

## 1. Key Words

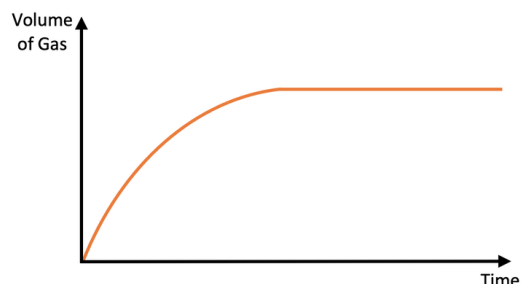
Rate of reaction	Amount of reactant used or product formed $\div$ time
Collision theory	Idea that for a reaction to occur the particles have to hit each other with enough energy
Activation energy	The minimum energy needed for a collision to cause a reaction
Catalyst	A substance which speeds up a chemical reaction by lowering the activation energy
Reversible reaction	A chemical reaction that can go in either direction
Equilibrium	When the forwards and backwards reactions happen at the same rate

## 2. Calculating rates from graphs

**Equation** Rate of reaction = amount of product  $\div$  time

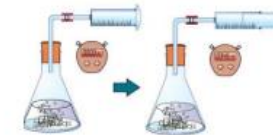
**Units**  $\text{cm}^3/\text{s}$  OR  $\text{g}/\text{s}$

The horizontal line on the graph shows that the reaction has finished



## 3. Ways to measure a rate of reaction

Volume of gas released



Method:

1. Connect a gas syringe to a conical flask
2. Add the reactants and start timing
3. Record the time taken to reach a specific volume OR record the volume collected in a given time

Formation of a solid product (become opaque)

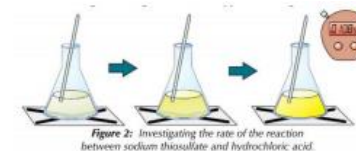
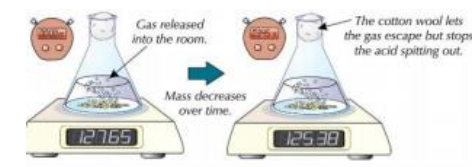


Figure 2: Investigating the rate of the reaction between sodium thiosulfate and hydrochloric acid.

Method:

1. Place a black cross below a conical flask
2. Add the reactants and start timing
3. Record the time taken for the cross to disappear (no longer visible from above)

Change in mass



Method:

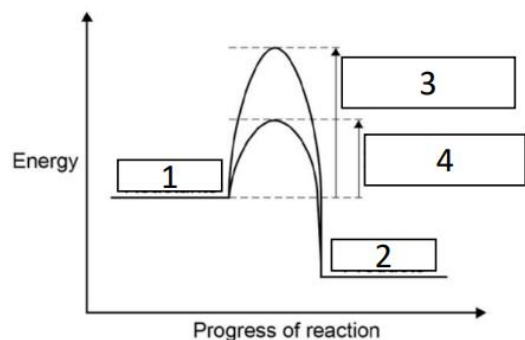
1. Place a conical flask containing the reactants onto an electronic balance
2. Start the timer and observe the mass
3. Record the mass decrease in a given time or until the reaction stops

## 4. Factors affecting the rate of reaction

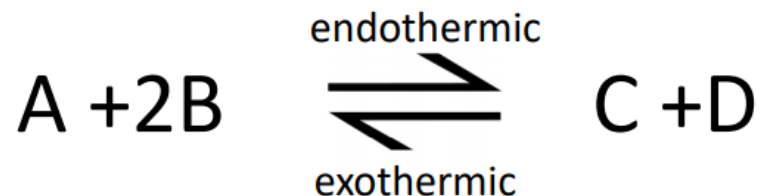
Factor	Change	Effect on rate	Reason
Temperature	Increase	Increase	The particles gain energy, so move faster and collide more often, increasing the proportion of successful collisions
Concentration	Increase	Increase	There are more particles so there are more frequent collisions
Surface area	Increase	Increase	There are more particles available so there are more frequent collisions
Catalyst	Add	Increase	The lower activation energy means that more successful collision occur

## 5. Catalysts

1	Reactants
2	Products
3	Activation energy without catalyst
4	Activation energy with catalyst



## 6. The effect of changing the conditions of equilibrium (H)



Le Chatelier's principal: a reaction at equilibrium will act to oppose any changes to it

Condition	Change	Effect
Concentration	Increase A or B	Shifts to the right to increase the concentration of C + D
	Decrease A or B	Shifts to the left to increase the concentration of A + B
Temperature	Increase	Shifts right to favour the endothermic reactions, making more C + D
	Decrease	Shifts left to favour the exothermic reactions, making more A + B
Pressure	Increase	Shifts to the right side with the fewest moles so makes more C + D
	Decrease	Shifts to the left side with the most moles so makes more A+B