



Cambridge IGCSE Chemistry

Topic 7: Chemical reactions

Rate (speed) of reaction

Notes

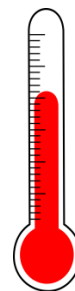




Describe and explain the effect of concentration, particle size, catalysts (including enzymes) and temperature on the rate of reactions



- Increasing the temperature increases the rate of reaction. As increasing temperature increases the speed of the moving particles, so they collide more frequently and energetically.



- Increasing concentration of reacting solutions increases the rate of reaction, as it increases the frequency of collisions.
- Increasing the surface area of solid reactants (same as decreasing the particle size) increases the rate of reaction, as it increases the frequency of collisions.
- Catalysts are substances that speed up chemical reactions without being changed or used up during the reaction.

(Extended only) Devise and evaluate a suitable method for investigating the effect of a given variable on the rate of a reaction

- Use equations below to find the rate of reaction to compare the effect of changes in surface area/particle size, concentration, temperature, use of a catalyst etc...
- Rates of reactions can be measured using the amount of product used, or amount of product formed over time:

$$\text{Rate of reaction} = \frac{\text{amount of reactant used}}{\text{Time}}$$

$$\text{Rate of reaction} = \frac{\text{amount of product formed}}{\text{Time}}$$

- Quantity of reactant or product can be measured by the mass in grams or by a volume in cm^3
- if a gas is produced in a reaction, you can either collect the gas produced in a gas syringe and measure the volume over time, or let the gas escape and measure loss of mass over time
- Units of rate of reaction may be given as g/s or cm^3/s
- Use quantity of reactants in terms of moles and therefore, units for rate of reaction in mol/s
- You would want to do multiple experiments changing the variable e.g. if it was temperature do the experiment at 20°C , 25°C , 30°C etc... measuring the rate at regular intervals each time to then compare (possibly graphically)





Describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. methane in mines)

- Flour mills
 - Particle size is very small
 - Therefore, surface area is very large
 - Could easily combust causing an explosion due to these flammable substances that have a large surface area
- Methane in mines
 - Increase in pressure
 - Same as increasing the concentration of the reactants – because now the volume has decreased, therefore there are more particles per unit volume
 - Increases chance of successful collisions

Demonstrate knowledge and understanding of a practical method for investigating the rate of a reaction involving gas evolution

- Measure the volume of a gas (if the gas is a product) using a gas syringe or an upside down measuring cylinder or burette
- Record the total volume of gas collected at regular intervals and plot a graph
- Use the rate of reaction equation above
 - In the example of production of a gas, you would do: volume of gas / time taken to find the rate at the specific time

*(Extended only) Describe and explain the effects of temperature and concentration in terms of collisions between reacting particles (An increase in temperature causes an increase in collision rate **and** more of the colliding molecules have sufficient energy, activation energy, to react whereas an increase in concentration only causes an increase in collision rate)*

- Increasing temperature: causes an increase in collision rate **and** more of the colliding molecules have sufficient energy, activation energy, to react, so rate of reaction increases
- Increasing concentration: causes an increase in collision rate, increasing frequency of successful collisions and so rate of reaction increases

Interpret data obtained from experiments concerned with rate of reaction (use the term rate over speed)

- use information above, look out for the key changes that lead to increased reaction rate: temperature, concentration, pressure, surface area (particle size) and use of a catalyst





(Extended only) Describe and explain the role of light in photochemical reactions and the effect of light on the rate of these reactions

- Photochemical reactions = reactions that are initiated by light
- The brighter the light/the greater the light intensity, the faster the rate of reaction

(Extended only) Describe the use of silver salts in photography as a process of reduction of silver ions to silver; and photosynthesis as the reaction between carbon dioxide and water in the presence of chlorophyll and sunlight (energy) to produce glucose and oxygen

- Use of silver salts in photography:
 - o Silver halide salts are used in black and white photography
 - o AgCl is sensitive to light & breaks down to form metallic silver $\text{Ag}^+ \rightarrow \text{Ag}$
 - Appears black
 - o Brighter the light on the film, the faster the reaction & the darker that part of the photograph appears i.e. improves efficiency & accuracy of photos
- Photosynthesis:
 - o Chemical change that occurs in the leaves of **green plants**
 - o Chlorophyll, a green pigment in the plants, absorbs light energy
 - CO_2 reacts with H_2O to produce $\text{C}_6\text{H}_{12}\text{O}_6$ (glucose) and O_2

