AQA GCSE The rate and extent of chemical change

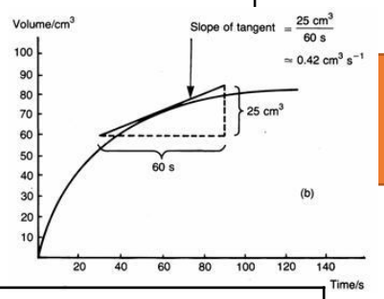
Calculating rates of reactions

Rate of chemical reaction	*This can be calculated by measuring the quantity of reactant used or product formed in a given time.*

Rate = $\frac{\text{quantity of reactant used}}{\text{time taken}}$

Rate = $\frac{\text{quantity of product formed}}{\text{time taken}}$

Quantity	Unit
Mass	Grams (g)
Volume	cm^3
Rate of reaction	Grams per cm^3 (g/cm^3) HT: moles per second (mol/s)

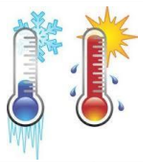


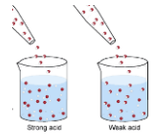
Rate of reaction

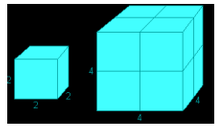
Factors affecting rates

Factors affecting the rate of reaction	
Temperature	*The higher the temperature, the quicker the rate of reaction.*
Concentration	*The higher the concentration, the quicker the rate of reaction.*
Surface area	*The larger the surface area of a reactant solid, the quicker the rate of reaction.*
Pressure (of gases)	*When gases react, the higher the pressure upon them, the quicker the rate of reaction.*

Collision theory and activation energy

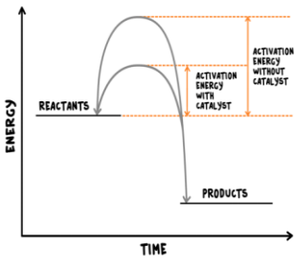






Collision theory	*Chemical reactions can only occur when reacting particles collide with each other with sufficient energy.*	Increasing the temperature increases the frequency of collisions and makes the collisions more energetic, therefore increasing the rate of reaction. Increasing the concentration, pressure (gases) and surface area (solids) of reactions increases the frequency of collisions, therefore increasing the rate of reaction.
Activation energy	*This is the minimum amount of energy colliding particles in a reaction need in order to react.*	

Catalysts



If a catalyst is used in a reaction, it is not shown in the word equation.

Catalyst	A catalyst changes the rate of a chemical reaction but is not used in the reaction.
Enzymes	These are biological catalysts.
How do they work?	Catalysts provide a different reaction pathway where reactants do not require as much energy to react when they collide.

Reversible reactions and dynamic equilibrium

Reversible reactions

Reversible reactions	In some chemical reactions, the products can react again to re-form the reactants.
Representing reversible reactions	A + B ⇌ C + D
The direction	The direction of reversible reactions can be changed by changing conditions: A + B ⇌ (heat / cool) C + D

Energy changes and reversible reactions

If one direction of a reversible reaction is exothermic, the opposite direction is endothermic. The same amount of energy is transferred in each case.

For example:
Hydrated copper sulfate ⇌ (endothermic / exothermic) Anhydrous copper + Water sulfate

Equilibrium

The relative amounts of reactants and products at equilibrium depend on the conditions of the reaction.

Equilibrium in reversible reactions	When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur exactly at the same rate.

Changing conditions and equilibrium (HT)

Le Chatelier's Principles	States that when a system experiences a disturbance (change in condition), it will respond to restore a new equilibrium state.
Changing concentration	If the concentration of a reactant is increased, more products will be formed . If the concentration of a product is decreased, more reactants will react.
Changing temperature	If the temperature of a system at equilibrium is increased: - Exothermic reaction = products decrease - Endothermic reaction = products increase
Changing pressure (gaseous reactions)	For a gaseous system at equilibrium: - Pressure increase = equilibrium position shifts to side of equation with smaller number of molecules. - Pressure decrease = equilibrium position shifts to side of equation with larger number of molecules.

