# UNIVERSITY OF SWAZILAND

## FACULTY OF EDUCATION

## SUPPLEMENTARY EXAMINATION PAPER

**B. Ed. II/PGCE**

**July 2014**

**Title of paper:** Curriculum Studies in Chemistry

**Course number:** EDC 279

**Time allowed:** 3 hours

**Instructions:**

1. This paper contains FIVE questions.
2. You may choose and answer **any four** questions.
3. Marks for each question are indicated at the end of the question.
4. Any piece of material or work which is not intended for marking purposes should be clearly CROSSED OUT.
5. Ensure that responses to questions are NUMBERED CORRECTLY.

**Special Requirements**

**Sheet A** **Information Sheet (Attached to question paper)**

**SGCSE Physical Science Syllabus 6888 (Chemistry section)**

**THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR**

## QUESTION 1

Use the IGCSE Physical Science syllabus section provided in Table 1 below, and the information attached as Sheet A, to respond to the tasks given below.

**Table 1 SGCSE Syllabus section**

| Sub-topic | Core<br>All students should be able to |
|---|---|
| 7.1 Production of energy | -describe the production of electrical energy from simple cells i.e. two electrodes in an electrolyte (this could be linked with the reactivity series) |

a) Write **three** properly constructed objectives for **a lesson** from this sub- topic. Objectives should include the different demands. [6]

b) Outline a plan for a practical activity you could run on this sub-topic. [8]

c) Indicate the scientific knowledge, processes of science and manipulative abilities you would expect students to develop from engaging in the practical activity outline in (b) above. [5]

d) Construct **three** questions or items you could use after the lesson to check for understanding. [6]

## QUESTION 2

a) Teachers are usually advised to allow for "wait time" when using questions to teaching.

What does "wait time" mean and what is its value in teaching and learning? [6]

b) What strategies might a teacher use to handle pupils' responses when using the question and answer method of teaching? [7]

c) Teachers need to take certain precautions when using practical work. State, and justify, **four** precautions that a teacher may need to take when teaching when using practical work to teach chemistry. [12]

## QUESTION 3

a) Debates on the nature of science indicate that science may be viewed as a "body of stable but tentative knowledge, as well as a process of inquiry".

Discuss this statement and briefly indicate its implications for teaching science. [10]

b) Science is considered an important subject that all pupils in schools should study. Discuss **three** reasons why the study of chemistry should be part of the school curriculum. [13]

## QUESTION 4

a) A student teacher provided the following for a 50-minute lesson in his preparation book during Teaching Practice.

> Instructional objectives
> *At the end of the lesson pupils should be able to:*
> i) *Describe the formation of single covalent bond in $H_2$, $Cl_2$, $H_2O$, $CH_4$ and HCl by sharing of electrons leading to the noble gas configuration*
> ii) *Describe the electron arrangement in more complex molecules such as $N_2$, $C_2H_4$, $CH_3OH$ and $CO_2$.*

Critically comment on the learning outcomes for the intended lesson. [8]

b) The question in the box below is taken from the Physical Science Alternative to Practical examination paper for October/November 2012. ***(You are not answering the question in the box)***

> *Lunga is a scientist who works for an environmental health organisation. She is given a sample of water which is contaminated by sodium sulfate and sodium chloride.*
>
> *Describe how Lunga could test for the presence of*
> *i) sulfate ions,*
> *test* .....
> *observation*.....
>
> *ii) chloride ions,*
> *test* .....
> *observation*.....

i) Which syllabus topic and sub-topic is this item assessing? [2]

ii) Suggest a suitable Practical Test item for this Alternative to Practical item [15]

## QUESTION 5

a) The question and answer method is a versatile technique in teaching as it complements most of the other methods of teaching. Questions used in the question and answer method may be classified as **convergent, divergent** or **evaluative**.

b) What is your understanding of the question and answer method of teaching? [2]

c) Describe the characteristics of each of the three classes of questions mentioned in 5(a) and give **two** examples for each from Chemistry. [23]

Sheet A Question 1

## 19.5 Making electricity from chemical reactions

We have already seen that electricity can cause chemical reactions to take place. The opposite is also possible. Chemical reactions can be used to produce electricity. This is what happens in a car or torch battery.

