

AQA Chemistry A-level

3.1.5: Kinetics

Detailed Notes

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3.1.5.1 - Collision Theory

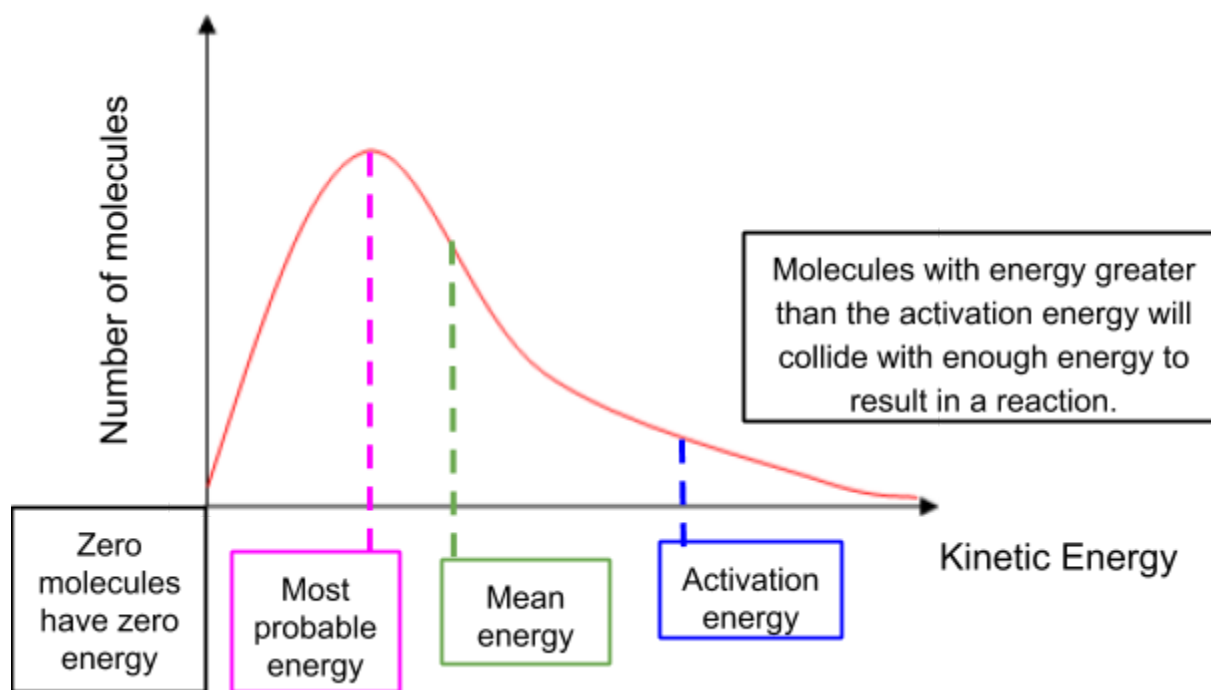
Chemical reactions occur when particles of substances **collide**. For a reaction to occur successfully, these collisions must have **energy greater than or equal to the activation energy** of the reaction and the **particle orientation** must be correct.

Reaction Conditions

The conditions of a reaction impact the collisions of the particles and can be altered to provide the particles with **more energy**. Therefore the conditions can be changed to increase the likelihood of a collision occurring with sufficient energy to react in order to increase rate.

3.1.5.2 - Maxwell-Boltzmann Distribution

Not all molecules in a substance have the same amount of energy. Their energies are **distributed** in a pattern called the **Maxwell-Boltzmann distribution**:



Changing the reaction conditions will **alter the shape of the curve** so that the number of particles with energy greater than the activation energy is different. The total **area under the curve** represents the **total number of molecules** in the sample, therefore it **must remain constant**.





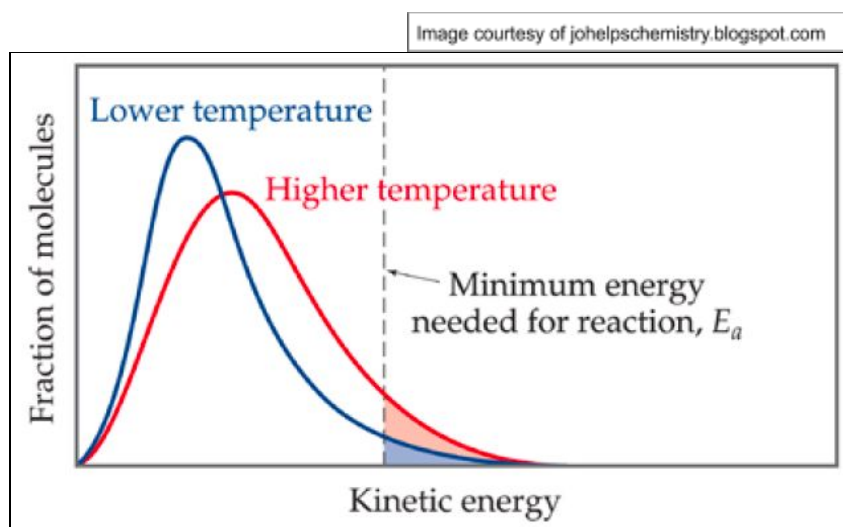
3.1.5.3 - Effect of Temperature

When a substance is heated, **thermal energy** is transferred to it. This energy is converted to **kinetic energy** and the molecules of the substance move **faster and further**. Increased movement of the molecules means **collisions will occur more often** and with **greater energy**. As a result, more collisions have energy greater than the activation energy and result in a reaction.

Therefore **increasing the reaction temperature will increase the rate of reaction** as more collisions of greater energy occur in a given time.

The Maxwell-Boltzmann distribution at an increased temperature **shifts to the right** so that a **greater proportion** of molecules have energy greater than or equal to the activation energy.

Example:



3.1.5.4 - Effect of Concentration and Pressure

When the concentration of a sample is increased, more molecules of substance occur in the same volume meaning they are **packed closer together**. Therefore collisions between molecules become **more likely** and the chances of a collision occurring with energy greater than the activation energy increases. As a result, the rate of reaction increases.

Increasing pressure has a similar effect as molecules are **packed closer together** into a smaller volume.

The Maxwell-Boltzmann distribution is **shifted to the right**.





3.1.5.5 - Effect of Catalysts

A catalyst is a substance that **increases the rate of reaction without being used up** in the reaction. It works by providing an **alternative reaction path** that requires a **lower activation energy** for the reaction to occur.

The Maxwell-Boltzmann distribution curve is **unchanged in shape** but the **position of the activation energy is shifted to the left** so that a greater proportion of molecules have sufficient energy to react.

Example:

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