Pearson Edexcel

International GCSE

Chemistry (9–1)

Specification

Pearson Edexcel International GCSE in Chemistry (4CH1)

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First examination June 2019

Issue 3

About Pearson

We are the world's leading learning company operating in countries all around the world. We provide content, assessment and digital services to learners, educational institutions, employers, governments and other partners globally. We are committed to helping equip learners with the skills they need to enhance their employability prospects and to succeed in the changing world of work. We believe that wherever learning flourishes so do people.

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All information in this specification is correct at time of publication.

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Summary of Pearson Edexcel International GCSE in Chemistry (4CH1) specification

Issue 3 changes

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If you need further information on these changes or what they mean, contact us via our website at: qualifications.pearson.com/en/support/contact-us.html.

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1 About this specification

The Pearson Edexcel International GCSE in Chemistry is part of a suite of International GCSE qualifications offered by Pearson.

This qualification is not accredited or regulated by any UK regulatory body.

This specification includes the following key features.

Structure: the Pearson Edexcel International GCSE in Chemistry is a linear qualification. Two written examinations must be taken in the same series at the end of the course of study.

Content: relevant, engaging, up to date and of equivalent standard to Pearson's regulated GCSE in Chemistry.

Assessment: untiered, written examinations with questions designed to be accessible to students of all abilities.

Approach: a solid basis for students wishing to progress to the Pearson Edexcel AS and Advanced GCE Level or equivalent qualifications, focusing on key chemistry theory.

Specification updates

This specification is Issue 2 and is valid for the Pearson Edexcel International GCSE in Chemistry examined from 2019. If there are any significant changes to the specification Pearson will inform centres. Changes will also be posted on our website.

For more information please visit qualifications.pearson.com

Using this specification

This specification has been designed to give guidance to teachers and encourage effective delivery of the qualification. The following information will help you get the most out of the content and guidance.

Content: this is arranged as four topics in *2: Chemistry content*. A summary of sub-topics is included at the start of each topic. As a minimum, all the bullet points in the content must be taught. The word 'including' in the content helps specify the detail of what must be covered.

Examples: throughout the content, we have included examples of what could be covered or what might support teaching and learning. It is important to note that examples are for illustrative purposes only and centres can use other examples. We have included examples that are easily understood and recognised by international centres.

Practical investigations: these are included within *2: Chemistry content* as specification points in italics. Students will develop knowledge and understanding of experimental skills through the context of the chemistry they are learning. Experimental skills are assessed through written examinations.

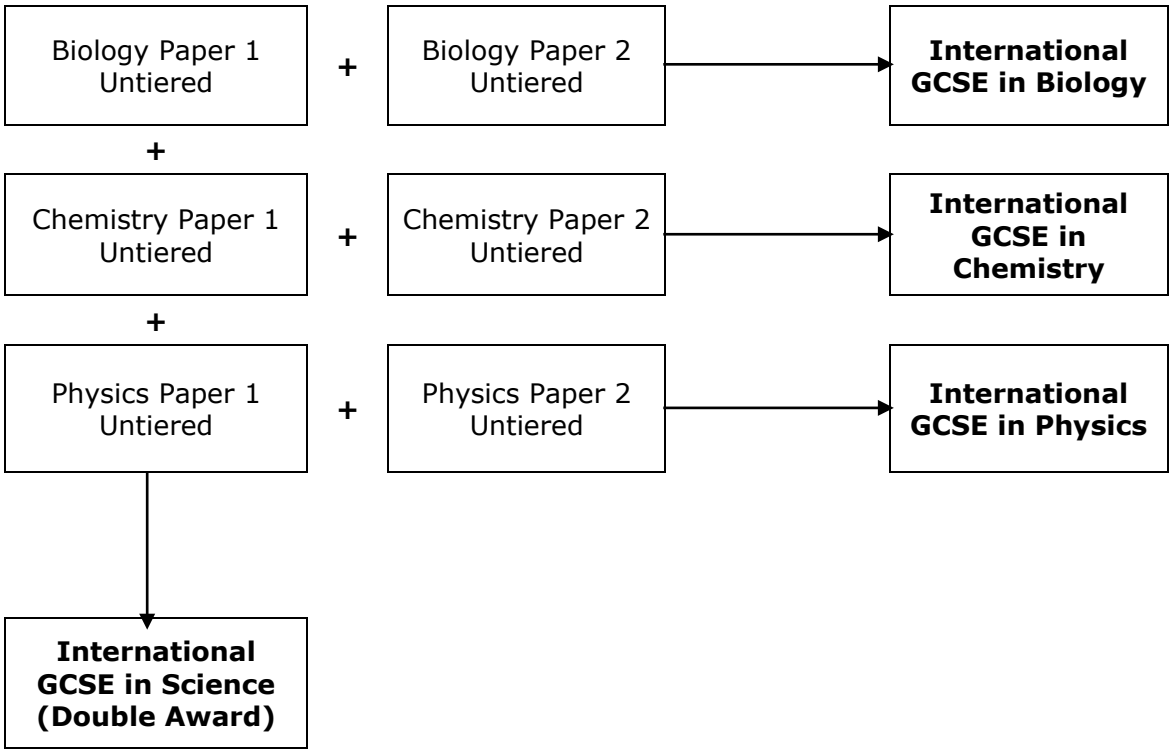
Referencing: specification statements that are in bold with a 'C' reference relate to content that is only in the International GCSE in Chemistry and is not found in the International GCSE in Science (Double Award).

Course introduction

The Pearson Edexcel International GCSE in Chemistry is designed for use in schools and colleges. It is part of a suite of International GCSE qualifications offered by Pearson.

The course gives students the opportunity to experience chemistry within the context of their general education.

How assessment relates to the qualifications available is shown below.



A Pearson Edexcel International GCSE in Science (Single Award) qualification is also available. This will cover approximately 50% of the Pearson Edexcel International GCSE in Science (Double Award) specification, while still having a comparable level of rigour and demand.

Qualification aims and objectives

The aims and objectives of this qualification are to enable students to:

- learn about unifying patterns and themes in chemistry and use them in new and changing situations
- acquire knowledge and understanding of chemical facts, terminology, concepts, principles and practical techniques
- apply the principles and concepts of chemistry, including those related to the applications of chemistry, to different contexts
- evaluate chemical information, making judgements on the basis of this information
- appreciate the practical nature of chemistry, developing experimental and investigative skills based on correct and safe laboratory techniques
- analyse, interpret and evaluate data and experimental methods, drawing conclusions that are consistent with evidence from experimental activities and suggesting possible improvements and further investigations
- recognise the importance of accurate experimental work and reporting scientific methods in chemistry
- select, organise and present relevant information clearly and logically using appropriate vocabulary, definitions and conventions
- develop a logical approach to problem solving in a wider context.
- select and apply appropriate areas of mathematics relevant to chemistry as set out under each topic
- prepare for more advanced courses in chemistry and for other courses that require knowledge of chemistry.

Why choose Edexcel qualifications?

Pearson – the world's largest education company

Edexcel academic qualifications are from Pearson, the UK's largest awarding organisation. With over 3.4 million students studying our academic and vocational qualifications worldwide, we offer internationally recognised qualifications to schools, colleges and employers globally.

Pearson is recognised as the world's largest education company, allowing us to drive innovation and provide comprehensive support for Edexcel students to acquire the knowledge and skills they need for progression in study, work and life.

A heritage you can trust

The background to Pearson becoming the UK's largest awarding organisation began in 1836, when a royal charter gave the University of London its first powers to conduct exams and confer degrees on its students. With over 150 years of international education experience, Edexcel qualifications have firm academic foundations, built on the traditions and rigour associated with Britain's education system.

