Energy changes and reversible reactions:

Energy changes:

- During a chemical reaction, there is always an energy change.
- Energy is either taken in or given out.
- Energy is given out in the form of heat, but it can also be given out as light or sound
- In all chemical reactions bonds are either made or broken
- When bonds are broken, energy is taken in,
- When bonds are made, energy is given out
- Bond energy (SI unit- kJ/mol) is the energy required to make or break bonds

Exothermic reactions

1. Give out energy, so there is a temperature rise
2. Reactants ==> product + energy
3. Energy of products is less than reactants
4. Energy change is –ive
5. E.g. 1) neutralization of acid by alkalis

   2) combustion of fuels

   3) respiration in our body cells
6. If the energy taken in to break the bonds is lesser than the energy given out to make the bonds then the reaction is exothermic.
7. Some exothermic reactions start off at room temp, without much energy, others require energy only to start off the reaction. The reaction will then go on by the energy that is released by bond formation.

Endothermic reactions

1. Endothermic reactions take in energy from their surroundings
2. Reactants + energy ==> products
3. Energy of products is more than reactants
4. Energy change is +ive
5. E.g. 1) reactions in cooking

   2) photosynthesis
6. Many endothermic reactions require energy to start the reaction and keep it going.
7. If the energy taken in to break the bonds is greater than the energy that is given out by making the bonds then the reaction in endothermic.
8. Some endothermic reactions do not need much energy. Most of end reaction require energy to be supplied throughout the reaction.

Fuel

A fuel is any substance we use to provide energy. We convert the chemical energy in them to another form of energy.

What makes a fuel good?

1. How much does the fuel cost
2. Is it easily available?
3. How much energy does the fuel give out?
4. Is it easy to store and transport?
5. Does it cause pollution

Ethanol: is an alcohol (formula C_2H_5OH). It can be made by fermentation of yeast or by plants.

Hydrogen: burns explosively in O_2 giving out a lot of energy. It can also be used in fuel cells w/o burning.

Advantages of hydrogen fuel cell

1. Produces large amount of energy
2. No waste products, only water forms
3. Easily available

However hydrogen reacts very quickly in air and is hence hard to store and transport

Nuclear fuels

1. These fuels are not burned. Radioisotopes decay giving out radiation and energy.
2. In nuclear power stations Uranium 235 (others are used too) is used. It is forced to decay by firing neutrons at it. It decays forming new elements and energy. These elements are also unstable and further decay.
3. It's better than fossil fuels as it releases more energy and does not cause pollution
4. However it produces radioactive waste

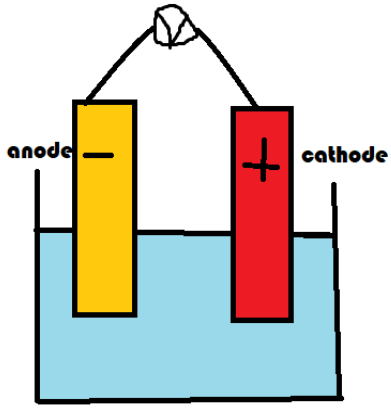
Electricity:

It is simply the flow of electrons.

Some reactions may release energy as heat however they may also release energy as electrical energy.

Simple (electrochemical cells)

- Consists of two electrodes and an electrolytic solution.
- The two electrodes must be metals that have a difference in reactivity so that electrons can flow through them.
- This type of cell does not require a battery.



- Anode: more reactive metal- stronger drive to become positively charged ions and hence it gives up electrons.
- Its electrons flow to the cathode.
- The anion present in the electrolyte gains these electrons and becomes discharged.
- Since the electrons come from the more reactive metal it is negatively charged. The less reactive metal is positively charged.

Larger voltage larger the difference in reactivity

Electrolytic cell	Electrochemical cell
Converts Electrical Energy to chemical Energy	Converts chemical energy to electrical energy
Anode (+) cathode (-)	Anode (-) Cathode(+)

<u>Reversible reactions</u>

- 2 directions: forward and Backward
- Reversible reactions use this symbol instead: ⇌
- Endothermic in one direction and exothermic in the other direction. Amount of energy released/taken in both directions is always the same.
- In a closed system, a reversible reaction will always reach a state of dynamic equilibrium.
- Equilibrium- no overall change
- Dynamic- there is continual change: molecules break down and new one's form at the same rate.
- Dynamic equilibrium- forwards and backward reactions take place at the same rate, so there is no overall change.

Le Chateliers's Principle: When a reversible reaction is in a state of dynamic equilibrium and you make a change, the system acts to oppose this change and restore the equilibrium. A new equilibrium mixture forms.

Temperature:

- Increasing the temperature - the endothermic reaction is favoured as the heat needs to be used up in order to oppose this change
- Decreasing the temperature- the exothermic reaction is favoured as heat needs to be produced in order to oppose this change
- Equilibrium is reached faster nevertheless by increasing the temperature (rate of forward and backward reaction increases)

Pressure:

- Increasing the pressure- The reaction producing fewer molecules is favored
- Decreasing the pressure is the opposite.
- Changing the pressure only works if the number of molecules in both directions are different.

Removing a product:

- Removing a product from the mixture as it is formed causes the reaction to form more of the product as equilibrium is not reached.

Catalyst:

- Speeds up reactions in both directions and hence there is no change.

Notes provided by Jeyan Mehta