WEEK TWO (22ND-26TH MARCH 2020)

CHEMISTRY

CHAPTER SEVEN:
CHEMICAL REACTIONS

Physical and Chemical Change

Physical change

- Physical changes (such as melting, evaporating, dissolving) do not produce any new chemical substances, but there is a change in appearance of the substance.
- These changes are often easy to reverse and mixtures produced are usually relatively easy to separate, since they consist of elements/compounds that are not fully combined, eg. Fractional distillation of crude oil.

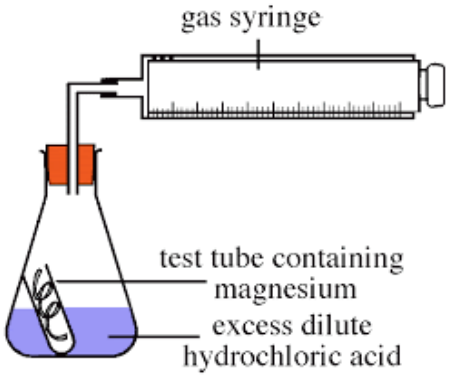
Chemical change

- In chemical reactions, new chemical products are formed that have very different properties to the reactants.
- Most chemical reactions are impossible to reverse.
- Energy changes also accompany chemical changes and energy can be given our (exothermic) or taken in (endothermic) when atomic bonds are broken or created.
- The majority of chemical reactions are exothermic with only a small number being endothermic.
- Eg. Neutralization reactions to produce salts, rusting.

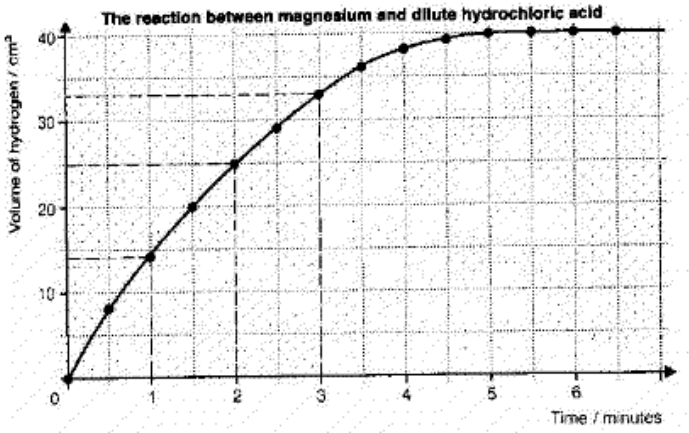
Rate (Speed) of Reactions

Rate is a measure of change per unit time.
A **reaction rate** or **rate of a reaction** is the speed at which reactants are converted into products.

Rate of reaction between magnesium and hydrochloric acid



- Set up the apparatus as described above.
- Once the test tube is removed and the magnesium ribbon touches the hydrochloric acid solution, start the **stopwatch**.
- At equal intervals of time, record the volume in the gas syringe (eg. 30 seconds).
- Repeat the experiment and obtain average to improve reliability of the experiment.

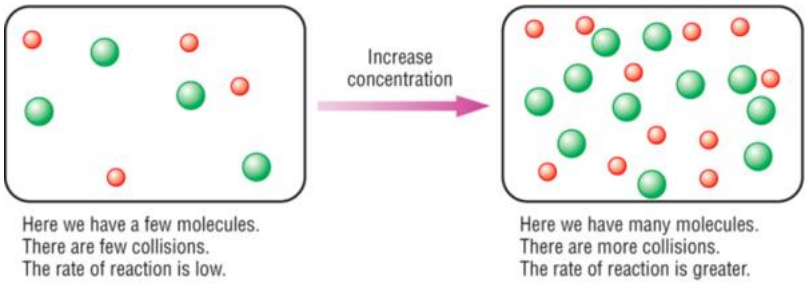


- At 30 seconds, reaction is fastest (highest gradient)
- At 3 minutes, reaction slows down (decreased gradient)
- At 5 minutes, the reaction has stopped (gradient is zero)

Rates of Reaction Factors

- Concentration
- Surface area/ Particle size
- Catalysts
- Temperature
- Pressure (for gases only)

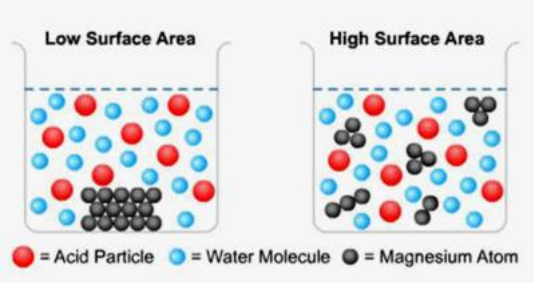
Effect of Concentration



Reason:

- Increase in the concentration of a solution, the rate of reaction will increase.
- This is because there will be more reactant particles in a given volume, allowing more **frequent** and **successful** collisions per second, increasing the rate of reaction.

