

Chemical changes

Explain what will happen when an aqueous solution of sodium chloride is electrolysed.

Electrolysis of aqueous solutions

Chemical changes

What happens at the cathode (negative electrode) during electrolysis?

Reactions at electrodes as half equations (HT).

Chemical changes

What type of reaction occurs at the cathode (negative electrode)?

Reactions at electrodes as half equations (HT).

Chemical changes

What happens at the anode (positive electrode) during electrolysis?

Reactions at electrodes as half equations (HT).

Chemical changes

What type of reaction occurs at the anode (positive electrode)?

Reactions at electrodes as half equations (HT).

Chemical changes

Write out the half equations for the electrolysis of copper sulfate solution.

Reactions at electrodes as half equations (HT).

Chemical changes

Write out the half equations for the electrolysis of sodium chloride solution.

Reactions at electrodes as half equations (HT).

Energy changes

What happens to energy in chemical reactions?

Exothermic and endothermic reactions

Energy changes

Compare the energy in the reactants and the products if energy is transferred to the surroundings during the reaction.

Exothermic and endothermic reactions

Energy changes

Compare the energy in the reactants and the products if energy is transferred from the surroundings during the reaction.

Exothermic and endothermic reactions

Positive metal ions or hydrogen gain electrons.

Sodium is more reactive than hydrogen so copper is formed at the negative electrode (cathode). As there are halide ions present in solution (the chloride ions) chlorine gas will be given off at the positive electrode (anode).

Negative non-metal ions lose electrons

Reduction.

At the negative electrode (cathode): $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$. At the positive electrode (anode): $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$.

Oxidation.

Energy is concerned in chemical reactions.

At the negative electrode (cathode): $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$. At the positive electrode (anode): $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$.

The reactant molecules have less energy than the reactant molecules.

The product molecules have less energy than the reactant molecules.

Energy changes

What reaction occurs when bonds are made?

The energy changes of reactions (HT)

Energy changes

How do you calculate the overall energy change for a reaction?

The energy changes of reactions (HT)

Energy changes

What is the overall energy change for an exothermic reaction?

The energy changes of reactions (HT)

Energy changes

What is the overall energy change for an endothermic reaction?

The energy changes of reactions (HT)

The rate and extent of chemical change

How do you measure the rate of a chemical reaction?

Calculating rates of reaction

The rate and extent of chemical change

What is the formula to calculate measure the mean rate of reaction from the reactants?

Calculating rates of reaction

The rate and extent of chemical change

What is the formula to calculate the mean rate of reaction from the products?

Calculating rates of reaction

The rate and extent of chemical change

What three quantities can be used to measure the the quantity of the product or reactant?

Calculating rates of reaction

The rate and extent of chemical change

What are the units for rate of reaction?

Calculating rates of reaction

The rate and extent of chemical change

What is a tangent?

Calculating rates of reaction

Calculate the difference between the sum of the energy needed to break the bonds of the reactants and the sum of the energy released when bonds of the products are formed.

Exothermic

The energy needed to break existing bonds is greater than the energy needed to break existing bonds (e.g. the products have more energy than the reactants).

The energy released from forming new bonds is greater than the energy needed to break existing bonds (e.g. the products have less energy than the reactants).

Mean rate of reaction = quantity of reactant used / time taken.

By measuring the the quantity of the reactant as it is used or the quantity of the product as it is formed.

Mass in grams, volume in cm^3 or moles.

Mean rate of reaction = quantity of product formed / time taken.

A straight line that touches the curve but does not cross it.

g/s , cm^3/s or mol/s

The rate and extent of chemical change

What is the slope of a tangent used to calculate?

Calculating rates of reaction

The rate and extent of chemical change

Name five factors which affect the rate of chemical reaction?

Factors which affect the rate of chemical reaction

The rate and extent of chemical change

Describe the effect of changing these factors on the rate of chemical reaction.

Factors which affect the rate of chemical reaction

The rate and extent of chemical change

What is turbidity?