AQA GCSE The rate and extent of chemical change

Rate of reaction

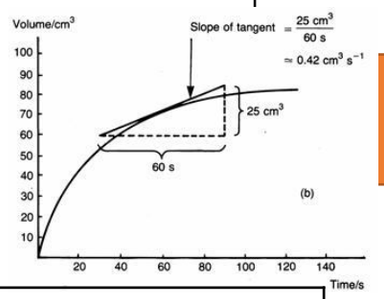
Calculating rates of reactions

	This can be calculated by measuring the quantity of reactant used or product formed in a given time.

Rate = $\frac{\text{quantity of reactant used}}{\text{time taken}}$

Rate = $\frac{\text{quantity of product formed}}{\text{time taken}}$

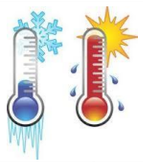
Quantity	Unit
Mass	
Volume	
Rate of reaction	

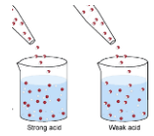


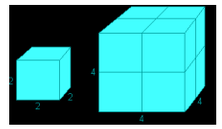
Factors affecting rates

Factors affecting the rate of reaction	
	The higher the temperature, the quicker the rate of reaction.
	The higher the concentration, the quicker the rate of reaction.
	The larger the surface area of a reactant solid, the quicker the rate of reaction.
	When gases react, the higher the pressure upon them, the quicker the rate of reaction.

Collision theory and activation energy

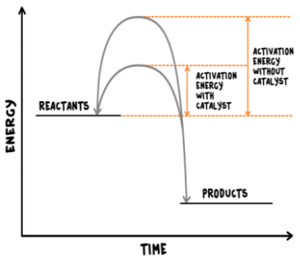






	Chemical reactions can only occur when reacting particles collide with each other with sufficient energy.	Increasing the temperature increases the frequency of collisions and makes the collisions more energetic, therefore increasing the rate of reaction.
	This is the minimum amount of energy colliding particles in a reaction need in order to react.	Increasing the concentration, pressure (gases) and surface area (solids) of reactions increases the frequency of collisions, therefore increasing the rate of reaction.

Catalysts



If a catalyst is used in a reaction, it is not shown in the word equation.

	A catalyst changes the rate of a chemical reaction but is not used in the reaction.
	These are biological catalysts.
	Catalysts provide a different reaction pathway where reactants do not require as much energy to react when they collide.

Reversible reactions and dynamic equilibrium

Reversible reactions

	In some chemical reactions, the products can react again to re-form the reactants.
	$A + B \rightleftharpoons C + D$
	The direction of reversible reactions can be changed by changing conditions: $A + B \overset{\text{heat}}{\underset{\text{cool}}{\rightleftharpoons}} C + D$

Energy changes and reversible reactions

If one direction of a reversible reaction is exothermic, the opposite direction is endothermic. The same amount of energy is transferred in each case.

For example: Hydrated copper sulfate $\overset{\text{endothermic}}{\underset{\text{exothermic}}{\rightleftharpoons}}$ Anhydrous copper sulfate + Water

Equilibrium

The relative amounts of reactants and products at equilibrium depend on the conditions of the reaction.

	When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur exactly at the same rate.

Changing conditions and equilibrium (HT)

	States that when a system experiences a disturbance (change in condition), it will respond to restore a new equilibrium state.
	If the concentration of a reactant is increased, more products will be formed . If the concentration of a product is decreased, more reactants will react.
	If the temperature of a system at equilibrium is increased: - Exothermic reaction = products decrease - Endothermic reaction = products increase
	For a gaseous system at equilibrium: - Pressure increase = equilibrium position shifts to side of equation with smaller number of molecules. - Pressure decrease = equilibrium position shifts to side of equation with larger number of molecules.

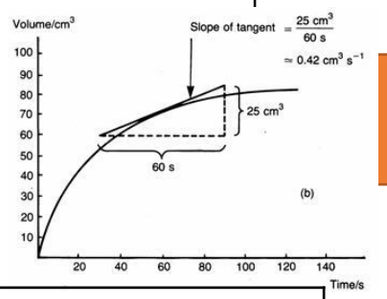
AQA GCSE The rate and extent of chemical change

Rate of reaction

Rate of chemical reaction	Rate = quantity of reactant used / time taken Rate = quantity of product formed / time taken

