

Dawood Public School
Cambridge O Level Chemistry 5070
Course Outline 2020-21
Grade IX

Text book:

Fundamental Chemistry, Rose Marie Gallagher & Paul Ingram Chemistry, edition 2-2012 Cambridge University Press

Introduction:

This syllabus is designed to place more emphasis on factual material and greater emphasis on the understanding and application of scientific concepts and principles.

Successful Cambridge O Level Chemistry candidates gain lifelong skills, including:

- A better understanding of the technological world in which they live, and take an informed interest in science and scientific developments
- Knowledge of the basic principles of chemistry through a mix of theoretical and practical studies
- An understanding of the scientific skills essential for further study at Cambridge International A Level,
- skills which are useful in everyday life
- How science is studied and practiced, and an awareness that the results of scientific research can have both good and bad effects on individuals, communities and the environment

Syllabus aims and assessment objectives**Aims**

The aims of the syllabus, which are not listed in order of priority, are to:

1. Provide, through well designed studies of experimental and practical chemistry, a worthwhile educational experience for all students, whether or not they go on to study science beyond this level and, in particular, to enable them to acquire sufficient understanding and knowledge to:
 - a) Become confident citizens in a technological world, able to take or develop an informed interest in matters of scientific import
 - b) Recognize the usefulness, and limitations, of scientific method and to appreciate its applicability in other disciplines and in everyday life
 - c) Be suitably prepared for studies beyond Cambridge O Level in pure sciences, in applied sciences or in science-dependent vocational courses
2. Develop abilities and skills that:
 - a) Are relevant to the study and practice of science
 - b) Are useful in everyday life
 - c) Encourage efficient and safe practice
 - d) Encourage effective communication
3. Develop attitudes relevant to science such as:
 - a) Concern for accuracy and precision
 - b) Objectivity
 - c) Integrity
 - d) Enquiry
 - e) Initiative
 - f) Inventiveness
4. Stimulate interest in and care for the local and global environment.
5. Promote awareness that:
 - a) The study and practice of science are co-operative and cumulative activities, and are subject to social, economic, technological, ethical and cultural influences and limitations
 - b) The applications of sciences may be both beneficial and detrimental to the individual, the community and the environment

Assessment objectives

The assessment objectives describe the knowledge, skills and abilities that candidates are expected to demonstrate at the end of the course. They reflect those aspects of the aims that are assessed.

AO1 Knowledge with understanding

Candidates should be able to demonstrate knowledge and understanding in relation to:

1. Scientific phenomena, facts, laws, definitions, concepts and theories

2. Scientific vocabulary, terminology and conventions (including symbols, quantities and units)
3. Scientific instruments and apparatus, including techniques of operation and aspects of safety
4. Scientific quantities and their determination
5. Scientific and technological applications with their social, economic and environmental implications.

Syllabus content defines the factual material that candidates may be required to recall and explain.

Questions testing these objectives will often begin with one of the following words:

- define
- stated
- describe
- explain
- outline

AO2 Handling information and solving problems

Candidates should be able, in words or using symbolic, graphical and numerical forms of presentation, to:

1. Locate, select, organise and present information from a variety of sources
2. Translate information from one form to another
3. Manipulate numerical and other data
4. Use information to identify patterns, report trends and draw inferences
5. Present reasoned explanations for phenomena, patterns and relationships
6. Make predictions and hypotheses
7. Solve problems

These assessment objectives cannot be precisely specified in the syllabus content because questions testing such skills may be based on information that is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, deductive or reasoned manner to a new situation. Questions testing these skills will often begin with one of the following words: predict, suggest, calculate or determine

AO3 Experimental skills and investigations

Candidates should be able to:

1. Follow a sequence of instructions
2. Use techniques, apparatus and materials
3. Make and record observations, measurements and estimates
4. Interpret, evaluate and report upon observations and experimental results
5. Design/plan an investigation, select techniques, apparatus and materials
6. Evaluate methods and suggest possible improvements.

