Edexcel GCSE Chemistry

Topic 7: Rates of reaction and energy changes

Rates of reaction

Notes

7.1 Core Practical: Investigate the effects of changing the conditions of a reaction on the rates of chemical reactions by: measuring the production of a gas (in the reaction between hydrochloric acid and marble chips) and observing a colour change (in the reaction between sodium thiosulfate and hydrochloric acid)

- in these experiments, you are investigating the effect on rate of changing the size of the marble chips (smaller chips=larger surface area= faster rate) and also the effect of changing the concentration of hydrochloric acid (greater concentration= greater number of particles in a given volume= faster rate)

7.2 Suggest practical methods for determining the rate of a given reaction

- Rates of reactions can be measured using the amount of product used, or amount of product formed over time:

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

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

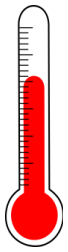
  - Quantity of reactant or product can be measured by the mass in grams or by a volume in cm^3
  - Units of rate of reaction may be given as g/s or cm^3/s
  - to measure reactant used: if the product is a gas, which will be given off, you can carry out the reaction on a set of weighing scales and measure how much mass is lost
  - to measure product formed: if the product is a gas, you can measure the volume of gas produced in a gas syringe

7.3 Explain how reactions occur when particles collide and that rates of reaction are increased when the frequency and/or energy of collisions is increased

- Chemical reactions only occur when the reacting particles collide with enough energy, the minimum amount of energy required is called the activation energy.
- in order to increase the rate of a reaction, you need to increase the frequency/energy of collisions, so that more of them reach the activation energy
- this can be done by: increasing temperature, pressure, concentration, surface area or by using a catalyst

7.4 Explain the effects on rates of reaction of changes in temperature, concentration, surface area to volume ratio of a solid and pressure (on reactions involving gases) in terms of frequency and/or energy of collisions between particles

- Increasing the temperature increases the rate of reaction. As increasing temperature increases the kinetic energy of particles, so they collide more frequently and energetically.
- Increasing pressure in reacting gases increases the rate of reaction, as it increases the number of particles in a given volume so increases the frequency of collisions.
- Increasing concentration of reacting solutions increases the rate of reaction, as it increases the number of particles in a given volume and so increases the frequency of collisions.
- Increasing the surface area of solid reactants increases the rate of reaction, as it increases the frequency of collisions so increases the rate of reaction



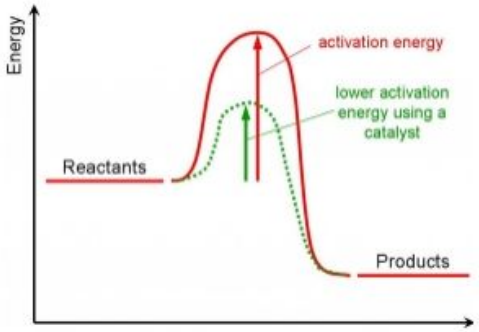
7.5 Interpret graphs of mass, volume or concentration of reactant or product against time

- To find the rate of reaction graphically
    - Draw tangents to curves and use the slope of the tangent as a measure of the rate of reaction
- Gradient = rate of reaction, therefore use this information to interpret any given graph, therefore a steeper line means a greater increase/decrease in rate
- remember to check if the graph is showing you a product or a reactant- for a product you would be expecting the mass/volume/concentration to increase, whereas for a reactant you would be expecting the mass/volume/concentration to decrease

7.6 Describe a catalyst as a substance that speeds up the rate of a reaction without altering the products of the reaction, being itself unchanged chemically and in mass at the end of the reaction

- Catalysts are substances that speed up chemical reactions without being changed or used up during the reaction. They are the same and have the same mass at the end of the reaction.

7.7 Explain how the addition of a catalyst increases the rate of a reaction in terms of activation energy



- Catalysts decrease the activation energy; this increases the proportion of particles with energy to react, leading to more frequent successful collisions and so an increased rate of reaction
- Catalysts lower the activation energy by providing a different pathway for a chemical reaction that has a lower activation energy.

7.8 Recall that enzymes are biological catalysts and that enzymes are used in the production of alcoholic drinks

- Enzymes act as catalysts in biological systems
- Yeast is the enzyme used in the production of ethanol as it is fermented from sugars, ethanol is in alcoholic drinks