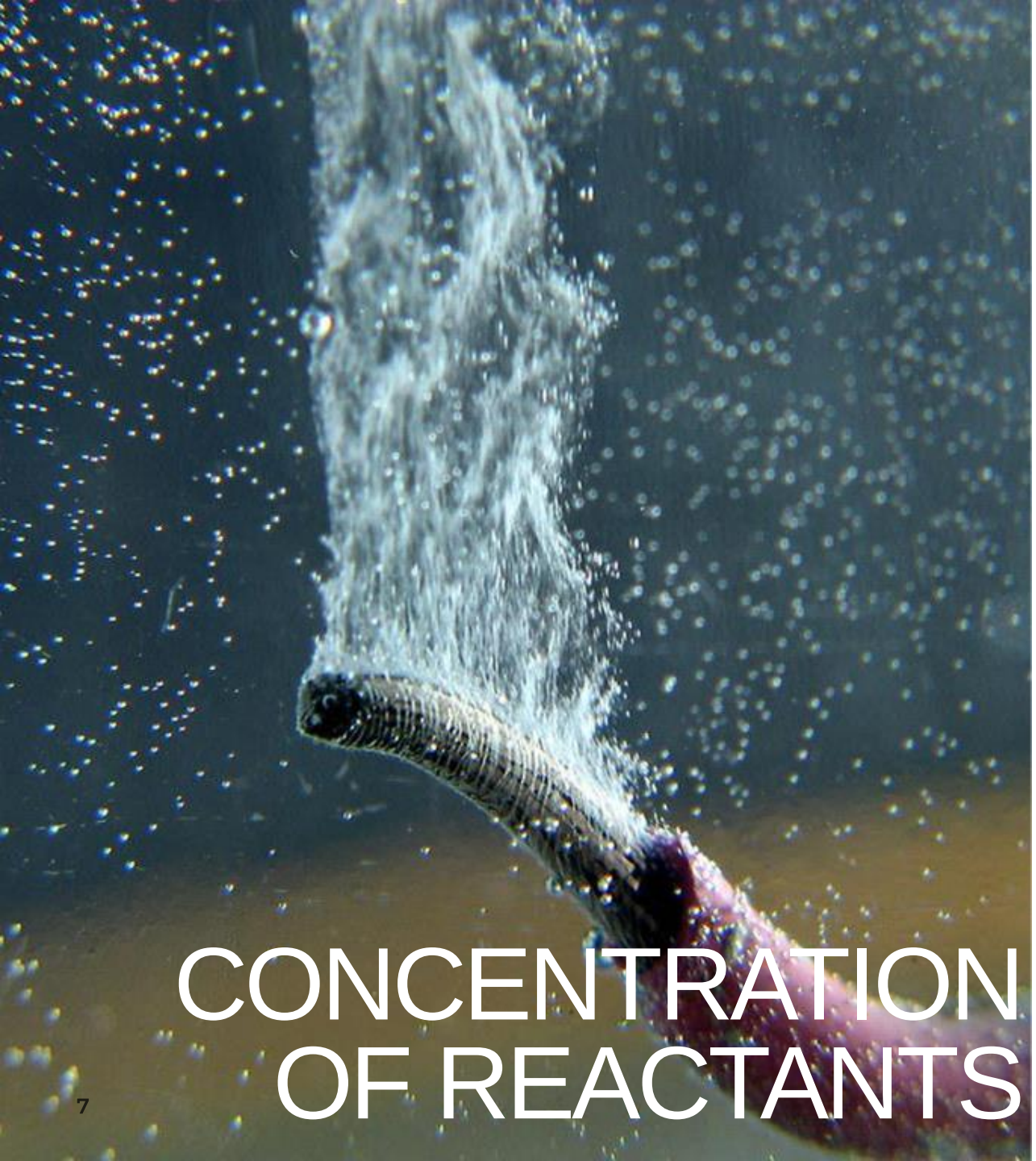
SIZE OF REACTANT PARTICLES

The **smaller the size of the particles**, the **faster the rate of reaction.**

The reason is that having a smaller particle size means that the total surface area for interaction between reacting particles is greater.