When magnesium is dropped into dilute hydrochloric acid, it reacts to produce hydrogen gas. The reaction is exothermic. Energy is given out as heat. When copper is placed in dilute hydrochloric acid there is no reaction.

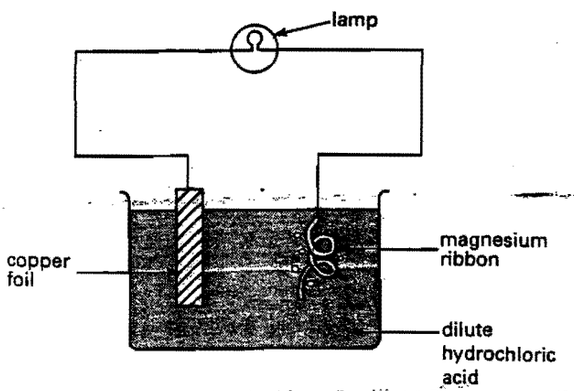


**Fig 19.10** Making a battery

Using the apparatus shown in Fig 19.10, some of the energy released when magnesium reacts with acid is released as electrical energy rather than heat energy. The electricity produced flows round the circuit and lights the lamp.

Whenever two different metals are placed in an electrolyte, electricity is produced. All cells or batteries work on this principle.

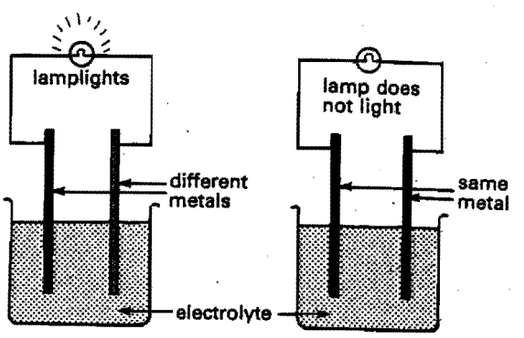


**Fig 19.11** A cell or no cell

In dry cells the electrolyte is made into a paste so that it will not spill.

You should note that the electricity produced by cells is direct current electricity (DC). The alternating current electricity (AC) that is supplied to our homes is produced by a different method.

**SWAZILAND GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**PHYSICAL SCIENCE SYLLABUS 6888**

(CHEMISTRY SECTION)

**SPECIAL REQUIREMENTS FOR**

Curriculum Studies in Chemistry

EDC279 and EDC379

**Main**

and

**Supplementary**

Examinations

*PLEASE DO NOT MARK THE SYLLABUS IN ANY WAY*

TO BE COLLECTED WITH EXAMINATIONS SCRIPTS

SGCSE PHYSICAL SCIENCE Syllabus 6888
November 2013 and November 2014 Examinations

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## NOTE

**Changes have made to the Curriculum content. These include additions to and deletions of topics and concepts, and movement of topics and concepts between the Core Curriculum and the Extended Curriculum.**


Developed in collaboration with the University of Cambridge International Examinations (CIE), part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

## SWAZILAND GENERAL CERTIFICATE OF SECONDARY EDUCATION

### Broad Guidelines

The Ministry of Education is committed, in accordance with the National Policy Statement on Education, to provide a Curriculum and Assessment System (Form 4 and Form 5) so that at the completion of secondary education, learners will

- be equipped to meet the changing needs of the Nation, and
- have attained internationally acceptable standards.

### Swaziland's National Education Policy Directives

SGCSE syllabuses for studies in Form 4 and Form 5 will individually, and collectively, enable learners to develop **essential skills** and provide a broad **learning experience** which

- inculcates values and attitudes as well as knowledge and understanding,
- encourages respect for human rights and freedom of speech,
- respects the values and beliefs of others, relating to issues of gender, culture and religion,
- develops desirable attitudes and behaviour towards the environment,
- provides insight and understanding of global issues which affect quality of life in Swaziland and elsewhere, e.g., the AIDS pandemic; global warming; maldistribution of wealth; and technological advances.