Nomenclature, units and significant figures

The proposals in 'Signs, Symbols and Systematics' (The Association for Science Education Companion to 16–19 Science)' will generally be adopted, although the traditional names sulfate, sulfite, nitrate, nitrite, sulfurous and nitrous acids will be used in question papers. Sulfur (and all compounds of sulfur) will be spelt with f, not ph. To avoid difficulties arising out of the use of l as the symbol for litre, use of dm³ in place of l or litre will be made.

In accordance with current ASE convention, decimal markers in examination papers will be a single dot on the line. Candidates are expected to follow this convention in their answers.

Candidates should be aware that misuse of units and/or significant figures, i.e. failure to quote units where necessary, the inclusion of units in quantities defined as ratios or quoting answers to an inappropriate number of significant figures, is liable to be penalised.

SCHEME OF ASSESSMENTS:

Students are required to enter:

1. In monthly and surprise tests;
2. In mid-year and final exams give two papers;

Total marks for both papers are 100

Paper	Type of Paper	Duration	Marks
1	Multiple Choice	30 minutes	25
2	Theory	1 hour 30 minutes	75

Instructions:

1. Students should have her own text book in the class.
2. Students are allowed to note the lecture points and ask questions after the lecture.
3. Students shall only submit their journals weekly on the allotted days after completing their work.
4. Students are allowed to ask and share their problems any time.
5. Students must write the name of the chapter and date on their work.
6. Students must draw diagrams where necessary and write neatly in journals.
7. Students are not permitted to use correction fluids in exams and in class work.
8. Talking, doing any other subject's work during class will be strictly penalized.
9. Sharing of stationery during test and exams is not allowed.

SYLLABUS CONTENTS

FIRST TERM

August

Week 01 and 02

Chapter: States of Matter

Learning and Assessment Objectives

Students should be able to:

- Differentiate, identify and draw states of matter diagrams.
- Determine the effects of impurities on melting and boiling points of different substances.
- Interpret graphs for melting and boiling points of substances.
- Determine the states of matter at room temperature from the given data.
- Describe the solid, liquid and gaseous states of matter and explain their inter-conversion in terms of the kinetic particle theory and of the energy changes involved.
- Describe and explain evidence for the movement of particles in liquids and gases (the treatment of Brownian motion is not required).
- Explain everyday effects of diffusion in terms of particles, e.g. the spread of perfumes and cooking aromas; tea and coffee grains in water.
- State qualitatively the effect of molecular mass on the rate of diffusion and explain the dependence of rate of diffusion on temperature.
- State qualitatively and explain the effects of temperature and pressure on the volumes of gases.

Contents:

- States of matter
- Kinetic Particle Theory
- Changes of states and the Kinetic Particle Theory
- Diffusion

Practical:

- Determine the rate of diffusion in gases and in liquids.
- Effects of impurities on melting and boiling point of substances.

Assignments:

- Exercise from Fundamental Chemistry Chapter 1
- Topical past papers
- Unit 1 MCQs and Structure questions

Resources and References:

Chemistry by Richard Harwood pg. 27- 31, 46 - 48

Chemistry for O Level by Christopher N Prescott pg. 19-20

Chemistry Matters pg. 1-22

Chemistry by Jane Morris pg. 52-63

Chemistry by Roger Norris pg. 2-5

Week 03 and 04

Chapter: Measurement and Experimental Techniques

Learning and Assessment Objectives

Students should be able to:

- Name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes, measuring cylinders and gas syringes.
- Suggest suitable apparatus, given relevant information, for a variety of simple experiments, including collection of gases and measurement of rates of reaction.

Assignments:

- Topical past papers Unit 1 MCQs and Structure questions

Practical:

- Determine the volume of liquid in measuring cylinder pipette, beaker, burette
- Determine the weight of sugar, salt in the balancer

Resources and References:

Chemistry by Roger Norris pg. 6-7

Chemistry for O Level by Christopher N Prescott pg. 1-10

Chemistry Matters pg. 23-30

Chapter: Elements Compounds and Mixtures**Learning and Assessment Objectives**

- Students should be able to:
- Define an atom and a molecule.
- Define elements, compounds and mixture.
- List the differences between mixture and compound.
- Describe alloys as mixture such as brass, as mixture of metal with other elements.
- Describe different types of mixtures.

