A diagram of energy and energy

Description automatically generatedA diagram of energy absorption

Description automatically generatedBackground pattern

Description automatically generated

**Ambitious Vocabulary**

Endothermic, exothermic, combustion, respiration, bond energies

Activation energy

catalysts

Reaction profiles

Endothermic

Exothermic

**Activation energy**

The minimum amount of energy required for a chemical reaction to take place.

**Catalyst**

Increase the rate of a reaction. Catalysts provide an alternative pathway for a chemical reaction to take place by lowering the activation energy.

**Required practical**

To investigate the variables that affect temperature changes in reacting solutions. ‘

**Apparatus**

Polystyrene cup - insulate reaction

Measuring cylinder – measure the volume of liquid

Thermometer to measure temperature change

Top pan balance – to measure mass.

Method

* Place polystyrene cup inside the beaker. This will prevent the cup from falling over.
* Using a measuring cylinder, measure out 30cm3 of the acid. Different acids such as hydrochloric acid. Pour this into the polystyrene cup.
* Record the temperature of the acid using a thermometer.
* Using a top pan balance measure out 2g of the solid or use a strip of a metal such as magnesium.
* Add the solid to the acid and record the temperature. You may choose to record the temperature of the acid and metal every minute for 10 minutes.

**Bond Making and bond breaking**

In an endothermic reaction, energy is needed to break chemical bonds. The energy change in an endothermic reaction is positive.

In an exothermic reaction, energy is needed to form chemical bonds. The energy change in an exothermic reaction is negative.

**Calculations using bond Energies**

Bond energies are used to calculate the change in energy of a chemical reaction.

Calculate the change in energy for the reaction: 2H2O2 🡪 2H2O + O2

The first step is to write the symbol equation for the reaction. Once you have done this, work out the bonds that are breaking and the ones that are being made.

2H-O-O-H 🡪 2 H-O-H + O=O

|  |  |
| --- | --- |
| Bond | Bond energy kJ/mol |
| H-O | 464 |
| O-O | 146 |
| O=O | 498 |

On the **reactant side** the **bonds are breaking**. There are two **O-H** bonds and one **O-O** bond.

So 464 + 146 + 464 = 1074

There are two moles of H2O2 therefore the answer needs to be multiplied by two.

**So 1074 x 2 = 2148**

On the **product side** of the equation the bonds are made.

There are two **H-O** bonds

**So 464 + 464 = 928**

Two moles of H2O are made therefore the answer needs to be multiplied by two.

**So 928 x 2 = 1856**

There is also one **O=O** bond with a bond energy of 498

**So 1856 + 498 = 2354**

**Energy change = sum (bonds broken) – (bonds made)**

**Energy change = 2148-2354 = -206 KJ/mol**

The reaction is exothermic as heat energy leaves the reaction.

**Exothermic and Endothermic Reactions**

When a chemical reaction takes place, energy is involved. Energy is transferred when chemical bonds are broken and when new bonds are made.

Exothermic reactions are those which involve the transfer of energy from the reacting chemicals to the surroundings. During a practical investigation an exothermic reaction would show an increase in temperature as the reaction takes place.

Exothermic reactions include combustion respiration and neutralisation reactions.

Endothermic reactions are those which involve the transfer of energy from the surroundings to the reacting chemicals. During a practical investigation, an endothermic reaction would show a decrease in temperature as the reaction takes place.

Endothermic reactions include thermal decomposition and photosynthesis.

**C5 Energy Changes**

**Science**