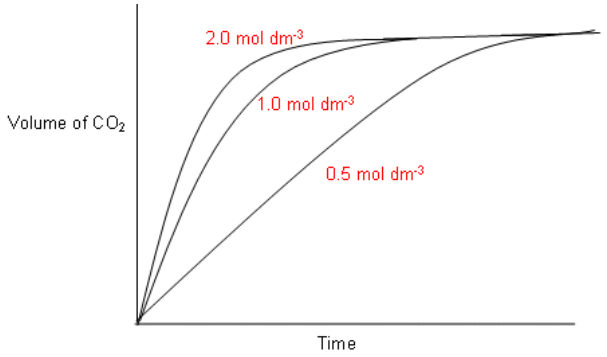
The frequency of effective collisions in Reaction 1 is higher than 2 because of the greater total surface area that is exposed for interaction between reactants.



CONCENTRATION OF REACTANTS

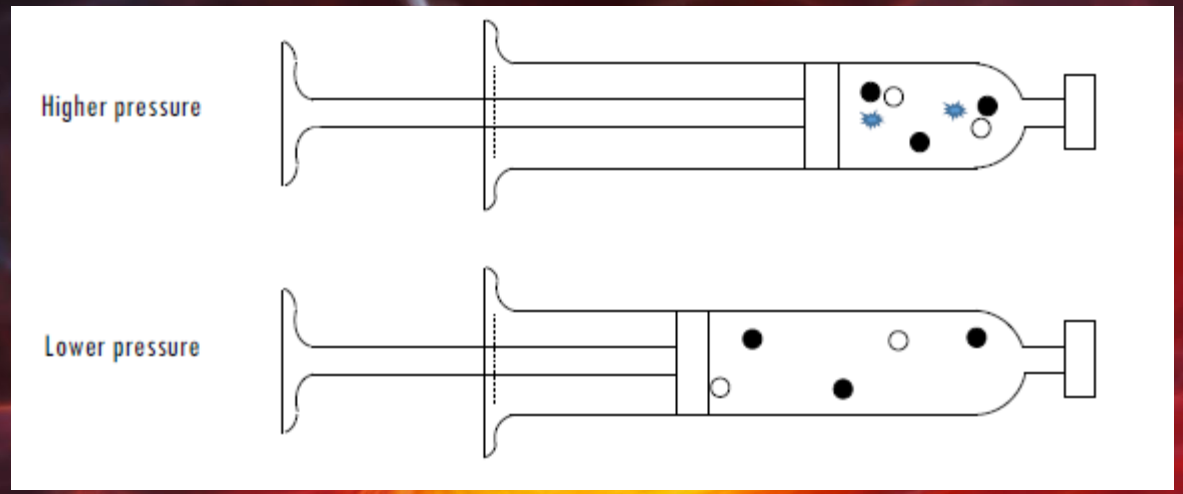
CONCENTRATION OF REACTANTS

A **higher concentration** means that within the same volume of reactants, there is a **higher number of reacting particles.**



For the reaction with 2 moldm^{-3}, the initial gradient of the graph is steeper compared to the rest, indicating a higher reaction rate.

However, the volume of CO_2 produced for three reactions are the same. If the number of moles of the limiting reagent used in the reactions is the same, volume of CO_2 produced from the reactions will be the same.



PRESSURE APPLIED

PRESSURE APPLIED

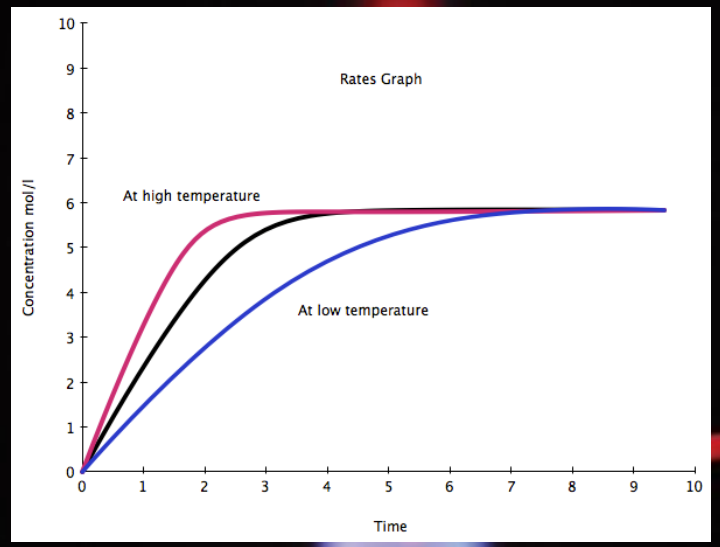
The **higher the pressure, the higher the rate of reaction.**

At a higher pressure, the reactants are brought closer together due to the decrease in volume.

