

**IGCSE Chemistry: Electrochemistry and Redox****Whole Unit Overview**

(Please note: (S) denotes material in the Supplement (Extended syllabus) only)

Learning Outcomes		Suggested Teaching Activities	Resources
7.3	Define oxidation and reduction in terms of oxygen loss/gain (see extraction and corrosion of metals). (Oxidation state limited to its use to name ions, e.g. iron(II), iron(III), copper(II), manganate(VII), dichromate(VI).)	<p>Link to the reactions of metals (Unit 1 - Periodic Table 1) and (section 6.2 in Unit 4 – Organic Chemistry 1) and halogens (section 9.2 Unit 7 – Periodic Table 2).</p> <p>Experiments possible include reaction of metals/non-metals with oxygen and the reaction of metal oxides with carbon.</p> <p>Link to ideas of the role of redox reactions in the production of energy from fuels and the extraction of metals. The reactions in car catalytic converters can also be studied here (link to Unit 2 - Air and Water).</p>	
7.3 (S)	Define redox in terms of electron transfer.	Link this to the reactivity series and reactions of metals and metal salt solutions in Periodic Table 1, Halogens in Unit 7 and electrolysis later in this Unit.	<a href="http://www.drydenaqua.com/">http://www.drydenaqua.com/</a>

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7.3 (S)	Identify redox reactions by changes in oxidation state and by the colour changes involved when using acidified potassium manganate(VII), and potassium iodide. (Recall of equations involving $\text{KMnO}_4$ is <i>not</i> required.)	Demonstrations can include the reaction of ethanol and acidified $\text{KMnO}_4$ to yield ethanoic acid (link to Unit 4 - Organic Reactions 1); preparation of chlorine by reaction of conc. $\text{HCl}$ and $\text{KMnO}_4$ solid and reaction of potassium iodide solution with either chlorine or bromine (link to Unit 7 - Periodic Table 2). Other reactions which could be demonstrated include zinc + copper(II) sulphate and iodide ions + hydrogen peroxide.	
7.1 (S)	Describe the use of silver salts in photography as a process of reduction of silver ions to silver.	A simple experiment can be done with the solid silver halide salts and sunlight.  Students can make silver chloride, bromide and iodide by precipitation (link to Unit 3 - Acids, Bases and Salts) and watch them change colour under strong light.	<a href="http://www.geocities.com/indy_troglodyte/chemistry.htm">http://www.geocities.com/indy_troglodyte/chemistry.htm</a>
5	Describe the electrode products in the electrolysis of  Molten lead(II) bromide  Concentrated hydrochloric acid  Concentrated aqueous sodium chloride.  Between inert electrodes (platinum or carbon).	These are demonstrations only and link with the production of halogens in Periodic Table 2.  The electrolysis of small quantities of aqueous sodium chloride can be safely carried out by students. Tests from Unit 3 - Acids, Bases and Salts, can be used to identify all three products.  Link this to the industrial electrolysis of brine later in this unit.  Students can practice electronic half equation writing and link this to ideas of redox from earlier in this unit.	

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5	Describe the electroplating of metals.	Students can electroplate zinc strips with copper. An initial can be painted onto the strip with clear nail varnish, to give a silver initial on a copper background.	Aid to electroplating (mainly lists of materials) <a href="http://www.finishing.com/">http://www.finishing.com/</a>
5 (S)	Relate the products of electrolysis to the electrolyte used, exemplified by the specific examples above together with aqueous copper(II) sulphate using carbon electrode and using copper electrodes (as used in the refining of copper).	Awareness of the need for very pure copper for electrical wiring (pupils can cut open samples of wire to find copper) due to the interruption of current flow by impurities.	
5	Name the uses of electroplating.	e.g. plating cutlery with silver and jewellery with gold or silver.	
5	State the general principle that metals or hydrogen are formed at the negative electrode (cathode), and that non-metals (other than hydrogen) are formed at the positive electrode (anode).	A demonstration of the electrolysis of lead bromide can be used to 'set the scheme'  Students can electrolyse a range of aqueous solutions of salts and collect and test electrode products to confirm this.	
5 (S)	Describe electrolysis in terms of the ions present and reactions at the electrodes in the examples given above.	This links with writing ionic equations (Unit 6 - Amount of Substance).	
5	Predict the products of the electrolysis of a specified binary compound in the molten state.	This should involve metal halides or metal oxides only.	
5 (S)	Predict the products of electrolysis of a specified halide in dilute or concentrated aqueous solution.	Demonstrations of the electrolysis of dilute and concentrated brine can show this.	

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10.3(a) (S)	Name the main ore of aluminium		
5	Describe, in outline, the manufacture of (i) aluminium from pure aluminium oxide in molten cryolite, (ii) chlorine and sodium hydroxide from concentrated aqueous sodium chloride. (Starting materials and essential conditions should be given but not technical details or diagrams.)	<p>Link the production of aluminium back to the production of other metals from their ores (Unit 1 - Periodic Table 1).</p> <p>Link to methods of extraction linked to metal reactivity, Unit 1 - Periodic Table 1).</p> <p>Awareness of the economic and environmental implications of the very high energy demand for electrolysis (link to need for recycling of aluminium and hydroelectric power).</p> <p>Awareness of the importance of the products of the processes in terms of their uses e.g. chlorine for water treatment, NaOH for making soap.</p>	
5	Describe the reasons for the use of copper and (steel-cored) aluminium in cables, and why plastics and ceramics are used as insulators.	The steel core provides additional strength. Aluminium is lightweight and a good conductor. Ceramics are found on pylons carrying high tension (voltage) cables.	
6.2 (S)	Describe the production of electrical energy from simple cells, i.e. two electrodes in an electrolyte. (This should be linked with the reactivity series in syllabus section 10.2 and redox in syllabus section 7.3.)		Battery questions and answers: <a href="http://www.powerstream.com/BatteryFAQ.html">http://www.powerstream.com/BatteryFAQ.html</a>

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6.2 (S)	State the use of batteries as a convenient, portable energy source.	Possible issues to discuss include.... <ul style="list-style-type: none"><li>• toxicity of heavy metals used in batteries and subsequent hazards of their disposal.</li><li>• usefulness of re-chargeable batteries including their use for storage of energy from alternative energy sources such as domestic solar panels and wind powered generators (and in cars).</li></ul>	
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