### The National Curriculum for Form 4 and Form 5

Learners will be given opportunities to develop **essential skills** which will overlap across the entire range of subjects studied. These skills are listed below.

- Communication and language skills
- Numeracy skills: mathematical ideas, techniques and applications
- Problem-solving skills
- Technological awareness and applications
- Critical thinking skills
- Work and study skills
- Independent learning
- Working with others

To develop these skills, learners must offer **four compulsory subjects** and at least **three elective subjects** chosen from one or more Field of Study.

**Compulsory Subjects**

- SiSwati – either First Language or Second Language
- English Language
- Mathematics
- Science

**Fields of Study**

- Agriculture Field of Study
- Business Studies Field of Study
- Home Economics Field of Study
- Social Sciences and Humanities Field of Study
- Technical Field of Study

## INTRODUCTION

The Swaziland General Certificate of Secondary Education (SGCSE) syllabuses are designed as two-year courses for examination in Form 5. Physical Science is designed for learners with a wide range of abilities and relevant to those from different backgrounds and experiences. It requires a wide range of learner-centred activities which are based on practical work. This provides learners with opportunities to acquire scientific knowledge and develop skills and processes which will enable them to apply science in everyday situations. As the learners explore and interpret the physical world, emphasis will be directed to the development of innovative ideas, processes and use of scientific equipment in this advancing technological world. This syllabus serves as a basis for further studies in science.

All SGCSE syllabuses follow a general pattern. The main sections are:
Aims
Assessment Objectives
Assessment
Curriculum Content

Physical Science falls into the Science Compulsory Subjects Group which includes: Biology and Combined Science. It is also an Elective Subject in the following Field of Study Groups: Agriculture, and Home Economics. This syllabus may not be offered in the same session with SGCSE Combined Science Syllabus 6886.

## AIMS

The aims of the syllabus are the same for all learners. These aims are set out below and describe the educational purposes of a course in Physical Science for the SGCSE Examination. They are not listed in order of priority.

The aims are to enable learners to:

1. provide, through well designed studies of experimental and practical science, 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
   - 1.1 become confident citizens in a technological world, to take or develop an informed interest in matters of scientific import;
   - 1.2 recognise the usefulness, and limitations, of scientific method and to appreciate its applicability in other disciplines and in everyday life;
   - 1.3 inspire learners to seek, acquire and develop scientific explanations of natural phenomena;
   - 1.4 be suitably prepared for studies beyond the SGCSE level in pure sciences, in applied sciences or in science-dependent vocational courses.
2. develop abilities and skills that
   - 2.1 develop and enhance scientific knowledge and understanding;
   - 2.2 are useful in everyday life and applicable in domestic, environmental and industrial situations;
   - 2.3 are necessary to communicate scientific findings of practical investigations using proper technical scientific terminology;
   - 2.4 encourage efficient and safe practice;
   - 2.5 will evaluate the positive and negative impact of scientific or technological development.
3. develop attitudes relevant to Physical Science such as
   - 3.1 concern for accuracy and precision;
   - 3.2 objectivity;
   - 3.3 integrity;
   - 3.4 enquiry;
   - 3.5 initiative;
   - 3.6 inventiveness;
   - 3.7 perseverance.
4. stimulate interest in, and care for, the environment.

5. promote an awareness
   - 5.1 of the potential of the indige nous technologies in developing local societies;
   - 5.2 that scientific theories and methods have developed, and continue to do so, as a result of the co-operative activities of groups and individuals;
   - 5.3 that the study and practice of science is subject to social, economic, technological, ethical and cultural influences and limitations;
   - 5.4 that the applications of science may be both beneficial and detrimental to the individual, the community and the environment;
   - 5.5 that science transcends national boundaries and that the language of science, correctly and rigorously applied, is universal.

## ASSESSMENT OBJECTIVES

Assessment Objectives in Physical Science are:

**A** Knowledge with Understanding
**B** Handling Information and Solving Problems
**C** Experimental Skills and Investigations

A description of each Assessment Objective follows.

### A KNOWLEDGE WITH UNDERSTANDING

Learners 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.