Results you can trust

Pearson's leading online marking technology has been shown to produce exceptionally reliable results, demonstrating that, at every stage, Edexcel qualifications maintain the highest standards.

Developed to Pearson's world class qualifications standards

Pearson's world-class standards mean that all Edexcel qualifications are developed to be rigorous, demanding, inclusive and empowering. We work collaboratively with a panel of education thought leaders and assessment experts to ensure that Edexcel qualifications are globally relevant, represent world-class best practice and maintain a consistent standard.

For more information on the world class qualification process and principles, please go to *Appendix 2: Pearson World Class Qualification design principles* or visit our website: uk.pearson.com/about-us/news-and-policy/reports-and-campaigns/world-class-qualifications/design-principles.html

Why choose Pearson Edexcel International GCSE in Chemistry?

We've listened to feedback from all parts of the International and UK school subject community, including a large number of teachers. We've made changes that will engage students and give them skills that will support progression to further study in chemistry and a range of other subjects, in chemical sciences and elsewhere. Our content and assessment approach has been designed to meet students' needs and be consistent with our approach across the sciences.

At Pearson we offer separate science qualifications in Biology, Human Biology, Chemistry and Physics, as well as Double Award and Single Award Science qualifications – these have been designed to meet different students' needs. The content and assessment approach in all our science qualifications has been designed to meet students' needs in the following ways.

- Content that is interesting and engaging for students but is also designed to ensure good preparation, both for those continuing to further study and for those who wish to work in a chemistry-related field.
- There are opportunities to 'localise' the content to make it more relevant for students in their own country.
- Question papers are clear and straightforward – our question papers are clear and accessible for all students of all ability ranges and learning styles. Our mark schemes are straightforward, so that the assessment requirements are clear.
- Students' skills are broadly developed – we have designed the International GCSE to extend students' knowledge by broadening and deepening skills, for example:
  - developing students' practical skills by including a number of practicals in the specification content. These can be supplemented with other suggested practicals. The skills developed will be assessed through questions in written examinations
  - improving students' analytical and logic skills by applying understanding of scientific concepts and principles to a range of situations. This will include some examination questions that are more problem solving in style
  - addressing the need for mathematical skills to complement students' chemistry skills by covering a range of mathematical areas.

Progression to A Level – International GCSEs enable successful progression to A Level and beyond. Through our World Class Qualification development process we have consulted with International Advanced Level and GCE A Level teachers as well as higher education professors to validate the appropriateness of the qualification, including its content, skills development and assessment structure.

Courses to suit your students' needs and interests – teachers of chemistry have a choice of International GCSE courses to deliver, each giving different levels of depth to meet students' needs. As well as the Pearson Edexcel International GCSE in Chemistry, students can also be taught our International GCSE in Science (Double Award) or our International GCSE in Science (Single Award). These courses offer a reduced amount of content, but are assessed to the same standard. Progression routes for these courses may vary slightly from those for the Pearson Edexcel International GCSE in Chemistry.

More information about all our qualifications can be found on our Edexcel International GCSE pages at qualifications.pearson.com

Supporting you in planning and implementing this qualification

Planning

- We will give you a course planner and editable schemes of work.
- Our mapping documents highlight key differences between the new and the 2011 legacy qualifications.

Teaching and learning

- Our *Getting Started Guide* gives you an overview of the Pearson Edexcel International GCSE in Chemistry to help you understand the changes to content and assessment, and what these changes mean for you and your students.
- Print and digital learning and teaching resources promote any time, any place learning to improve student motivation and encourage new ways of working.

Preparing for exams

We will also give you a range of resources to help you prepare your students for the assessments, including:

- specimen papers to support formative assessments and mock exams
- examiner commentaries following each examination series.

ResultsPlus

ResultsPlus provides the most detailed analysis available of your students' exam performance. It can help you to identify the topics and skills where further learning would benefit your students.

examWizard

This is a free online data bank of past exam questions designed to support students and teachers with exam preparation and assessment.

Training events

In addition to online training, we host a series of training events each year (both online and face-to-face) that give teachers a deeper understanding of our qualifications.

Get help and support

Our subject advisor service ensures that you receive help and guidance from us. You can sign up to receive the Edexcel newsletter to keep up to date with our qualifications and receive product and service news.

Qualification at a glance

The Pearson Edexcel International GCSE in Chemistry comprises two externally-assessed papers:

- Chemistry Paper 1
- Chemistry Paper 2.

Paper overview

Chemistry Paper 1	*Paper code 4CH1/1C and 4SD0/1C
• Externally assessed • Availability: November and June • First assessment: June 2019	61.1% of the total International GCSE
Content summary Assesses core content that is **not** in bold and does not have a 'C' reference. Questions may come from any topic area across the specification. 1 Principles of chemistry 2 Inorganic chemistry 3 Physical chemistry 4 Organic chemistry	
Assessment • The paper is assessed through a 2-hour written examination paper set and marked by Pearson. • The total number of marks is 110. • A mixture of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions. • A calculator may be used in the examinations.	

Chemistry Paper 2	*Paper code 4CH1/2C
• Externally assessed • Availability: November and June • First assessment: June 2019	38.9% of the total International GCSE

Content summary

Assesses **all the content**, including content that is in bold and has a 'C' reference.
Questions may come from any topic area across the specification.
Bold statements cover some sub-topics in greater depth.

1 Principles of chemistry

2 Inorganic chemistry

3 Physical chemistry

4 Organic chemistry

Assessment

- The paper is assessed through a 1-hour and 15-minute written examination paper set and marked by Pearson.
- The total number of marks is 70.
- A mixture of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions.
- A calculator may be used in the examinations.

* See *Appendix 1: Codes* for a description of this code and all the other codes relevant to this qualification.

2 Chemistry content

1 Principles of chemistry

The following sub-topics are covered in this section.

(a) States of matter

(b) Elements, compounds and mixtures

(c) Atomic structure

(d) The Periodic Table

(e) Chemical formulae, equations and calculations

(f) Ionic bonding

(g) Covalent bonding

(h) Metallic bonding

(i) Electrolysis

(a)	**States of matter**
Students should:	
1.1	understand the three states of matter in terms of the arrangement, movement and energy of the particles
1.2	understand the interconversions between the three states of matter in terms of: • the names of the interconversions • how they are achieved • the changes in arrangement, movement and energy of the particles.
1.3	understand how the results of experiments involving the dilution of coloured solutions and diffusion of gases can be explained
1.4	know what is meant by the terms: • solvent • solute • solution • saturated solution.
1.5C	**know what is meant by the term solubility in the units g per 100 g of solvent**
1.6C	**understand how to plot and interpret solubility curves**
1.7C	***practical: investigate the solubility of a solid in water at a specific temperature***

(b)	Elements, compounds and mixtures
Students should:	
1.8	understand how to classify a substance as an element, compound or mixture
1.9	understand that a pure substance has a fixed melting and boiling point, but that a mixture may melt or boil over a range of temperatures
1.10	describe these experimental techniques for the separation of mixtures: • simple distillation • fractional distillation • filtration • crystallisation • paper chromatography.
1.11	understand how a chromatogram provides information about the composition of a mixture
1.12	understand how to use the calculation of R_f values to identify the components of a mixture
1.13	*practical: investigate paper chromatography using inks/food colourings*

(c)	Atomic structure
Students should:	
1.14	know what is meant by the terms atom and molecule
1.15	know the structure of an atom in terms of the positions, relative masses and relative charges of sub-atomic particles
1.16	know what is meant by the terms atomic number, mass number, isotopes and relative atomic mass (A_r)
1.17	be able to calculate the relative atomic mass of an element (A_r) from isotopic abundances