Factors which affect the rate of chemical reaction

The rate and extent of chemical change

Describe an experiment involving colour change or turbidity to measure the effect of concentration on the rate of reaction.

Factors which affect the rate of chemical reaction

The rate and extent of chemical change

Describe an experiment involving the collection of gas to measure the effect of concentration on the rate of reaction.

Factors which affect the rate of chemical reaction

The rate and extent of chemical change

Explain collision theory.

Collision theory and activation energy

The rate and extent of chemical change

What is activation energy.

Collision theory and activation energy

The rate and extent of chemical change

Describe the effect of increasing the concentration of the reactants on the rate of reaction using collision theory.

Collision theory and activation energy

The rate and extent of chemical change

Describe the effect of increasing the pressure of the reactants on the rate of reaction using collision theory.

Collision theory and activation energy

Concentration of reactants, pressure of reacting gases, surface area of reactants, temperature of the reaction and the presence of catalysts.

The rate of reaction at a particular point.

A measure of how cloudy a solution is.

Increasing concentration of reactants increases the number of colliding molecules. Increasing pressure of reacting gases increases the number of collisions between molecules. Large surface area of reactants increases number of colliding molecules. Increasing temperature of the reaction increases number of collisions. The presence of catalysts lowers the activation energy.

Add a set volume and concentration of hydrochloric acid to a conical flask. Add a set mass of magnesium to the flask. Place a bung with a tube attached to a gas syringe on top of the flask. Start the timer. Note the volume of gas produced every 20 seconds until the reaction stops. Repeat the experiment using different concentrations of hydrochloric acid.

Add a set volume and concentration of sodium thiosulfate to a conical flask. Place the flask on a black cross drawn on paper. Add a known volume of hydrochloric acid to the conical flask. Start the stopwatch. Time how long it takes for the cross to disappear (due to turbidity of the reacting solution). Repeat the reaction for different concentrations of hydrochloric acid.

The minimum energy particles must have to react.

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

Increasing the pressure means there are more particles near each other so they are more likely to collide. This increases the rate of reaction.

Increasing the concentration means there are more particles and as a result there are more collisions. This will increase the rate of reaction.

Energy changes

What is an exothermic reaction?

Exothermic and endothermic reactions

Energy changes

Give three examples of exothermic reactions.

Exothermic and endothermic reactions

Energy changes

What is an endothermic reaction?

Exothermic and endothermic reactions

Energy changes

Give three examples of endothermic reactions.

Exothermic and endothermic reactions

Energy changes

Describe how chemical reactions can occur between particles.

Reaction profiles

Energy changes

What is activation energy?

Reaction profiles

Energy changes

What is a reaction profile?

Reaction profiles

Energy changes

Describe a chemical reaction in terms of energy and bonds.

The energy changes of reactions (HT)

Energy changes

What is the bond energy of a molecule?

The energy changes of reactions (HT)

Energy changes

What reaction occurs when bonds are broken?

The energy changes of reactions (HT)

Combustion, oxidation reactions and neutralisation reactions.

A reaction that transfers energy to the surroundings, increasing the temperature of the surroundings.

Thermal decomposition, the reaction between citric acid and sodium hydrogencarbonate and some sports injury packs.

A reaction that transfers energy from the surroundings, decreasing the temperature of the surroundings.

The minimum amount of energy the particles must have for a reaction to take place.

A chemical reaction occurs when particles collide with each with sufficient energy.

Energy needs to be supplied to break bonds in the reactants. Energy is released when bonds in the products are formed.

A graph to show the change in energy between reactants and products over the course of a reaction.

Endothermic

The energy needed to break or form bonds between atoms.

The rate and extent of chemical change

Describe the effect of increasing the surface area of the reactants on the rate of reaction using collision theory.

Collision theory and activation energy

The rate and extent of chemical change

Describe the effect of increasing the temperature of the reactants on the rate of reaction using collision theory.

Collision theory and activation energy

The rate and extent of chemical change

What is a catalyst?

Catalysts

The rate and extent of chemical change

How do catalysts work?

