

GCSE (9–1)

Transition Guide

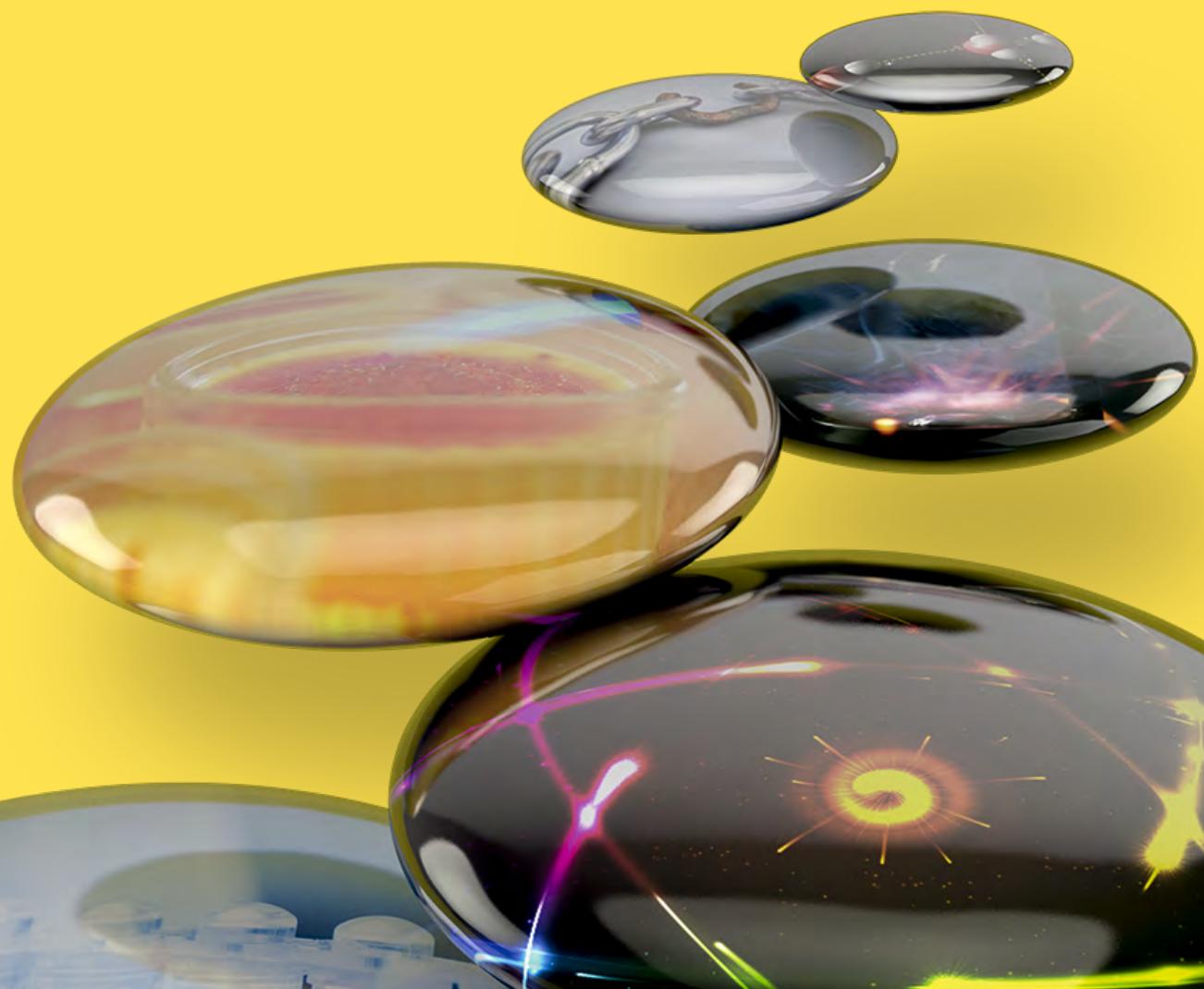
GATEWAY SCIENCE CHEMISTRY A

J248

For first teaching in 2016

KS3–KS4 Elements, compounds and mixtures

Version 1



GCSE (9–1) **CHEMISTRY A**

**QUALIFICATION
AWAITING
ACCREDITATION**

Key Stage 3 to 4 Transition guides focus on how a particular topic is covered at the different key stages and provide information on:

- Differences in the demand and approach at the different levels;
- Useful ways to think about the content at Key Stage 3 which will help prepare students for progression to Key Stage 4;
- Common student misconceptions in this topic.