(d)	The Periodic Table
Students should:	
1.18	understand how elements are arranged in the Periodic Table: • in order of atomic number • in groups and periods.
1.19	understand how to deduce the electronic configurations of the first 20 elements from their positions in the Periodic Table
1.20	understand how to use electrical conductivity and the acid-base character of oxides to classify elements as metals or non-metals
1.21	identify an element as a metal or a non-metal according to its position in the Periodic Table
1.22	understand how the electronic configuration of a main group element is related to its position in the Periodic Table

Students should:	
1.23	understand why elements in the same group of the Periodic Table have similar chemical properties
1.24	understand why the noble gases (Group 0) do not readily react

(e)	**Chemical formulae, equations and calculations**
Students should:	
1.25	write word equations and balanced chemical equations (including state symbols): • for reactions studied in this specification • for unfamiliar reactions where suitable information is provided.
1.26	calculate relative formula masses (including relative molecular masses) (M_r) from relative atomic masses (A_r)
1.27	know that the mole (mol) is the unit for the amount of a substance
1.28	understand how to carry out calculations involving amount of substance, relative atomic mass (A_r) and relative formula mass (M_r)
1.29	calculate reacting masses using experimental data and chemical equations
1.30	calculate percentage yield
1.31	understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallisation
1.32	know what is meant by the terms empirical formula and molecular formula
1.33	calculate empirical and molecular formulae from experimental data
1.34C	**understand how to carry out calculations involving amount of substance, volume and concentration (in mol/dm^3) of solution**
1.35C	**understand how to carry out calculations involving gas volumes and the molar volume of a gas (24 dm^3 and 24 000 cm^3 at room temperature and pressure (rtp))**
1.36	*practical: know how to determine the formula of a metal oxide by combustion (e.g. magnesium oxide) or by reduction (e.g. copper(II) oxide)*

(f)	Ionic bonding
Students should:	
1.37	understand how ions are formed by electron loss or gain
1.38	know the charges of these ions: • metals in Groups 1, 2 and 3 • non-metals in Groups 5, 6 and 7 • Ag^{+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Pb^{2+}, Zn^{2+} • hydrogen (H^{+}), hydroxide (OH^{-}), ammonium (NH_4^{+}), carbonate (CO_3^{2-}), nitrate (NO_3^{-}), sulfate (SO_4^{2-}).
1.39	write formulae for compounds formed between the ions listed above
1.40	draw dot-and-cross diagrams to show the formation of ionic compounds by electron transfer, limited to combinations of elements from Groups 1, 2, 3 and 5, 6, 7 *only outer electrons need be shown*
1.41	understand ionic bonding in terms of electrostatic attractions
1.42	understand why compounds with giant ionic lattices have high melting and boiling points
1.43	know that ionic compounds do not conduct electricity when solid, but do conduct electricity when molten and in aqueous solution

(g)	Covalent bonding
Students should:	
1.44	know that a covalent bond is formed between atoms by the sharing of a pair of electrons
1.45	understand covalent bonds in terms of electrostatic attractions
1.46	understand how to use dot-and-cross diagrams to represent covalent bonds in: • diatomic molecules, including hydrogen, oxygen, nitrogen, halogens and hydrogen halides • inorganic molecules including water, ammonia and carbon dioxide • organic molecules containing up to two carbon atoms, including methane, ethane, ethene and those containing halogen atoms.
1.47	explain why substances with a simple molecular structures are gases or liquids, or solids with low melting and boiling points *the term intermolecular forces of attraction can be used to represent all forces between molecules*
1.48	explain why the melting and boiling points of substances with simple molecular structures increase, in general, with increasing relative molecular mass
1.49	explain why substances with giant covalent structures are solids with high melting and boiling points
1.50	explain how the structures of diamond, graphite and C_{60} fullerene influence their physical properties, including electrical conductivity and hardness
1.51	know that covalent compounds do not usually conduct electricity

(h) Metallic bonding
Students should:
1.52C know how to represent a metallic lattice by a 2-D diagram
1.53C understand metallic bonding in terms of electrostatic attractions
1.54C explain typical physical properties of metals, including electrical conductivity and malleability

(i) Electrolysis
Students should:
1.55C understand why covalent compounds do not conduct electricity
1.56C understand why ionic compounds conduct electricity only when molten or in aqueous solution
1.57C know that anion and cation are terms used to refer to negative and positive ions respectively
1.58C describe experiments to investigate electrolysis, using inert electrodes, of molten compounds (including lead(II) bromide) and aqueous solutions (including sodium chloride, dilute sulfuric acid and copper(II) sulfate) and to predict the products
1.59C write ionic half-equations representing the reactions at the electrodes during electrolysis and understand why these reactions are classified as oxidation or reduction
1.60C *practical: investigate the electrolysis of aqueous solutions*

2 Inorganic chemistry

The following sub-topics are covered in this section.

(a) Group 1 (alkali metals) – lithium, sodium and potassium

(b) Group 7 (halogens) – chlorine, bromine and iodine

(c) Gases in the atmosphere

(d) Reactivity series

(e) Extraction and uses of metals

(f) Acids, alkalis and titrations

(g) Acids, bases and salt preparations

(h) Chemical tests

(a)	**Group 1 (alkali metals) – lithium, sodium and potassium**
Students should:	
2.1	understand how the similarities in the reactions of these elements with water provide evidence for their recognition as a family of elements
2.2	understand how the differences between the reactions of these elements with air and water provide evidence for the trend in reactivity in Group 1
2.3	use knowledge of trends in Group 1 to predict the properties of other alkali metals
2.4C	**explain the trend in reactivity in Group 1 in terms of electronic configurations**

(b)	**Group 7 (halogens) – chlorine, bromine and iodine**
Students should:	
2.5	know the colours, physical states (at room temperature) and trends in physical properties of these elements
2.6	use knowledge of trends in Group 7 to predict the properties of other halogens
2.7	understand how displacement reactions involving halogens and halides provide evidence for the trend in reactivity in Group 7
2.8C	**explain the trend in reactivity in Group 7 in terms of electronic configurations**

(c)	Gases in the atmosphere
Students should:	
2.9	know the approximate percentages by volume of the four most abundant gases in dry air
2.10	understand how to determine the percentage by volume of oxygen in air using experiments involving the reactions of metals (e.g. iron) and non-metals (e.g. phosphorus) with air
2.11	describe the combustion of elements in oxygen, including magnesium, hydrogen and sulfur
2.12	describe the formation of carbon dioxide from the thermal decomposition of metal carbonates, including copper(II) carbonate
2.13	know that carbon dioxide is a greenhouse gas and that increasing amounts in the atmosphere may contribute to climate change
2.14	*practical: determine the approximate percentage by volume of oxygen in air using a metal or a non-metal*

(d)	Reactivity series
Students should:	
2.15	understand how metals can be arranged in a reactivity series based on their reactions with: • water • dilute hydrochloric or sulfuric acid.
2.16	understand how metals can be arranged in a reactivity series based on their displacement reactions between: • metals and metal oxides • metals and aqueous solutions of metal salts.
2.17	know the order of reactivity of these metals: potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, copper, silver, gold
2.18	know the conditions under which iron rusts
2.19	understand how the rusting of iron may be prevented by: • barrier methods • galvanising • sacrificial protection.
2.20	understand the terms: • oxidation • reduction • redox • oxidising agent • reducing agent in terms of gain or loss of oxygen and loss or gain of electrons.

