

Rates of Reaction

Q-1) What is rate of reaction?

> Rate of reaction is how fast the reactants are converted into products.

$$\text{rate} = \frac{\text{change in amount of reactants/products}}{\text{time}}$$

Q-2) Collision theory?

> Collision theory states that the particles must collide with correct orientation and sufficient energy for reactions to occur. These will result in effective collisions.

The rate of reaction will speed up if:

- * frequency of collisions increases.
- * proportion of particles with greater energy than activation energy increases.

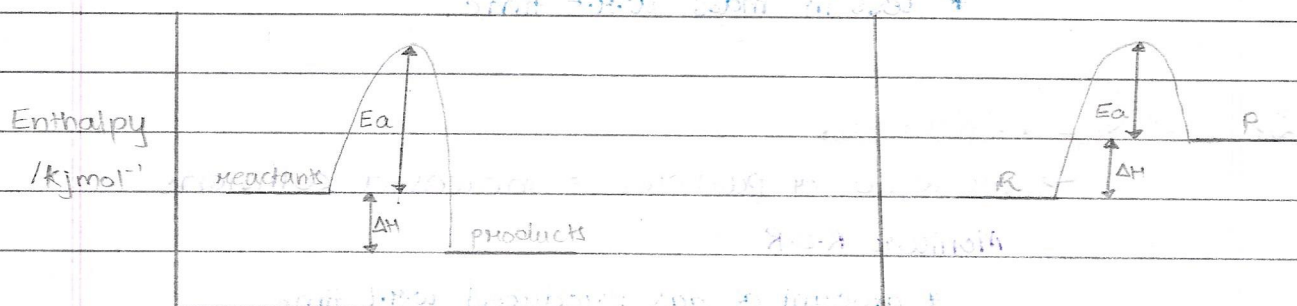
Q-3) What is the activation energy?

> Activation energy is the minimum energy required for (the particles to have successful collisions) reactions to take place.

Transition theory

Enthalpy diagrams

Exothermic Endothermic



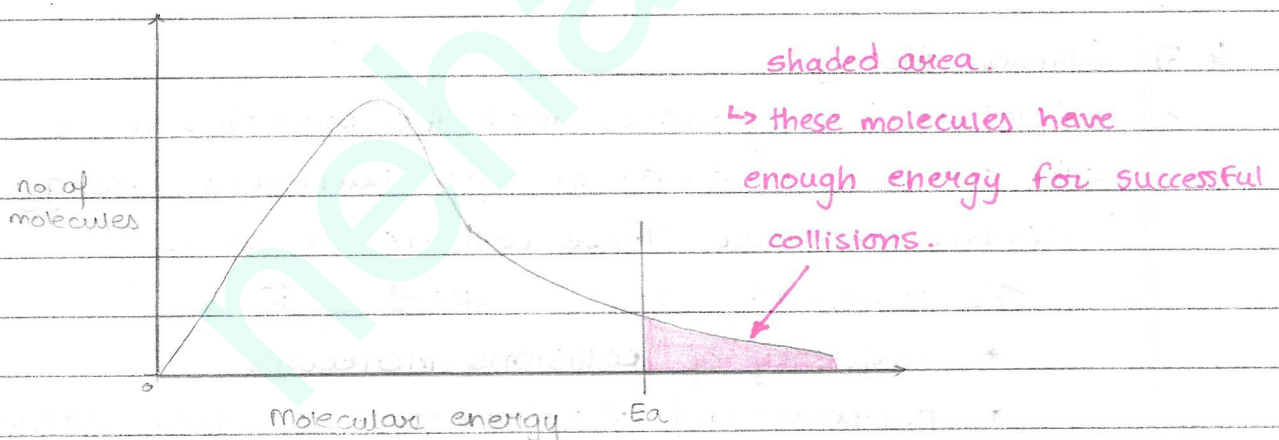
Reaction pathway $E_a \Rightarrow$ activation energy
 $\Delta H \Rightarrow$ change in enthalpy

$$\Delta H = H_p - H_r$$

ΔH negative -ve = exothermic

ΔH positive +ve = endothermic

Not all particles have the same amount of energy.
It can be shown by the Boltzmann distribution graph.



Q-4) Factors affecting rate of reaction.

① **SURFACE AREA** (solids)

→ use ^{powder} ~~lumps~~ rather than ^{lumps} ~~powder~~ so surface area is increased ∴ R.O.R increases.

Monitor R.O.R

* amount of gas evolved w.r.t time

* less in mass w.r.t time.

② **CONCENTRATION**

→ more no. of particles = increased collisions.

Monitor R.O.R

* amount of gas produced w.r.t time

* precipitate (print on paper disappears) w.r.t time.

③ > TEMPERATURE

→ higher temperature; particles have more kinetic energy
 ∴ more successful collisions.

④ > PRESSURE (gases)

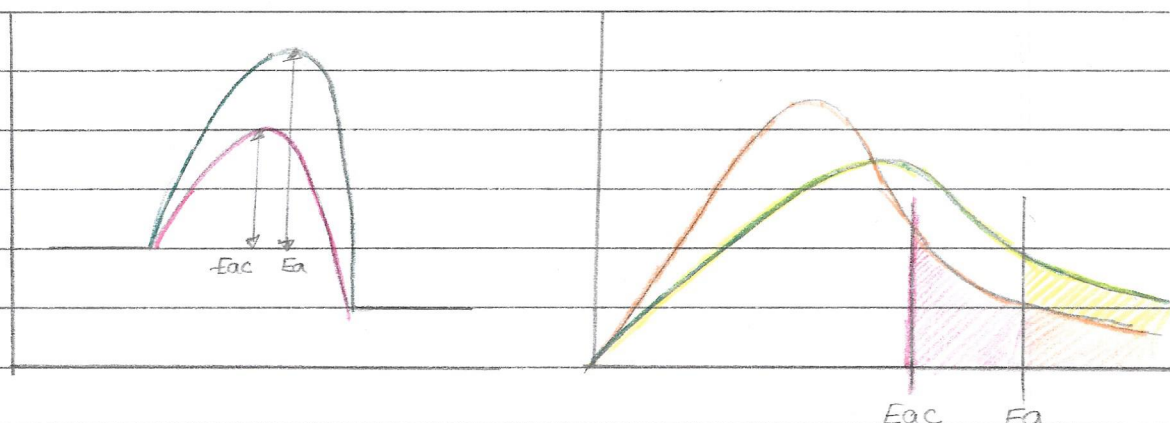
→ higher pressure; the particles are closer together -
 more particles per unit volume ∴ no. of successful
 collisions increases.

⑤ > CATALYST

Catalyst is a substance that increases the rate of
 reaction by reducing activation energy, but is not used up
 in the reaction itself.

⑥ > LIGHT

→ photosynthesis
 → film development in photography
 → alkane + halogen $\xrightarrow{\text{u.v.}}$ halo-alkane.



- normal
- higher temperature
- with catalyst.

Q-5) Ways to monitor rate of reaction.

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- ① volume of gas evolved per unit time
- ② mass of solid formed per unit time
- ③ intensity of colour per unit time
↳ (colorimeter or spectrophotometer / spectrometer)
- ④ change in pH per unit time
- ⑤ change in temperature per unit time
- ⑥ change in pressure per unit time
- ⑦ conductivity.