

## IGCSE Co-ordinated Sciences 0654

### Unit 12: C7 Ions and Electrolysis & C8 Solvents and Solutions

#### Recommended Prior Knowledge

Be familiar with the terms “atom”, “ion” and “molecule”.

#### Context

Knowledge from this Unit will be useful for future study in topics C9, C10 and C15.

#### Outline

The extraction and purification of metals and the production of other useful material by electrolysis is studied. Water sources and the purification of water lead on to the solubility of different compounds in water, and to the cleaning action of detergents.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
AB	<p>Know that electrolysis can be used to split up compounds.</p> <p>Know the meaning of the terms <i>electrode</i>, <i>electrolyte</i>, <i>anode</i> and <i>cathode</i>.</p>	<p>Electrolysis of molten lead(II) bromide may be demonstrated in a fume cupboard.</p> <p>The extraction of aluminium by electrolysis of purified bauxite may be used as an example. Students may use information from the web sites to prepare written or oral presentations.</p>	<p><i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 6.</p> <p>Extraction of aluminium:  <a href="http://www.gcsechemistry.com">http://www.gcsechemistry.com</a>  <a href="http://www.bbc.co.uk/schools/gcsebitesize">http://www.bbc.co.uk/schools/gcsebitesize</a></p>
AB	<b>Know that reactive metals are extracted by electrolysis.</b>	Methods of extraction of metals can be related to the reactivity series.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 6.
ABC	Be able to describe the effect of chlorine on damp litmus paper (see also notes	Students may perform or have demonstrated these tests for chlorine, hydrogen and oxygen gases. These tests can be carried out on	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 6.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
	for use in qualitative analysis).	products of the electrolysis reactions described above.	<i>Teaching and Assessing Practical Skills in Science</i> by Dave Hayward
AB	Be able to test for hydrogen (lighted splint) and oxygen (glowing splint).  <b>Know that metals or hydrogen are produced at the cathode and non-metals other than hydrogen are produced at the anode during electrolysis of concentrated solutions of ionic compounds.</b>	The electrolysis of acidified water and of concentrated sodium chloride solution (brine) may be demonstrated.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 6.
ABC	<b>Understand the need for ionic mobility in electrolysis.</b>  Understand the economic importance of salt and be aware of the need for alkali, chlorine and hydrogen made from this raw material.	The economic importance of the chlor-alkali industry should be emphasised using photographs and diagrams. Students may collect data for a written or oral presentation.  Students may prepare a sample of pure sodium chloride crystals from rock salt.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 6. <i>Teaching and Assessing Practical Skills in Science</i> by Dave Hayward <a href="http://www.bbc.co.uk/schools/gcsebitesize">http://www.bbc.co.uk/schools/gcsebitesize</a>
AB	Know that electrolysis can be used to purify metals.	The electrolysis of copper(II) sulphate using copper electrodes may be demonstrated. Use of this reaction to purify copper after smelting should be discussed.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 6.
AB	Understand the problems involved in obtaining an adequate supply of pure water.	An article could be plated with copper or another metal by electrolysis.  Water sources and the possible sources of their contamination may be discussed. This could be illustrated with photographs. Students could collect information for a written or oral presentation. Emphasis should be given to local issues.	<a href="http://en.wikipedia.org">http://en.wikipedia.org</a>
ABC	Understand the processes involved in purifying water in terms of filtration and	A flow diagram of the water purification process may be used to explain the procedures used in water purification. Information is provided in the	Purification of water: <a href="http://www.lenntech.com">http://www.lenntech.com</a>