The Curriculum Content defines the factual material that candidates may be required to recall and explain. Questions testing this will often begin with one of the following words: define, state, describe, explain (using your knowledge and understanding) or outline. (See Appendix: Glossary of Terms.)

### B HANDLING INFORMATION AND SOLVING PROBLEMS

Learners should be able, in words or using other written forms of presentation (i.e., symbolic, graphical and numerical), to:

6. locate, select, organize and present information from a variety of sources;
7. translate information from one form to another;
8. manipulate numerical and other data;
9. use information to identify patterns, report trends and draw inferences;
10. present reasoned explanations for phenomena, patterns and relationships;
11. make predictions and hypotheses;
12. solve problems, including some of a quantitative nature.

These Assessment Objectives cannot be precisely specified in the Curriculum Content because questions testing such skills are often based on information which 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 manner to a novel situation. Questions testing these objectives will often begin with one of the following words: discuss, predict, suggest, calculate, explain or determine. (See Appendix: Glossary of Terms.)

### C EXPERIMENTAL SKILLS AND INVESTIGATIONS

Learners should be able to:

13. use techniques, apparatus and materials (including the following of a sequence of instructions where appropriate);
14. make and record observations, measurements and estimates;
15. interpret and evaluate experimental observations and data;
16. plan and carry out investigations, evaluate methods and suggest possible improvements (including the selection of techniques, apparatus and materials).

**Specification Grid**

The approximate weightings allocated to each of the Assessment Objectives in the assessment model are summarised in the table below.

| **Assessment Objectives** | **Weighting** |
|---|---|
| **A** Knowledge with understanding | 50% (not more than 25% recall) |
| **B** Handling information and solving problems | 30% |
| **C** Experimental skills and investigations | 20% |

Teachers should take note that there is an equal weighting of 50% for skills (including handling information, solving problems, practical, experimental and investigative skills) and for knowledge and understanding. Teacher's schemes of work, and the sequence of learning activities should reflect this balance, so that the aims of the syllabus may be met, and the candidates prepared for the assessment.

## ASSESSMENT

### Scheme of Assessment

**All** candidates must enter for three papers. These will be Paper 1, **one** from either Paper 2 or Paper 3, and **one** from the practical assessment Papers 4 (Practical Test) or 5 (Alternative to Practical).

Candidates who have only studied the Core Curriculum or who are expected to achieve a Grade D or below should be entered for Paper 2. Candidates who have also studied the Extended Curriculum and who are expected to achieve a Grade C or above should be entered for Paper 3.

A description of each paper follows.

*The Data Sheet (The Periodic Table of the Elements)* **will** be included in Papers 1, 2 and 3.

<table>
<tr><td>Core Curriculum<br>Grades C to G available</td><td>Extended Curriculum<br>Grades A* to G available</td></tr>
<tr><td colspan="2">Paper 1 (1 hour)<br>Compulsory short answer paper consisting of 40 marks, with questions designed to discriminate between grades C to G. The questions, targeted at the lower grades, will be based on the Core Curriculum and will test skills mainly in Assessment Objectives A and B.<br><br>This paper will be weighted at 27% of the final total available marks.</td></tr>
<tr><td>Either<br>Paper 2 (1 hour 15 minutes)<br>Core theory paper consisting of 80 marks of short-answer and structured questions, designed to discriminate between grades C to G.<br><br>The questions will be based on the Core Curriculum and will test skills mainly in Assessment Objectives A and B.<br><br>This paper will be weighted at 53% of the final total available marks.</td><td>Or<br>Paper 3 (1 hour 15 minutes)<br>Extended theory paper consisting of 80 marks of short-answer and structured questions, designed to discriminate between grades A to C.<br><br>The questions are targeted at the higher grades and will test skills mainly in Assessment Objectives A and B. A quarter of the marks available will be targeted at the lower grades and contain Core Curriculum only material. The remainder will be targeted at higher grades and will contain material from the Extended Curriculum as well as the Core.<br><br>This paper will be weighted at 53% of the final total available marks.</td></tr>
<tr><td colspan="2">Practical Assessment<br>Compulsory The purpose of this component is to test appropriate skills in Assessment Objective C. Candidates will not be required to use knowledge outside the Core Curriculum. Candidates must be entered for one of the following:<br><br>Either<br>Paper 4 Practical Test (1 hour 30 minutes), consisting of 30 marks, with questions covering experimental and observational skills. (See Appendix: Assessment Criteria for Practicals.)<br><br>Or<br>Paper 5 Alternative to Practical (1 hour 30 minutes), consisting of 60 marks. This is a written paper designed to test familiarity with laboratory based procedures. (See Appendix: Assessment Criteria for Practicals.)<br><br>The practical assessment will be weighted at 20% of the final total available marks.</td></tr>
</table>