Catalysts

The rate and extent of chemical change

What are enzymes?

Catalysts

The rate and extent of chemical change

What is a reaction profile?

Catalysts

The rate and extent of chemical change

What is a reversible reaction?

Reversible reactions

The rate and extent of chemical change

Represent a reversible reaction with the reactants A and B and the products C and D.

Reversible reactions

The rate and extent of chemical change

How can the direction of a reversible reaction be changed?

Reversible reactions

The rate and extent of chemical change

How can the direction of the decomposition of ammonium chloride into ammonia and hydrogen chloride be changed? Ammonium chloride \rightleftharpoons ammonia + hydrogen chloride.

Reversible reactions

Increasing the temperature increases the speed of the particles. As they are moving faster they will collide more frequently and with more energy.

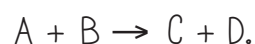
Increasing the surface area (by breaking into smaller pieces) increases the number of particles available to collide. This increases the rate of reaction.

Catalysts work by providing a pathway for the reaction which has a lower activation energy.

A substance that changes the rate of a chemical reaction but is not used up in the process.

A reaction profile is a graph which shows the levels of energy required over the course of a reaction.

Enzymes are biological catalysts found in living organisms.



A reaction where the products of the reaction can react to produce the original reactants.

If heated the reaction will move to the right (produce ammonia and hydrogen chloride).
If cooled the reaction will move to the left (produce ammonium chloride).

By changing the conditions of the reaction.

The rate and extent of chemical change

If a reaction is exothermic in one direction
what will it be in the opposite direction?

Energy changes and reversible reactions

The rate and extent of chemical change

What does hydrated mean?

Energy changes and reversible reactions

The rate and extent of chemical change

What does anhydrous mean?

Energy changes and reversible reactions

The rate and extent of chemical change

What are energy changes associated with the
reversible reaction of hydrated copper sulfate
changing into anhydrous copper sulfate and
water. Hydrated copper sulfate \rightleftharpoons anhydrous
copper sulfate + water.

Energy changes and reversible reactions

The rate and extent of chemical change

What is equilibrium?

Equilibrium

The rate and extent of chemical change

What is a closed system?

Equilibrium

The rate and extent of chemical change

What do the relative amounts of reactants
and products at equilibrium depend upon?

The effect of changing conditions on equilibrium (HT)

The rate and extent of chemical change

Describe what happens to a system at
equilibrium when a change is made to one
of the conditions.

The effect of changing conditions on equilibrium (HT)

The rate and extent of chemical change

What is Le Chatelier's principle?

The effect of changing conditions on equilibrium (HT)

The rate and extent of chemical change

Where will the position of equilibrium be
when ammonium chloride is heated?

The effect of changing conditions on equilibrium (HT)

The compound is associated with water molecules.

Endothermic.

The reaction is endothermic to the right (formation of anhydrous copper sulfate) and exothermic to the left (formation of hydrated copper sulfate).

The compound has no water molecules associated with it.

Apparatus which prevents the escape of the products or reactants of a reaction.

Equilibrium occurs when the forward and reverse reactions occur at exactly the same rate (no apparent change).

The system will respond to counteract the change.

They depend on the conditions of the reaction.

To the right (ammonia and hydrogen chloride formed).

If the conditions of a reaction in equilibrium are changed the system will respond to counteract the change. This results in a new point of equilibrium.

The rate and extent of chemical change

Where will the position of equilibrium be when ammonia and hydrogen chloride are cooled?

The effect of changing conditions on equilibrium (HT)

The rate and extent of chemical change

Where will the position of equilibrium be when hydrated copper sulfate is heated?

The effect of changing conditions on equilibrium (HT)

The rate and extent of chemical change

Describe what happens if the concentration of a reactant or product in a reversible reaction is changed.

The effect of changing concentration equilibrium (HT)

The rate and extent of chemical change

Describe the effect of increasing the concentration of a reactant in a reversible reaction.

The effect of changing concentration equilibrium (HT)

The rate and extent of chemical change

Describe the effect of decreasing the concentration of a product in a reversible reaction.