Assignments:

- Topical past papers Unit 1 MCQs and Structure questions

Resources and References:

Chemistry by Roger Norris pg. 24-25

Chemistry for O Level by Christopher N Prescott pg. 53-64

Chemistry Matters pg. 59-72

September**Week 01 and 02****Chapter: Separating Substances****Learning and Assessment Objectives**

Students should be able to:

- Understand the differences between pure and impure substances.
- Describe methods of purification by the use of a suitable solvent, filtration and crystallisation, distillation and fractional distillation, with particular references to the fractional distillation of crude oil, liquid air and fermented liquor.
- Suggest suitable methods of purification, given information about the substances involved.
- Describe paper chromatography and interpret chromatograms including comparisons with known samples and the use of R_f values.
- Explain the need and use of locating agents in the chromatography of colorless substances.
- Deduce from the given melting and boiling points, the identities of substances and their purity.
- Explain that the measurement of purity in substances used in everyday life, drugs and foodstuffs is very important.

Contents:

- Determining purity
- Chromatography
- Separation Techniques
- Separating a Solid from a Liquid
- Separating Solids
- Separating a Liquid from a Solution
- Separating Liquids

Practical:

- Separate different salts from the given mixture
- Perform paper chromatography for different substances
- Perform sublimation of naphthalene

Assignments:

- Exercise from Fundamental Chemistry Chapter 2
- Collect information on medicinal importance of chromatography

- Topical past papers Unit 2 Topic 2B

Resources and References:

Chemistry by Richard Harwood pg. 34-43

Chemistry for O Level by Christopher N Prescott pg. 26-40

Chemistry Matters pg. 32-57

Chemistry by Jane Morris pg. 6-11

Chemistry by Roger Norris pg. 8-17

October

Week 01

Chapter: Qualitative Analysis

Learning and Assessment Objectives

Students should be able to:

- Describe the use of aqueous sodium hydroxide and aqueous ammonia to identify the following aqueous cations (formulae of complex ions are not required):
 - aluminum
 - ammonium
 - calcium
 - copper(II)
 - iron(II)
 - iron(III)
 - zinc
- Describe tests to identify the following anions:
 - carbonate (by the addition of dilute acid and subsequent use of limewater)
 - chloride (by reaction of an aqueous solution with nitric acid and aqueous silver nitrate)
 - iodide (by reaction of an aqueous solution with nitric acid and aqueous silver nitrate)
 - nitrate (by reduction with aluminum and aqueous sodium hydroxide to ammonia and subsequent use of litmus paper)
 - sulfate (by reaction of an aqueous solution with nitric acid and aqueous barium nitrate)
- Describe tests to identify the following gases:
 - ammonia (using damp red litmus paper)
 - carbon dioxide (using limewater)
 - chlorine (using damp litmus paper)
 - hydrogen (using a burning splint)
 - oxygen (using a glowing splint)
 - sulfur dioxide (using acidified potassium dichromate(VI))
- Describe a chemical test for water.

Contents:

- Identification of cations and anions and gases
- Identification of water

Practical:

- Qualitative analysis of salts like iron (ii) sulfate, copper (ii) chloride, ammonium sulfate, calcium nitrate, zinc sulfate and aluminum chloride
- Perform test of water

Resources and References:

Chemistry by Richard Harwood pg. 136-137, 348-351

Chemistry for O Level by Christopher N Prescott pg. 191-197

Chemistry Matters pg. 204-209

Chemistry by Jane Morris pg. 218

Chemistry by Roger Norris pg. 140-143, 253

Chapter: Atomic Structure

Learning and Assessment Objectives

Students should be able to:

- State the relative charges and approximate relative masses of protons, neutrons and electrons.

