

IGCSE Co-ordinated Sciences 0654

Unit 16: C16 Metals and Alloys & C17 Atoms, Bonding and the Periodic Table

Recommended Prior Knowledge

Student should already have covered topics C1, C2 and C7.

Context

Knowledge in this Unit has links with topics C1, C2, C6, C7 and C9.

Outline

The bonding in metals is used as a starting point to study alloy and transition metal properties and uses. Metals are identified using flame tests and hydroxide precipitation. Ionic and covalent bonding are compared.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
AB	Know some of the properties of common metals and alloys.	Students may use data tables to help them derive a list of common metal properties.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 9.
AB	Be able to describe the metallic bond using the 'sea of electrons' model to account for malleability and electrical conductivity of metals.	Studying a model of a metal crystal provides opportunities to work out what the model can explain and to examine its limitations.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 4. Animation of sea of electrons: http://ithacasciencezone.com/chemzone/lessons/03bonding/mleebonding/metallisbonding.htm
AB	Understand that metals have giant structures.	Students should look for patterns in the properties of metals and to explore the connection between these properties and the use of the metal.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 4.
ABC	Know that the transition elements are metals with high densities and high boiling	The website contains data on physical properties of transition metals, along with a great deal of information on their chemistry and uses. Students can read through this information and answer questions in the quiz on this site.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 3 & 9. Teaching and Assessing Practical Skills

	Learning outcomes	Suggested Teaching activities	Learning resources
AO	points which form coloured compounds.		in Science by Dave Hayward.
ABC		The ability of transition metals or their ions to act as catalysts forms a link with topic 11 Fertilisers. An investigation of the action of a range of metal ions on the decomposition of hydrogen peroxide will give students practical experience of the action of a catalyst and the skills involved in collecting and measuring gases.	http://www.wpbschoolhouse.btinternet.co.uk/page04/4_75trans.htm <i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 11. Teaching and Assessing Practical Skills in Science by Dave Hayward. http://chemed.chem.purdue.edu
AB	Know that alloys are mixtures of metals. Know that alloys are made by mixing molten metals.	Uses of a range of alloys can be discussed. Properties of alloys and unalloyed metals can be compared. Students can extract information about a number of alloys from the website.	http://www.gcsechemistry.com/ex32.htm
A	Know that alloys may also contain non-metals, as exemplified by carbon in most types of steel.	Properties and uses of steels can be discussed. Students can extract information about steels from the web site.	http://www.gcsechemistry.com/ex32.htm
AB	Understand, in terms of the difference in atomic size, why the malleability of an alloy of two metals is different from either of the pure metals used to make it.	The effect of different sized atoms in alloys on the properties of the mixture can be discussed, using diagrams and/or models.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 9.
AB	Be able to use the mole concept to describe the amounts of metals in an alloy.	Student can perform calculations to arrive at mole compositions of alloys.	
ABC	Know that some metal cations	Student should perform flame tests and tests on a range of metal compounds.	<i>IGCSE Chemistry</i> by B Earl and LCR

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AO	<p>can be identified by characteristic flame colours and this can be used as a basis for chemical analysis.</p> <p>Know the characteristic flame colours for sodium, copper, calcium and potassium.</p>	<p>They can then be given a number of 'unknown' compounds to identify.</p> <p>The web site contains a lesson plan for this activity.</p> <p>This work can be linked with identification of ions in topics 8, 9 and 11. (Notes for use in Qualitative Analysis are reproduced in the question paper for the Practical Test.)</p>	<p>Wilford, Chapter 3.</p> <p>Teaching and Assessing Practical Skills in Science by Dave Hayward</p> <p>http://www.creative-chemistry.org.uk</p>
ABC	<p>Know the tests for aqueous copper(II), iron(II), iron(III) and zinc, using aqueous sodium hydroxide and aqueous ammonia.</p>	<p>Students should carry out experiments to find the colour of precipitates formed when sodium hydroxide solution or aqueous ammonia are added to solutions containing these metal ions. They should also investigate the effect of adding each of these alkalis in excess. They can then be given a number of 'unknown' compounds to identify.</p> <p>This work can be linked with identification of ions in topics 8, 9 and 11. (Notes for use in Qualitative Analysis are reproduced in the question paper for the Practical Test.)</p>	<p><i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 9.</p> <p>Teaching and Assessing Practical Skills in Science by Dave Hayward Tests for aqueous metal ions: http://library.thinkquest.org</p>
AB	<p>Know that there is a relationship between the group number and the number of outer electrons.</p>	<p>Students should be given the opportunity to draw together their knowledge of the structures of simple compounds and relate them to the position of the elements in the Periodic Table. There are also opportunities for students to analyse patterns related to the Periodic Table by reference to tables of data (e.g. melting and boiling points). Students can use cards with data regarding electron arrangement to build up the Periodic Table and then form their own ideas about patterns within the Periodic Table.</p>	<p><i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 3.</p>
AB	<p>Know that ions are formed by gain or loss of electrons.</p>	<p>Students should draw dot and cross diagrams to show the formation of ions in ionic bonding in e.g. sodium chloride, magnesium oxide. They can use information from the web sites to help them do this.</p>	<p><i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 4.</p> <p>http://www.bbc.co.uk/schools/gcsebitesize/chemistry/classifyingmaterials/ionic_bondingrev1.shtml</p> <p>http://www.wpbschoolhouse.btinternet.co.uk/page04/4_72bond.htm</p>

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AB	Know that the electrons in an atom are arranged in a series of shells.	Students aiming for higher grades should practice working out and drawing diagrams of the electron arrangement of a variety of elements.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 3.
AB	Understand how the arrangement of elements in the Periodic Table can be explained in terms of atomic structure.	The electron arrangement of atoms should be related to the position of each element in the Periodic Table. See card sort activity earlier in Unit. Students aiming for higher grades should have an understanding the problems faced by Mendeleev and other scientists involved in classifying and arranging elements.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 3. Mendelleev's Periodic table: http://www.bbc.co.uk/schools/gcsebitesize/chemistry/periodictablenadgroups/periodictablerev5.shtml
AB	Understand the significance of the noble gas electronic structure.	Students should work out the noble gas structure attained when atoms of different metal and non-metal elements lose or gain electrons to form ions.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 4.
A	Know that the term <i>covalent bond</i> refers to a shared pair of electrons between two atoms.	Students should draw diagrams to represent the arrangement of electrons in a number of small covalent molecules. They can use information from the web sites to help them do this.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 3. Notes on covalent bonding in these molecules: http://www.wpbschoolhouse.btinternet.co.uk http://www.rjclarkson.demon.co.uk/
AB	Understand the meaning of the term <i>isotopes</i> in terms of atomic structure.	Students aiming for higher grades should represent atomic structures with symbols showing nucleon number and proton number and appreciate that all atoms of an element have the same proton number whereas isotopes of an element have different nucleon numbers.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 3.
AB	Know that molecules are formed by sharing pairs of electrons and appreciate that	Students should draw dot and cross diagrams to show the covalent bonding in a range of compounds, and relate this to the number of electrons in the outer	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 4.

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	the number of bonds formed by an atom in a molecule can be explained in terms of atomic structure.	shells of the atoms involved.	
AB	Understand, with reference to simple examples, how atoms turn into ions and ions into atoms during electrolysis.	This concept is linked to topic 7 Ions and Electrolysis.	<i>IGCSE Chemistry</i> by B Earl and LCR Wilford, Chapter 6. How atoms turn into ions: http://chemed.chem.purdue.edu