The effect of changing concentration equilibrium (HT)

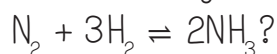
The rate and extent of chemical change

What happens if more nitrogen is added in the following reaction: $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$?

The effect of changing concentration equilibrium (HT)

The rate and extent of chemical change

What happens if more hydrogen is added in the following reaction:



The effect of changing concentration equilibrium (HT)

The rate and extent of chemical change

What happens if the concentration of ammonia is decreased in the following reaction: $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$

The effect of changing concentration equilibrium (HT)

The rate and extent of chemical change

Describe the effect of increasing the temperature of a system at equilibrium on the relative amount of products for an exothermic reaction.

The effect of temperature changes on equilibrium (HT)

The rate and extent of chemical change

Describe the effect of increasing the temperature of a system at equilibrium on the relative amount of products for an endothermic reaction.

The effect of temperature changes on equilibrium (HT)

To the right (anhydrous copper sulfate and water formed).

To the left (ammonium chloride formed).

More products will be formed until equilibrium is reached.

The system will no longer be in equilibrium. The concentrations of the substance will change until equilibrium is reached again.

More is NH_3 produced.

More reactants will react until equilibrium is reached.

More $\text{N}_2 + 3\text{H}_2$ will react

More is NH_3 produced.

The relative amount of products at equilibrium increase.

The relative amount of products at equilibrium decrease.

The rate and extent of chemical change

Describe the effect of decreasing the temperature of a system at equilibrium on the relative amount of products for an exothermic reaction.

The effect of temperature changes on equilibrium (HT)

The rate and extent of chemical change

Describe the effect of decreasing the temperature of a system at equilibrium on the relative amount of products for an endothermic reaction.

The effect of temperature changes on equilibrium (HT)

The rate and extent of chemical change

The following reaction is exothermic in the forward direction and endothermic in the opposite direction: $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$. Describe what happens if the temperature is decreased.

The effect of temperature changes on equilibrium (HT)

The rate and extent of chemical change

The following reaction is exothermic in the forward direction and endothermic in the opposite direction: $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$. Describe what happens if the temperature is increased.

The effect of temperature changes on equilibrium (HT)

The rate and extent of chemical change

Describe the effect of decreasing the pressure of a gaseous reaction at equilibrium.

The effect of pressure changes on equilibrium (HT)

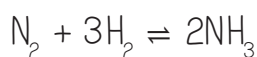
The rate and extent of chemical change

Describe the effect of increasing the pressure of a gaseous reaction at equilibrium.

The effect of pressure changes on equilibrium (HT)

The rate and extent of chemical change

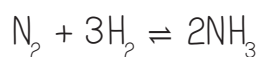
Describe what will happen to the equilibrium position if the pressure is increased for the following reaction:



The effect of pressure changes on equilibrium (HT)

The rate and extent of chemical change

Describe what will happen to the equilibrium position if the pressure is decreased for the following reaction:



The effect of pressure changes on equilibrium (HT)

Organic chemistry

What is crude oil formed from?

Organic chemistry

What is the composition of crude oil?

Crude oil, hydrocarbons and alkanes.

The relative amount of products at equilibrium decrease.

The relative amount of products at equilibrium increase.

The relative amounts of NH_3 will decrease at equilibrium.

The relative amounts of NH_3 will increase at equilibrium.

An increase in pressure will cause the reaction to shift to the side with the smaller number of molecules (from the balanced symbol equation).

A decrease in pressure will cause the reaction to shift to the side with the larger number of molecules (from the balanced symbol equation).

. There are more molecules on the right (4 moles compared to 2 moles) so the reaction will shift to the left (more $\text{N}_2 + \text{H}_2$).

There are less molecules on the left (2 moles compared to 4 moles) so the reaction will shift to the right (more NH_3).

Crude oil is a mixture of a very large number of compounds, mainly hydrocarbons.

Crude oil is the remains of biomass consisting mainly of plankton buried in mud.