- Describe, with the aid of diagrams, the structure of an atom as containing protons and neutrons (nucleons) in the nucleus and electrons arranged in shells (energy levels) (no knowledge of s, p, d and f classification will be expected; a copy of the Periodic Table will be available in Papers 1 and 2).
- Define proton number and nucleon number.
- Use and interpret such symbols as ${}^6_{12}\text{C}$.
- Use proton number and the simple structure of atoms to explain the periodic table with special reference to the elements 1 to 20.
- Define isotopes.
- State that some isotopes are radioactive.
- Describe one medicinal and one industrial use of a named radioactive isotope.
- Understand electronic configuration of 1 to 20 elements of periodic table.
- Deduce the numbers of protons, neutrons and electrons in atoms and ions from proton and nucleon numbers.

Contents:

- Inside an atom
- The proton number and nucleon number
- Isotopes
- Arranging electrons in an atom

Assignments:

- Exercise from chemistry matters
- Topical past paper

Resources and References:

Chemistry by Richard Harwood pg. 52-55
 Chemistry for O Level by Christopher N Prescott pg. 41-52
 Chemistry Matters pg. 74-88
 Chemistry by Jane Morris pg. 76-79
 Chemistry by Roger Norris pg. 18-20

October

Week 02

Chapter: The Periodic Table

Learning and Assessment Objectives

Students should be able to:

- Describe the Periodic Table as an arrangement of the elements in the order of increasing proton (atomic) number.
- Describe how the position of an element in the Periodic Table is related to proton number and electronic structure.
- Describe the relationship between Group number and the ionic charge of an element
- Explain the similarities between the elements in the same Group of the Periodic Table in terms of their electronic structure.
- Describe the change from metallic to non-metallic character from left to right across a period of the Periodic Table.
- Describe the relationship between Group number, number of valency electrons and metallic or nonmetallic character
- Predict the properties of elements in Group I, VII and the transition elements using the Periodic Table
- Describe lithium, sodium and potassium in Group I (the alkali metals) as a collection of relatively soft, low-density metals showing a trend in melting point and in their reaction with water.
- Describe chlorine, bromine and iodine in Group VII (the halogens) as a collection of diatomic non-metals showing a trend in colour, state and their displacement reactions with solutions of other halide ions.
- Describe the elements in Group 0 (the noble gases) as a collection of monatomic elements that are chemically unreactive and hence important in providing an inert atmosphere, e.g. argon and neon in light bulbs; helium in balloons; argon in the manufacture of steel.
- Describe the lack of reactivity of the noble gases in terms of their electronic structures
- Describe the central block of elements (transition metals) as metals having high melting points, high density variable oxidation state and forming coloured compounds.

- State the use of these elements and/or their compounds as catalysts, e.g. iron in the Haber process; vanadium (V) oxide in the Contact process; nickel in the hydrogenation of alkenes, and how catalysts are used in industry to lower energy demands and hence are economically advantageous and help conserve energy sources.

Content:

- Periodic trends
- Group properties
- Transition elements

Practical:

- Determine the displacement of bromine by hydrogen chloride

Assignments:

- Exercise from fundamental chemistry
- Topical past paper

Resources and References:

Chemistry by Richard Harwood pg. 253-255

Chemistry for O Level by Christopher N Prescott pg. 224-241

Chemistry Matters pg. 283-300

Chemistry by Jane Morris pg. 146-182

Chemistry by Roger Norris pg. 146-156

October

Week 03 and 04

Chapter: Bonding

Learning and Assessment Objectives

Students should be able to:

- Compare the structure of simple molecular substances, e.g. methane, iodine, with those of giant molecular substances, e.g. sand, diamond, graphite in order to deduce their properties.
- Compare the bonding and structures of diamond and graphite in order to deduce properties such as electrical conductivity, lubricating or cutting action (candidates will not be required to draw the structures).
- Deduce the physical and chemical properties of substances from their structures and bonding and vice versa.

