Edexcel IGCSE Flashcards

Section 3: Physical Chemistry

What is the conservation of energy principle?

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Energy is conserved in chemical reactions. The amount of energy in the universe at the end of a chemical reaction is the same as before the reaction takes place.

What is an exothermic reaction? Give examples

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A reaction where energy is transferred to the surroundings so that the surroundings temperature increases – combustion, oxidation reactions and neutralisation (acid + alkali) reactions. Negative sign of energy change.

What is an endothermic reaction? Give examples

What is an endothermic reaction? Give examples

A reaction where energy is taken in from the surroundings so the surroundings temperature decreases – thermal decomposition, reaction of citric acid and sodium hydrogencarbonate. Positive sign of energy change.

What is activation energy?

What is activation energy?

Minimum amount of energy that particles need to react.

What is a reaction profile?

What is a reaction profile?

Reaction profile is a graph which shows the relative energies of reactants and products, as well as the activation energy of the reaction.

What occurs in a chemical reaction in terms of bond energies? Describe exothermic and endothermic reactions in terms of bond breaking/forming.

What occurs in a chemical reaction in terms of bond energies? Describe exothermic and endothermic reactions in terms of bond breaking/forming.

Energy is supplied to break bonds and energy is released when bonds are made; exothermic – energy released from forming bonds is greater than that needed to break the bonds; endothermic – energy needed to break bonds is greater than energy released making them.

What is the equation to find enthalpy change in terms of bond energies?

What is the equation to find enthalpy change in terms of bond energies?

Energy of reaction = sum of bond energies of bonds broken – sum of bond energies of bonds made

How could you find the enthalpy change for a reaction involving aqueous solutions?

How could you find the enthalpy change for a reaction involving aqueous solutions?

a) Mix known quantities of the reagents (concentrations, volumes) in a polystyrene cup (a decent insulator, so as to minimise heat losses to surroundings).
b) Measure the temperature change with a thermometer (ΔT)
c) Assume the solution to have a density of H_2O. Find the mass of the solution (m).
d) Knowing 4.2 J are required to increase the temperature of 1 g of H_2O by 1 degree, calculate the heat change (c, specific heat capacity of water).
e) Enthalpy change (ΔH) = $cm\Delta T$. Convert to kJ/mol by including the stoichiometry of your reagents
f) Include the sign of the enthalpy change, e.g. if the temperature decreased, the sign is +ve (endothermic process).

How is rate of reaction calculated?

How is rate of reaction calculated?

Rate of reaction = amount (e.g. grams, cm^3) of reactant used or product formed / time

Rate of reaction (mol/s) = Moles of reactant used or product formed / time

What are the various units for rate of reaction?

What are the various units for rate of reaction?

E.g. g/s or cm^3/s or mol/s

Generally, mass/time, volume/time, moles/time

Name three common ways of measuring rate of reaction

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Loss in mass of reactants, volume of gas produced, time for a solution to become opaque (precipitation).

Describe measuring the rate by monitoring mass loss

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Place the reaction flask on a balance. In these reactions (e.g. metal carbonate + acid) a gas is given off, so record the decrease in mass in time intervals (note hydrogen is too light). Plot a graph of mass vs time.

Describe measuring the rate by monitoring the volume of a gas

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Connect a gas syringe to a reaction flask and measure the volume of a gas formed in time intervals. Plot a graph of volume vs time.

Describe measuring the rate by monitoring the disappearance of a cross.

Describe measuring the rate by monitoring the disappearance of a cross

Take a piece of paper and mark a cross (X) on it. Put the reaction flask on this cross. Mix the reagents, and measure how long it takes for a cloudy mixture to conceal a cross.

How to find a rate of reaction at some time, t, from a graph of amount of reactant vs time?

How to find a rate of reaction at some time, t, from a graph of amount of reactant vs time?

Pick a point corresponding to the time t, and find the tangent to the curve at this point.