This means there are **more reactants per unit volume**. This would result in the rate of reaction to increase.

For the set-up at higher pressure, as there are more reactant particles per unit volume compared to the set-up at lower pressure, the reacting particles are closer together as well.

As a result, there would be more collisions between reactants and thus leading to a higher frequency of effective collisions.



TEMPERATURE OF SYSTEM

TEMPERATURE OF SYSTEM

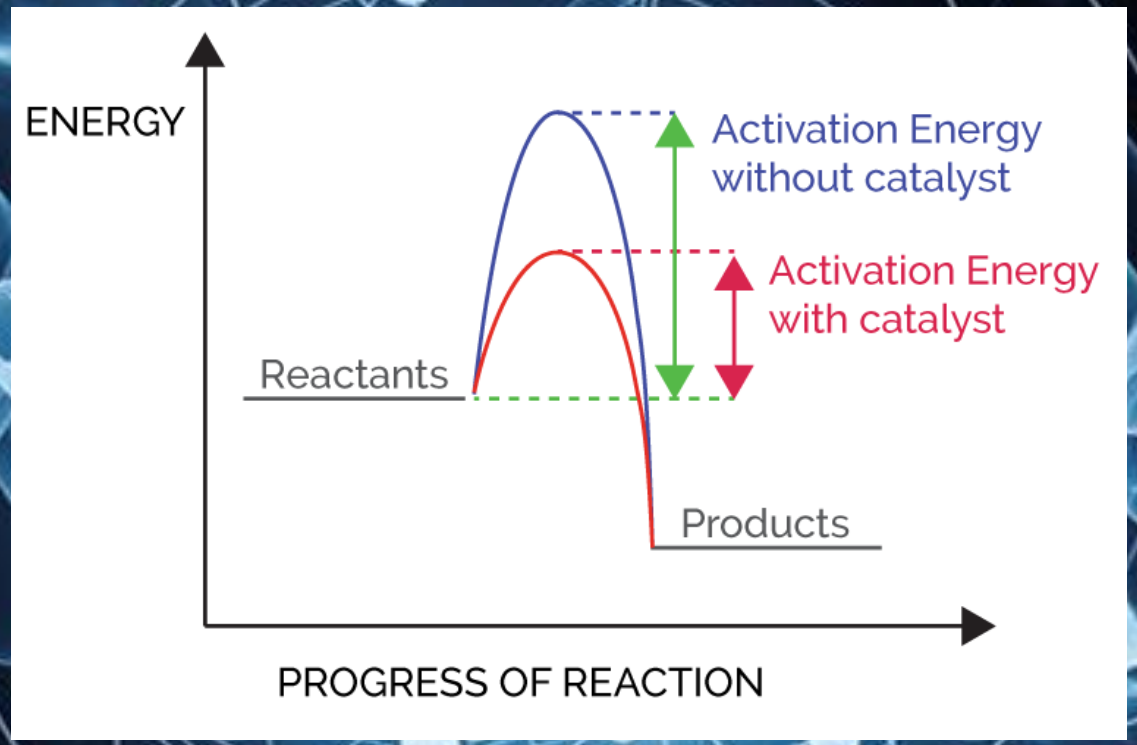
When the temperature of a system is increased, the average kinetic energy of the particles in the system increases too.

A higher temperature of a system means that:

1) Reactant particles have **higher kinetic energy and move faster**

2) The **fraction of reactant particles** in the system that have energy **more than or equal to the activation energy** is higher

These two factors would increase the **frequency of effective collisions** and resulting in an increase in the rate of reaction.



USE OF CATALYSTS

USE OF CATALYSTS

A catalyst provides an **alternative reaction pathway** that allows a **lower activation energy barrier.**

As less activation energy is required, a **higher number of reacting particles will have sufficient kinetic energy** to overcome the activation energy barrier for reaction. Hence, it is more likely to be an **effective collision**.

CHARACTERISTICS OF CATALYSTS

1) A catalyst **changes the rate of reaction without being chemically altered.**

2) **The yield from the reaction is not altered** by catalyst.

3) The purpose of catalysts are to **speed up the rates of reactions** and only a **small amount of the catalyst is required**.

4) Many catalysts are **transition metals** due to variable oxidation states.

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