Ionic bonding

- Describe the formation of ions by electron loss/gain in order to obtain the electronic configuration of an inert gas.
- Describe the formation of ionic bonds between metals and non-metals, e.g. NaCl; MgCl₂.
- State that ionic materials contain a giant lattice in which the ions are held by electrostatic attraction, e.g. NaCl (candidates will not be required to draw diagrams of ionic lattices).
- Deduce the formulae of other ionic compounds from diagrams of their lattice structures, limited to binary compounds.
- Relate the physical properties (including electrical property) of ionic compounds to their lattice structure.

Covalent bonding

- Describe the formation of a covalent bond by the sharing of a pair of electrons in order to gain the electronic configuration of an inert gas.
- Describe, using 'dot-and-cross' diagrams, the formation of covalent bonds between non-metallic elements, e.g. H₂; Cl₂; O₂; HCl; N₂; H₂O; CH₄; C₂H₄; CO₂
- Deduce the arrangement of electrons in other covalent molecules.
- Relate the physical properties (including electrical properties) of covalent compounds to their structure and bonding.

Metallic bonding

- Describe metals as a lattice of positive ions in a 'sea of electrons'.
- Relate the malleability of metals to their structure and the electrical conductivity of metals to the mobility of the electrons in the structure.

Practical:

- Determine the electrical conductivity of sugar solution, dilute acid

- Determine the melting point of wax, sodium chloride
- Determine the boiling point of water, sodium chloride solution

Assignments:

- Exercise from chemistry matters
- Topical past paper

Resources and References:

Chemistry by Richard Harwood pg. 72-92

Chemistry for O Level by Christopher N Prescott pg. 65-78

Chemistry Matters pg. 87-118

Chemistry by Jane Morris pg. 80-99

Chemistry by Roger Norris pg. 30-42

November - Revision for Mid-Year Examination

December - Mid-Year Examination
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FINAL TERM**January****Week 01****Chapter 8: Writing Equations****Learning and Assessment Objectives**

Students should be able to:

- Understand how to write a symbolic and word equation.
- Know the balancing of equations.
- Deduce the ionic equations from symbolic equations.

Content:

- Chemical equations
- Ionic equations

Assignments:

- Exercise from Fundamental Chemistry

Week 02, 03 and 04**Chapter: The Mole****Learning and Assessment Objectives**

Students should be able to:

- State the symbols of the elements and formulae of the compounds mentioned in the syllabus.
- Deduce the formulae of simple compounds from the relative numbers of atoms present and vice versa.
- Deduce the formulae of ionic compounds from the charges on the ions present and vice versa.
- Interpret and construct chemical equations, with state symbols, including ionic equations.
- Define relative atomic mass, A_r .
- Define relative molecular mass, M_r , and calculate relative molecular mass (and relative formula mass) as the sum of relative atomic masses.
- Calculate the percentage mass of an element in a compound when given appropriate information.
- Calculate empirical and molecular formulae from relevant data.

Contents:

- Relative atomic mass
- Relative molecular mass
- The mole
- Mole and molecular mass
- Percentage composition of compounds
- Finding the formula of compound

- Molar gas volume

Resources and References:

Chemistry by Richard Harwood pg. 156-167

Chemistry for O Level by Christopher N Prescott pg. 96-113

Chemistry Matters pg. 127-149

Chemistry by Jane Morris pg. 100-130

Chemistry by Roger Norris pg. 54-68

Chapter: Chemical Calculations

Learning and Assessment Objectives

Students should be able to:

- Calculate stoichiometric reacting masses and volumes of gases and solutions, solution concentrations being expressed in g/dm^3 and /or in mol/dm^3 ; calculations involving the idea of limiting reactants may be set.
- Calculate % yield and purity.