Transition guides also contain links to a range of teaching activities that can be used to deliver the content at Key Stage 3 and 4 and are designed to be of use to teachers of both key stages. Central to the transition guide is a Checkpoint task which is specifically designed to help teachers determine whether students have developed deep conceptual understanding of the topic at Key Stage 3 and assess their 'readiness for progression' to Key Stage 4 content on this topic. This checkpoint task can be used as a summative assessment at the end of Key Stage 3 teaching of the topic or by Key Stage 4 teachers to establish their students' conceptual starting point.

Key Stage 3 to 4 Transition Guides are written by experts with experience of teaching at both key stages.

'These draft qualifications have not yet been accredited by Ofqual. They are published (along with specimen assessment materials, summary brochures and sample resources) to enable teachers to have early sight of our proposed approach.'

Further changes may be required and no assurance can be given at this time that the proposed qualifications will be made available in their current form, or that they will be accredited in time for first teaching in 2016 and first award in 2018 (2017 for AS Level qualifications).'

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Key Stage 3 Content

Pure and impure substances

- the concept of a pure substance
- mixtures, including dissolving
- simple techniques for separating mixtures
- the identification of pure substances.

Chemical reactions

- chemical reactions as the rearrangement of atoms
- representing chemical reactions using formulae and using equations.

The Periodic Table

- the principles underpinning the Mendeleev Periodic Table
- the Periodic Table: periods and groups; metals and non-metals
- how patterns in reactions can be predicted with reference to the Periodic Table
- the properties of metals and non-metals.

Materials

- the order of metals and carbon in the reactivity series
- properties of ceramics, polymers and composites (qualitative).



Key Stage 4 Content

Sub-Topic C2.1 Purity and separating mixtures

- C2.1a explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term 'pure'
- C2.1b use melting point data to distinguish pure from impure substances
- C2.1c calculate relative formula masses of species separately and in a balanced chemical equation
- C2.1d deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa
- C2.1e explain that many useful materials are formulations of mixtures (to include alloys)
- C2.1f describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation (to include knowledge of the techniques of filtration, crystallisation, simple distillation and fractional distillation)
- C2.1g describe the techniques of paper and thin layer chromatography
- C2.1h recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases (to include identification of the mobile and stationary phases)
- C2.1i interpret chromatograms, including measuring R_f values (to include the recall and the use of the formula)
- C2.1j suggest suitable purification techniques given information about the substances involved
- C2.1k suggest chromatographic methods for distinguishing pure from impure substances (to include paper, thin layer (TLC) and gas chromatography)

Sub-Topic C2.2 Bonding

- C2.2a describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties (to include physical properties, formation of ions and common reactions e.g. with oxygen to form oxides)
- C2.2b explain how the atomic structure of metals and non-metals relates to their position in the Periodic Table
- C2.2c explain how the position of an element in the Periodic Table is related to the arrangement of electrons in its atoms and hence to its atomic number (to include group number and period number)
- C2.2d describe and compare the nature and arrangement of chemical bonds in:
 - i. ionic compounds
 - ii. simple molecules
 - iii. giant covalent structures
 - iv. polymers
 - v. metals

... continues

Key Stage 4 Content *(continued)*

- C2.2e explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons
- C2.2f construct dot and cross diagrams for simple covalent and binary ionic substances
- C2.2g describe the limitations of particular representations and models to include dot and cross diagrams, ball and stick models and two and three dimensional representations
- C2.2h explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number
- C2.2i explain in terms of atomic number how Mendeleev's arrangement was refined into the modern Periodic Table