Effect of Surface Area



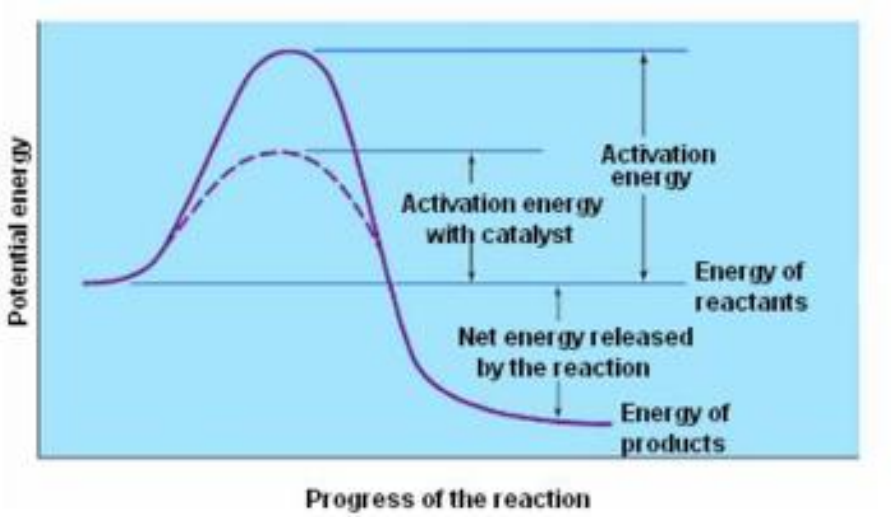
smaller surface area: volume ratio → bigger surface area: volume ratio

***Reason*:**

- Increase in the surface area of the solid, the rate of reaction will increase.

- This is because more surface area particles will be exposed to the other reactant so there will be more frequent and successful collisions per second, increasing the rate of reaction.
- This is why powdered magnesium reacts faster than a lump of magnesium. Increasing the surface area increases the rate of reaction but does not alter the total amount of product formed.

Effect of Using a Catalyst

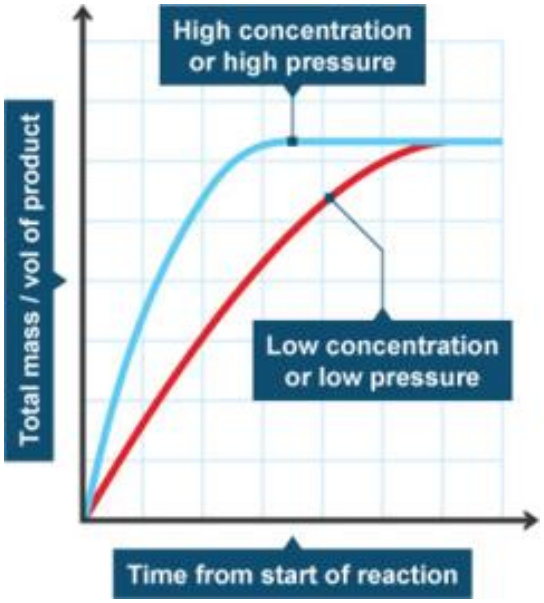


Reason:

- A catalyst is a substance that speeds up a reaction, but is not used up in the process (is not a reactant).
- Catalysts reduce the activation energy of a reaction. Activation energy is the energy needed to initiate a chemical reaction.
- A certain level of energy is often needed in order to break existing bond, before new bonds can be formed and energy is released.
- This can be seen on the graph as a 'hump' -energy must first be put into the reaction (the graph rises), before energy is released from the reaction (the graph fall).
- A catalyst means that less energy is needed to get the reaction started.
- Catalysts reduce the activation energy as they create alternative pathways requiring lower activation energy, allowing more successful and frequent collisions.

- Some catalysts (such as enzymes) increase the rate of reaction by temporarily binding with the reactants and providing them with the correct orientation for a successful collision to occur.
- A catalyst does not increase the frequency of collisions but increases the likelihood that each collision will be successful.

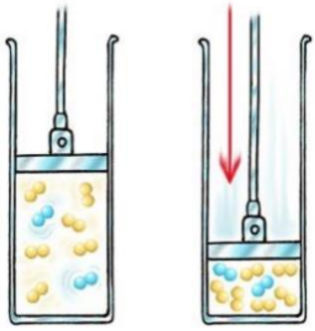
Effect of Temperature



Reason:

- Increasing the temperature increases the kinetic energy of the reactant particles.
- The particles move more quickly increasing the frequency of collisions. The particles also collide with more energy which increases the likelihood of each collision being successful.
- Increasing the temperature does not alter the total amount of product that is formed. This is because the amount of reactant particles doesn't change.
- If the temperature is low it simply takes longer for the same amount of product to be formed. This is why the line representing the reaction at a lower temperature is flatter but still eventually reaches the same height.

Effect of Pressure (gases only)



- Increasing the pressure in gaseous systems increases the rate of reaction.
- The distance between particles is reduced under pressure.
- There are more particles per unit volume, so the collision rate increases, resulting in an increased rate of reaction.

https://www.youtube.com/watch?v=6HCGWhWMEMI

Explosive Combustion

- Explosive combustion occurs when there are many **fine particles** in the air.
- Many industrial processes such as metal working, coal mining or flour milling produce very fine and tiny particles.
- These particles have a very large **surface area** and are **combustible** in air.
- Even a small spark may cause them to ignite and since the surface area is so large, the rate of reaction can be incredibly **fast,** hence they are explosive.
- Methane gas mixed with air in coal mines can also form an explosive mixture.
- In flour mills, a high concentration of flour powder (high surface area) can react with air, causing a spark.
- In both cases, a spark to provide activation energy can cause a very rapid explosive reaction.