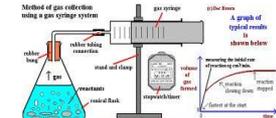
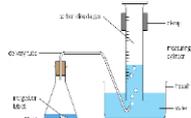
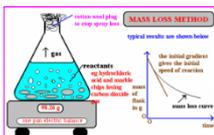


Knowledge Organiser: The Rate and Extent of Chemical Change

Section 1 - Measuring Rate of Reaction

Mean rate of reaction =

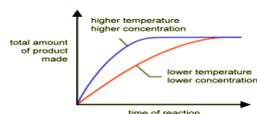
$\frac{\text{quantity of reactant used}}{\text{Time}}$ or $\frac{\text{quantity of product formed}}{\text{Time}}$



Measured in grams (g), volume (cm³) or moles (mol).

Rate of reaction measured in g/s, cm³/s or mol/s.

Interpret rate of reaction graphs

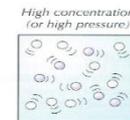


Higher Tier – Calculate the gradient of a tangent to the curve as a measure of rate of reaction at a specific time.

Section 2 - Factors Affecting Rate

Increasing Concentration of reactants in solution

– increases frequency of collisions

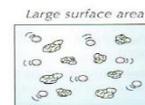


Increasing Pressure of reacting gases

– increases frequency of collisions

Increasing the Surface area of solid reactants

– increases frequency of collisions



Increasing the Temperature of the reaction

– increases energy of reacting particles

-- increases the frequency of collisions

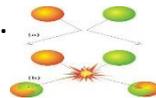


Presence of a **catalyst**



Section 3 - Collision Theory

Chemical reactions can only occur when reacting **particles collide** with each other and **with sufficient energy**.



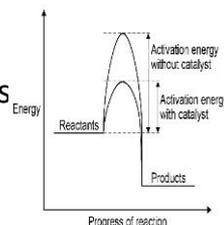
Activation Energy is the minimum amount of energy particles must have to react.

Catalysts: increase rate of reaction but are not used up during reaction.

Different reactions need different catalysts.

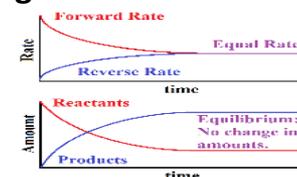
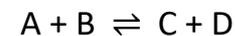
Enzymes act as catalysts in biological systems

Catalysts increase the rate of reaction by providing an **alternative pathway** that has a **lower activation energy**.



Section 4- Reversible Reactions and Dynamic Equilibrium

Reversible reaction: a reaction where the products can react to form the original reactants.



If a reversible reaction is **exothermic in one direction** it is **endothermic in the opposite direction**.

In a **closed system** equilibrium is reached when

rate of the forward reaction = rate of the reverse reaction.

Knowledge Organiser: The Rate and Extent of Chemical Change

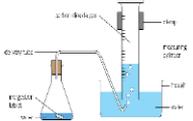
Section 1 - Measuring Rate of Reaction

Mean rate of reaction =

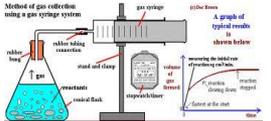


or

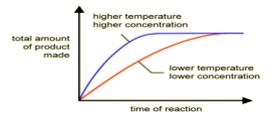
Time



Time



Measured in
Rate of reaction measured in
Interpret rate of reaction graphs



Higher Tier – Calculate the gradient of a tangent to the curve as a measure of rate of reaction at a specific time.

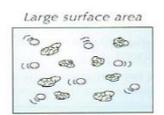
Section 2 - Factors Affecting Rate

Increasing Concentration of reactants in solution

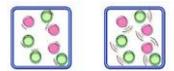


Increasing Pressure of reacting gases

Increasing the Surface area of solid reactants



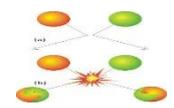
Increasing the Temperature of the reaction



Presence of a

Section 3 - Collision Theory

Chemical reactions can only occur when

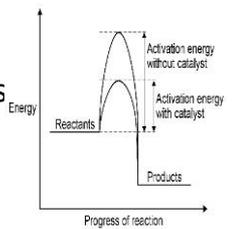


Activation Energy is the

Catalysts:

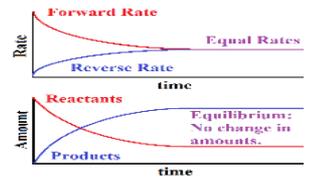
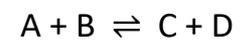
during reaction.
Different reactions need different catalysts.
act as catalysts in biological systems

Catalysts increase the rate of reaction by



Section 4- Reversible Reactions and Dynamic Equilibrium

Reversible reaction: a reaction where



If a reversible reaction is **exothermic in one direction** it is

In a **closed system** equilibrium is reached when

Higher Tier

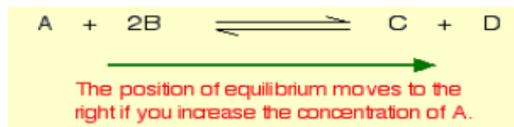
Section 5- Le Chatelier's Principle



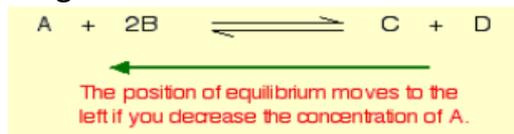
When a system at equilibrium is disturbed, the system acts to reverse the effect of the disturbance.

Effect of concentration on Equilibrium

Increasing the concentration of a reactant

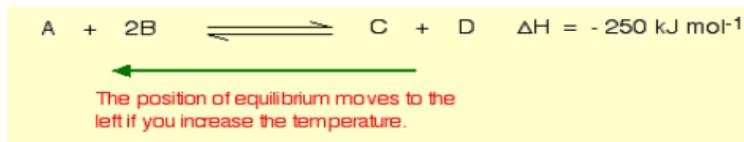


Decreasing the concentration of a reactant

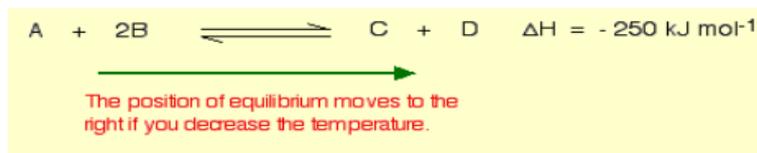


Section 6 - Effect of Temperature on Equilibrium

Exothermic reaction - raise the temperature and the equilibrium moves to the left,



lower the temperature and the equilibrium moves to the right.

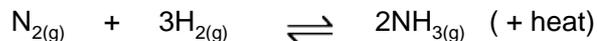


Endothermic - raise the temperature and the equilibrium moves to the right, lower it and the equilibrium moves to the left.

Section 8 -Industrial Application

The Haber Process

Nitrogen + Hydrogen \rightleftharpoons Ammonia (+ heat)



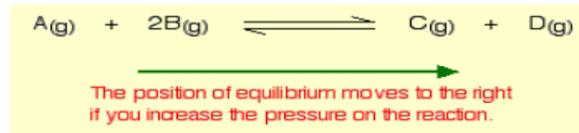
The industrial conditions are

- 1) **Temperature** between 450 °C and 500 °C.
- 2) **Pressure** of 200 atmospheres..
- 3) **iron catalyst**.

Section 7 - Effect of Pressure on Equilibrium

Pressure only affect reactions that involve at least one gas.

Increasing pressure causes equilibrium position to shift towards the side with fewer moles of gas.



Decreasing pressure causes equilibrium position to shift towards the side with more moles of gas.

