# Scheme of work

## Chemistry – Energy changes

This resource provides guidance for teaching the Energy changes topic from our new GCSE Chemistry (8462). It has been updated from the draft version to reflect the changes made in the accredited specification. Changes have been made to 4.5.1.1 and minor amendments to each of the other sections.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive, it only suggests activities and resources you could find useful in your teaching.

### 4.5 Energy changes

#### 4.5.1 Exothermic and endothermic reactions

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
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| 4.5.1.1 | 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. If a reaction transfers energy to the surroundings the product molecules must have less energy than the reactants, by the amount transferred.  An exothermic reaction is one that transfers energy to the surroundings so the temperature of the surroundings increases.  Exothermic reactions include combustion, many oxidation reactions and neutralisation.  Everyday uses of exothermic reactions include self-heating cans and hand warmers.  An endothermic reaction is one that takes in energy from the surroundings so the temperature of the surroundings decreases.  Endothermic reactions include thermal decompositions and the reaction of citric acid and sodium hydrogencarbonate. Some sports injury packs are based on endothermic reactions. | Distinguish between exothermic and endothermic reactions on the basis of the temperature change of the surroundings.  Evaluate uses and applications of exothermic and endothermic reactions given appropriate information.  *Limited to measurement of temperature change. Calculation of energy changes or ΔH is not required.*  WS 2.1, 2.2, 2.3, 2.4, 2.6, 2.7  MS 1a, 2a, 2b, 4a, 4c. | 2 | Define the terms:   * exothermic * endothermic.   Write-up the practical investigations ensuring the following are included:   * hypothesis * plan including identification of the independent, dependent and control variables * data collection * analysis of results * evaluation of the results and plan. | **Required practical 4:**  Investigate the variables that affect temperature changes in reacting solutions such as, eg acid plus metals, acid plus carbonates, neutralisations, displacement of metals.  AT skills covered by this practical activity: 1, 3, 5 and 6. | Video clips:  [BBC Bitesize Endothermic and exothermic reactions](http://www.bbc.co.uk/education/clips/zy886sg)  YouTube: [Exothermic and Endothermic Reactions](https://www.youtube.com/watch?v=yvyHVA1Ww_M)  [Exampro user guide PowerPoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |
| 4.5.1.2 | Chemical reactions can occur only when reacting particles collide with each other with sufficient energy. The minimum amount of energy that particles must have to react is called the activation energy.  Reaction profiles can be used to show the relative energies of reactants and products, the activation energy and the overall energy change of a reaction. | Draw simple reaction profiles (energy level diagrams) for exothermic and endothermic reactions showing the relative energies of reactants and products, the activation energy and the overall energy change, with a curved arrow to show the energy as the reaction proceeds.  Use reaction profiles to identify reactions as exothermic or endothermic.  Explain that the activation energy is the energy needed for a reaction to occur.  WS 4.1 | 1 | Define the term activation energy.  Draw reaction profiles for exothermic and endothermic. Explain what the diagrams display. | Demo, and where appropriate practically investigate, exothermic and endothermic reactions, such as thermal decomposition of marble or copper sulfate, barium hydroxide + ammonium chloride, thermite reaction etc. |  |
| 4.5.1.3  (HT only) | During a chemical reaction:   * energy must be supplied to break bonds in the reactants * energy is released when bonds in the products are formed.   The energy needed to break bonds and the energy released when bonds are formed can be calculated from bond energies.  The difference between the sum of the energy needed to break bonds in the reactants and the sum of the energy released when bonds in the products are formed is the overall energy change of the reaction.  In an exothermic reaction, the energy released from forming new bonds is greater than the energy needed to break existing bonds.  In an endothermic reaction, the energy needed to break existing bonds is greater than the energy released from forming new bonds. | Be able to calculate the energy transferred in chemical reactions using bond energies supplied.  MS1a | 2 | Calculate the energy transferred in chemical reactions.  Extended writing:write instructions to another student how to calculate the energy transferred in a chemical reaction.  Explain why a chemical reaction is classed as being exothermic or endothermic in relation to the energy involved in breaking and making bonds. | Research common bond energies and use these in calculation for simple reactions. | Video clip  YouTube: [Introduction to bond energies](https://www.youtube.com/watch?v=5-TPVHIi39w) |

**4.5.2 Chemical cells and fuel cells**

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| --- | --- | --- | --- | --- | --- | --- |
| 4.5.2.1 | Cells contain chemicals which react to produce electricity.  The voltage produced by a cell is dependent upon a number of factors including the type of electrode and electrolyte.  A simple cell can be made by connecting two different metals in contact with an electrolyte.  Batteries consist of two or more cells connected together in series to provide a greater voltage.  In non-rechargeable cells and batteries the chemical reactions stop when one of the reactants has been used up. Alkaline batteries are non-rechargeable.  Rechargeable cells and batteries can be recharged because the chemical reactions are reversed when an external electrical current is supplied. | Be able to interpret data in terms of the relative reactivity of different metals and to evaluate the use of cells.  *Students do not need to know details of cells and batteries other than those specified.* | 1 | Describe the composition of a simple cell and a battery as stated in the unit content.  Explain how the following cells produce electricity:   * simple cell * non-rechargeable battery * rechargeable battery. | Research and evaluate uses of cells and batteries.  Construct simple cells using combinations of metal strips in contact with their salt solution via a salt bridge.  AT6 - Safe and careful use of liquids.  Compare the magnitude of the resulting potential difference with the position of the metals in the reactivity series. | Video clip  YouTube:  [How do Batteries Work?](https://www.youtube.com/watch?v=KkRwuM4S8BQ) |
| 4.5.2.2 | Fuel cells are supplied by an external source of fuel (eg hydrogen) and oxygen or air. The fuel is oxidised electrochemically within the fuel cell to produce a potential difference.  The overall reaction in a hydrogen fuel cell involves the oxidation of hydrogen to produce water.  Hydrogen fuel cells offer a potential alternative to rechargeable cells and batteries. | Be able to evaluate the use of hydrogen fuel cells in comparison with rechargeable cells and batteries.  (HT only)  Be able to write the half equations for the electrode reactions in the hydrogen fuel cell. | 1 | Compare and contrast the uses of hydrogen cells, batteries and rechargeable cells.  Construct half equations for the electrode reactions in the hydrogen cells.  Research fuel cell development and use in various space programs including Apollo, the Space Shuttle and the ISS. | Research and evaluate uses of hydrogen cells.  Construct simple fuel cells – there are several websites devoted to their construction, for example:  Mad Science – [DIY hydrogen fuel cell](http://mad-science.wonderhowto.com/how-to/diy-hydrogen-fuel-cell-create-fuel-future-home-0134598/)  Instructables – [How to Make A Simple Hydrogen Fuel Cell](http://www.instructables.com/id/How-to-Make-A-Simple-Hydrogen-Fuel-Cell/) | Video clip  YouTube:  [Hydrogen fuel cell](https://www.youtube.com/watch?v=oy8dzOB-Ykg) |