Students should:	
2.21	*practical: investigate reactions between dilute hydrochloric and sulfuric acids and metals (e.g. magnesium, zinc and iron)*

(e)	**Extraction and uses of metals**
Students should:	
2.22C	**know that most metals are extracted from ores found in the Earth's crust and that unreactive metals are often found as the uncombined element**
2.23C	**explain how the method of extraction of a metal is related to its position in the reactivity series, illustrated by carbon extraction for iron and electrolysis for aluminium**
2.24C	**be able to comment on a metal extraction process, given appropriate information** ***detailed knowledge of the processes used in the extraction of a specific metal is not required***
2.25C	**explain the uses of aluminium, copper, iron and steel in terms of their properties** ***the types of steel will be limited to low-carbon (mild), high-carbon and stainless***
2.26C	**know that an alloy is a mixture of a metal and one or more elements, usually other metals or carbon**
2.27C	**explain why alloys are harder than pure metals**

(f)	**Acids, alkalis and titrations**
Students should:	
2.28	describe the use of litmus, phenolphthalein and methyl orange to distinguish between acidic and alkaline solutions
2.29	understand how to use the pH scale, from 0–14, can be used to classify solutions as strongly acidic (0–3), weakly acidic (4–6), neutral (7), weakly alkaline (8–10) and strongly alkaline (11–14)
2.30	describe the use of universal indicator to measure the approximate pH value of an aqueous solution
2.31	know that acids in aqueous solution are a source of hydrogen ions and alkalis in a aqueous solution are a source of hydroxide ions
2.32	know that alkalis can neutralise acids
2.33C	**describe how to carry out an acid-alkali titration**

(g)	**Acids, bases and salt preparations**
Students should:	
2.34	know the general rules for predicting the solubility of ionic compounds in water: • common sodium, potassium and ammonium compounds are soluble • all nitrates are soluble • common chlorides are soluble, except those of silver and lead(II) • common sulfates are soluble, except for those of barium, calcium and lead(II) • common carbonates are insoluble, except for those of sodium, potassium and ammonium • common hydroxides are insoluble except for those of sodium, potassium and calcium (calcium hydroxide is slightly soluble).
2.35	understand acids and bases in terms of proton transfer
2.36	understand that an acid is a proton donor and a base is a proton acceptor
2.37	describe the reactions of hydrochloric acid, sulfuric acid and nitric acid with metals, bases and metal carbonates (excluding the reactions between nitric acid and metals) to form salts
2.38	know that metal oxides, metal hydroxides and ammonia can act as bases, and that alkalis are bases that are soluble in water
2.39	describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an insoluble reactant
2.40C	**describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an acid and alkali**
2.41C	**describe an experiment to prepare a pure, dry sample of an insoluble salt, starting from two soluble reactants**
2.42	*practical: prepare a sample of pure, dry hydrated copper(II) sulfate crystals starting from copper(II) oxide*
2.43C	***practical: prepare a sample of pure, dry lead(II) sulfate***

(h)	Chemical tests
Students should:	
2.44	describe tests for these gases: • hydrogen • oxygen • carbon dioxide • ammonia • chlorine.
2.45	describe how to carry out a flame test
2.46	know the colours formed in flame tests for these cations: • Li^+ is red • Na^+ is yellow • K^+ is lilac • Ca^{2+} is orange-red • Cu^{2+} is blue-green.
2.47	describe tests for these cations: • NH_4^+ using sodium hydroxide solution and identifying the gas evolved • Cu^{2+}, Fe^{2+} and Fe^{3+} using sodium hydroxide solution.
2.48	describe tests for these anions: • Cl^-, Br^- and I^- using acidified silver nitrate solution • SO_4^{2-} using acidified barium chloride solution • CO_3^{2-} using hydrochloric acid and identifying the gas evolved.
2.49	describe a test for the presence of water using anhydrous copper(II) sulfate
2.50	describe a physical test to show whether a sample of water is pure

3 Physical chemistry

The following sub-topics are covered in this section:

(a) Energetics

(b) Rates of reaction

(c) Reversible reactions and equilibria

(a)	**Energetics**
Students should:	
3.1	know that chemical reactions in which heat energy is given out are described as exothermic, and those in which heat energy is taken in are described as endothermic
3.2	describe simple calorimetry experiments for reactions such as combustion, displacement, dissolving and neutralisation
3.3	calculate the heat energy change from a measured temperature change using the expression $Q = mc\Delta T$
3.4	calculate the molar enthalpy change (ΔH) from the heat energy change, Q
3.5C	**draw and explain energy level diagrams to represent exothermic and endothermic reactions**
3.6C	**know that bond-breaking is an endothermic process and that bond-making is an exothermic process**
3.7C	**use bond energies to calculate the enthalpy change during a chemical reaction**
3.8	*practical: investigate temperature changes accompanying some of the following types of change:* • *salts dissolving in water* • *neutralisation reactions* • *displacement reactions* • *combustion reactions.*

(b)	Rates of reaction
Students should:	
3.9	describe experiments to investigate the effects of changes in surface area of a solid, concentration of a solution, temperature and the use of a catalyst on the rate of a reaction
3.10	describe the effects of changes in surface area of a solid, concentration of a solution, pressure of a gas, temperature and the use of a catalyst on the rate of a reaction
3.11	explain the effects of changes in surface area of a solid, concentration of a solution, pressure of a gas and temperature on the rate of a reaction in terms of particle collision theory
3.12	know that a catalyst is a substance that increases the rate of a reaction, but is chemically unchanged at the end of the reaction
3.13	know that a catalyst works by providing an alternative pathway with lower activation energy
3.14C	**draw and explain reaction profile diagrams showing Δ*H* and activation energy**
3.15	*practical: investigate the effect of changing the surface area of marble chips and of changing the concentration of hydrochloric acid on the rate of reaction between marble chips and dilute hydrochloric acid*
3.16	*practical: investigate the effect of different solids on the catalytic decomposition of hydrogen peroxide solution*

(c)	Reversible reactions and equilibria
Students should:	
3.17	know that some reactions are reversible and this is indicated by the symbol ⇌ in equations
3.18	describe reversible reactions such as the dehydration of hydrated copper(II) sulfate and the effect of heat on ammonium chloride
3.19C	**know that a reversible reaction can reach dynamic equilibrium in a sealed container**
3.20C	**know that the characteristics of a reaction at dynamic equilibrium are:** • **the forward and reverse reactions occur at the same rate** • **the concentrations of reactants and products remain constant.**
3.21C	**understand why a catalyst does not affect the position of equilibrium in a reversible reaction**
3.22C	**know the effect of changing either temperature or pressure on the position of equilibrium in a reversible reaction:** • **an increase (or decrease) in temperature shifts the position of equilibrium in the direction of the endothermic (or exothermic) reaction** • **an increase (or decrease) in pressure shifts the position of equilibrium in the direction that produces fewer (or more) moles of gas** ***References to Le Chatelier's principle are not required***

4 Organic chemistry

The following sub-topics are covered in this section.

(a) Introduction

(b) Crude oil

(c) Alkanes

(d) Alkenes

(e) Alcohols

(f) Carboxylic acids

(g) Esters

(h) Synthetic polymers

(a)	**Introduction**
Students should:	
4.1	know that a hydrocarbon is a compound of hydrogen and carbon only
4.2	understand how to represent organic molecules using empirical formulae, molecular formulae, general formulae, structural formulae and displayed formulae
4.3	know what is meant by the terms homologous series, functional group and isomerism
4.4	understand how to name compounds relevant to this specification using the rules of International Union of Pure and Applied Chemistry (IUPAC) nomenclature *students will be expected to name compounds containing up to six carbon atoms*
4.5	understand how to write the possible structural and displayed formulae of an organic molecule given its molecular formula
4.6	understand how to classify reactions of organic compounds as substitution, addition and combustion *knowledge of reaction mechanisms is not required*

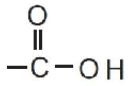
(b)	**Crude oil**
Students should:	
4.7	know that crude oil is a mixture of hydrocarbons
4.8	describe how the industrial process of fractional distillation separates crude oil into fractions
4.9	know the names and uses of the main fractions obtained from crude oil: refinery gases, gasoline, kerosene, diesel, fuel oil and bitumen
4.10	know the trend in colour, boiling point and viscosity of the main fractions
4.11	know that a fuel is a substance that, when burned, releases heat energy
4.12	know the possible products of complete and incomplete combustion of hydrocarbons with oxygen in the air

