

Energetics

Define *Exothermic Reaction* and *Endothermic Reaction*.
Are bond making and bond breaking endothermic or exothermic?

Draw and label energy level diagrams to represent exothermic and endothermic reactions.

What is the *Bond Energy*?

State the equation for calculating the *Energy Change of Reaction*.

Definitions:

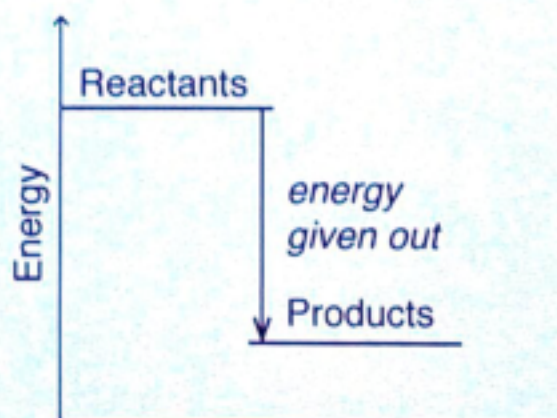
Exothermic Reactions give out energy (so there is a temperature increase)

Bond making is exothermic

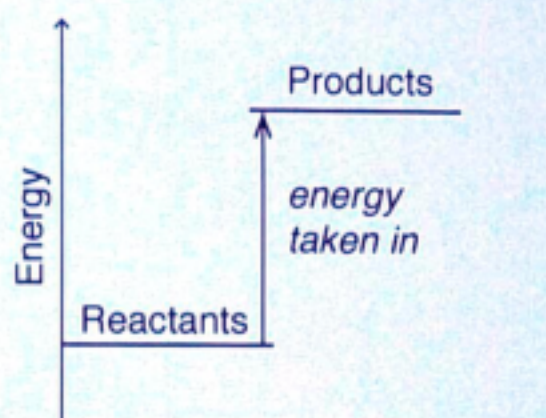
Endothermic Reactions take in energy from their surroundings (so there is a temperature decrease)

Bond breaking is endothermic

Energy Level Diagrams:



Exothermic



Endothermic

Bond Energy:

The energy required to **break** a particular bond

The same amount of energy is given out when that bond is formed

Energy Change of Reaction:

$$\text{Energy Change of Reaction} = \text{Total energy of bonds broken} - \text{Total energy of bonds formed}$$

A reaction is **exothermic** if the energy given out when making new bonds is more than the energy required to break the original bonds.

A reaction is **endothermic** if more energy is required to break the bonds than is given out when new bonds are made.

Releasing Energy

Give 4 ways in which energy can be released.
State the type of energy released in each case.

Photochemical Reactions

What are *Photochemical Reactions*?
How can the rate of reaction be increased?

Give 2 examples of photochemical reactions.
Write equations.

Releasing Energy:

Burning Fuels (Combustion): Heat energy is released
e.g. burning coal, oil, natural gas, ethanol or hydrogen

Nuclear Fuel: Radioisotopes decay to release heat energy (they are not burned)
e.g. uranium-135

Fuel Cells: Hydrogen reacts with oxygen (without burning) to produce electrical energy

Electrochemical Cells: Two different electrodes (usually metal) in an electrolyte produce electrical energy
e.g. batteries

Photochemical Reactions:

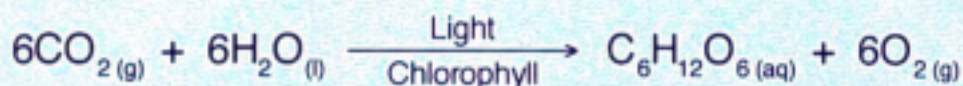
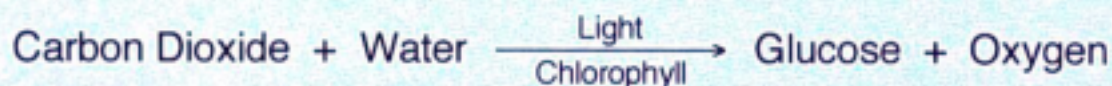
Reactions which obtain the energy they need from light

The rate of reaction increases as the light intensity increases

Examples of Photochemical Reactions:

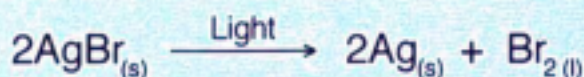
Photosynthesis:

Plants convert carbon dioxide and water into glucose (chlorophyll acts as the catalyst and light provides the required energy):

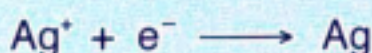


Film Photography:

Silver ions in silver salts (e.g. silver bromide) are reduced to neutral silver atoms by light:



The half-equation for the reduction of silver ions is:



Rates of Reaction

Define *Rate of Reaction*.

State 4 factors which affect the rate of a reaction.

What are *Catalysts*?

What is *Collision Theory*?

How does collision theory explain the factors which affect the rate of reaction.

Rate of Reaction:

Rate of reaction = amount of reactant used up per unit time

Changing the Rate:

The rate of reaction increases if you:

- increase the **concentration** of a reactant
 - increase the **temperature**
 - increase the **surface area** (i.e. use smaller pieces of a solid)
 - use a **catalyst**
-

Catalysts:

Substances which speed up chemical reactions, and remain chemically unchanged (are not used up)

*Biological catalysts are called **enzymes***

Collision Theory:

Collision theory states that for two particles to react successfully they must collide with sufficient energy to break the necessary bonds (i.e. the Activation Energy)

Increasing Concentration:

There are more particles in a given volume, so collisions occur more frequently. Therefore there is more chance of a successful collision, so the rate increases.

Increasing Temperature:

The particles have more kinetic energy so they move faster, so collisions occur more frequently. The extra energy also means more of the collisions are successful, so the rate increases.

Increasing Surface Area:

More particles of the solid are exposed, so collisions occur more frequently. Therefore there is more chance of a successful collision, so the rate increases.

Catalysts:

Cause a reaction to take an alternative pathway requiring less energy. Therefore more of the collisions now have enough energy to be successful, so the rate increases.