Calculating rates of reactions

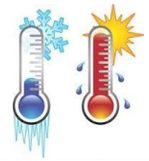
Quantity	Unit
	Grams (g)
	cm^3
	Grams per cm^3 (g/cm^3) HT: moles per second (mol/s)

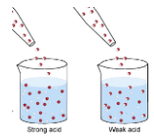


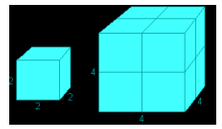
Factors affecting rates

Factors affecting the rate of reaction	
Temperature	
Concentration	
Surface area	
Pressure (of gases)	

Collision theory and activation energy

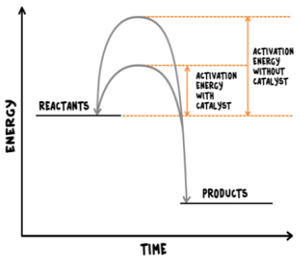






Collision theory		Increasing the temperature increases the frequency of collisions and makes the collisions more energetic, therefore increasing the rate of reaction. Increasing the concentration, pressure (gases) and surface area (solids) of reactions increases the frequency of collisions, therefore increasing the rate of reaction.
Activation energy		

Catalysts



Catalyst	
Enzymes	
How do they work?	

If a catalyst is used in a reaction, it is not shown in the word equation.

Reversible reactions and dynamic equilibrium

Reversible reactions

Reversible reactions	
Representing reversible reactions	
The direction	The direction of reversible reactions can be changed by changing conditions: $A + B \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} C + D$

Energy changes and reversible reactions

If one direction of a reversible reaction is exothermic, the opposite direction is endothermic. The same amount of energy is transferred in each case.

For example:
Hydrated copper sulfate $\underset{\text{exothermic}}{\overset{\text{endothermic}}{\rightleftharpoons}}$ Anhydrous copper + Water sulfate

Equilibrium

The relative amounts of reactants and products at equilibrium depend on the conditions of the reaction.

Equilibrium in reversible reactions	When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur exactly at the same rate.

Changing conditions and equilibrium (HT)

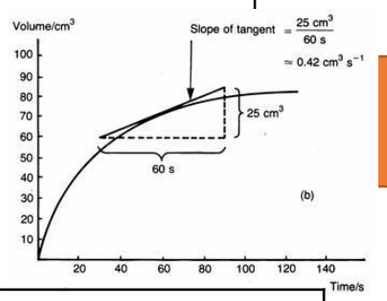
Le Chatelier's Principles	
Changing concentration	
Changing temperature	
Changing pressure (gaseous reactions)	

AQA GCSE The rate and extent of chemical change

Rate of chemical reaction		Equation:

Calculating rates of reactions

Quantity	Unit
	Grams (g)
	cm^3
	Grams per cm^3 (g/cm^3) HT: moles per second (mol/s)

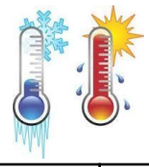


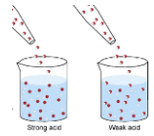
Rate of reaction

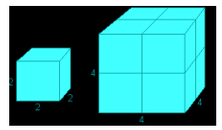
Factors affecting rates

Factors affecting the rate of reaction	

Collision theory and activation energy

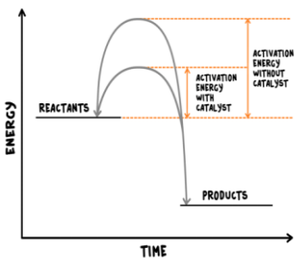






Collision theory		
Activation energy		

Catalysts



If a catalyst is used in a reaction, it is not shown in the word equation.

Catalyst	
Enzymes	
How do they work?	

Reversible reactions and dynamic equilibrium

Reversible reactions

Reversible reactions	
Representing reversible reactions	
The direction	

Energy changes and reversible reactions

If one direction of a reversible reaction is exothermic, the opposite direction is endothermic. The same amount of energy is transferred in each case.

For example:
Hydrated copper sulfate $\overset{\text{endothermic}}{\underset{\text{exothermic}}{\rightleftharpoons}}$ Anhydrous copper sulfate + Water

Equilibrium

Changing conditions and equilibrium (HT)

The relative amounts of reactants and products at equilibrium depend on the conditions of the reaction.

Equilibrium in reversible reactions	

Le Chatelier's Principles	