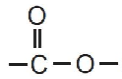
Students should:	
4.13	understand why carbon monoxide is poisonous, in terms of its effect on the capacity of blood to transport oxygen *references to haemoglobin are not required*
4.14	know that, in car engines, the temperature reached is high enough to allow nitrogen and oxygen from air to react, forming oxides of nitrogen
4.15	explain how the combustion of some impurities in hydrocarbon fuels results in the formation of sulfur dioxide
4.16	understand how sulfur dioxide and oxides of nitrogen contribute to acid rain
4.17	describe how long-chain alkanes are converted to alkenes and shorter-chain alkanes by catalytic cracking (using silica or alumina as the catalyst and a temperature in the range of 600–700 ºC)
4.18	explain why cracking is necessary, in terms of the balance between supply and demand for different fractions

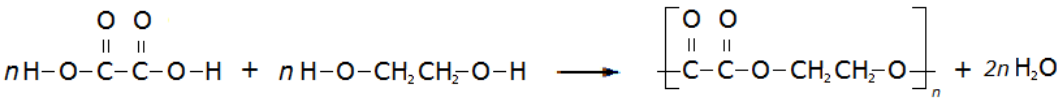
(c)	**Alkanes**
Students should:	
4.19	know the general formula for alkanes
4.20	explain why alkanes are classified as saturated hydrocarbons
4.21	understand how to draw the structural and displayed formulae for alkanes with up to five carbon atoms in the molecule, and to name the unbranched-chain isomers
4.22	describe the reactions of alkanes with halogens in the presence of ultraviolet radiation, limited to mono-substitution *knowledge of reaction mechanisms is not required*

(d)	**Alkenes**
Students should:	
4.23	know that alkenes contain the functional group >C=C<
4.24	know the general formula for alkenes
4.25	explain why alkenes are classified as unsaturated hydrocarbons
4.26	understand how to draw the structural and displayed formulae for alkenes with up to four carbon atoms in the molecule, and name the unbranched-chain isomers *knowledge of cis/trans or E/Z notation is not required*
4.27	describe the reactions of alkenes with bromine to produce dibromoalkanes
4.28	describe how bromine water can be used to distinguish between an alkane and an alkene

(e) Alcohols
Students should:
4.29C know that alcohols contain the functional group −OH
4.30C understand how to draw structural and displayed formulae for methanol, ethanol, propanol (*propan-1-ol only*) and butanol (*butan-1-ol only*), and name each compound ***the names propanol and butanol are acceptable***
4.31C know that ethanol can be oxidised by: • **burning in air or oxygen (complete combustion)** • **reaction with oxygen in the air to form ethanoic acid (microbial oxidation)** • **heating with potassium dichromate(VI) in dilute sulfuric acid to form ethanoic acid**
4.32C know that ethanol can be manufactured by: • **reacting ethene with steam in the presence of a phosphoric acid catalyst at a temperature of about 300 °C and a pressure of about 60–70 atm** • **the fermentation of glucose, in the absence of air, at an optimum temperature of about 30 °C and using the enzymes in yeast**
4.33C understand the reasons for fermentation, in the absence of air, and at an optimum temperature

(f) Carboxylic acids
Students should:
4.34C know that carboxylic acids contain the functional group 
4.35C understand how to draw structural and displayed formulae for unbranched-chain carboxylic acids with up to four carbon atoms in the molecule, and name each compound
4.36C describe the reactions of aqueous solutions of carboxylic acids with metals and metal carbonates
4.37C know that vinegar is an aqueous solution containing ethanoic acid

(g) Esters
Students should:
4.38C know that esters contain the functional group 
4.39C know that ethyl ethanoate is the ester produced when ethanol and ethanoic acid react in the presence of an acid catalyst
4.40C understand how to write the structural and displayed formulae of ethyl ethanoate
4.41C understand how to write the structural and displayed formulae of an ester, given the name or formula of the alcohol and carboxylic acid from which it is formed and vice versa
4.42C know that esters are volatile compounds with distinctive smells and are used as food flavourings and in perfumes
4.43C *practical: prepare a sample of an ester such as ethyl ethanoate*

(h) Synthetic polymers	
Students should:	
4.44	know that an addition polymer is formed by joining up many small molecules called monomers
4.45	understand how to draw the repeat unit of an addition polymer, including poly(ethene), poly(propene), poly(chloroethene) and (poly)tetrafluoroethene
4.46	understand how to deduce the structure of a monomer from the repeat unit of an addition polymer and vice versa
4.47	explain problems in the disposal of addition polymers, including: • their inertness and inability to biodegrade • the production of toxic gases when they are burned.
4.48C know that condensation polymerisation, in which a dicarboxylic acid reacts with a diol, produces a polyester and water	
4.49C understand how to write the structural and displayed formula of a polyester, showing the repeat unit, given the formulae of the monomers from which it is formed including the reaction of ethanedioic acid and ethanediol: 	
4.50C know that some polyesters, known as biopolyesters, are biodegradable	

3 Assessment information

Assessment requirements

Paper number	Level	Assessment information	Number of marks allocated in the paper
Paper 1C	1/2	Assessed through a 2-hour written examination set and marked by Pearson. The paper is weighted at 61.1% of the qualification. A mixture of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions. Assesses the content that is **not** in bold and does not have a 'C' reference. Questions may come from any topic area across the specification.	110
Paper 2C	1/2	Assessed through a 1-hour and 15-minute written examination set and marked by Pearson. The paper is weighted at 38.9% of the qualification. A mixture of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions. Assesses **all the content**, including content that is in bold and has a 'C' reference. Questions may come from any topic area across the specification. Bold statements cover some sub-topics in greater depth.	70

The total number of marks for this qualification is 180. This total is obtained by adding the mark for Paper 1C (out of 110 marks) to the mark for Paper 2C (out of 70 marks). The marks for the papers are not scaled.

Based on the overall mark, students will be awarded a grade. The grades available range from 9 to 1, where 9 is the highest grade.

Sample assessment materials

Sample papers and mark schemes can be found in the *Pearson Edexcel International GCSE in Chemistry Sample Assessment Materials (SAMs)* document.

Experimental skills

The best way to develop experimental skills is to embed practical investigations in teaching or theory. The development of knowledge and experimental skills can then happen together, leading to secure acquisition of both knowledge and skills.

Our practical investigations are embedded within *2: Chemistry content* as specification points in italics. The skills developed through these and other practicals will be assessed through written examinations.

In the assessment of experimental skills, students may be tested on their ability to:

- solve problems set in a practical context
- apply scientific knowledge and understanding in questions with a practical context
- devise and plan investigations, using scientific knowledge and understanding when selecting appropriate techniques
- demonstrate or describe appropriate experimental and investigative methods, including safe and skilful practical techniques
- make observations and measurements with appropriate precision, record these methodically and present them in appropriate ways
- identify independent, dependent and control variables
- use scientific knowledge and understanding to analyse and interpret data to draw conclusions from experimental activities that are consistent with the evidence
- communicate the findings from experimental activities, using appropriate technical language, relevant calculations and graphs
- assess the reliability of an experimental activity
- evaluate data and methods taking into account factors that affect accuracy and validity.

Calculators

Students will be expected to have access to a suitable electronic calculator for all examination papers. Calculators that allow for the retrieval of text or formulae or QWERTY keyboards will not be allowed for use in examinations.

Assessment objectives and weightings

		International GCSE
AO1	Knowledge and understanding of chemistry	38–42%
AO2	Application of knowledge and understanding, analysis and evaluation of chemistry	38 42%
AO3	Experimental skills, analysis and evaluation of data and methods in chemistry	19–21%
		100%

Relationship of assessment objectives to units

Unit number	Assessment objective		
	AO1	AO2	AO3
Chemistry Paper 1	23.2–25.7%	23.2–25.7%	11.6–12.8%
Chemistry Paper 2	14.8–16.3%	14.8–16.3%	7.4–8.2%
Total for International GCSE	38–42%	38–42%	19–21%

All components will be available for assessment from June 2019.

4 Administration and general information

Entries

Details of how to enter students for the examinations for this qualification can be found in our *International information manual*. A copy is made available to all examinations officers and is also available on our website.

Students should be advised that if they take two qualifications in the same subject, colleges, universities and employers are very likely to take the view that they have achieved only one of the two GCSEs/International GCSEs. Students or their advisers, who have any doubts about subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

Forbidden combinations

This qualification may not be taken alongside:

- Pearson Edexcel International GCSE in Science (Double Award) (Linear) (4SD0)
- Pearson Edexcel International GCSE in Chemistry (Modular) (4XCH1)
- Pearson Edexcel International GCSE in Science (Double Award) (Modular) (4XSD1)

Access arrangements, reasonable adjustments, special consideration and malpractice

Equality and fairness are central to our work. Our Equality Policy requires all students to have equal opportunity to access our qualifications and assessments, and our qualifications to be awarded in a way that is fair to every student.

We are committed to making sure that:

- students with a protected characteristic (as defined by the UK Equality Act 2010) are not, when they are undertaking one of our qualifications, disadvantaged in comparison to students who do not share that characteristic
- all students achieve the recognition they deserve for undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

Language of assessment

Assessment of this qualification will only be available in English. All student work must be in English.

We recommend that students are able to read and write in English at Level B2 of the Common European Framework of Reference for Languages.

Access arrangements

Access arrangements are agreed before an assessment. They allow students with special educational needs, disabilities or temporary injuries to:

- access the assessment
- show what they know and can do without changing the demands of the assessment.

The intention behind an access arrangement is to meet the particular needs of an individual student with a disability without affecting the integrity of the assessment. Access arrangements are the principal way in which awarding bodies comply with the duty under the UK Equality Act 2010 to make 'reasonable adjustments'.

Access arrangements should always be processed at the start of the course. Students will then know what is available and have the access arrangement(s) in place for assessment.

Reasonable adjustments

The UK Equality Act 2010 requires an awarding organisation to make reasonable adjustments where a student with a disability would be at a substantial disadvantage in undertaking an assessment. The awarding organisation is required to take reasonable steps to overcome that disadvantage.

A reasonable adjustment for a particular student may be unique to that individual and therefore might not be in the list of available access arrangements.

Whether an adjustment will be considered reasonable will depend on a number of factors, including:

- the needs of the student with the disability
- the effectiveness of the adjustment
- the cost of the adjustment
- the likely impact of the adjustment on the student with the disability and other students.

An adjustment will not be approved if it involves unreasonable costs to the awarding organisation or unreasonable timeframes or if it affects the security or integrity of the assessment. This is because the adjustment is not 'reasonable'.

Special consideration

Special consideration is a post-examination adjustment to a student's mark or grade to reflect temporary injury, illness or other indisposition at the time of the examination/assessment, which has had, or is reasonably likely to have had, a material effect on a candidate's ability to take an assessment or demonstrate their level of attainment in an assessment.

Further information

Please see our website for further information about how to apply for access arrangements and special consideration.

For further information about access arrangements, reasonable adjustments and special consideration, please refer to the JCQ website: www.jcq.org.uk

Candidate malpractice

Candidate malpractice refers to any act by a candidate that compromises or seeks to compromise the process of assessment, or undermines the integrity of the qualifications or the validity of results/certificates.

Candidate malpractice in examinations **must** be reported to Pearson using a *JCQ Form M1* (available at www.jcq.org.uk/exams-office/malpractice). The form can be emailed to pqsmalpractice@pearson.com or posted to: Investigations Team, Pearson, 190 High Holborn, London, WC1V 7BH. Please provide as much information and supporting documentation as possible. Note that the final decision regarding appropriate sanctions lies with Pearson.

Failure to report malpractice constitutes staff or centre malpractice.

Staff/centre malpractice

Staff and centre malpractice includes both deliberate malpractice and maladministration of our qualifications. As with candidate malpractice, staff and centre malpractice is any act that compromises or seeks to compromise the process of assessment, or undermines the integrity of the qualifications or the validity of results/certificates.

All cases of suspected staff malpractice and maladministration **must** be reported immediately, before any investigation is undertaken by the centre, to Pearson on a *JCQ Form M2* (available at www.jcq.org.uk/exams-office/malpractice).

The form, supporting documentation and as much information as possible can be emailed to pqsmalpractice@pearson.com or posted to: Investigations Team, Pearson, 190 High Holborn, London, WC1V 7BH. Note that the final decision regarding appropriate sanctions lies with Pearson.

Failure to report malpractice itself constitutes malpractice.

More-detailed guidance on malpractice can be found in the latest version of the document *General and Vocational Qualifications Suspected Malpractice in Examinations and Assessments,* available at www.jcq.org.uk/exams-office/malpractice

Awarding and reporting

This International GCSE qualification will be graded and certificated on a nine-grade scale from 9 to 1 using the total subject mark where 9 is the highest grade. Individual papers are not graded. The first certification opportunity for the Pearson Edexcel International GCSE in Chemistry will be in June 2019. Students whose level of achievement is below the minimum judged by Pearson to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Student recruitment and progression

Pearson's policy concerning recruitment to our qualifications is that:

- they must be available to anyone who is capable of reaching the required standard
- they must be free from barriers that restrict access and progression
- equal opportunities exist for all students.

Prior learning and other requirements

The qualification builds on the content, knowledge and skills developed in the Key Stage 3 Programme of Study (ages 11–14) or international equivalences for science.

Progression

Students can progress from this qualification to:

- International Advanced Subsidiary, for example in Chemistry
- International Advanced Level, for example in Chemistry
- GCE Advanced Subsidiary, for example in Chemistry
- GCE Advanced Level, for example in Chemistry
- Level 3 vocational qualifications in science, for example BTEC Level 3 in Applied Science
- other comparable, Level 3 qualifications, such as the International Baccalaureate
- employment, for example in a science-based industry where an apprenticeship may be available.

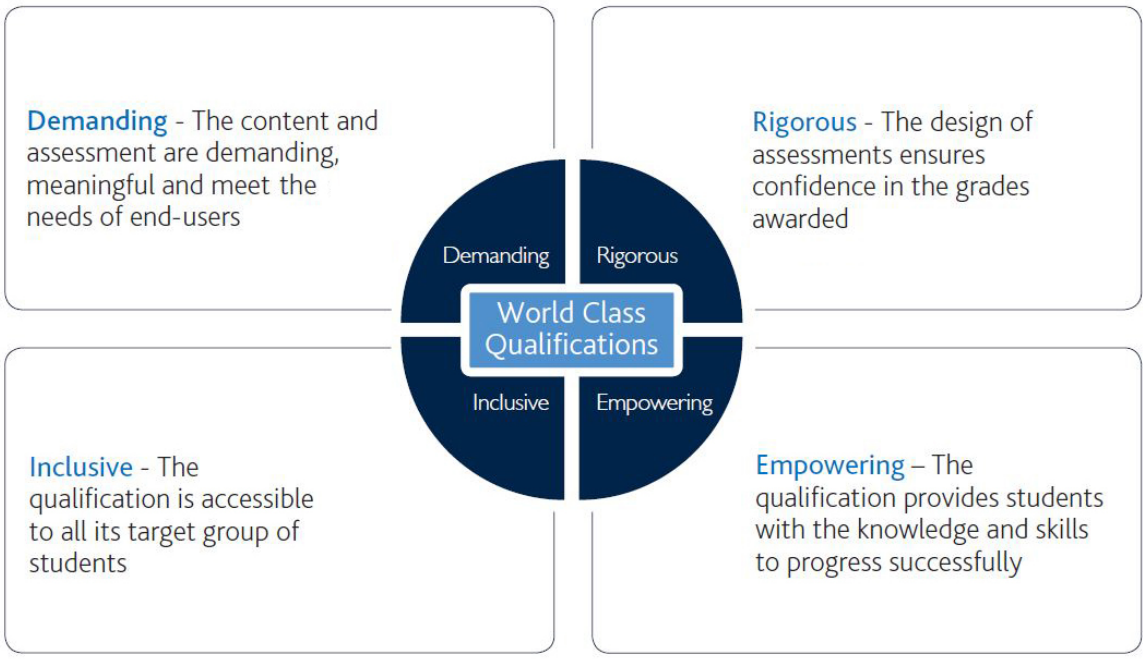
Appendices

Appendix 1: Codes

Type of code	Use of code	Code
Subject codes	The subject code is used by centres to enter students for a qualification.	Pearson Edexcel International GCSE in Chemistry – 4CH1 Pearson Edexcel International GCSE in Science (Double Award) – 4SD0
Paper codes	These codes are provided for information. Students may need to be entered for individual papers.	Chemistry Paper 1: 4CH1/1C, 4SD0/1C Chemistry Paper 2: 4CH1/2C

Appendix 2: Pearson World Class Qualification design principles

Pearson's World Class Qualification design principles mean that all Edexcel qualifications are developed to be **rigorous, demanding, inclusive and empowering**.



We work collaboratively to gain approval from an external panel of educational thought leaders and assessment experts from across the globe. This is to ensure that Edexcel qualifications are globally relevant, represent world-class best practice in qualification and assessment design, maintain a consistent standard and support learner progression in today's fast-changing world.

Pearson's Expert Panel for World-class Qualifications is chaired by Sir Michael Barber, a leading authority on education systems and reform. He is joined by a wide range of key influencers with expertise in education and employability.

'I'm excited to be in a position to work with the global leaders in curriculum and assessment to take a fresh look at what young people need to know and be able to do in the 21st century, and to consider how we can give them the opportunity to access that sort of education.' Sir Michael Barber.

Endorsement from Pearson's Expert Panel for World Class Qualifications for the International GCSE development process

December 2015

"We were chosen, either because of our expertise in the UK education system, or because of our experience in reforming qualifications in other systems around the world as diverse as Singapore, Hong Kong, Australia and a number of countries across Europe.

We have guided Pearson through what we judge to be a rigorous world class qualification development process that has included, where appropriate:

- extensive international comparability of subject content against the highest-performing jurisdictions in the world
- benchmarking assessments against UK and overseas providers to ensure that they are at the right level of demand
- establishing External Subject Advisory Groups, drawing on independent subject-specific expertise to challenge and validate our qualifications.

Importantly, we have worked to ensure that the content and learning is future oriented, and that the design has been guided by Pearson's Efficacy Framework. This is a structured, evidenced process which means that learner outcomes have been at the heart of this development throughout.

We understand that ultimately it is excellent teaching that is the key factor to a learner's success in education but as a result of our work as a panel we are confident that we have supported the development of Edexcel International GCSE qualifications that are outstanding for their coherence, thoroughness and attention to detail and can be regarded as representing world-class best practice."

Sir Michael Barber (Chair)
Chief Education Advisor, Pearson plc

Professor Lee Sing Kong
Dean and Managing Director, National Institute of Education International, Singapore

Dr Peter Hill
Former Chief Executive ACARA

Bahram Bekhradnia
President, Higher Education Policy Institute

Professor Jonathan Osborne
Stanford University

Dame Sally Coates
Director of Academies (South), United Learning Trust

Professor Dr Ursula Renold
Federal Institute of Technology, Switzerland

Professor Bob Schwartz
Harvard Graduate School of Education

Professor Janice Kay
Provost, University of Exeter

Jane Beine
Head of Partner Development, John Lewis Partnership

Jason Holt
CEO, Holts Group

All titles correct as at December 2015

Appendix 3: Transferable skills

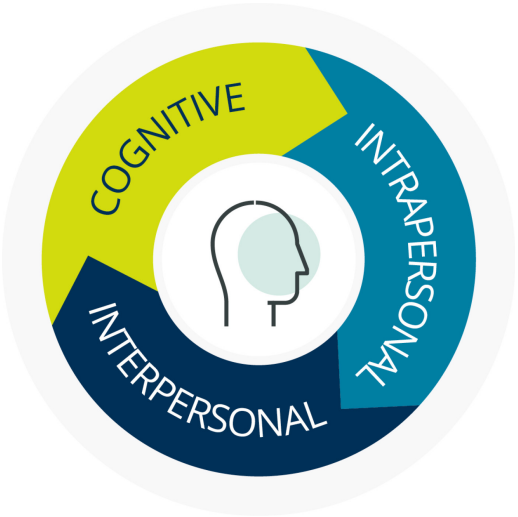
The need for transferable skills

In recent years, higher-education institutions and employers have consistently flagged the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work.

The Organisation for Economic Co-operation and Development (OECD) defines skills, or competencies, as 'the bundle of knowledge, attributes and capacities that can be learned and that enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning.'[1]

To support the design of our qualifications, the Pearson Research Team selected and evaluated seven global 21st-century skills frameworks. Following on from this process, we identified the National Research Council's (NRC) framework [2] as the most evidence-based and robust skills framework, and have used this as a basis for our adapted skills framework.

The framework includes cognitive, intrapersonal skills and interpersonal skills.



The skills have been interpreted for this specification to ensure they are appropriate for the subject. All of the skills listed are evident or accessible in the teaching, learning and/or assessment of the qualification. Some skills are directly assessed. Pearson materials will support you in identifying these skills and developing these skills in students.

The table on the next page sets out the framework and gives an indication of the skills that can be found in chemistry and indicates the interpretation of the skill in this area. A full subject interpretation of each skill, with mapping to show opportunities for students' development is provided on the subject pages of our website: qualifications.pearson.com

[1] OECD – *Better Skills, Better Jobs, Better Lives: A Strategic Approach to Skills Policies* (OECD Publishing, 2012)
[2] Koenig, J. A. (2011) – *Assessing 21st Century Skills: Summary of a Workshop* (National Academies Press, 2011)

Cognitive skills	Cognitive processes and strategies	• Critical thinking • Problem solving • Analysis • Reasoning • Interpretation • Decision making • Adaptive learning • Executive function
	Creativity	• Creativity • Innovation
Intrapersonal skills	Intellectual openness	• Adaptability • Personal and social responsibility • Continuous learning • Intellectual interest and curiosity
	Work ethic/ conscientiousness	• Initiative • Self-direction • Responsibility • Perseverance • Productivity • Self-regulation (metacognition, forethought, reflection) • Ethics • Integrity
	Positive core self-evaluation	• Self-monitoring/self-evaluation/self-reinforcement
Interpersonal skills	Teamwork and collaboration	• Communication • Collaboration • Teamwork • Cooperation • Interpersonal skills
	Leadership	• Leadership • Responsibility • Assertive communication • Self-presentation

Problem solving in the application of unifying patterns and themes in chemistry and using them in new and changing situations.

Initiative when using knowledge of chemistry, independently (without guided learning), to further own understanding.

Communication to convey a chemical process or technique (verbally or written) to peers and teachers and answer questions from others.

Appendix 4: Mathematical skills

The table below identifies the mathematical skills that will be developed and assessed throughout this qualification. These are not explicitly referenced in the content. Details of the mathematical skills in other science subjects are given for reference.

