

Topic 7 – Kinetics

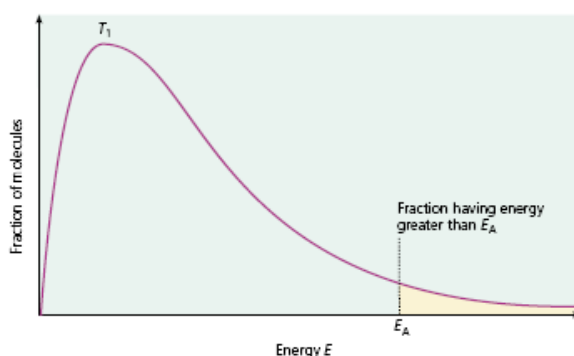
Revision Notes

1) Increasing reaction rate

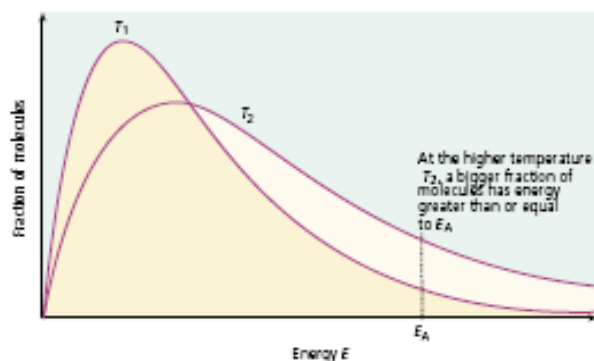
- Rate of reaction = amount of substance produced per second (g/s or cm^3/s)
- 5 ways of increasing rate are to increase surface area, increase concentration, increase temperature, use a catalyst, increase pressure (if gases involved)
- The effect of changing these factors is explained using Collision Theory. For a reaction to occur particles must collide with a minimum amount of energy (called the Activation Energy). To increase the rate we need to increase the number of successful collisions per second.
- Increased surface area = more particles exposed = greater collision frequency
- Increased concentration = particles closer together = greater collision frequency
- Increased temperature = particles have more energy and move faster = greater collision frequency and more collisions are successful = double effect on rate
- Adding a catalyst = lower activation energy = more collisions are successful
- Increasing the pressure in a reaction involving gases has the same effect as increasing the concentration of a solution i.e. particles closer together = greater collision frequency (more collisions per second)

2) The Maxwell-Boltzmann Distribution

- The Maxwell-Boltzmann distribution is a graph showing the distribution of molecular energies in a gas
- The x-axis is labelled "energy" and the y-axis is labelled "number of molecules"
- The area under the curve gives the total number of particles in the sample
- The graph starts at (0,0) because there are no molecules with zero energy



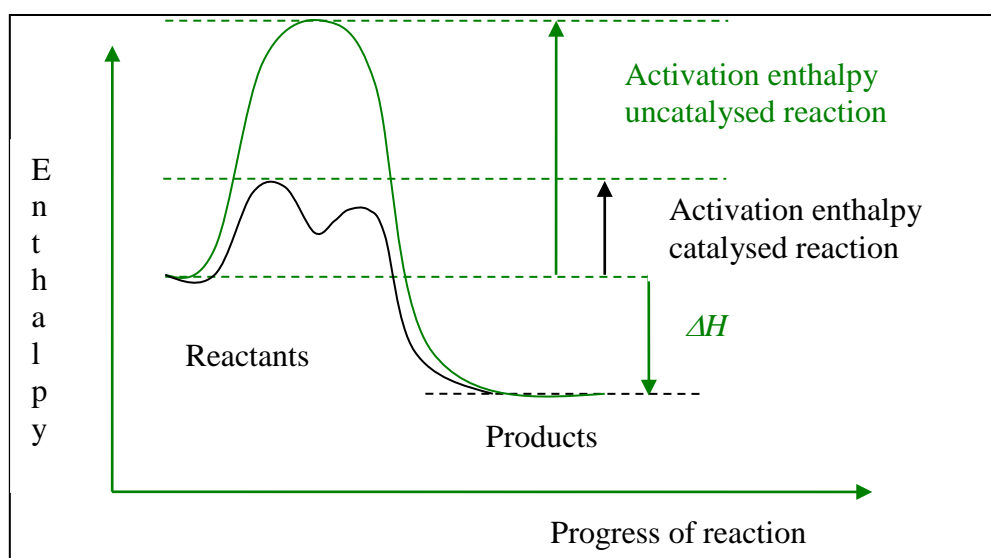
- Increasing the temperature lowers the peak and shifts the distribution to the right. The area under the curve does not change



- Increasing the temperature means more molecules have an energy greater than the activation energy. In turn this means that more collisions are successful
- A small increase in temperature can produce a large increase in rate because **many** more molecules will have an energy above the E_a
- Lowering the temperature raises the peak and shifts the distribution to the left. The area under the curve does not change
- Decreasing the temperature means fewer molecules have an energy greater than the activation energy and so fewer collisions are successful

3) Catalysts

- The catalyst provides an alternative route for the reaction with a lower activation energy than the uncatalysed reaction
- This can be shown on an enthalpy profile diagram:



Source: <http://www.york.ac.uk/org/seg/salters/chemistry/DIY/word/JB%20C1%2010.1The%20collision%20theory%20of%20reactions%2010.2,%2010.5,%20SL%20what's%20removing%20ozone%2013.1.doc>

- In terms of the Maxwell-Boltzmann distribution, lowering the activation energy means many more molecules have an energy greater than the activation energy (so more collisions will be successful and the rate will increase)
- Catalysts do not appear in the equation for a reaction. They are written on top of the arrow