**Weighting of Papers**

| Paper | Weighting Core Curriculum candidates (Papers 1, 2 and 4 or 5 only) | Weighting Extended Curriculum candidates (Papers 1, 3 and 4 or 5 only) |
|---|---|---|
| 1 | 27% | 27% |
| 2 | 53% | Not taken by Extended Curriculum candidates |
| 3 | Not taken by Core Curriculum candidates | 53% |
| 4 or 5 | 20% | 20% |

## CURRICULUM CONTENT

Learners will follow either the Core Curriculum only, or the Extended Curriculum which includes both the Core and the Extended. The Curriculum Content that follows is divided into two (2) sections: Chemistry and Physics. Candidates entered for this subject must study both sections.

**Notes:**

(i) The Curriculum Content is designed to provide guidance to teachers as to what will be assessed in the overall evaluation of the learner. It is not meant to limit, in any way, the teaching programme of any particular school.

(ii) Due to the spiral nature of the curriculum, it is assumed that the elementary concepts of the syllabus have been covered during study at Junior Secondary level.

(ii) The Curriculum Content is set out in topic areas within Chemistry and Physics. The main topic areas and concepts are indicated in **bold**. The left-hand column provides amplification of the Core Curriculum topics, which all learners are to study. Topics in the right-hand column are supplementary and should be studied by learners following the Extended Curriculum.

(iv) Cross-references are provided to indicate areas of overlap or close association within the syllabus.

(v) It is intended that, in order to avoid difficulties arising out of the use of l as the symbol for litre, use of $dm^3$ in place of l or litre will be made.

Appropriate teaching time for the Physical Science syllabus should be equivalent to six (6) periods of forty (40) minutes each over a period of sixty (60) weeks/cycles.

| **CHEMISTRY SECTION** | |
|---|---|
| **CORE** | **EXTENDED** |
| **C1. Definition of chemistry and its importance in society** | |
| All learners should be able to:<br>- define chemistry as the study of the composition of substances and their effects upon one another.<br>- describe the importance of chemistry to Swaziland. | |
| **C2. Particulate nature of matter** | |
| All learners should be able to:<br>- describe evidence for the movement of particles in gases and liquids i.e., diffusion.<br>- describe the states of matter and explain their interconversions in terms of the kinetic particle theory. | |
| **C3. Experimental techniques** | |
| All learners should be able to:<br>**C3.1 Measurement**<br>- name and use appropriately the measuring cylinder, burette and pipette.<br>**C3.2 Methods of purification**<br>- describe methods of purification by use of suitable solvent, filtration, evaporation, crystallisation, distillation (simple and fractional), separating funnel, sublimation. | |

