***Chemistry notes:***

***Topic 5 – Energy Changes:***

A close up of a logo

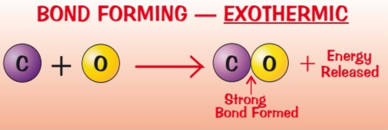
Description automatically generated**Endothermic and Exothermic reactions**

Energy is transferred in chemical reactions however energy is always conserved.

* Exothermic reactions
  + Transfers energy to the surroundings
    - Temperature of the surroundings increase
    - Energy of the products is lower than the energy of the reactants
  + Examples of these include:
    - Combustion, neutralisation reactions, oxidation reactions
  + Everyday uses include:
    - Hand warmers, self-heating cans
* A screenshot of a cell phone

  Description automatically generatedEndothermic reactions
  + Takes in energy from the surroundings
    - Temperature of the surroundings decrease
    - Energy of the products is higher than the energy of the reactants
  + Examples of these are less common but these include:
    - The reaction between citric acid and sodium hydrogencarbonate
    - Thermal decomposition
  + Everyday uses include:
    - Sports injury packs
* Activation energy
  + The minimum amount of energy the reactants need to collide with each other and react

**Bond Energies**

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  Description automatically generatedDuring a chemical reaction, old bonds are broken, and new bonds are formed
* Energy must be supplied to break existing bonds
  + Bond breaking is endothermic
* Energy is released when new bonds are formed
  + Bond formation is exothermic

**Cells and batteries**

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  Description automatically generatedElectrochemical cell – non rechargeable
  + A basic system made up of two different electrodes in contact with an electrolyte
    - The two electrodes must be able to conduct electricity and so they are usually metals
    - The electrolyte is a liquid that contains ions which react with the electrodes
    - The chemical reactions between the electrodes and the electrolyte set up a charge difference between the electrodes
    - If the electrodes are then connected by a wire, the charge is able to flow, and electricity is produced. A voltmeter can also be connected to the circuit to measure the voltage of the cell
  + Voltage depends on many factors:
    - Different metals will react differently with the same electrolyte
      * This is what causes the charge difference, or the voltage of the cell
      * The type of electrodes will affect the voltage of the cell
    - The bigger the difference in reactivity of the electrodes, the bigger the voltage of the cell
    - You can predict what the voltage of the cell might be information about the voltages of other cells
    - The electrolyte used in a cell will also affect the size of the voltage since different ions in solution will react differently with the metal electrodes used
    - A battery is formed by connecting two or more cells together in series
      * The voltages of the cells in the battery are combined so there is a bigger voltage overall
* Non-Rechargeable batteries
  + In these batteries, all the reactants get used up and the chemical reactions which occur at the electrodes are irreversible
  + Once any one of the reactants is used up, the reaction can’t happen and so no electricity is produced
  + The products can’t be turned back into the reactants, so the cell can’t be recharged
  + In a rechargeable cell, the reaction can be reversed by connecting it to an external electric current

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Description automatically generated**Fuel Cells**

* A fuel cell is an electrical cell which is supplied with a fuel and oxygen/air
  + It uses energy from the reaction between them to produce electrical energy efficiently
* When the fuel enters the cell, it becomes oxidised and sets up a potential difference within the cell
* The overall reaction in a hydrogen fuel cell involves the oxidation of hydrogen to produce water
* One important example is the hydrogen-oxygen fuel cell
* The fuel cell combines hydrogen and oxygen to produce nice clean water and release energy
* Hydrogen Fuel cell – How it works:

1. The electrolyte is often a solution of potassium hydroxide
   1. The electrodes are often porous carbon with a catalyst
2. Hydrogen goes into the anode compartment and oxygen goes into the cathode compartment
   1. A picture containing object

      Description automatically generatedCATHODE IS POSITIVE  
      ANODE IS NEGATIVE
3. At the anode, hydrogen loses electrons to produce H+ ions. This is oxidation
   1. A picture containing object

      Description automatically generatedThe H+ ions in the electrolyte move toward the cathode
4. At the cathode, oxygen gains electrons from the cathode and reacts with H+ ions to make water, this is reduction
5. A close up of a sign

   Description automatically generatedThe electrons flow through an external circuit from the anode to the cathode, this is electrical current
6. The overall reaction is hydrogen plus oxygen, which gives water

* A screenshot of a cell phone

  Description automatically generatedAdvantages and disadvantages: