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INTERNATIONAL GCSE
Chemistry

Specification and Sample Assessment Material

Edexcel International GCSE in Chemistry (4CH0)

First examination June 2013

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International GCSE

Chemistry (4CH0)

Specification

First examination June 2013

An internationally recognised option within Edexcel's learning pathways for students

Depending on the learning approach that suits them, and the progression route that they wish to follow, different learning pathways can suit different students. For many, especially those capable of progression to further academic study in science-related subjects, this International GCSE qualification, forms an ideal grounding in scientific theory.

Used by many UK independent schools as well as renowned international schools, the content of the Certificate is:

- examined terminally to ensure secure acquisition of knowledge
- examined externally – controlled assessment is not required
- focused on the key theory that all students need to consider further study in Science.

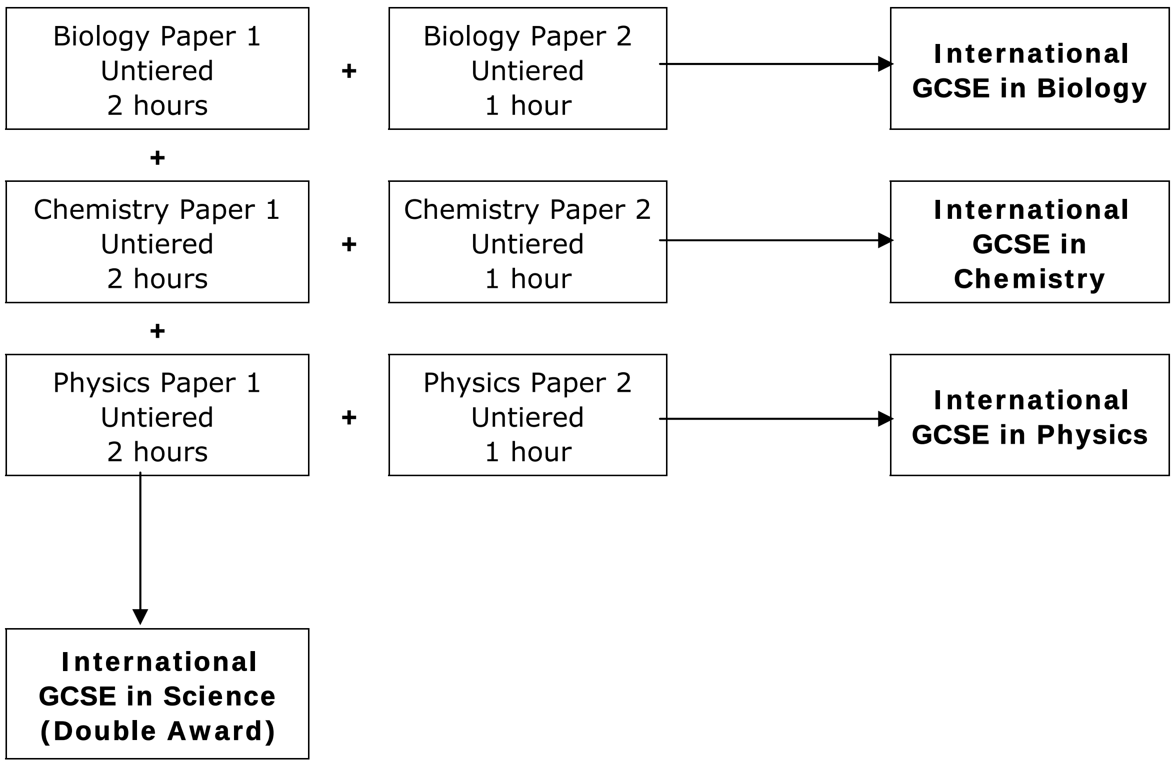
Introduction

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

The course gives students the opportunity to experience chemistry within the context of their general education. The course design provides a basis for progression to further study in GCE Advanced Subsidiary and Advanced Level Chemistry.

How assessment relates to the qualifications available is shown below.

The assessment for this qualification is linear and both papers need to be completed in the same series.



National Qualifications Framework (NQF) criteria

This specification complies with the requirements of the common criteria which are prescribed by the regulatory authorities.

About this specification

Key subject aims

The Edexcel International in GCSE Chemistry enables students to:

- learn about the unifying patterns and themes of chemistry
- acquire knowledge and understanding of chemical facts, concepts and principles
- appreciate the practical nature of chemistry, developing experimental and investigative skills based on correct and safe laboratory techniques
- appreciate the importance of accurate experimental work and reporting as scientific methods
- develop a logical approach to problem solving in a wider context
- understand the widespread importance of chemistry and how materials are used in the world
- evaluate, in terms of their chemical knowledge and understanding, the benefits and drawbacks of real-life applications of science, including their everyday, industrial and environmental aspects
- select, organise and present information clearly and logically, using appropriate scientific terms and conventions
- prepare for more advanced courses in chemistry and for other courses which require them to have a knowledge of chemistry.

Key features and benefits of the specification

Key features and benefits of the specification are:

- it includes aspects of science appropriate for the 21st century
- straightforward linear assessment
- untiered assessment
- assessment of experimental skills through an examination paper
- it provides a sound foundation for progression to Edexcel GCE Advanced Subsidiary (AS) and Advanced Level in Chemistry, and other comparable post-16 qualifications.

Contents

Specification at a glance

This Edexcel International GCSE in Chemistry comprises two externally assessed papers:

- Chemistry Paper 1
- Chemistry Paper 2

<table>
<tr><td>Chemistry Paper 1</td><td>Paper code: 4CH0/1C</td></tr>
<tr><td>• Externally assessed
• Availability: January and June series
• First assessment: June 2013</td><td>66.7% of the total qualification marks</td></tr>
<tr><td colspan="2">Overview of content
Assesses only the content not in bold
• Section 1: Principles of chemistry
• Section 2: Chemistry of the elements
• Section 3: Organic chemistry
• Section 4: Physical chemistry
• Section 5: Chemistry in industry</td></tr>
<tr><td colspan="2">Overview of assessment
• The paper is assessed through a 2-hour examination paper set and marked by Edexcel.
• The total number of marks is 120.
• Grades A*–G are available.</td></tr>
</table>

Chemistry Paper 2	Paper code: 4CH0/2C
• Externally assessed • Availability: January and June series • First assessment: June 2013	**33.3% of the total qualification marks**
Overview of content Assesses all content including content in **bold** • Section 1: Principles of chemistry • Section 2: Chemistry of the elements • Section 3: Organic chemistry • Section 4: Physical chemistry • Section 5: Chemistry in industry	
Overview of assessment • The paper is assessed through a 1-hour examination paper set and marked by Edexcel. • The total number of marks is 60. • Grades A*–G are available.	

Practicals

The best way to develop practical and investigative skills is to embed practical activities in your teaching of theory. The development of knowledge and skills can happen together, leading to secure acquisition of knowledge and skills.

There are some practicals in the specification content, which students need to describe. Knowledge of these practicals, and the ability to interpret the resulting data, is required for the examinations.

The teachers' guide materials contain additional suggested practicals.

Appendix 3 also contains some suggestions of practical activities.

Qualification content

Paper 1 assesses only the content that is **not** in bold.

Paper 2 assesses all content including content in **bold**.

This Edexcel International GCSE in Chemistry requires students to demonstrate an understanding of:

- principles of chemistry
- chemistry of the elements
- organic chemistry
- physical chemistry
- chemistry in industry.

Section 1: Principles of chemistry

a) States of matter

b) Atoms

c) Atomic structure

d) Relative formula masses and molar volumes of gases

e) Chemical formulae and chemical equations

f) Ionic compounds

g) Covalent substances

h) Metallic crystals

i) Electrolysis

a) States of matter

Students will be assessed on their ability to:

1.1 understand the arrangement, movement and energy of the particles in each of the three states of matter: solid, liquid and gas

1.2 understand how the interconversions of solids, liquids and gases are achieved and recall the names used for these interconversions

1.3 explain the changes in arrangement, movement and energy of particles during these interconversions.

b) Atoms

Students will be assessed on their ability to:

1.4 describe and explain experiments to investigate the small size of particles and their movement including:

- i dilution of coloured solutions
- ii diffusion experiments

1.5 understand the terms atom and molecule

1.6 understand the differences between elements, compounds and mixtures

1.7 describe experimental techniques for the separation of mixtures, including simple distillation, fractional distillation, filtration, crystallisation and paper chromatography

1.8 explain how information from chromatograms can be used to identify the composition of a mixture.

c) Atomic structure

Students will be assessed on their ability to:

1.9 understand that atoms consist of a central nucleus, composed of protons and neutrons, surrounded by electrons, orbiting in shells

1.10 recall the relative mass and relative charge of a proton, neutron and electron

1.11 understand the terms atomic number, mass number, isotopes and relative atomic mass (A_r)

1.12 calculate the relative atomic mass of an element from the relative abundances of its isotopes

1.13 understand that the Periodic Table is an arrangement of elements in order of atomic number

1.14 deduce the electronic configurations of the first 20 elements from their positions in the Periodic Table

1.15 deduce the number of outer electrons in a main group element from its position in the Periodic Table.

d) Relative formula masses and molar volumes of gases

Students will be assessed on their ability to:

1.16 calculate relative formula masses (M_r) from relative atomic masses (A_r)

1.17 understand the use of the term mole to represent the amount of substance

1.18 understand the term mole as the Avogadro number of particles (atoms, molecules, formulae, ions or electrons) in a substance

1.19 carry out mole calculations using relative atomic mass (A_r) and relative formula mass (M_r)

1.20 understand the term molar volume of a gas and use its values (24 dm^3 and 24,000 cm^3) at room temperature and pressure (rtp) in calculations.

e) Chemical formulae and chemical equations

Students will be assessed on their ability to:

1.21 write word equations and balanced chemical equations to represent the reactions studied in this specification

1.22 use the state symbols (s), (l), (g) and (aq) in chemical equations to represent solids, liquids, gases and aqueous solutions respectively

1.23 understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallisation

1.24 calculate empirical and molecular formulae from experimental data

1.25 calculate reacting masses using experimental data and chemical equations

1.26 calculate percentage yield

1.27 carry out mole calculations using volumes and molar concentrations.

f) Ionic compounds

Students will be assessed on their ability to:

1.28 describe the formation of ions by the gain or loss of electrons

1.29 understand oxidation as the loss of electrons and reduction as the gain of electrons

1.30 recall the charges of common ions in this specification

1.31 deduce the charge of an ion from the electronic configuration of the atom from which the ion is formed

1.32 explain, using dot and cross diagrams, the formation of ionic compounds by electron transfer, limited to combinations of elements from Groups 1, 2, 3 and 5, 6, 7

1.33 understand ionic bonding as a strong electrostatic attraction between oppositely charged ions

1.34 understand that ionic compounds have high melting and boiling points because of strong electrostatic forces between oppositely charged ions

1.35 understand the relationship between ionic charge and the melting point and boiling point of an ionic compound

1.36 describe an ionic crystal as a giant three-dimensional lattice structure held together by the attraction between oppositely charged ions

1.37 draw a diagram to represent the positions of the ions in a crystal of sodium chloride.

g) Covalent substances

Students will be assessed on their ability to:

1.38 describe the formation of a covalent bond by the sharing of a pair of electrons between two atoms

1.39 understand covalent bonding as a strong attraction between the bonding pair of electrons and the nuclei of the atoms involved in the bond

1.40 explain, using dot and cross diagrams, the formation of covalent compounds by electron sharing for the following substances:

- i hydrogen
- ii chlorine
- iii hydrogen chloride
- iv water
- v methane
- vi ammonia
- vii oxygen
- viii nitrogen
- ix carbon dioxide
- x ethane
- xi ethene

1.41 understand that substances with simple molecular structures are gases or liquids, or solids with low melting points

1.42 explain why substances with simple molecular structures have low melting and boiling points in terms of the relatively weak forces between the molecules

1.43 explain the high melting and boiling points of substances with giant covalent structures in terms of the breaking of many strong covalent bonds

1.44 draw diagrams representing the positions of the atoms in diamond and graphite

1.45 explain how the uses of diamond and graphite depend on their structures, limited to graphite as a lubricant and diamond in cutting.

h) Metallic crystals

Students will be assessed on their ability to:

1.46 understand that a metal can be described as a giant structure of positive ions surrounded by a sea of delocalised electrons

1.47 explain the electrical conductivity and malleability of a metal in terms of its structure and bonding.

i) Electrolysis

Students will be assessed on their ability to:

1.48 understand that an electric current is a flow of electrons or ions

1.49 understand why covalent compounds do not conduct electricity

1.50 understand why ionic compounds conduct electricity only when molten or in solution

1.51 describe experiments to distinguish between electrolytes and non-electrolytes

1.52 understand that electrolysis involves the formation of new substances when ionic compounds conduct electricity

1.53 describe experiments to investigate electrolysis, using inert electrodes, of molten salts such as lead(II) bromide and predict the products

1.54 describe experiments to investigate electrolysis, using inert electrodes, of aqueous solutions such as sodium chloride, copper(II) sulfate and dilute sulfuric acid and predict the products

1.55 write ionic half-equations representing the reactions at the electrodes during electrolysis

1.56 recall that one faraday represents one mole of electrons

1.57 calculate the amounts of the products of the electrolysis of molten salts and aqueous solutions.

Section 2: Chemistry of the elements

a) The Periodic Table

b) Group 1 elements – lithium, sodium and potassium

c) Group 7 elements – chlorine, bromine and iodine

d) Oxygen and oxides

e) Hydrogen and water

f) Reactivity series

g) Tests for ions and gases

a) The Periodic Table

Students will be assessed on their ability to:

2.1 understand the terms group and period

2.2 recall the positions of metals and non-metals in the Periodic Table

2.3 explain the classification of elements as metals or non-metals on the basis of their electrical conductivity and the acid-base character of their oxides

2.4 understand why elements in the same group of the Periodic Table have similar chemical properties

2.5 understand that the noble gases (Group 0) are a family of inert gases and explain their lack of reactivity in terms of their electronic configurations.

b) Group 1 elements — lithium, sodium and potassium

Students will be assessed on their ability to:

2.6 describe the reactions of these elements with water and understand that the reactions provide a basis for their recognition as a family of elements

2.7 describe the relative reactivities of the elements in Group 1

2.8 explain the relative reactivities of the elements in Group 1 in terms of distance between the outer electrons and the nucleus.

c) Group 7 elements — chlorine, bromine and iodine

Students will be assessed on their ability to:

2.9 recall the colours and physical states of the elements at room temperature

2.10 make predictions about the properties of other halogens in this group

2.11 understand the difference between hydrogen chloride gas and hydrochloric acid

2.12 explain, in terms of dissociation, why hydrogen chloride is acidic in water but not in methylbenzene

2.13 describe the relative reactivities of the elements in Group 7

2.14 describe experiments to demonstrate that a more reactive halogen will displace a less reactive halogen from a solution of one of its salts

2.15 understand these displacement reactions as redox reactions.

d) Oxygen and oxides

Students will be assessed on their ability to:

2.16 recall the gases present in air and their approximate percentage by volume

2.17 explain how experiments involving the reactions of elements such as copper, iron and phosphorus with air can be used to investigate the percentage by volume of oxygen in air

2.18 describe the laboratory preparation of oxygen from hydrogen peroxide, using manganese(IV) oxide as a catalyst

2.19 describe the reactions of magnesium, carbon and sulfur with oxygen in air, and the acid-base character of the oxides produced

2.20 describe the laboratory preparation of carbon dioxide from calcium carbonate and dilute hydrochloric acid

2.21 describe the formation of carbon dioxide from the thermal decomposition of metal carbonates such as copper(II) carbonate

2.22 describe the properties of carbon dioxide, limited to its solubility and density

2.23 explain the use of carbon dioxide in carbonating drinks and in fire extinguishers, in terms of its solubility and density

2.24 understand that carbon dioxide is a greenhouse gas and may contribute to climate change.

e) Hydrogen and water

Students will be assessed on their ability to:

2.25 describe the reactions of dilute hydrochloric and dilute sulfuric acids with magnesium, aluminium, zinc and iron

2.26 describe the combustion of hydrogen

2.27 describe the use of anhydrous copper(II) sulfate in the chemical test for water

2.28 describe a physical test to show whether water is pure.

f) Reactivity series

Students will be assessed on their ability to:

2.29 understand that metals can be arranged in a reactivity series based on the reactions of the metals and their compounds: potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, copper, silver and gold

2.30 describe how reactions with water and dilute acids can be used to deduce the following order of reactivity: potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper

2.31 deduce the position of a metal within the reactivity series using displacement reactions between metals and their oxides, and between metals and their salts in aqueous solutions

2.32 understand oxidation and reduction as the addition and removal of oxygen respectively

2.33 understand the terms redox, oxidising agent, reducing agent

2.34 describe the conditions under which iron rusts

2.35 describe how the rusting of iron may be prevented by grease, oil, paint, plastic and galvanising

2.36 understand the sacrificial protection of iron in terms of the reactivity series.

g) Tests for ions and gases

Students will be assessed on their ability to:

2.37 describe tests for the cations:

- i Li^+, Na^+, K^+, Ca^{2+} using flame tests
- ii NH_4^+, using sodium hydroxide solution and identifying the ammonia evolved
- iii Cu^{2+}, Fe^{2+} and Fe^{3+}, using sodium hydroxide solution

2.38 describe tests for the anions:

- i Cl^-, Br^- and I^-, using dilute nitric acid and silver nitrate solution
- ii SO_4^{2-}, using dilute hydrochloric acid and barium chloride solution
- iii CO_3^{2-}, using dilute hydrochloric acid and identifying the carbon dioxide evolved

2.39 describe tests for the gases:

- i hydrogen
- ii oxygen
- iii carbon dioxide
- iv ammonia
- v chlorine.

Section 3: Organic chemistry

a) Introduction

b) Alkanes

c) Alkenes

d) Ethanol

a) Introduction

Students will be assessed on their ability to:

3.1 explain the terms homologous series, hydrocarbon, saturated, unsaturated, general formula and isomerism.

b) Alkanes

Students will be assessed on their ability to:

3.2 recall that alkanes have the general formula C_nH_{2n+2}

3.3 draw displayed formulae for alkanes with up to five carbon atoms in a molecule, and name the straight-chain isomers

3.4 recall the products of the complete and incomplete combustion of alkanes

3.5 describe the substitution reaction of methane with bromine to form bromomethane in the presence of UV light.

c) Alkenes

Students will be assessed on their ability to:

3.6 recall that alkenes have the general formula C_nH_{2n}

3.7 draw displayed formulae for alkenes with up to four carbon atoms in a molecule, and name the straight-chain isomers (knowledge of cis- and trans-isomers is not required)

3.8 describe the addition reaction of alkenes with bromine, including the decolourising of bromine water as a test for alkenes.

d) Ethanol

Students will be assessed on their ability to:

3.9 describe the <u>manufacture</u> of ethanol by passing ethene and steam over a phosphoric acid catalyst at a temperature of about 300°C and a pressure of about 60–70 atm

3.10 describe the <u>manufacture</u> of ethanol by the fermentation of sugars, for example glucose, at a temperature of about 30°C

3.11 evaluate the factors relevant to the choice of method used in the manufacture of ethanol, for example the relative availability of sugar cane and crude oil

3.12 describe the dehydration of ethanol to ethene, using aluminium oxide.

Section 4: Physical chemistry

a) Acids, alkalis and salts

b) Energetics

c) Rates of reaction

d) Equilibria

a) Acids, alkalis and salts

Students will be assessed on their ability to:

4.1 describe the use of the indicators litmus, phenolphthalein and methyl orange to distinguish between acidic and alkaline solutions

4.2 understand how the pH scale, from 0–14, can be used to classify solutions as strongly acidic, weakly acidic, neutral, weakly alkaline or strongly alkaline

4.3 describe the use of universal indicator to measure the approximate pH value of a solution

4.4 define acids as sources of hydrogen ions, H^+, and alkalis as sources of hydroxide ions, OH^-

4.5 predict the products of reactions between dilute hydrochloric, nitric and sulfuric acids; and metals, metal oxides and metal carbonates (excluding the reactions between nitric acid and metals)

4.6 understand the general rules for predicting the solubility of salts in water:

- i all common sodium, potassium and ammonium salts are soluble
- ii all nitrates are soluble
- iii common chlorides are soluble, except silver chloride
- iv common sulfates are soluble, except those of barium and calcium
- v common carbonates are insoluble, except those of sodium, potassium and ammonium

4.7 describe experiments to prepare soluble salts from acids

4.8 describe experiments to prepare insoluble salts using precipitation reactions

4.9 describe experiments to carry out acid-alkali titrations.

b) Energetics

Students will be assessed on their ability to:

4.10 understand that chemical reactions in which heat energy is given out are described as exothermic and those in which heat energy is taken in are endothermic

4.11 describe simple calorimetry experiments for reactions such as combustion, displacement, dissolving and neutralisation in which heat energy changes can be calculated from measured temperature changes

4.12 calculate molar enthalpy change from heat energy change

4.13 understand the use of ΔH to represent enthalpy change for exothermic and endothermic reactions

4.14 represent exothermic and endothermic reactions on a simple energy level diagram

4.15 understand that the breaking of bonds is endothermic and that the making of bonds is exothermic

4.16 use average bond energies to calculate the enthalpy change during a simple chemical reaction.

c) Rates of reaction

Students will be assessed on their ability to:

4.17 describe experiments to investigate the effects of changes in surface area of a solid, concentration of solutions, temperature and the use of a catalyst on the rate of a reaction

4.18 describe the effects of changes in surface area of a solid, concentration of solutions, pressure of gases, temperature and the use of a catalyst on the rate of a reaction

4.19 understand the term activation energy and represent it on a reaction profile

4.20 explain the effects of changes in surface area of a solid, concentration of solutions, pressure of gases and temperature on the rate of a reaction in terms of particle collision theory

4.21 explain that a catalyst speeds up a reaction by providing an alternative pathway with lower activation energy.

d) Equilibria

Students will be assessed on their ability to:

4.22 understand that some reactions are reversible and are indicated by the symbol $\rightleftharpoons$ in equations

4.23 describe reversible reactions such as the dehydration of hydrated copper(II) sulfate and the effect of heat on ammonium chloride

4.24 understand the concept of dynamic equilibrium

4.25 predict the effects of changing the pressure and temperature on the equilibrium position in reversible reactions.

Section 5: Chemistry in industry

a) Extraction and uses of metals

b) Crude oil

c) Synthetic polymers

d) The industrial manufacture of chemicals

a) Extraction and uses of metals

Students will be assessed on their ability to:

5.1 explain how the methods of extraction of the metals in this section are related to their positions in the reactivity series

5.2 describe and explain the extraction of aluminium from <u>purified</u> aluminium oxide by electrolysis, including:

- i the use of molten cryolite as a solvent and to decrease the required operating temperature
- ii the need to replace the positive electrodes
- iii the cost of the electricity as a major factor

5.3 write ionic half-equations for the reactions at the electrodes in aluminium extraction

5.4 describe and explain the main reactions involved in the extraction of iron from iron ore (haematite), using coke, limestone and air in a blast furnace

5.5 explain the uses of aluminium and iron, in terms of their properties.

b) Crude oil

Students will be assessed on their ability to:

5.6 understand that crude oil is a mixture of hydrocarbons

5.7 describe and explain how the industrial process of fractional distillation separates crude oil into fractions

5.8 recall the names and uses of the main fractions obtained from crude oil: refinery gases, gasoline, kerosene, diesel, fuel oil and bitumen

5.9 describe the trend in boiling point and viscosity of the main fractions

5.10 understand that incomplete combustion of fuels may produce carbon monoxide and explain that carbon monoxide is poisonous because it reduces the capacity of the blood to carry oxygen

5.11 understand that, in car engines, the temperature reached is high enough to allow nitrogen and oxygen from air to react, forming nitrogen oxides

5.12 understand that nitrogen oxides and sulfur dioxide are pollutant gases which contribute to acid rain, and describe the problems caused by acid rain

5.13 understand that fractional distillation of crude oil produces more long-chain hydrocarbons than can be used directly and fewer short-chain hydrocarbons than required and explain why this makes cracking necessary

5.14 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°C.

c) Synthetic polymers

Students will be assessed on their ability to:

5.15 understand that an addition polymer is formed by joining up many small molecules called monomers

5.16 draw the repeat unit of addition polymers, including poly(ethene), poly(propene) **and poly(chloroethene)**

5.17 deduce the structure of a monomer from the repeat unit of an addition polymer

5.18 describe some uses for polymers, including poly(ethene), poly(propene) **and poly(chloroethene)**

5.19 explain that addition polymers are hard to dispose of as their inertness means that they do not easily biodegrade

5.20 understand that some polymers, such as nylon, form by a different process called condensation polymerisation

5.21 understand that condensation polymerisation produces a small molecule, such as water, as well as the polymer.

d) The industrial manufacture of chemicals

Students will be assessed on their ability to:

5.22 understand that nitrogen from air, and hydrogen from natural gas or the cracking of hydrocarbons, are used in the manufacture of ammonia

5.23 describe the manufacture of ammonia by the Haber process, including the essential conditions:

i a temperature of about 450°C

ii a pressure of about 200 atmospheres

iii an iron catalyst

5.24 understand how the cooling of the reaction mixture liquefies the ammonia produced and allows the unused hydrogen and nitrogen to be recirculated

5.25 describe the use of ammonia in the manufacture of nitric acid and fertilisers

5.26 recall the raw materials used in the manufacture of sulfuric acid

5.27 describe the manufacture of sulfuric acid by the contact process, including the essential conditions:

i a temperature of about 450°C

ii a pressure of about 2 atmospheres

iii a vanadium(V) oxide catalyst

5.28 describe the use of sulfuric acid in the manufacture of detergents, fertilisers and paints

5.29 describe the manufacture of sodium hydroxide and chlorine by the electrolysis of concentrated sodium chloride solution (brine) in a diaphragm cell

5.30 write ionic half-equations for the reactions at the electrodes in the diaphragm cell

5.31 describe important uses of sodium hydroxide, including the manufacture of bleach, paper and soap; and of chlorine, including sterilising water supplies and in the manufacture of bleach and hydrochloric acid.

Assessment

Assessment summary

Paper 1 is externally assessed through an examination paper lasting 2 hours.

Paper 2 is externally assessed through an examination paper lasting 1 hour.

The assessment for this qualification is linear and both papers must be taken in the same series.

There will be a range of compulsory, short-answer structured questions in both papers which are ramped to ensure accessibility for less able students, as well as to stretch more able students.

Students may be required to perform calculations, draw graphs and describe, explain and interpret chemical phenomena. Some of the question content will be unfamiliar to students; these questions are designed to assess data-handling skills and the ability to apply chemical principles to unfamiliar situations. Questions targeted at grades A*–B will include questions designed to test knowledge, understanding and skills at a higher level, including some requiring longer prose answers.

Summary of table of assessment

Chemistry Paper 1	**Paper code: 4CH0/1C**
• Externally assessed • Availability: January and June series • First assessment: June 2013 • Assesses all Assessment Objectives • Maximum mark 120 • 2-hour examination • Assesses specification content **not** in bold	
Chemistry Paper 2	**Paper code: 4CH0/2C**
• Externally assessed • Availability: January and June series • First assessment: June 2013 • Assesses all Assessment Objectives • Maximum mark 60 • 1-hour examination • Assesses all specification content, including that in **bold**	

Assessment Objectives and weightings

In the examination, students will be tested on the following areas:

AO1 Knowledge and understanding

AO2 Application of knowledge and understanding, analysis and evaluation

AO3 Experimental skills, analysis and evaluation of data and methods

Assessment Objectives weightings

	% in GCSE
AO1: Knowledge and understanding*	45–50%
AO2: Application of knowledge and understanding, analysis and evaluation	27.5–32.5%
AO3: Experimental skills, analysis and evaluation of data and methods	20–25%
TOTAL	**100%**

Relationship of Assessment Objectives to Papers for Certificate

Paper number	Assessment Objectives			
	AO1*	AO2	AO3	Total marks for AO1, AO2 and AO3
Chemistry Paper 1	54–60 marks	33–39 marks	24–30 marks	120 marks
Chemistry Paper 2	27–30 marks	16–20 marks	12–15 marks	60 marks
Percentage of Certificate	45–50%	27.5–32.5%	20–25%	100%

* No more than 50% of the AO1 marks **for the International GCSE** will be for recall of knowledge

Entering your students for assessment

Student entry

Details of how to enter students for this qualification can be found in Edexcel's *International Information Manual*, copies of which are sent to all active Edexcel centres. The information can also be found on the Edexcel website.

Forbidden combinations

It is forbidden for students to take this qualification at the same time as the following:

- Edexcel Level 1/Level 2 Certificate in Chemistry (KCH0)
- Edexcel Level 1/Level 2 Certificate in Science (Double Award) (KSC0)
- Edexcel International GCSE in Science (Double Award) (4SC0).

Classification code

Centres should be aware that students who enter for more than one qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE, International GCSE and Entry Level qualifications aims to enhance access to the qualifications for students with disabilities and other difficulties without compromising the assessment of skills, knowledge, understanding or competence.

Please see the Edexcel website (www.edexcel.com) for:

- the Joint Council for Qualifications (JCQ) policy *Access Arrangements, Reasonable Adjustments and Special Considerations 2010–2011*
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

Requests for access arrangements and special considerations must be addressed to:

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

Please see the Edexcel website (www.edexcel.com) for information on the Equality Act 2010

Health and safety

Students must follow the health and safety rules which normally operate in their laboratories.

Responsibility for safety during practical activities rests with the centre.

With all laboratory practicals it is essential that centres carry out a detailed risk assessment before allowing students to carry out the practical.

For further information on risk assessments and chemical hazards please refer to the CLEAPSS website (www.cleapss.org.uk).

Assessing your students

The first assessment opportunity for Chemistry Paper 1 and Chemistry Paper 2 in this qualification will take place in the June 2013 series and in each January and June series thereafter for the lifetime of the specification.

Your student assessment opportunities

	June 2012	Jan 2013	June 2013	Jan 2014
Chemistry			✓	✓

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The International GCSE qualification will be graded and certificated on an eight-grade scale from A* to G.

The first certification opportunity for the Edexcel International GCSE in Chemistry will be June 2013.

Students whose level of achievement is below the minimum judged by Edexcel to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Language of assessment

Assessment of this qualification will be available in English only. Assessment materials will be published in English only and all work submitted for examination and moderation must be produced in English.

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the JCQ's *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document on the JCQ website, www.jcq.org.uk.

Student recruitment

Edexcel's access 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.

Guided learning hours

The number of guided learning hours required for this qualification is 120–140.

This reflects how centres will use time for practical activities differently.

Progression

This qualification supports progression to:

- Edexcel GCE Advanced Subsidiary and Advanced Level in Chemistry
- Edexcel Level 3 BTEC National Award/Certificate/Diploma in Applied Science.

Grade descriptions

Grade A

Candidates can:

- recall a wide range of knowledge from all areas of the specification
- use detailed scientific knowledge and understanding in many different areas relating to scientific systems or phenomena. For example, they routinely use a range of balanced chemical equations and the particle model to explain variations in reaction rates
- draw together and communicate knowledge from more than one area, routinely use scientific or mathematical conventions in support of arguments, and use a wide range of scientific and technical vocabulary throughout their work
- use scientific knowledge and understanding to describe an appropriate method for a practical task, identifying the key factors to be considered. They can recall or describe a range of apparatus required for the task. They can select a method of presenting data that is appropriate to the task; they can select information from a range of sources where it is appropriate to do so. They can identify and explain anomalous observations and measurements and the salient features of graphs
- use scientific knowledge and understanding to identify and explain patterns and draw conclusions from the evidence by combining data of more than one kind or from more than one source. They can identify shortcomings in the evidence, use scientific knowledge and understanding to draw conclusions from their evidence and suggest improvements to the methods used that would enable them to collect more reliable evidence.

Grade C

Candidates can:

- recall a range of scientific information from all areas of the specification, for example they recall simple chemical symbols and formulae
- use and apply scientific knowledge and understanding in some general contexts, for example, they use simple balanced equations
- describe links between related phenomena in different contexts; use diagrams, charts and graphs to support arguments; use appropriate scientific and technical vocabulary in a range of contexts
- use scientific knowledge and understanding to identify an approach to a practical scenario. For example, they can identify key factors to vary and control; they can recall or describe a range of apparatus required for the task; they can present data systematically, in graphs where appropriate, and use lines of best fit; they can identify and explain patterns within data and draw conclusions consistent with the evidence. They can explain these conclusions on the basis of their scientific knowledge and understanding, and evaluate how strongly their evidence supports the conclusions.

Grade F

Candidates can:

- recall a limited range of information, for example they state some uses of materials obtained from oil
- use and apply knowledge and understanding in some specific everyday contexts, for example they suggest a way of speeding up a particular chemical reaction
- make some use of scientific and technical vocabulary and make simple generalisations from information
- devise fair tests in contexts which involve only a few factors. They can recall or describe simple apparatus appropriate for the task. They can obtain information from simple tables, charts and graphs and identify simple patterns in information and observations. They can offer explanations consistent with the evidence obtained.

Support and training

Edexcel support services

Edexcel has a wide range of support services to help you implement this qualification successfully.

ResultsPlus – ResultsPlus is an application launched by Edexcel to help subject teachers, senior management teams and students by providing detailed analysis of examination performance. Reports that compare performance between subjects, classes, your centre and similar centres can be generated with one click. Skills maps that show performance according to the specification topic being tested are available for some subjects. For further information about which subjects will be analysed through ResultsPlus, and for information on how to access and use the service, please visit www.edexcel.com/resultsplus.

Ask the Expert – to make it easier for you to raise a query with us online, we have merged our **Ask Edexcel** and **Ask the Expert** services.

There is now one easy-to-use web query form that will allow you to ask any question about the delivery or teaching of Edexcel qualifications. You will receive a personal response, from one of our administrative or teaching experts, sent to the email address you provide.

We'll also be doing lots of work to improve the quantity and quality of information in our FAQ database where you will be able to find answers to many questions.

Examzone – the Examzone site is aimed at students sitting external examinations and gives information on revision, advice from examiners and guidance on results, including remarking, resitting and progression opportunities. Further services for students – many of which will also be of interest to parents – will be available in the near future. Links to this site can be found on the main homepage at www.examzone.co.uk.

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel. Full details can be obtained from our website: www.edexcel.com.

Appendices

Appendix 1: Periodic Table

The Periodic Table of the Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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						

***** *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.

Appendix 2: Wider curriculum

Signposting and development suggestions

Issue	Paper	Opportunities for development
Spiritual	None	
Moral	All	5b
Ethical	None	
Social	All	2.24, 5.5, 5b
Legislative	All	5b
Economic	All	5.2, 5b, 5.28
Cultural	None	
Sustainable	All	2.24, 5b
Health and safety	All	5b, practical work
European initiatives	All	2.24

Appendix 3: Suggested practicals

The following suggestions for practical investigations exemplify the scientific process and can support students' understanding of the subject

- **Investigate the proportion of oxygen in the atmosphere**
- **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 presence of water vapour and carbon dioxide in the atmosphere
- 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
- Investigate mass changes before and after the reaction of eg copper sulfate and sodium chloride
- Carry out simple neutralisation reactions of acids, using metal oxides, hydroxides and/or carbonates
- Carry out tests for hydrogen, chlorine and oxygen.
- 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 properties of a metal, such as electrical conductivity
- 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
- Prepare an insoluble salt by precipitation
- Classify different types of elements and compounds by investigating their melting points and boiling points, solubility in water and electrical conductivity (as solids and in solution) including sodium chloride, magnesium sulfate, hexane, liquid paraffin, silicon(IV) oxide, copper sulfate, and sucrose (sugar)
- Investigate the effect of temperature, concentration and surface area of a solid on the rate of a reaction such as hydrochloric acid and marble chips
- Determine the empirical formula of a simple compound, such as magnesium oxide
- Investigate the properties of a group of elements, eg Group 2
- Investigate the properties of typical ionic compounds
- Test predictions of whether a precipitate forms when soluble salts are combined
- 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
- Use paper chromatography to separate inks, food dyes etc
- Investigate the properties of metals
- Carry out an activity to show that transition metal salts have a variety of colours
- Investigate heat energy changes in neutralisation and/or displacement reactions
- Investigate the rate of reactions, such as magnesium and hydrochloric acid; or sodium thiosulfate and hydrochloric acid
- Investigate the effect of potential catalysts on the rate of decomposition of hydrogen peroxide
- Determine the formula of copper oxide by reduction of the oxide to copper
- 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, eg 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 using a heavier gas (eg carbon dioxide)
- Investigate simple reversible reactions, such as the decomposition of ammonium chloride

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International GCSE

Chemistry (4CH0)

Sample Assessment Material

First examination June 2013

Contents

Paper 1C

Paper 2C

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, ie if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Write your name here

Surname	Other names

Edexcel
International GCSE

Centre Number

Candidate Number

Chemistry

Paper: 1C

Sample Assessment Material
Time: 2 hours

Paper Reference
4CH0/1C

You must have:
Ruler
Candidates may use a calculator.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is **120**.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

The Periodic Table of the Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
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***** The Lanthanides (atomic numbers 58-71) and the Actinides(atomic numbers 90-103) have been omitted.**

Cu and Cl have not been rounded to the nearest whole number.

Answer ALL questions.

1 The table shows the properties of four substances.

Use the information in the table to answer the following questions.

Substance	Melting point in °C	Boiling point in °C	Conducts electricity when	
			solid	liquid
A	1650	2230	no	no
B	1538	2862	yes	yes
C	– 7	59	no	no
D	801	1413	no	yes

Place a cross (☒) in the appropriate box to indicate your answer.

Choose from **A** to **D** a substance that could be:

(5)

(a) a metal

A ☒ **B** ☒ **C** ☒ **D** ☒

(b) a giant covalent structure

A ☒ **B** ☒ **C** ☒ **D** ☒

(c) an ionic compound

A ☒ **B** ☒ **C** ☒ **D** ☒

(d) a liquid at 25 °C

A ☒ **B** ☒ **C** ☒ **D** ☒

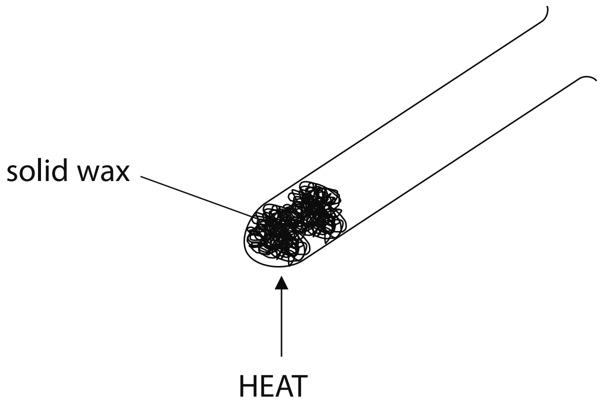
(e) a solid at 1600 °C

A ☒ **B** ☒ **C** ☒ **D** ☒

(Total for Question 1 = 5 marks)

2 A student investigated what happened when a sample of wax was heated using a Bunsen burner.

He set up the apparatus as shown in the diagram.



The student heated the solid wax strongly with a Bunsen burner until it turned into a liquid.

(a) Give the name of the process that occurs when a solid turns into a liquid.

(1)

....

(b) Explain **one** change needed to make the experiment safer.

(2)

....

....

....

....

(c) Describe the changes in arrangement, movement and energy of the particles when the liquid wax cools to become a solid.

(3)

....

....

....

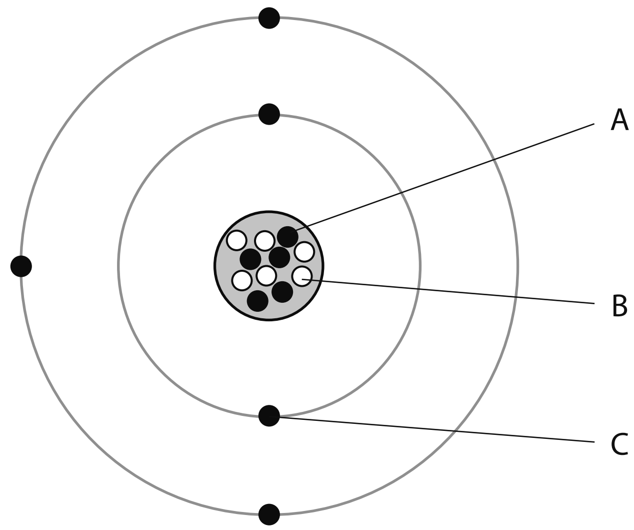
....

....

....

(Total for Question 2 = 6 marks)

3 The diagram represents an atom of an element.



(a) The diagram shows that there are equal numbers of particles **A** and **C**.

(i) State the name of each of the particles **A** and **B**.

(2)

A ....

B ....

(ii) State the atomic number and mass number of this atom.

(2)

Atomic number ....

Mass number ....

(b) (i) State the **name** of this element.

(1)

....

(ii) State the electronic configuration of this element.

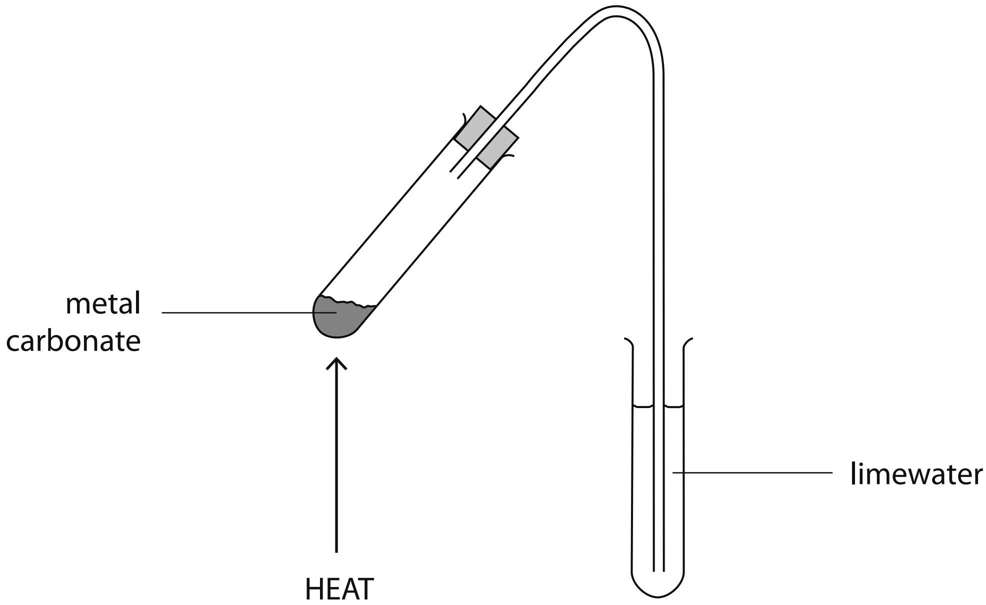
(1)

....

(Total for Question 3 = 6 marks)

4 A student wanted to find out how easily different metal carbonates decomposed on heating.

She placed a sample of a metal carbonate into a test tube and heated it, passing the gas given off through limewater using the apparatus shown in the diagram.



She heated three other metal carbonates in turn and measured the time taken for the limewater to turn milky.

Her results are given in the table.

Metal carbonate	Time taken in seconds
copper(II) carbonate	5
magnesium carbonate	25
lead(II) carbonate	15
sodium carbonate	does not turn milky

(a) State the name of the gas that causes the limewater to turn milky.

(1)

....

(b) Use the results to identify, with a reason, which metal carbonate decomposed most easily.

(2)

....

....

....

(c) What do the results suggest about the effect of heat on sodium carbonate?

(1)

....

(d) State **two** things that the student must do to make sure the experiment is valid (a fair test).

(2)

1 ....

....

2 ....

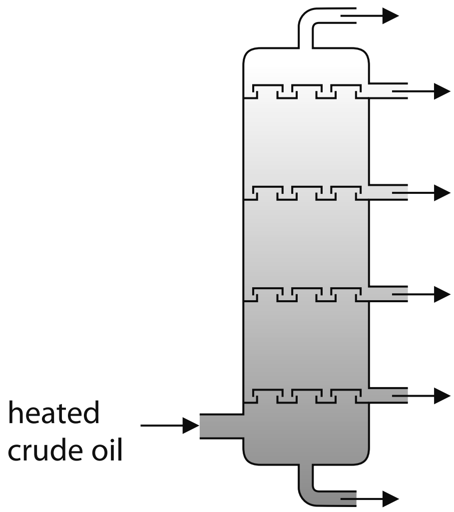
....

(Total for Question 4 = 6 marks)

5 Fractional distillation is an important process in the oil industry.

In this process, the crude oil is separated into a number of fractions. Each fraction is a mixture of hydrocarbons.

The diagram shows the column used for fractional distillation.



(a) What is meant by the term **hydrocarbon**?

(2)

....

....

(b) Bitumen, diesel, gasoline and refinery gases are three of the fractions obtained from crude oil.

(i) Which one of these three fractions has the lowest boiling point?

(1)

....

(ii) Which one of these three fractions is the most viscous?

(1)

....

(c) Explain how the separation of crude oil into fractions takes place in the fractionating column.

(4)

....

....

....

....

....

....

....

....

....

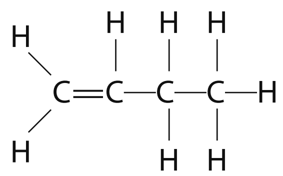
....

(Total for Question 5 = 8 marks)

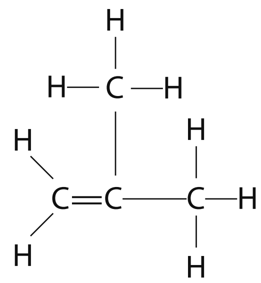
6 (a) Isomers are compounds that have the same molecular formula but different displayed formulae.

The molecular formula C_4H_8 represents several isomers.

The displayed formulae and names for two of these isomers are



but-1-ene



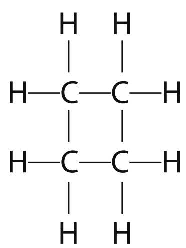
methylpropene

(i) Draw the displayed formula and give the name for another alkene with the molecular formula C_4H_8

(2)

Name ....

(ii) The displayed formula of another isomer of C_4H_8 is



cyclobutane

The general formula of cyclobutane is also C_nH_{2n}

State why cyclobutane is not an alkene.

(1)

....

....

(iii) Cyclobutane can be distinguished from but-1-ene by adding bromine water and shaking. Bromine water is orange.

State what you would see when bromine water is shaken separately with each compound.

(2)

Observation with cyclobutane

....

Observation with but-1-ene

....

(b) Cracking is used to break long alkane molecules into shorter alkanes and alkenes.

Explain why this process is of such importance in the petrochemical industry.

(2)

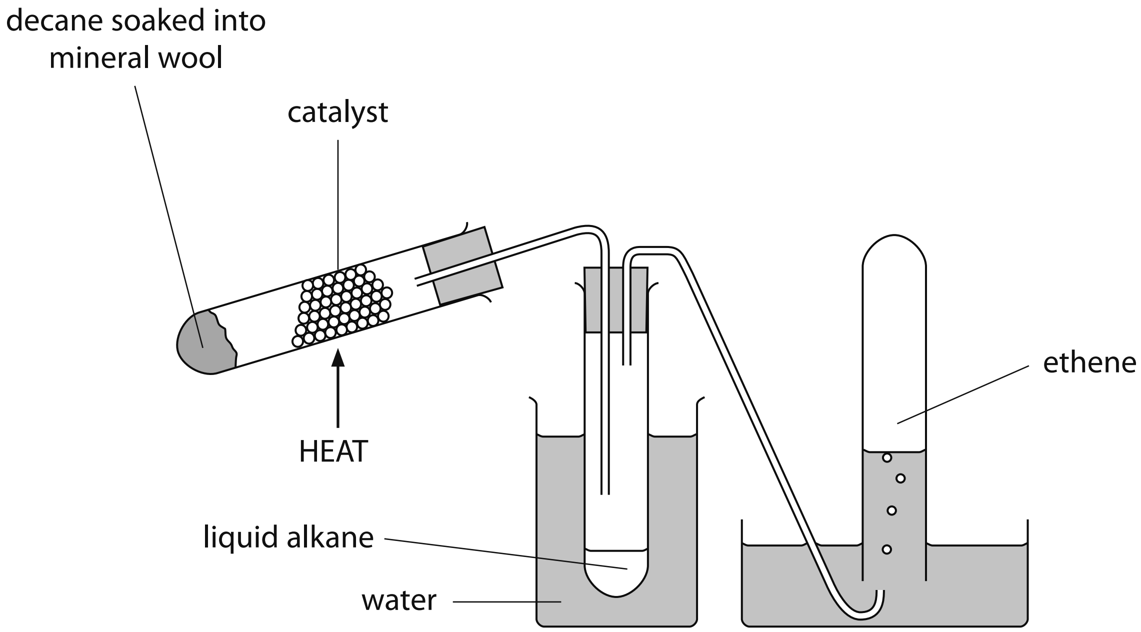
....

....

....

....

(c) Cracking can be carried out in the laboratory by passing the vapour of an alkane over a heated catalyst using the apparatus shown.



When decane ($C_{10}H_{22}$) is cracked, a shorter chain alkane and ethene (C_2H_4) can be produced.

(i) Write a chemical equation for the cracking of decane.

(2)

....

(ii) The alkane produced can be used as a fuel for cars.

When this fuel is burned in a car engine, some incomplete combustion occurs. This produces carbon monoxide, which is dangerous to humans.

Explain why carbon monoxide is dangerous to humans.

(2)

....

....

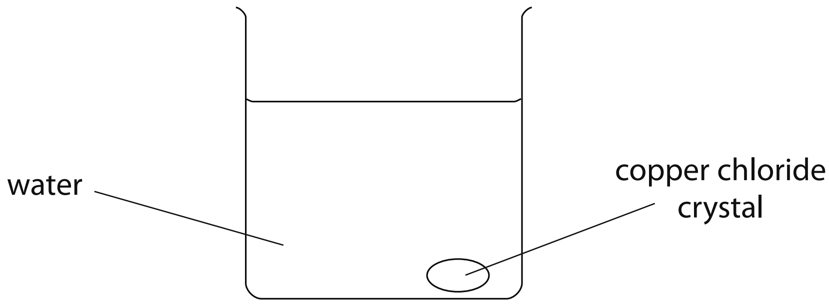
....

....

(Total for Question 6 = 11 marks)

7 Copper chloride is a soluble ionic compound. Solid copper chloride is green.

(a) A crystal of copper chloride was placed in a beaker containing water. It was left for several days.



Explain how the appearance of the liquid in the beaker changes after several days.

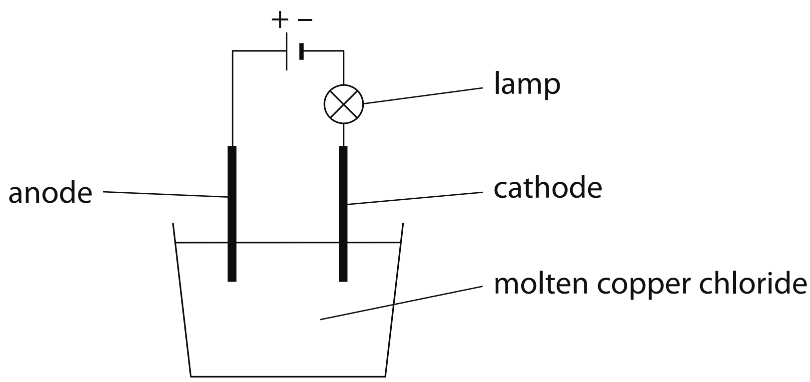
(2)

....

....

....

(b) A chemist electrolyses a sample of molten copper chloride, $CuCl_2$.



Name the products formed at the electrodes.

(2)

Anode ....

Cathode ....

(c) Write an equation to show the formation of the product at the negative electrode.

(2)

....

(Total for Question 7 = 6 marks)

8 Equal masses of iron, magnesium and zinc were placed in separate beakers, each containing 50 cm^3 of copper(II) sulfate solution.

The mass of copper displaced in each case was found and each experiment was performed three times. The results obtained are given in the table.

Metal	Mass of copper produced in grams		
	Experiment 1	**Experiment 2**	**Experiment 3**
iron	1.1	1.3	1.2
magnesium	2.3	3.2	2.2
zinc	0.9	0.8	1.10

(a) How can you tell that one of the results has been recorded to a greater precision than the others?

(1)

....

....

(b) Write a chemical equation for the reaction taking place between magnesium and copper(II) sulfate.

(2)

....

....

(c) (i) State, in terms of electrons, what happens when a copper ion becomes a copper atom.

(1)

....

(ii) What name is given to the type of change occurring in (c)(i)?

(1)

....

(iii) State **two** observations you would expect to make when magnesium is added to copper(II) sulfate solution.

(2)

....

....

(Total for Question 8 = 7 marks)

9 (a) An aqueous solution of hydrogen peroxide (H_2O_2) decomposes very slowly into water (H_2O) and oxygen (O_2) according to the following equation:

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The reaction is faster when manganese(IV) oxide (MnO_2) is added. The manganese(IV) oxide remains chemically unchanged at the end of the reaction.

A student investigated the reaction in the presence of manganese(IV) oxide. He collected the oxygen gas produced and recorded its volume every five minutes. His results are shown in the table.

Time in minutes	0	5	10	15	20	25	30	35	40
Volume in cm^3	0	20	32	42	50	55	58	60	60

(i) The volume of gas given off between 5 and 10 minutes is 12 cm^3.

Calculate the volume of gas given off between 30 and 35 minutes.

(1)

Answer .... cm^3

(ii) Explain, in terms of the changes in the rate of the reaction and collisions between particles, why your calculated volume is less than 12 cm^3.

(3)

....

....

....

....

....

(iii) After how many minutes did the reaction finish?

(1)

....

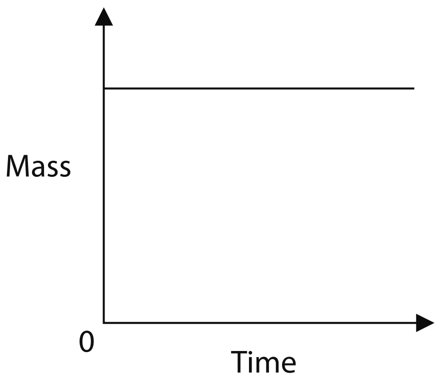
(b) What type of substance is manganese(IV) oxide in this experiment?

(1)

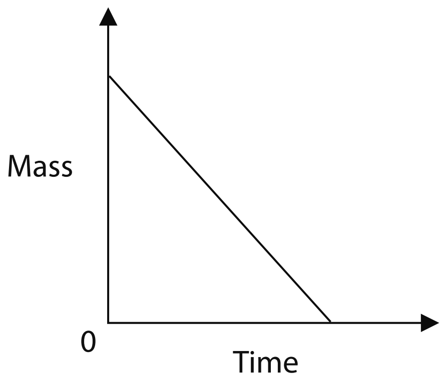
....

(c) Some of the graphs **A** to **F** below could represent changes occuring during the decomposition of hydrogen peroxide.

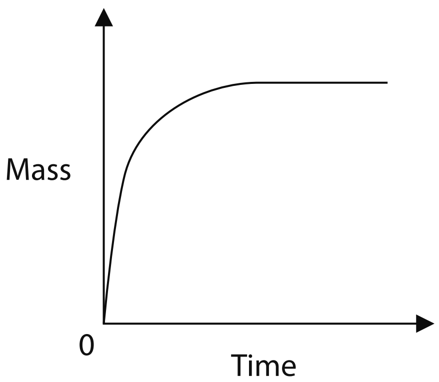
A



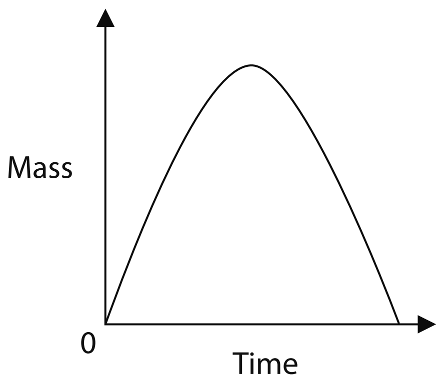
B



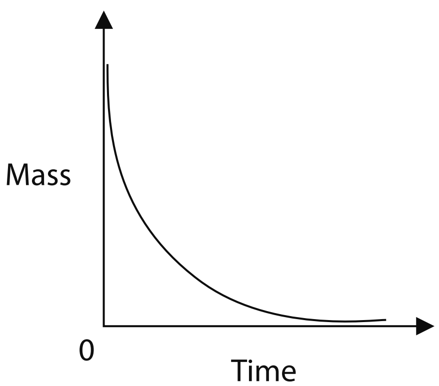
C



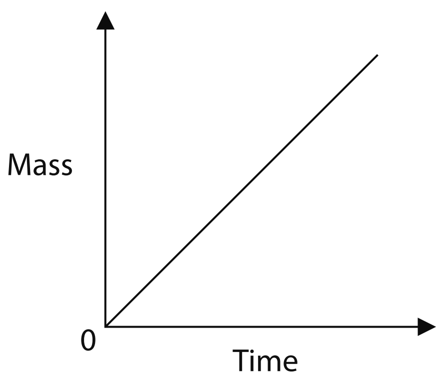
D



E



F



Answer the questions below by placing a cross (☒) in the appropriate box to indicate your answer.

Which graph could represent

(i) the total mass of oxygen given off as the experiment in (a) proceeds?

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D** ☒ **E** ☒ **F**

(ii) the mass of hydrogen peroxide remaining as the experiment in (a) proceeds?

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D** ☒ **E** ☒ **F**

(iii) the mass of the manganese(IV) oxide as the experiment in (a) proceeds?

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D** ☒ **E** ☒ **F**

(Total for Question 9 = 9 marks)

10 When potassium iodide solution is mixed with lead(II) nitrate solution, a reaction occurs to form the insoluble salt, lead(II) iodide.

The equation for this reaction is:

$$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

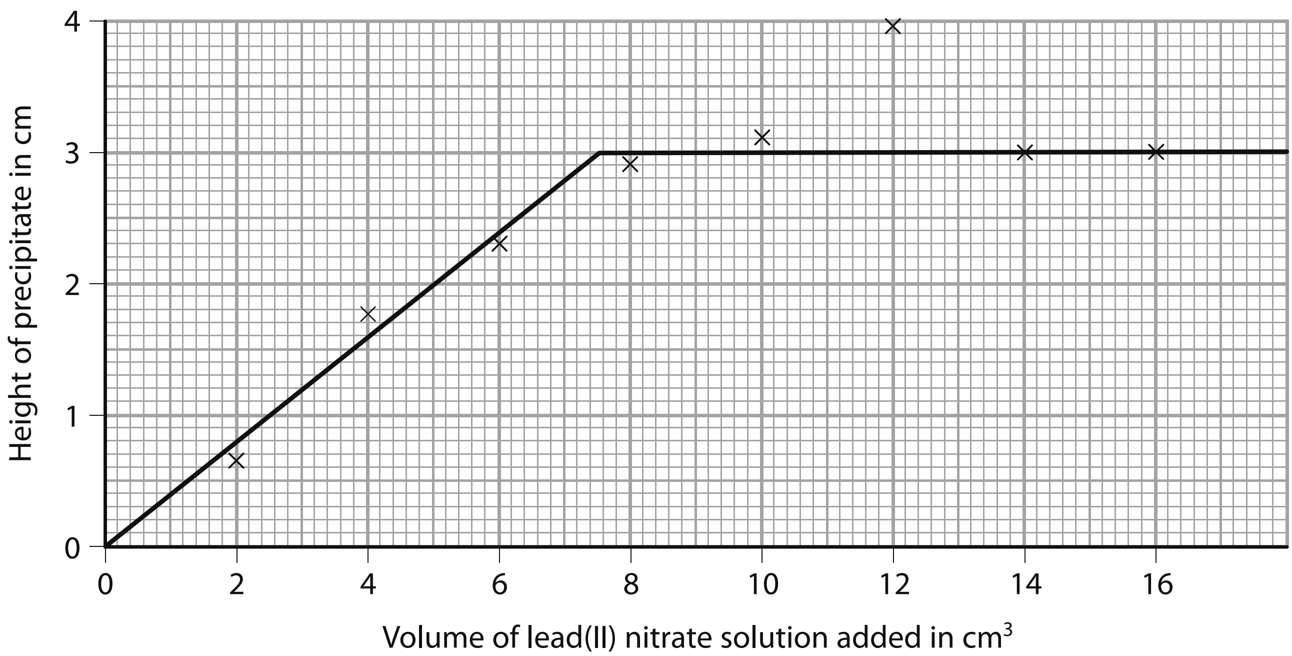
A student carried out an investigation to find how much precipitate was formed with different volumes of lead(II) nitrate solution.

- He used a measuring cylinder to transfer 15 cm^3 of potassium iodide solution into a clean boiling tube.
- Using a different measuring cylinder, he measured out 2 cm^3 of lead(II) nitrate solution and added this to the potassium iodide solution in the boiling tube.
- A yellow precipitate formed in the tube and was allowed to settle.
- The student then measured the height (in cm) of the precipitate using a ruler.

He repeated the experiment using different volumes of lead(II) nitrate solution.

In each experiment, the potassium iodide solution and lead(II) nitrate solution he used were of the same concentration.

The graph shows the results he obtained.



(a) Explain why the line on the graph rises to a maximum level, but then does not change.

(2)

....

....

....

....

(b) (i) On the graph, circle the point which seems to be anomalous.

(1)

(ii) Explain **two** things that the student may have done in the experiment to give this anomalous result.

(4)

1 ....

....

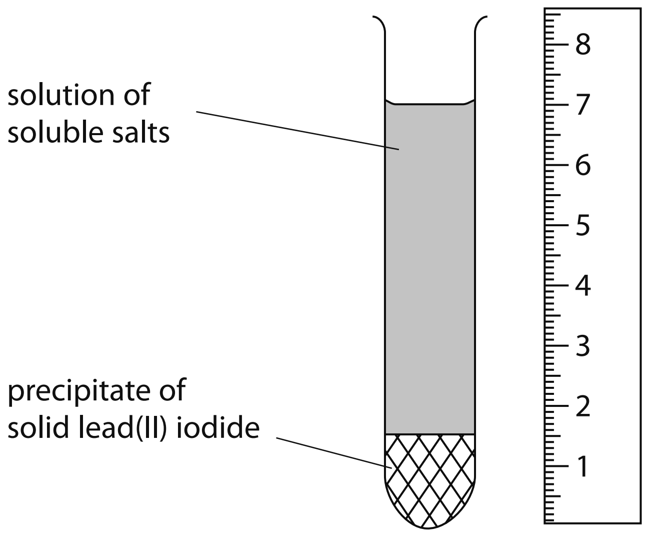
....

2 ....

....

....

(c) The diagram shows a result of an identical experiment.



(i) How much precipitate has been made in the tube?

(1)

.... cm

(ii) Use the graph to find the voume of lead(II) nitrate solution needed to make this amount of precipitate.

(1)

.... cm^3

(Total for Question 10 = 9 marks)

11 Fluorine and chlorine are two elements in Group 7 of the Periodic Table.

Fluorine reacts with most elements in the Periodic Table, but it does not react with neon.

Neon is in Group 0 of the Periodic Table.

(a) Explain, in terms of the arrangement of electrons in its atoms, why neon is very unreactive.

(2)

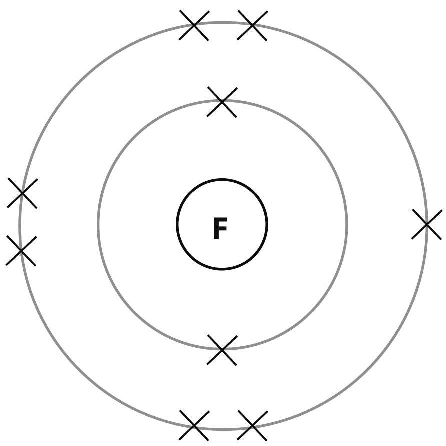
....

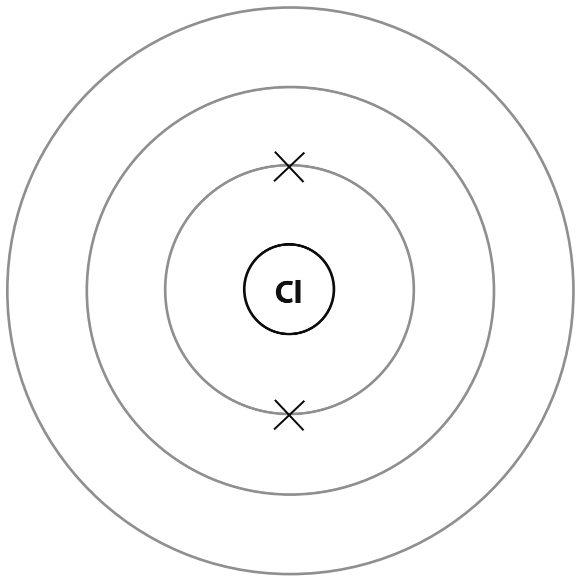
....

(b) The diagram on the left shows the arrangement of the electrons in a fluorine atom.

Use the Periodic Table to help you to complete the diagram on the right to show the arrangement of electrons in a chlorine atom.

(2)





(c) When chlorine gas is bubbled into an aqueous solution of potassium iodide, the colourless solution turns brown.

(i) Complete the following ionic equation for the reaction that takes place.

(2)

$Cl_2(g)$ + ...$I^-(aq)$ → .... (aq) + ... (aq)

(ii) What is the name given to this type of reaction?

(1)

....

(iii) Why does the solution turn brown?

(1)

....

(d) When chlorine reacts with concentrated sodium hydroxide solution, a compound is formed that contains 21.6% by mass of sodium and 33.3% by mass of chlorine. The rest is oxygen.

Calculate the empirical formula of this compound.

(4)

....

....

....

....

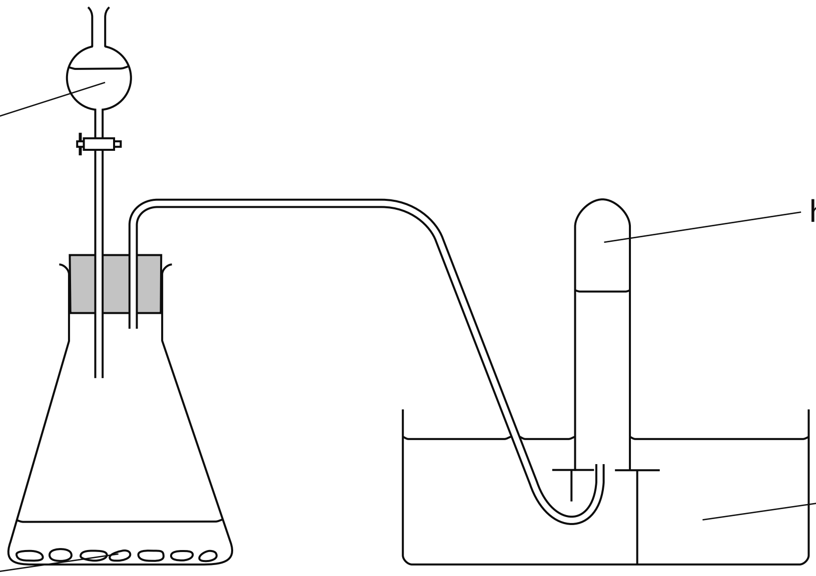
....

....

....

(Total for Question 11 = 12 marks)

12 Hydrogen can be prepared in the laboratory by reacting zinc with dilute sulfuric acid using the apparatus shown.



The equation for the reaction is:

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

The reaction is fairly slow but, when copper(II) sulfate solution is added, bubbles of hydrogen form much more quickly.

A student decided to investigate how copper(II) sulfate solution increased the rate of this reaction.

She set up the apparatus as shown, without copper(II) sulfate present, and counted the number of bubbles of hydrogen produced every 15 seconds.

She then repeated the experiment with copper(II) sulfate present.

(a) Explain why her method of counting the number of bubbles of hydrogen might not give accurate results in her second experiment, with copper(II) sulfate present.

(2)

....

....

....

....

....

....

(b) Describe how she should change the experiment to allow the collection of more precise results.

(2)

....

....

....

....

....

....

The student then decided that she wanted to show that the gas collected was hydrogen. She burned a sample in oxygen and collected the colourless liquid that formed on cooling. If the gas were hydrogen then the colourless liquid should be pure water.

(c) Describe a **physical** test that she could perform to show that the colourless liquid is pure water.

(2)

....

....

The student's teacher said that even if the colourless liquid were pure water then it does not necessarily mean that the gas was hydrogen.

(d) Suggest the name of another **gas** that produces water when it is burned in oxygen.

(1)

....

(Total for Question 12 = 7 marks)

13 Ammonia (NH_3) is manufactured in the exothermic reaction between nitrogen gas (N_2) and hydrogen gas (H_2) in the presence of an iron catalyst.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92 \text{ kJ/mol}$$

The nitrogen and hydrogen mixture is passed into a reaction chamber at a pressure of 200 atmospheres and a temperature of 450 °C.

The reaction is reversible and, if left for long enough, can reach a position of dynamic equilibrium.

(a) Why is a catalyst needed in this reaction?

(1)

....

(b) What is meant by the term **dynamic equilibrium**?

(2)

....

....

(c) A scientist working in the factory making ammonia suggested changing the reaction conditions to a pressure of 1000 atmospheres and a temperature of 250 °C.

Use your knowledge of equilibrium reactions and reaction rates to explain whether the scientist's suggestion was a good one.

(4)

....

....

....

....

....

....

....

....

(d) The mixture of gases leaving the reaction chamber contains unreacted nitrogen and hydrogen as well as ammonia.

(i) Explain how the ammonia can be separated from the unreacted nitrogen and hydrogen after the mixture has left the reaction chamber.

(2)

....

....

....

....

(ii) What happens to the unreacted nitrogen and hydrogen after it has been separated from the ammonia?

(1)

....

(e) Ammonia is used to make the fertiliser ammonium nitrate (NH_4NO_3) by reacting ammonia with nitric acid.

Write a chemical equation for the reaction between ammonia and nitric acid.

(1)

....

(f) Describe a chemical test that you could perform to show that ammonium nitrate contains ammonium ions.

(3)

....

....

....

....

....

(Total for Question 13 = 14 marks)

14 Zinc phosphide (Zn_3P_2) is found in some rat poisons. It is an ionic compound manufactured by heating zinc and phosphorus together.

(a) (i) The formula of the zinc ion is Zn^{2+}.

Deduce the formula of the phosphide ion.

(1)

....

(ii) Explain why zinc phosphide does **not** conduct electricity when solid, but **does** when molten.

(2)

....

....

....

....

(b) Calculate the relative formula mass (M_r) of zinc phosphide.

(2)

Relative formula mass = ...

(c) A bag containing 51.4 kg (51 400 g) of zinc phosphide stored in a factory warehouse was accidentally contaminated with water.

Zinc phosphide reacts with water to form zinc hydroxide and phosphine gas, PH_3.

The equation for the reaction is:

$$Zn_3P_2(s) + 6H_2O(l) \rightarrow 3Zn(OH)_2(s) + 2PH_3(g)$$

(i) Calculate the minimum mass of water, in kg, needed to react with all of the zinc phosphide in the bag.

(3)

Mass of water needed = ... kg

(ii) The factory was evacuated because phosphine can burst into flames immediately when it comes into contact with oxygen in the air.

What does this suggest about the activation energy for the reaction between phosphine and oxygen?

(1)

....

(iii) Is the reaction between phosphine and oxygen endothermic or exothermic? Use information from part (ii) to justify your answer.

(1)

....

....

....

(d) (i) Phosphine is similar to ammonia (NH_3) in the way its atoms are bonded.

Draw a dot and cross diagram to show the arrangement of electrons in a molecule of phosphine. You should show only the outer electrons of each atom.

(2)

(ii) Explain why phosphine has a low boiling point.

(2)

....

....

....

....

(Total for Question 14 = 14 marks)

TOTAL FOR PAPER = 120 MARKS

Sample Mark Scheme

Paper 1C

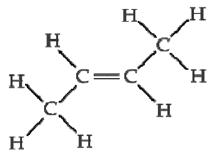
Question number	Answer	Notes	Marks
1 (a)	B		1
(b)	A		1
(c)	D		1
(d)	C		1
(e)	A		1
			Total: 5

Question number	Answer	Notes	Marks
2 (a)	melting		1
(b)	An explanation linking the following : • heat with electric heater / in water bath / sand bath • because wax may catch fire / prevent liquid wax boiling over or spitting	ACCEPT • use test tube holder / clamp • to prevent being burned by hot test tube	2
(c)	A description including the following: • (becomes) regular arrangement / pattern (of particles) • particles slow down / vibrate (in fixed positions) • particles lose (kinetic) energy	ACCEPT closer together ACCEPT stop moving around (freely)	3
			Total: 6

Question number	Answer	Notes	Marks
3 (a) (i)	A = proton(s) B = neutron(s)	Award 1 mark for two correct particles in the wrong order	2
(ii)	atomic number = 5 mass number = 11	No mark for two numbers transposed	2
(b) (i)	boron		1
(ii)	2, 3	ACCEPT any other punctuation marks, such as ‘.’ ‘/’ ‘-‘ or no punctuation	1
			Total: 6

Question number	Answer	Notes	Marks
4 (a)	carbon dioxide	ALLOW CO_2	1
(b)	copper(II) / copper (carbonate) (because) limewater turned milky in **least** time / **most** quickly		2
(c)	(sodium carbonate / it) does not decompose	ALLOW no carbon dioxide / gas given off	1
(d)	Any **two** from: • same volume / concentration of limewater • same flame e.g. “always roaring flame” • same amount of solid • same distance of flame to tube • same form / state of division of solid e.g. “all powders”	ACCEPT: • same amount of limewater • same temperature / Bunsen setting • same mass of solid	max 2
			Total: 6

Question number	Answer	Notes	Marks
5 (a)	compounds / substances containing hydrogen and carbon <u>only</u>	DO NOT ACCEPT atoms/elements in place of compounds/substances	2
(b) (i)	refinery gases		1
(ii)	bitumen		1
(c)	An explanation linking any **four** of the following: • crude oil / vapour rises through the (fractionating) column • idea of temperature gradient in column e.g. hotter at the bottom than the top • different fractions have different boiling point • condense when they get to part of the column that has lower temperature than their boiling point • vapour passes through bubble caps / one-way valves OR idea that liquid fractions cannot trickle back down because of bubble caps	ALLOW vaporising point / condensing temperature	max 4
			Total: 8

Question number	Answer	Notes	Marks
6 (a) (i)	 but-2-ene	1 mark for formula 1 mark for name	2
(ii)	no double bond / saturated		1
(iii)	cyclobutane: no change / remains orange but-1-ene: (bromine) turns (from orange to) colourless / decolourised	IGNORE starting colour of bromine	2
(b)	An explanation linking the following points: • crude oil contains too many long chain hydrocarbons • which are economically less useful / need converting to more economically useful smaller hydrocarbons	ACCEPT • alkenes need in polymer industry • to make useful plastics	2
(c) (i)	$C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4$ 1 mark for correct formula for alkane 1 mark for balanced equation	ALLOW equations which finish: $\rightarrow C_6H_{14} + 2C_2H_4$ $\rightarrow C_4H_{10} + 3C_2H_4$ $\rightarrow C_2H_6 + 4C_2H_4$	2
(ii)	An explanation linking the following points: • toxic / poisonous • (because) it restricts blood carrying oxygen	ACCEPT comments about binding to haemoglobin / forming carboxyhaemoglobin	2
			Total: 11

Question number	Answer	Notes	Marks
7 (a)	An explanation linking the following points: • green colour spreads throughout liquid • (because of) diffusion	ACCEPT dark green at bottom and light green at top	2
(b)	Anode = copper Cathode = chlorine	Award 1 mark for both correct products, but at incorrect electrodes	2
(c)	$2Cl^{-} \rightarrow Cl_2 + 2e$ 1 mark for correct species 1 mark for balance	ALLOW $2Cl^{-} - 2e \rightarrow Cl_2$	2
			Total: 6

Question number	Answer	Notes	Marks
8 (a)	extra decimal place / trailing zero / to 0.01 g		1
(b)	$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$	1 mark for reactants 1 mark for products	2
(c) (i)	gains (two) electrons		1
(ii)	reduction		1
(iii)	Any **two** from: • (blue) colour of solution fades /solution turns colourless • brown/pink/pink(y)-brown solid forms • gets warm/hot	NOT solution turns clear ALLOW precipitate ALLOW fizzing / bubbles	max 2
			Total: 7

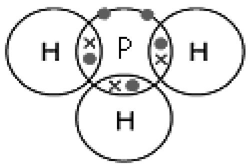
Question number	Answer	Notes	Marks
9 (a) (i)	2 (cm^3)		1
(ii)	An explanation linking the following points: • reaction rate slows down • (because there are) fewer **hydrogen peroxide** particles • (therefore) less **frequent** collisions/fewer collisions **per second**	ACCEPT hydrogen peroxide is less concentrated	3
(iii)	35 (minutes)	ACCEPT any number **between** 30 and 35	1
(b)	catalyst		1
(c) (i)	C		1
(ii)	E		1
(iii)	A		1
			Total: 9

Question number	Answer	Notes	Marks
10 (a)	An explanation linking the following points: • more precipitate as more lead(II) nitrate present (to react with potassium iodide) • but eventually all potassium iodide used up / lead(II) nitrate becomes in excess / the reaction finishes		2
(b) (i)	correct point circled (at $12cm^3$ of lead(II) nitrate added)	ACCEPT any way in which this point is indicated	1
(ii)	Any **two** of the following pairs of statements: • not left long enough • therefore precipitate / solid not fully settled **OR** • too much potassium iodide added • so more precipitate made **OR** • tube not vertical when precipitate was settling • so precipitate not level in the tube	ACCEPT reasonable alternatives, as long as they explain why the height is **too high**	max 4
(c) (i)	1.5 ± 0.1 (cm)	ACCEPT 0.8 cm (for candidates who use their own ruler)	1
(ii)	3.7 – 3.8 (cm^3)	ALLOW consequential on answer to (c)(i)	1
			Total: 9

Question number	Answer	Notes	Marks
11 (a)	An explanation linking the following points: • 8 electrons in **outer(most)** shell • does not **easily/readily** gain or lose electrons	ACCEPT full **outer(most)** shell ACCEPT argument based on energy required	2
(b)	8 electrons in middle shell 7 electrons in outer shell	ACCEPT dots, circles, crosses or e to represent electrons	2
(c) (i)	$2(I^-)$ and $2\,Cl^- + I_2$	1 mark - correct formulae 1 mark - correct balancing	2
(ii)	displacement / redox	ACCEPT oxidation **and** reduction	1
(iii)	iodine (formed, and it is brown in solution)	I_2	1
(d)	calculation of % O = 45.1 dividing by A_r values: Na 21.6/23 Cl = 33.3/35.5 O = 45.1/16 simplest whole number ratio = 1:1:3 translating this ratio to a formula = $NaClO_3$	If division by atomic number, neither 2nd nor 3rd mark can be scored - although 4th mark can (probably $NaClO_3$ or $Na_8Cl_8O_{23}$) Final answer consequential on slips in calculation above	4
			Total: 12

Question number	Answer	Notes	Marks
12 (a)	An explanation linking the following points: • reaction rate is faster • (therefore) counting bubbles is more difficult / bubbles may form continuous stream	ACCEPT: • bubbles may be different size • so not valid / poor comparison with first experiment	2
(b)	A description linking the following points: • measure the volume of gas produced • using a graduated test-tube / gas syringe / inverted measuring cylinder	ACCEPT: answers which lead to decreased rate to allow bubble counting to work e.g. • reduced concentration of acid / larger pieces of zinc • to slow rate / make bubbles smaller	2
(c)	measure the boiling point / freezing point 100°C / 0°C	boils at 100°C OR freezes at 0°C are worth 2 marks	2
(d)	any named **gas** that burns in oxygen to form water as a product e.g. methane, ethane	ACCEPT correct formula for gas	1
			Total: 7

Question number	Answer	Notes	Marks
13 (a)	to speed up the reaction **OR** to allow a lower temperature to be used but still have a reasonably / acceptably fast reaction	ACCEPT to lower the activation energy / achieve a better balance of yield and rate	1
(b)	forward and reverse reactions **are** occurring at same rate/speed	ACCEPT amounts of reactants / products / macroscopic properties remain constant	2
(c)	An explanation linking **four** of the following points: • increased pressure favours forward reaction / increases yield • increased pressure also increases rate • decreased temperature favours forward reaction / increases yield • decreased temperature decreases rate • concluding comment e.g. greater yield, but probably at reduced rate / increase in rate due to pressure cancels decrease in rate due to temperature change **Concluding comment must be present to score full 4 marks, but can be agreement or disagreement with scientist's idea.**	ACCEPT moves equilibrium to right ACCEPT moves equilibrium to right ACCEPT good idea but increased pressure increases cost	max 4
(d) (i)	An explanation linking the following points: • ammonia has low boiling point / liquefies • (therefore) mixture is cooled		2
(ii)	recirculated / recycled / re-used / returned to reaction chamber / used to make more ammonia		1
(e)	$NH_3 + HNO_3 \rightarrow NH_4NO_3$		1
(f)	A description linking the following points: • add aqueous sodium hydroxide (and warm) • gas / ammonia (given off) • turns (damp) red litmus blue	ACCEPT forms white smoke with HCl	3
			Total: 14

Question number	Answer	Notes	Marks
14 (a) (i)	P^{3-}	ACCEPT P^{-3}	1
(ii)	An explanation linking the following points: • ions are not free to move in solid (IGNORE ref to electrons) • (however) ions are free to move when molten	REJECT any mention of electron movement	2
(b)	(65 × 3) + (31 × 2) = 257	Award 1 mark for correct use of Mr of Zn and P	2
(c) (i)	• moles phosphine = 51400 / 257 • moles water = moles phosphine × 6 • mass water = moles water × 18 = 21600 g / 21.6 kg **OR** • 6 × 18 = 108 • 257 / 108 = 51.4 / mass water • mass water = 21.6 kg	Mark consequentially on (b) ACCEPT answer in g or kg, as long as unit matches value	3
(ii)	low / small		1
(iii)	exothermic, because it burst into flames	NOT just 'exothermic'	1
(d) (i)		1 mark for 3 bonding pairs 1 mark for non-bonding pair	2
(ii)	An explanation linking any **two** of the following points: • small molecules • weak (attractive) forces between molecules • (therefore) little energy required to overcome forces / separate molecules	ACCEPT "weak bonds", but not "weak <u>covalent</u> bonds"	max 2
			Total: 14

Write your name here

Surname	Other names

Edexcel
International GCSE

Centre Number

Candidate Number

Chemistry

Paper: 2C

Sample Assessment Material
Time: 1 hour

Paper Reference
4CH0/2C

You must have:
Ruler
Candidates may use a calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 4 1 6 4 7 A 0 1 1 5

PEARSON

The Periodic Table of the Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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						

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

Cu and Cl have not been rounded to the nearest whole number.

Answer ALL questions.

1 Lithium sulfate (Li_2SO_4) is used in some medicines. The presence of lithium sulfate in a medicine can be shown by two tests.

(a) A flame test can be used to show that the medicine contains lithium ions.

State the colour that lithium ions produce in a flame.

(1)

....

(b) A sample of a medicine containing lithium sulfate is dissolved in water.

(i) Describe how you would test the solution for the presence of sulfate ions.

(3)

....

....

....

....

....

....

(ii) Write a chemical equation for the reaction occurring in (b)(i).

(2)

....

(Total for Question 1 = 6 marks)

2 Ethanol can be manufactured by two different methods. The table gives some information about these two methods.

	Raw material	**Quality of ethanol produced**
Method **A**	crude oil	pure
Method **B**	sugar cane	impure

(a) In method **A**, ethanol is formed in the final step.

(i) Identify the **two** compounds that react together to form ethanol.

(2)

.... and ....

(ii) State **two** conditions used in this reaction.

(2)

....

....

(b) The equation for the reaction that occurs in method **B** is

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

(i) Name the compound with the formula $C_6H_{12}O_6$.

(1)

....

(ii) Identify the main impurity in the ethanol formed in this reaction.

(1)

....

....

(c) Some of the ethanol produced by method **B** is converted into ethene by heating it with a catalyst.

(i) Name the catalyst used in this reaction.

(1)

....

(ii) Name the type of reaction.

(1)

....

(iii) Write the chemical equation for this reaction.

(1)

....

(d) Some of the ethanol produced by method **B** is used as a fuel. Balance the chemical equation for the complete combustion of ethanol.

(1)

$$C_2H_5OH + \ldots\ldots O_2 \rightarrow \ldots\ldots CO_2 + \ldots\ldots H_2O$$

(Total for Question 2 = 10 marks)

3 Margaret goes on holiday to the seaside.

She notices some iron railings on the beach that are often in contact with the seawater. They are very rusty.

The iron railings in front of her hotel, some distance from the sea, are much less rusty.

Margaret predicts that seawater makes iron rust faster than rain water.

(a) Describe an experiment that Margaret could carry out to test her prediction.

(5)

(b) Why is rusting described as an oxidation reaction?

(1)

(Total for Question 3 = 6 marks)

4 The gas hydrogen chloride, HCl, dissolves in water. The solution in water turns blue litmus paper red.

(a) (i) This solution of hydrogen chloride in water contains two ions.

Give the **formula** of each ion.

(2)

.... and ....

(ii) What is the name given to a solution of hydrogen chloride in water?

(1)

(b) Hydrogen chloride gas also dissolves in methylbenzene. This solution has no effect on blue litmus paper.

A student sets up two test tubes, one containing a solution of hydrogen chloride in water and the other containing a solution of hydrogen chloride in methylbenzene.

He adds a piece of magnesium ribbon to each test tube.

Compare the results that he would observe in both test tubes.

(3)

....

....

....

....

....

....

....

....

....

(Total for Question 4 = 6 marks)

5 Polymers can be classified as addition polymers or condensation polymers.

(a) An addition polymer can be formed from the monomer C_3H_6

(i) Name this monomer and the addition polymer it forms.

(1)

Monomer ....

Polymer ....

(ii) Explain why there are problems with the disposal of addition polymers.

(2)

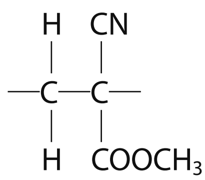
....

....

....

....

(b) Superglues are liquid adhesives that easily form addition polymers, giving a solid that sticks objects together firmly. The repeat unit of a superglue polymer is shown below.



Draw the structure of the monomer used to make this polymer.

(1)

(c) Nylon is an example of a condensation polymer.

Describe one difference between a condensation polymer and an addition polymer.

(2)

....

....

....

....

(Total for Question 5 = 6 marks)

6 Potassium chloride is a soluble salt. It can be prepared by reacting together solutions of potassium hydroxide and hydrochloric acid.

(a) A student did a titration to find the volume of hydrochloric acid needed to react with 25.0 cm^3 of potassium hydroxide solution, KOH.

Exactly 25.0 cm^3 of potassium hydroxide solution and a few drops of methyl orange indicator were added to a conical flask.

Hydrochloric acid was then added until a colour change was seen.

(i) State the type of reaction occurring between potassium hydroxide and hydrochloric acid.

(1)

....

(ii) Write a chemical equation for this reaction.

(1)

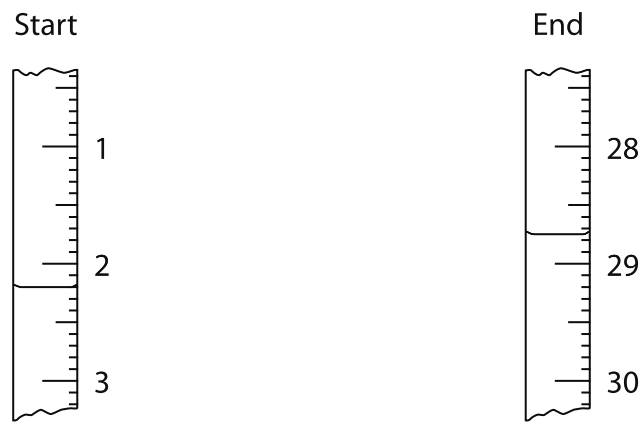
....

(iii) State the final colour of methyl orange in the titration.

(1)

....

(iv) The diagrams show the readings on the burette at the start and at the end of a titration.



Use these diagrams to complete the table, entering all values to the nearest 0.05 cm^3.

(3)

Burette reading at end in cm^3	
Burette reading at start in cm^3	
Volume of acid added in cm^3	

(b) Another student did the titration and recorded these results.

Burette reading at end in cm^3	27.35	28.50	27.30	29.15
Burette reading at start in cm^3	0.20	1.80	1.20	2.65
Volume of acid added in cm^3	27.15	26.70	26.10	26.50
Titration results to be used (✓)				

(i) Concordant results are those that differ from each other by 0.20 cm^3 or less.

Identify the concordant results by placing ticks (✓) in the table as shown.

(1)

(ii) Use your ticked results to calculate the average volume of acid added.

(2)

Average volume = ... cm^3

(c) A student was asked to suggest a method of obtaining pure, dry crystals of potassium chloride from the dilute solution of potassium chloride formed in the titration.

This is her suggested method.

- Pour the neutral potassium chloride solution from the conical flask into an evaporating basin.
- Heat the solution until it has been bubbling for a few minutes.
- Stop heating and leave it until crystals start to form.
- Pour the liquid away so the crystals are left behind.
- Scrape the crystals onto some blotting paper and to dry them.

Identify **two** problems with the student's method. For each problem, suggest an improvement to the method to overcome the problem.

You may assume that the student is working safely.

(4)

Problem 1 ....

....

....

Improvement ....

....

....

....

Problem 2 ....

....

....

Improvement ....

....

....

....

....

(d) In another titration, some potassium hydroxide solution was neutralised by sulfuric acid. The equation for the reaction is

$$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$$

A 25.0 cm^3 sample of 0.200 mol/dm^3 potassium hydroxide was neutralised by 28.40 cm^3 of sulfuric acid.

(i) Calculate the amount, in moles, of potassium hydroxide used.

(2)

(ii) Calculate the amount, in moles, of sulfuric acid used.

(1)

(iii) Calculate the concentration, in mol/dm^3, of the sulfuric acid.

(2)

(Total for Question 6 = 18 marks)

7 Lansfordite is the common name for a form of hydrated magnesium carbonate, $MgCO_3.xH_2O$.

This formula shows that lansfordite contains water of crystallisation. When a sample of lansfordite is heated gently, the water of crystallisation is given off and eventually anhydrous magnesium carbonate is left.

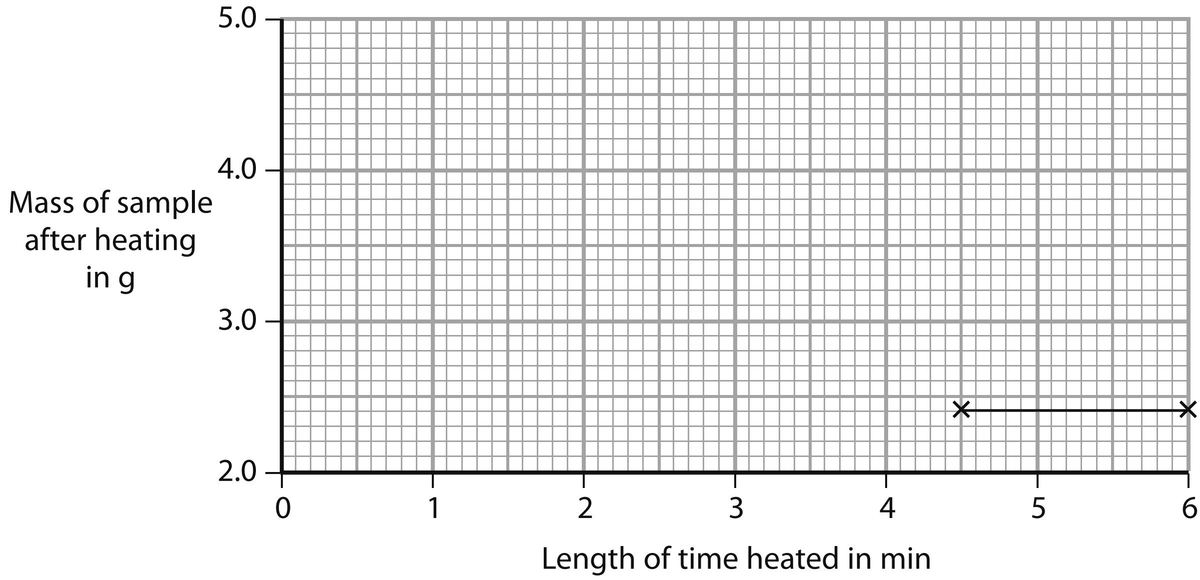
A teacher gave 5.0 g samples of powdered lansfordite to some students and told each student to heat the sample, then to let it cool and reweigh it.

The students heated the samples for different times. The teacher recorded their results in a table.

Length of time heated in min	0.0	1.0	3.0	3.5	4.0	4.5	6.0
Mass of sample after heating in g	5.0	4.4	3.3	3.0	2.7	2.4	2.4

(a) Plot a graph of these results on the grid. The last two results have been plotted for you.

Draw a straight line of best fit through the points you have plotted.



(3)

(b) Use your graph to predict the mass of a sample after heating for 2.0 minutes.

(1)

....

(c) Suggest why the masses of the samples after heating for 4.5 minutes and after heating for 6.0 minutes were the same.

(1)

....

....

(d) The teacher told one of the students that the amount of hydrated salt in a sample of lansfordite was 0.030 mol, and that the amount of water lost on heating was 0.15 mol.

Calculate the value of x in the formula $MgCO_3.xH_2O$

(1)

(e) When anhydrous magnesium carbonate is heated strongly it decomposes. The equation for the reaction is:

$$MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$$

Calculate the volume, in dm^3, of carbon dioxide formed when 0.030 mol of anhydrous magnesium carbonate is completely decomposed.

(You may assume that the molar volume of a gas is 24 dm^3)

(2)

(Total for Question 7 = 8 marks)

TOTAL FOR PAPER = 60 MARKS

Sample Mark Scheme

Paper 2C

Question number	Answer	Notes	Marks
1 (a)	red	IGNORE qualifiers such as pale / dark NOT ‘brick red’	1
(b) (i)	barium chloride / barium nitrate (solution) (dilute) hydrochloric acid / nitric acid white precipitate	ACCEPT correct formulae ACCEPT solid / suspension / ppt(e)	3
(ii)	$BaCl_2 + Li_2SO_4 \rightarrow BaSO_4 + 2LiCl$	ACCEPT correct ionic equation 1 mark for formula of $BaSO_4$ 1 mark for rest of equation	2
			Total: 6

Question number	Answer	Notes	Marks
2 (a) (i)	ethene / C_2H_4 water / steam / H_2O	ACCEPT in either order	2
(ii)	Any **two** from: 300 °C (+/– 50 °C) 60 – 70 atm phosphoric acid (catalyst)		max 2
(b) (i)	glucose	NOT sugar	1
(ii)	water / H_2O		1
(c) (i)	aluminium oxide	ACCEPT porous pot / conc. sulfuric acid / conc. phosphoric acid	1
(ii)	dehydration		1
(iii)	$C_2H_5OH \rightarrow C_2H_4 + H_2O$		1
(d)	3 O_2 **AND** 2 CO_2 **AND** 3H_2O	ACCEPT multiples	1
			Total: 10

Question number	Answer	Notes	Marks
3 (a)	A description linking **five** of the following points: • set up tubes containing iron (nail) in rainwater and iron (nail) in seawater • control tube / tube with iron (nail) and no water • same mass of iron (nail) / same volume of water • leave tubes for same length of time / stated time interval • method to measure rusting e.g. colour change / mass change • repeat experiment / more than one set of tubes set up		max 5
(b)	involves gain / addition of oxygen	ACCEPT involves loss of electrons / increase in oxidation number	1
			Total: 6

Question number	Answer	Notes	Marks
4 (a) (i)	H^+ / H_3O^+ Cl^-	ACCEPT in either order	2
(ii)	hydrochloric acid		1
(b)	<u>hydrogen chloride in methylbenzene:</u> no reaction / no bubbles / magnesium does nothing <u>hydrogen chloride in water:</u> any **two** from: bubbles / fizzing / gas produced magnesium ribbon gets smaller / reacts away / disappears test tube becomes warm	NOTE candidates can only score full marks by giving observations for BOTH tubes NOT 'hydrogen produced' NOT 'magnesium dissolves'	max 3
			Total: 6

Question number	Answer	Notes	Marks
5 (a) (i)	monomer = propene / propylene **AND** polymer = poly(propene) / polypropylene	Both must be correct for 1 mark	1
(ii)	An explanation linking any **two** from: • not biodegradable • (because) they are inert • (because) they have strong C-C / C-H bonds		max 2
(b)	H CN | | C=C | | H $COOCH_3$	IGNORE the geometry of the molecule	1
(c)	Any valid comparison e.g. Addition: only one type of monomer reacts with itself Condensation: two different monomers **OR** Addition: only one product formed Condensation: forms another product / water / hydrogen chloride	ACCEPT: differences in properties e.g. Addition: inert Condensation: may be hydrolysed / broken down REJECT: comparison of uses	2
			Total: 6

Question number	Answer	Notes	Marks
6 (a) (i)	neutralisation	ACCEPT exothermic	1
(ii)	$KOH + HCl \rightarrow KCl + H_2O$		1
(iii)	orange	ACCEPT red	1
(iv)	28.75 2.20 26.55	NOT 2.2 3rd mark consequential on other two	3
(b) (i)	ticks under 26.70 and 26.50		1
(ii)	$\frac{26.70 + 26.50}{2}$ = 26.6(0)	consequential on ticked results 2nd mark consequential on 1st	2

(c)	Any **two** from the following: P: initial solution contaminated with indicator I: repeat titration / mix same volumes with no indicator / add charcoal and filter (to remove indicator) P: solution heated for too little / too long a time I: evaporate until crystallisation point / check solution with glass rod P: liquid poured off when crystals start to form I: leave to cool until crystallisation complete P: crystals lost when solution poured off I: filter / centrifuge / decant carefully to obtain crystals P: blotting paper may not dry crystals completely I: place crystals in (warm) oven to dry	In each case, 1 mark for identifying the problem; and 1 mark for a correct suggestion for that problem	max 4
(d) (i)	$\frac{0.200 \times 25.0}{1000}$ = 0.005(00)	2nd mark consequential on 1st IGNORE units	2
(ii)	0.0025	ACCEPT answer from (d)(i) ÷ 2	1
(iii)	$\frac{0.0025 \times 1000}{28.4}$ = 0.088(0)	2nd mark consequential on 1st IGNORE units and sig figs ACCEPT correct answer from incorrect (d)(ii)	2
			Total: 18

Question number	Answer	Notes	Marks
7 (a)	all points plotted correctly to nearest gridline straight line through first 5 points	Deduct 1 mark for each error	2 1
(b)	Answer in range 3.8 - 3.9 (g)	Consequential on candidate's line Units not needed, but do not award mark if incorrect units given	1
(c)	all water lost / same amount of water lost	ACCEPT reactions/decompositions complete	1
(d)	5		1
(e)	24 × 0.03(0) = 0.72 (dm^3)	Units not needed, but award max 1 if incorrect units	2
			Total: 8

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