| | |
|---|---|
| **C3.3 Criteria for purity**<br>- describe paper chromatography.<br>- interpret simple chromatograms. | - identify substances and test their purity by melting point and boiling point determination and by paper chromatography.<br>- describe how chromatography techniques can be applied to colourless substances by exposing chromatograms to locating agents. |
| **C4. Physical and chemical change** | |
| All learners should be able to:<br>- identify and describe physical and chemical changes. | |
| **C5. Atoms, elements and compounds** | |
| All learners should be able to:<br>**C5.1 Basic chemistry**<br>- define element.<br>- name and give symbols of the first 20 elements of the Periodic Table.<br>- define compound.<br>- name and give formulae of simple compounds.<br>- describe the Periodic Table as a method of classifying elements (see C9.1).<br>- define atoms and molecules as smallest particles of elements and compounds.<br>- describe differences between elements, mixtures and compounds and between metals and non-metals.<br>- describe alloys as a mixture of a metal with other elements e.g., brass as a mixture of a metal with other elements.<br>- describe the simple structure of atoms in terms of, neutrons, protons and electrons.<br>**C5.2 Atomic structure and the Periodic Table**<br>- state relative charges and approximate relative masses of protons, neutrons and electrons.<br>- define proton (atomic) number and nucleon number.<br>-explain, for the first 20 elements, the basis of the Periodic Table using the proton number and the simple structure of atoms<br>- deduce information from the notation $^{a}_{b}X$ for an atom.<br>- describe the build up of electrons in shells.<br>- describe the significance of the outermost electrons and the noble gas electronic configuration.<br>- Note that a copy of the Periodic Table will be provided in Papers 1, 2 and 3.<br>- define isotopes.<br>(The ideas of the distribution of electrons in s- and p-orbitals and in d-block elements are **not** required.)<br>**C5.3 Bonding: the structure of matter**<br>**C5.3.1 Ions and ionic bonds**<br>- describe the formation of ions by electron loss or | |

| | |
|---|---|
| gain.<br>- describe the formation of ionic bonds between the alkali metals and the halogens.<br>**C5.3.2 Molecules and covalent bonds**<br>- describe the formation of single covalent bonds in $H_2$, $Cl_2$, $H_2O$, $CH_4$ and $HCl$ as the sharing of pairs of electrons leading to the noble gas configuration.<br>- describe the differences in volatility (including m.p. and b.p.), solubility and electrical conductivity between ionic and covalent compounds.<br>**C5.3.3 Macromolecules**<br>- describe the 'structure' of graphite and of diamond.<br>**C5.3.4 Metallic bonding** | - describe the formation of ionic bonds between metallic and non-metallic elements.<br><br>- describe the electron arrangement in more complex molecules such as $N_2$, $C_2H_4$, $CH_3OH$ and $CO_2$<br><br>- relate these structures to melting point, conductivity and hardness.<br><br>- describe metallic bonding as a lattice of positive ions in a 'sea of electrons' and use these to describe the electrical conductivity and malleability of metals. |
| **C6. Stoichiometry** | |
| All learners should be able to:<br><br>- use the symbols of the elements and write the formulae of simple compounds.<br>- deduce formulae of simple compounds from relative numbers of atoms present.<br>- construct word equations and simple balanced chemical equations.<br>- define relative atomic mass ($A_r$) and relative molecular mass ($M_r$) and calculate $M_r$ as the sum of the relative atomic masses. | - use the mole and the Avogadro constant.<br>- use molar gas volume taken as 24 $dm^3$ at room temperature and pressure.<br>- determine the formula of an ionic compound from the charges of the ions present.<br>- deduce the balanced equation of a chemical reaction given relevant information.<br>- calculate stoichiometric reacting masses and volumes of gases and solutions, solution concentrations expressed in $mol/dm^3$ or $g/dm^3$ (Calculations based on limiting reactants may be set. Questions on the gas laws and the conversions of gaseous volumes to different temperatures and pressures will **not** be set.) |
| **C7. Chemical reactions** | |
| All learners should be able to:<br><br>**C7.1 Production of energy**<br>- describe and explain the use of hydrogen as a fuel e.g., in rockets.<br>- describe radioactive isotopes such as $^{235}U$ as a source of energy.<br>- describe the production of electrical energy from simple cells i.e., two electrodes in an electrolyte (this should be linked with the reactivity series).<br>- describe the use of batteries as a convenient portable energy source.<br><br>**C7.2 Energetics of a reaction** | |

| | |
|---|---|
| - describe, using examples, exothermic and endothermic reactions.<br>- describe bond breaking as endothermic and bond formation as exothermic.<br>**C7.3 Speed of reaction**<br>- define speed of a reaction.<br>- describe the effect of concentration, particle size, catalysts (including enzymes) and temperature on the speed of reactions.<br>- interpret data obtained from experiments concerned with speed of reaction.<br><br>- state that organic compounds that catalyse organic reactions are called enzymes.<br>- describe the application of the above factors to the danger of explosive combustion with fine powders (e.g., flour mills) and gases (e.g., mines)<br><br>**C7.4 Redox**<br>- define oxidation and reduction in terms of oxygen/hydrogen gain/loss. | - explain the effect of concentration, particle size, catalysts (including enzyme) and temperature on the speed of reactions in terms of the collision theory.<br><br>- show awareness that light can provide energy needed for certain chemical reactions by:<br>describing the use of silver salts in photography i.e., reduction of silver ions to silver, stating that photosynthesis leads to the production of glucose from carbon dioxide and water in the presence of chlorophyll and sunlight (energy).<br>- define oxidation and reduction in terms of electron transfer. |
| **C8. Acids, bases and salts** | |
| All learners should be able to:<br>**C8.1 Characteristics and properties of acids and bases**<br>- describe the characteristic properties of acids as in their reactions with metals, bases, carbonates and their effect on litmus.<br>- describe neutrality and relative acidity and alkalinity in terms of pH (whole numbers only) measured using Universal Indicator paper.<br>- describe and explain the importance of controlling the acidity in soil.<br>- prepare and use plant extracts as acid/base indicators.<br>- define acids and bases in terms of proton transfer, limited to aqueous solutions.<br>**C8.2 Types of oxides**<br>- classify oxides as either basic or acidic related to metallic and non-metallic character of the element forming the oxide.<br>**C8.3 Preparation of salts**<br>- describe and prepare soluble salts from bases, carbonates, metals and ammonium salts.<br>- prepare, separate and purify insoluble salts (see C3.2 – Methods of purification).<br>**C8.4 Identification of ions**<br>- describe and use the following tests to identify:<br>**C8.4.1 Aqueous cations**<br>- ammonium, calcium, copper (II), iron (II), iron (III) and zinc using aqueous sodium hydroxide and aqueous ammonia as appropriate. (Formulae | - use the ideas of acidity, alkalinity and neutrality to explain acid/base reactions.<br><br>- classify other oxides as neutral or amphoteric. |

| | |
|---|---|
| of complex ions are **not** required).<br>**C8.4.2 Aqueous anions**<br>- carbonate (by reaction with dilute acid and then lime water), chloride (by reaction under acidic conditions with aqueous silver nitrate), iodide (by reaction under acidic conditions with aqueous lead (II) nitrate), nitrate (by reduction with aluminium to ammonia) and sulfate (by reaction under acidic conditions with aqueous barium ions).<br>**C8.5 Identification of gases**<br>- identify carbon dioxide using limewater.<br>- identify hydrogen using a lighted splint.<br>- identify oxygen using a glowing splint.<br>- identify ammonia using damp litmus paper. | |
| **C9. The Periodic Table** | |
| All learners should be able to:<br>**C9.1 Periodic trends**<br>- describe the Periodic Table as a method of classifying elements and its use in predicting properties of elements.<br>- describe the trend from metallic to non-metallic character across a Period.<br>- identify alkali metals, alkaline earth metals, halogens and noble gases.<br>**C9.2 Group properties**<br>- describe the relationship between group number and the number of outer electrons.<br>- describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point, density and in reaction with water.<br>- predict the properties of other elements in the Group given data, where appropriate.<br>- describe chlorine, bromine and iodine in Group VII as a collection of diatomic non-metals showing a trend in colour and state their reaction with other halide ions.<br>- predict the properties of other elements in the Group given data where appropriate.<br>- identify trends in other groups given information about the elements concerned.<br>**C9.3 Transition elements**<br>- describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compound, and which, as elements and compounds, often act as catalysts.<br>**C9.4 Noble gases**<br>- describe the noble gases as being unreactive.<br>- describe the uses of noble gases in providing an inert atmosphere, e.g., argon in lamps; helium for filling weather balloons. | |