Sub-Topic C2.3 Properties of materials

- C2.3a recall that carbon can form four covalent bonds
 - C2.3b explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings
 - C2.3c explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding
 - C2.3d use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to explain the different temperatures at which changes of state occur
 - C2.3e use data to predict states of substances under given conditions (to include data such as temperature and how this may be linked to changes of state)
 - C2.3f explain how the bulk properties of materials (ionic compounds; simple molecules; giant covalent structures; polymers and metals) are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged (to include recognition that the atoms themselves do not have the bulk properties of these materials)
 - *C2.3g compare 'nano' dimensions to typical dimensions of atoms and molecules
 - *C2.3h describe the surface area to volume relationship for different-sized particles and describe how this affects properties
 - *C2.3i describe how the properties of nanoparticulate materials are related to their uses
 - *C2.3j explain the possible risks associated with some nanoparticulate materials
- *Separate Chemistry Statements only

Comment

There are several key areas in this transition that involve quite a lot new understanding. One of the subjects with the most growth is bonding and chemical structure.

At Key Stage 3, learners must understand that atoms combine to make compounds and that there are lots of different types of compounds which make up all of the substances around us.

At Key Stage 4, they have to understand how these compounds form, they have to describe how electrons are donated or shared in different types of bonds and they have to begin to think of the macromolecular structure and properties of these substances.

Formation of ions can be a common stumbling point as learners struggle to see why losing an electron causes a positive charge. This can be helped by using the concept of losing a disease or illness as being a positive thing.

The properties of the different structures can be hard for learners to remember as they require work and practice. Understanding the physical causes of the properties can often help, for example, delocalised electrons cause conductivity in metals and graphite. If they know this, they can then link the properties to their understanding of the structures.

Another large jump in understanding is in mathematical skills. At Key Stage 3, there is very little maths involved in chemistry, limited mainly to mass changes. Some high level learners may have looked into the proton and mass numbers and may have calculated the number of neutrons using these values. At Key Stage 4, learners must understand the meaning of chemical formulas and be able to calculate formula mass and empirical formula. Although the maths involved for these topics is not high level, empirical formula does rely on learners following a procedure from memory and doing multiple steps in the right order.

One common source of error during empirical formula is due to rounding. Be careful to explain that the numbers should only be rounded **after** the 'mole values' have been divided by the smallest value.

At Key Stage 3, learners learn about separating simple mixtures with techniques like filtration and crystallisation. At Key Stage 4, learners must extend this knowledge into chromatography. This is a higher level concept as it is harder to visualise compared to filtration. This topic contains a few common misconceptions, for example learners often think that test samples travel less far up the stationary phase due to their mass, when in fact it is affected by the chemical properties of the material and the mobile/stationary phase.

Chemistry at Key Stage 3 will often make reference to the Periodic Table and learners are often familiar with its layout and some of the elements on it. At Key Stage 4, they must link their understanding of atomic structure to the layout of the Periodic Table. The various groups on the Periodic Table contain elements which are similar because of their electronic structure.

Learners often mix up the idea that elements have the same amount of electrons in total, rather than just the same number of outer electrons.

Activities

Atoms and elements in compounds

Learner Resource – activity 1:

<http://www.ocr.org.uk/Images/305594-elements-compounds-and-mixtures-transition-guide-learner-resources.zip>

This task develops the use of the terms, atom, element, compound and makes learners analyse the atoms in a substance by looking at its formula.

Naming compounds

Learner Resource – activity 2 and Naming compounds PowerPoint:

<http://www.ocr.org.uk/Images/305594-elements-compounds-and-mixtures-transition-guide-learner-resources.zip>

This activity allows learners to practice naming binary compounds and more complex substances.

The PowerPoint gives simple instructions on how to determine the name from the formula.

Periodic table groups

BBC Bitesize

Resources: http://www.bbc.co.uk/schools/gcsebitesize/science/add_edexcel/periodic-table/groupsact.shtml

This activity introduces some of the groups in the Periodic Table and describes the similarities of elements which share the same group.

Development of the periodic table

BBC Bitesize

Resources: <http://www.bbc.co.uk/education/guides/zfn9q6f/revision/1>

These three pages explain how the periodic table was developed, explaining Newlands' octave, Mendeleev's table and compares the two.

It also has an interactive test which can be used to assess understanding.

Separation

Nuffield practical

Resources: <http://www.nuffieldfoundation.org/practical-chemistry/chemicals-seawater>

This is a practical guide for separating chemicals from seawater.

Chromatography

Nuffield practical chemistry

Resources: <http://www.nuffieldfoundation.org/practical-chemistry/chromatography-sweets>

This is a practical guide for simple chromatography which introduces the topic at a simple level before it is covered in detail at GCSE.

Mapping KS3 to KS4

Possible Teaching
Activities (KS3 focus)

Checkpoint task

Possible Teaching
Activities (KS4 focus)Possible Extension
Activities (KS4 focus)Resources, links
and support

Checkpoint task

The checkpoint tasks are provided in the format of assessment questions. The questions vary in the level of demand, some recall or identify tasks where others are explain or evaluate tasks.

These should be given to the learners as individual work.

Little preparation is needed other than printing of the tasks.

Checkpoint tasks:

<http://www.ocr.org.uk/Images/305608-elements-compounds-and-mixtures-checkpoint-task.doc>

Activities

Chromatography (true/false)

Learner Resource – activity 3:

<http://www.ocr.org.uk/Images/305594-elements-compounds-and-mixtures-transition-guide-learner-resources.zip>

This activity provides multiple choice questions which test learners' understanding of chromatography.

Chromatography animation

Chromatography animation PowerPoint:

<http://www.ocr.org.uk/Images/305594-elements-compounds-and-mixtures-transition-guide-learner-resources.zip>

This is a simple animation which exemplifies the components of gas chromatography and shows how a mixture of substances can create peaks on a detector screen.

Relative formula mass

Learner Resource – activity 4:

<http://www.ocr.org.uk/Images/305594-elements-compounds-and-mixtures-transition-guide-learner-resources.zip>

This activity provides a selection of compounds for which learners must determine the relative formula mass. The questions range from Foundation level to Higher level and end with some extension tasks too.

Empirical formulae

Learner Resource – activity 5:

<http://www.ocr.org.uk/Images/305594-elements-compounds-and-mixtures-transition-guide-learner-resources.zip>

This is a selection of questions for learners to practice their calculation of empirical formulae.

Calculating M_r of a compound

[Calculating \$M_r\$ of a compound PowerPoint](#)

This PowerPoint gives instructions on how to perform calculations on relative formula mass (M_r).

Calculate empirical formula

[Calculate Empirical formula PowerPoint](#)

This PowerPoint gives instructions on how to perform calculations to determine empirical formulae.

Structures of different elements

<http://www.educationscotland.gov.uk/highersciences/chemistry/animations/bondingstructure.asp>

This webpage shows the atomic structure of different elements using simple animations.

Activities

Allotropes of carbon puzzle

RSC

<http://www.rsc.org/learn-chemistry/resources/gridlocks/downloads/AllotropesofCarbon.pdf>

This puzzle requires understanding of the different allotropes of carbon as well as some problem solving skills.

Ionic bonding questions

Learner Resource – activity 6:

<http://www.ocr.org.uk/Images/305594-elements-compounds-and-mixtures-transition-guide-learner-resources.zip>

This activity gives step by step tasks to help learners to display ionic bonding, then tests their understanding of ionic properties.

The second side tackles balancing of equations and a long answer question about properties of materials.

Resources, links and support

Science Spotlight – Our termly update Science Spotlight provides useful information and helps to support our Science teaching community. Science Spotlight is designed to keep you up-to-date with Science here at OCR, as well as to share information, news and resources. Each issue is packed full with a series of exciting articles across the whole range of our Science qualifications: www.ocr.org.uk/qualifications/by-subject/science/science-spotlight/

Find resources and qualification information through our science page: <http://www.ocr.org.uk/qualifications/by-subject/science/>

Contact the team: science@ocr.org.uk

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To find out more about GCSE and A Level reform please visit: <http://www.ocr.org.uk/qualifications/gcse-and-a-level-reform>



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