The tangent is the gradient of this graph - it tells you how fast the reaction proceeds at this point. The steeper the tangent line, the faster the rate. Gradient of tangent can be expressed in change in *y* values / change in *x* values.

State five factors affecting the rate of a chemical reaction

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Concentration of reactants
Pressure of gases (volume)
Surface area
Temperature
Catalysts

What is the collision theory?

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Chemical reactions can occur only when reacting particles collide with each other with sufficient energy (more than or equal to activation energy).

Describe and explain the effect of increasing temperature on the rate of reaction

Describe and explain the effect of increasing temperature on the rate of reaction

- T increases = faster reaction
- As T increases, kinetic energy of particles increases, i.e. more energetic collisions
- Also, they move faster, so they collide more frequently
- However, there is no straight line relationship between rate and temperature, i.e. they are not directly proportional to each other

Describe and explain the effect of increasing concentration on the rate of reaction

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- Conc. increases = faster reaction,
- More reactants = more frequent collisions

Describe and explain the effect of increasing pressure of a gas on the rate of reaction

Describe and explain the effect of increasing pressure of a gas on the rate of reaction

- Increasing the pressure of reacting gases, is the same as increasing concentration.
- It increases the number of gas molecules in the same volume and so increases the frequency of collisions and therefore increases the rate of reaction.

Note that volume and pressure are inversely proportional to each other. Increasing the volume slows down the reaction.

Describe and explain the effect of increasing surface area

Describe and explain the effect of increasing surface area

- If solid reactants are in smaller pieces, they have a greater surface area.
- Increasing the surface area of solid reactants increases the frequency of collisions and so increases the rate of reaction, e.g. block of magnesium reacts slower with acid then magnesium powder.

What is a catalyst and how does it work? How does it affect the reaction profile?

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A catalyst changes the rate of reaction but is not used up. It increases rate of reaction by providing a different pathway for the reaction that has a lower activation energy. The reaction profile for a catalysed reaction will have a lower maximum of the curve (lower activation energy).

What is an enzyme?

What is an enzyme?

An enzyme is a molecule that acts as a catalyst in a biological system.

What is a reversible reaction?

What is a reversible reaction?

A reversible reaction occurs when the products of a reaction can react backwards to produce the original reactants.

When is dynamic equilibrium reached?

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In a closed system, when the forward and reverse reactions occur at the same rate and the concentrations of reactants and products remain constant.

Describe Le Chatelier's Principle

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If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract change and restore the equilibrium.

Describe the effect of changing the concentration of reactant and product on the position of the equilibrium

Describe the effect of changing the concentration of reactant and product on the position of the equilibrium

- If the concentration of one of the reactants or products is changed, the system is no longer at equilibrium and the concentrations of all the substances will change until equilibrium is reached again.
- If the concentration of a reactant is increased, more products will be formed until equilibrium is reached again.
- If the concentration of a product is decreased, more reactants will react until equilibrium is reached again.

Describe the effect of changing temperature on the position of the equilibrium

Describe the effect of changing temperature on the position of the equilibrium

- If the temperature of a system at equilibrium is increased:
  - The relative amount of products at equilibrium increases for an endothermic reaction.
  - The relative amount of products at equilibrium decreases for an exothermic reaction.

- If the temperature of a system at equilibrium is decreased:
  - The relative amount of products at equilibrium increases for an exothermic reaction.
  - The relative amount of products at equilibrium decreases for an endothermic reaction.

Describe the effect of changing pressure on the position of the equilibrium

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This applies to equilibria that involve gases

- An increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules as shown by the symbol equation for that reaction.
- A decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules as shown by the symbol equation for that reaction. Pressure has no effect on the reactions where the numbers of gas molecules are equal on both sides of the equation.

Describe the effect of a catalyst on the position of the equilibrium

Describe the effect of a catalyst on the position of the equilibrium

- No effect.
- It just speeds up both forward and backward reactions equally.
- i.e. equilibrium is achieved faster.