AO	Learning outcomes	Suggested Teaching activities	Learning resources
	chlorination.	web site.	<i>Teaching and Assessing Practical Skills in Science</i> by Dave Hayward <i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 7.
ABC	Know that some substances are more soluble in water than others.	Tables of solubility data for different salts may be studied. Students can use tables from the web site to construct graphs, or interpret the graphs provided on the web site. Students can plan and carry out an investigation into the solubility of common salts in water and plot their own graphs.	<a href="http://www.wpbschoolhouse.btinternet.co.uk">http://www.wpbschoolhouse.btinternet.co.uk</a>
ABC	Know the test for chloride ions using acidified silver nitrate solution.  Know the test for sulphate ions using acidified barium nitrate solution.	Students should perform the tests for chloride ions and for sulphate ions. They may then be given 'unknown' solutions to identify.  This section provides practice in the use of chemical symbols and equations  <b>Students aiming for higher grades should use symbols for ions to explain what happens during precipitation reactions in terms of the solubility of substances (e.g. the addition of OH<sup>-</sup> ions to aqueous salt solutions).</b>	
AB	<b>Understand the measurement of concentrations in moles per dm<sup>3</sup>.</b>	The concept of amount of substance should be extended to cover the measurement of concentrations in moles per dm <sup>3</sup> for those aiming for higher grades. They should perform suitable calculations related to the content of this unit.	
ABC	Know that hardness is caused by the presence of dissolved calcium or	Students should have the opportunity to plan and carry out experiments on hard and soft water e.g. testing by measurement of amount of soap	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 8.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
	magnesium compounds and be familiar with the behaviour of soap in hard and soft water.	solution required to form a permanent lather.  Students can read through the information on the website and then answer the questions provided.	<i>Teaching and Assessing Practical Skills in Science</i> by Dave Hayward.  <a href="http://www.chemistry.wustl.edu">http://www.chemistry.wustl.edu</a>
		Student may compare the efficiency of different methods of cleaning e.g. using soap and soapless detergents.	
ABC	Understand how boiling and scale removers help to soften water.	Students may design and carry out experiments to assess the efficacy of different substances as scale removers.	<i>Teaching and Assessing Practical Skills in Science</i> by Dave Hayward.
AB	Know that non-aqueous solvents may be used in cleaning.	The need for some clothes to be dry-cleaned may be discussed.	<a href="http://science.howstuffworks.com">http://science.howstuffworks.com</a>
AB	<b>Understand equations which describe hard water, scale formation and water softening processes.</b>	Students aiming for higher grades should write the equations involved in the formation and softening of hard water. Details are provided on the website.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 8.  <a href="http://www.chemistry.wustl.edu">http://www.chemistry.wustl.edu</a>
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AB	<b>Understand how the process of ion exchange can be used to soften water.</b>	The exchange of ions in, and the use of an ion exchange resin to soften water, should be studied by use of diagrams. If possible this method of softening water may be demonstrated.	
AB	<b>Know that ionic compounds dissolve</b>	The attraction between charges on ions and on water molecules should	

AO	Learning outcomes in water and molecular compounds usually dissolve in non-aqueous solvents.	Suggested Teaching activities	Learning resources
ABC	Know that detergents are needed to help get things clean.	be described as the basis for the high solubility of most ionic compounds. The lack of solubility of molecular compounds in water, but high solubility in organic compounds may be demonstrated and discussed. Allow students to try dissolving ionic and molecular compounds in water and in non-aqueous solvents.	
AB	Know that detergents are needed to help get things clean.	Student may compare dirtied cloths when washed with or without the use of detergents.	<p><i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 10.</p> <p><i>Teaching and Assessing Practical Skills in Science</i> by Dave Hayward.</p> <p><a href="http://www.umich.edu">http://www.umich.edu</a></p> <p><a href="http://en.wikipedia.org">http://en.wikipedia.org</a></p>
AB	Know some of the domestic, industrial and agricultural sources of water pollution.	<p>Student may gather data on water pollution from the web site or local sources to prepare a written or oral presentation.</p> <p>Local water supplies may be tested e.g. for nitrates.</p>	<p><i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 16.</p> <p><a href="http://www.cleaning101.com">http://www.cleaning101.com</a></p> <p><a href="http://science.csustan.edu">http://science.csustan.edu</a></p>
	<b>Understand a simple molecular explanation of the action of detergents.</b>	Diagrams may be used to follow the action of the hydrophobic and hydrophilic ends of detergent molecules in the removal of greasy dirt from clothing. Students may use information from the web site to prepare a written or oral presentation.	