		B	C	P
1	**Arithmetic and numerical computation**			
A	Recognise and use numbers in decimal form	✓	✓	✓
B	Recognise and use numbers in standard form	✓	✓	✓
C	Use ratios, fractions, percentages, powers and roots	✓	✓	✓
D	Make estimates of the results of simple calculations, without using a calculator	✓		✓
E	Use calculators to handle sin x and $\sin^{-1} x$, where x is expressed in degrees			✓
2	**Handling data**			
A	Use an appropriate number of significant figures	✓	✓	✓
B	Understand and find the arithmetic mean (average)	✓	✓	✓
C	Construct and interpret bar charts	✓	✓	✓
D	Construct and interpret frequency tables, diagrams and histograms	✓		✓
E	Understand the principles of sampling as applied to scientific data	✓		
F	Understand simple probability	✓	✓	✓
G	Understand the terms mode and median	✓		
H	Use a scatter diagram to identify a pattern or trend between two variables	✓	✓	✓
I	Make order of magnitude calculations	✓	✓	✓
3	**Algebra**			
A	Understand and use the symbols <, >, ∝, ~		✓	✓
B	Change the subject of an equation	✓	✓	✓
C	Substitute numerical values into algebraic equations using appropriate units for physical quantities	✓	✓	✓
D	Solve simple algebraic equations	✓	✓	✓
4	**Graphs**			
A	Translate information between graphical and numerical form	✓	✓	✓
B	Understand that $y = mx + c$ represents a linear relationship		✓	✓
C	Plot two variables (discrete and continuous) from experimental or other data	✓	✓	✓
D	Determine the slope and intercept of a linear graph	✓	✓	✓
E	Understand, draw and use the slope of a tangent to a curve as a measure of rate of change		✓	✓
F	Understand the physical significance of area between a curve and the x-axis, and measure it by counting squares as appropriate			✓

		B	C	P
5	**Geometry and trigonometry**			
A	Use angular measures in degrees			✓
B	Visualise and represent 2D and 3D objects, including two dimensional representations of 3D objects			✓
C	Calculate areas of triangles and rectangles, surface areas and volumes of cubes	✓		✓

Appendix 5: Command word taxonomy

The following table lists the command words used in the external assessments.

Command word	Definition
Add/Label	Requires the addition or labelling of a stimulus material given in the question, for example labelling a diagram or adding units to a table.
Calculate	Obtain a numerical answer, showing relevant working.
Comment on	Requires the synthesis of a number of variables from data/information to form a judgement.
Complete	Requires the completion of a table/diagram.
Deduce	Draw/reach conclusion(s) from the information provided.
Describe	To give an account of something. Statements in the response need to be developed, as they are often linked but **do not** need to include a justification or reason.
Determine	The answer must have an element that is quantitative from the stimulus provided, or must show how the answer can be reached quantitatively. To gain maximum marks, there must be a quantitative element to the answer.
Design	Plan or invent a procedure from existing principles/ideas.
Discuss	• Identify the issue/situation/problem/argument that is being assessed within the question. • Explore all aspects of an issue/situation/problem/argument. • Investigate the issue/situation etc. by reasoning or argument.
Draw	Produce a diagram either using a ruler or freehand.
Estimate	Find an approximate value, number or quantity from a diagram/given data or through a calculation.
Evaluate	Review information (e.g. data, methods) then bring it together to form a conclusion, drawing on evidence including strengths, weaknesses, alternative actions, relevant data or information. Come to a supported judgement of a subject's quality and relate it to its context.
Explain	An explanation requires a justification/exemplification of a point. The answer must contain some element of reasoning/justification – this can include mathematical explanations.
Give/State/Name	All of these command words are really synonyms. They generally all require recall of one or more pieces of information.
Give a reason/reasons	When a statement has been made and the requirement is only to give the reason(s) why.
Identify	Usually requires some key information to be selected from a given stimulus/resource.

Command word	Definition
Justify	Give evidence to support (either the statement given in the question or an earlier answer).
Plot	Produce a graph by marking points accurately on a grid from data that is provided and then draw a line of best fit through these points. A suitable scale and appropriately labelled axes must be included if these are not provided in the question.
Predict	Give an expected result.
Show that	Verify the statement given in the question.
Sketch	Produce a freehand drawing. For a graph, this would need a line and labelled axes with important features indicated. The axes are not scaled.
State what is meant by	When the meaning of a term is expected but there are different ways for how these can be described.
Suggest	Use your knowledge to propose a solution to a problem in a novel context.
Verb preceding a command word	
Analyse the data/graph to explain	Examine the data/graph in detail to provide an explanation.
Multiple choice questions	
What, Why, Which	Direct command words used for multiple-choice questions.

Appendix 6: Suggested practical investigations

The following suggestions are *additional* practical investigations that exemplify the scientific process. They can be used to supplement students' understanding of chemistry in addition to the practical investigations found within the main body of the content.

- Investigate the ease of thermal decomposition of carbonates, including calcium carbonate, zinc carbonate and copper carbonate.
- Compare the temperature rise produced when the same volume of water is heated by different fuels.
- Investigate the volume of air used up and products formed when candles are burned.
- Investigate the reactions of calcium compounds: the decomposition of calcium carbonate and the reaction of calcium oxide with water; the reaction of calcium carbonate with acid.
- Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates.
- Carry out electrolysis of sea water/acidified water.
- Investigate the rusting of iron.
- Investigate simple oxidation and reduction reactions, such as burning elements in oxygen or competition reactions between metals and metal oxides.
- Investigate the fractional distillation of synthetic crude oil and the ease of ignition and viscosity of the fractions.
- Investigate the products produced from the complete combustion of a hydrocarbon.
- Investigate the cracking of paraffin oil.
- Investigate the properties of a group of elements, e.g. Group 2.
- Investigate the properties of typical ionic compounds.
- Test predictions of whether a precipitate forms when soluble salts are mixed.
- Carry out a series of ion tests to identify unknown compounds.
- Build models of simple covalent molecules.
- Investigate the typical properties of simple and giant covalent compounds.
- Investigate the rate of reactions, such as magnesium and hydrochloric acid; or sodium thiosulfate and hydrochloric acid.
- Determine the formula of a hydrated salt such as barium chloride or copper sulfate by heating to drive off water of crystallisation.
- Prepare a substance and calculate the % yield, given the theoretical yield.
- Evaporate a solution to dryness to determine the mass of solute in a given mass of solution.
- Investigate the mass changes at the electrodes during the electrolysis of copper sulfate solution using copper electrodes.
- Investigate the migration of ions in, e.g. potassium manganate (VII) solution.
- Electroplate a metal object.
- Determine the volume of one mole of hydrogen gas by using the reaction of magnesium with hydrochloric acid.
- Determine the molar volume by measuring the volume and mass of a gas (e.g. carbon dioxide).

- Investigate simple reversible reactions, such as the decomposition of ammonium chloride.

Safety is an overriding requirement for all practical work. Centres are responsible for ensuring that whenever their students complete practical work appropriate safety procedures are followed.

Appendix 7: The Periodic Table

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111		Elements with atomic numbers 112-116 have been reported but not fully authenticated					

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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Appendix 8: Glossary

Term	Definition
Assessment objectives	The requirements that students need to meet to succeed in the qualification. Each assessment objective has a unique focus, which is then targeted in examinations or coursework. Assessment objectives may be assessed individually or in combination.
External assessment	An examination that is held at the same time and place in a global region.
JCQ	Joint Council for Qualifications. This is a group of UK exam boards that develop policy related to the administration of examinations.
Linear	Linear qualifications have all assessments at the end of a course of study. It is not possible to take one assessment earlier in the course of study.

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