Contents:

- Calculations from chemical reactions
- The volume of reacting gases
- Limiting reactants
- The concentration of a solution
- Volumetric analysis
- Percentage yield and percentage purity

Assignment:

- Exercise from Chemistry Matters

Resources and References:

Chemistry by Richard Harwood pg. 52-55

Chemistry for O Level by Christopher N Prescott pg. 41-52

Chemistry Matters pg. 74- 88

Chemistry by Jane Morris pg. 76-79

Chemistry by Roger Norris pg. 18-20

February

Week 01 and 02

Chapter: Acids and Bases

Learning and Assessment objectives

Students should be able to:

- Describe the meanings of the terms acid and alkali in terms of the ions they contain or produce in aqueous solution and their effects on indicator paper.
- Describe neutrality and relative acidity and alkalinity in terms of PH measured using universal indicator paper.
- Describe the characteristics properties of acids as in reactions with metals, bases, alkalis, carbonates.
- Describe the characteristic properties of bases as in reactions with acids and with ammonium salts.
- Describe and explain the importance of controlling the pH of soil.
- Classify oxides as either acidic, basic or amphoteric related to metallic /non metallic character.
- State the use of sulfur dioxide as bleach in the manufacture of wood pulp for paper; as a food preservative.

Contents:

- Acids
- Bases and Alkalis
- Concentration and strength
- The pH scale
- Types of oxides

Practical:

- Determine the pH of different solutions (distilled water, dilute acid and sugar solution)
- Perform acid base titration (b/w sodium hydroxide and dilute hydrochloric acid, sodium hydroxide and dilute sulfuric acid)

Assignments:

- Search the physical and chemical properties of acids and alkalis with their industrial uses.

Resources and References:

Chemistry by Richard Harwood pg. 126-137

Chemistry for O Level by Christopher N Prescott pg. 169-183

Chemistry Matters pg.169-193

Chemistry by Jane Morris pg. 132-144

Chemistry by Roger Norris pg. 120-130

Week 03 and 04**Chapter 12: Salts****Learning and Assessment Objectives**

Students should be able to:

- Describe the preparation, separation and purification of salts.
- Describe preparation of salts by a titration method.
- Suggest a method of preparing a given salt from suitable starting materials, given appropriate information.
- Describe and explain the tests to identify:
 - Aqueous cat ions; Aluminums, ammonium, calcium, copper (II), iron (II), iron (III) and zinc ,using
 - aqueous ammonia and aqueous sodium hydroxide
 - Anions; Carbonate; chloride; iodide; nitrate and sulfate
 - Gases; Ammonia, carbon dioxide, chlorine; hydrogen, oxygen; and sulfur dioxide

Contents:

- Salts
- Preparing salts
- Qualitative analysis

Practical:

- Perform acid base titration
- Prepare insoluble salts by neutralization

Assignments:

- Search the importance of salts in industries and daily life.
- Exercise from chemistry matters.

Resources and References:

Chemistry by Richard Harwood pg. 138-144

Chemistry by Roger Norris pg. 132-144

N Prescott pg.184-200

Chemistry Matters pg.194- 200

Chemistry by Jane Morris pg.194 - 210

March & April - Revision for Final Examination

May - Final Examination

Resource List:

Students may also find references to the following books helpful; these are suitable for use with this syllabus.

- ❖ Harwood, R Chemistry (edition 2, 2003), Cambridge University Press
- ❖ Berry, R IGCSE study guide for chemistry (2005) Hodder Murray
- ❖ Clegg, A Chemistry for IGCSE (2006) Heinemann

- ❖ Eral, B & Chemistry John Murray, Hooder Murray (2003) Wilford, L D R
- ❖ Hill, g Chemistry counts Hooder and Stoughton (2003)
- ❖ Lewis & Thinking Chemistry (GCSE edition) Oxford University press (2004) Waller

Websites for general use:

- ❖ http://www.chemsc.org/networks/learnnet/classic_exp.htm
- ❖ <http://www.thecatalyst.org/>
- ❖ <http://www.wpbschoolhouse.btinternet.co.uk/page10.htm>
- ❖ <http://www.s-cool.co.uk/contents.asp>
- ❖ <http://www.howstuffworks.com/>