| **C10. Metals** | |
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| All learners should be able to:<br>**C10.1 Properties**<br>- compare the general physical and chemical properties of metals with those of non-metals.<br>**C10.2 Reactivity series**<br>- place in order of reactivity: calcium, aluminium, copper, (hydrogen), iron, magnesium, potassium, sodium, zinc and gold by reference to their reactions, if any, with aqueous ions of other metals, reaction with water, steam and hydrochloric acid.<br>- deduce an order of reactivity from a given set of experimental results.<br>**C10.3 Extraction of metals**<br>- describe the ease in obtaining metals from their ores by relating the elements to the reactivity series.<br>- name metals that occur native including copper and gold.<br>- name the main ores of aluminium, copper and iron.<br>- describe the essential reactions in the extraction of iron.<br>**C10.4 Uses of metals**<br>- describe the idea of changing the properties of iron by the controlled addition of additives to form steel alloys.<br>- name the uses of mild steel (car bodies, machinery) and stainless steel (chemical plant, cutlery)<br>- name the uses of zinc for galvanizing and making brass.<br>- name the uses of copper (electrical wiring, cooking utensils) and of aluminium (aircraft bodies and food containers). | - account for the apparent unreactivity of aluminium in terms of the oxide layer adhering to the metal.<br>- describe the environmental impact of the extraction of metals on land, plants, human beings and animals.<br>- explain how alloying affects the properties of metals.<br>- relate the uses of mild steel and stainless steel to their properties.<br>relate the uses of copper and aluminium to their properties. |
| **C11. Electricity and chemistry** | |
| All learners should be able to:<br>- describe electrolysis<br>- describe the electrode products formed in the electrolysis of copper chloride (aqueous solution) between inert electrodes (platinum or carbon).<br>- state the general principle that metals or hydrogen are formed at the negative electrode and that oxygen or halogens are formed at the positive electrode.<br>- outline the manufacture of aluminium from pure aluminium oxide, and that of chlorine and sodium hydroxide from concentrated aqueous sodium chloride (starting materials and essential conditions should be given).<br>- describe the plating of metals. | - describe the electrolysis of dilute sulfuric acid (as essentially the electrolysis of water).<br>- describe electrolysis in terms of the ions present and reactions at the electrodes in examples given.<br>- predict the likely products of the electrolysis of a specified binary compound in the molten sate or in aqueous solution.<br>- construct equations for the electrode reactions involved in the manufacture of aluminium, chlorine and sodium hydroxide. |
| **C12. Non-metals** | |

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| All learners should be able to:<br>**C12.1 Air**<br>- describe the volume composition of air.- name common pollutants in air as carbon monoxide, sulfur dioxide, oxides of nitrogen and lead compounds.<br>- list the sources of each of the pollutants:<br>carbon monoxide (from incomplete combustion of carbon-containing compounds),<br>sulfur dioxide (from the combustion of fossil fuels containing sulfur compounds leading to 'acid' rain),<br>oxides of nitrogen and lead compounds from car exhausts.<br>- state adverse effects of common pollutants on buildings, plants and health. | - describe the catalytic removal of nitrogen oxides from car exhausts.<br><br>- describe in simple terms the role of carbon dioxide and other polyatomic molecules in global warming.<br>- describe the roles of ozone in absorbing ultraviolet (UV) radiation.<br>- show understanding that chlorofluorocarbons (CFCs) can lead to the depletion of the ozone layer (limited to the idea that electromagnetic absorption by CFCs leads to decomposition of ozone, i.e., free-radical mechanism not required). |
| **C12.2 Water**<br>- describe and perform a chemical test for water using anhydrous copper (II) sulfate or cobalt (II) chloride.<br>- show understanding that hydration may be reversible e.g., by heating hydrated copper (II) sulfte or hydrated cobalt (II) chloride.<br>- distinguish between soft and hard water.<br>- distinguish between temporary hardness and permanent hardness.<br>- state advantages and disadvantages of hard water.<br>- describe how hard water can be made soft.<br>- describe in outline the purification of water in terms of filtration, sedimentation and chlorination.<br>**C12.3 Hydrogen**<br>- name the uses of hydrogen in the manufacture of ammonia, margarine (see C13 – Organic Chemistry) and as a fuel in rockets.<br>- describe the preparation, collection and properties of hydrogen.<br>**C12.4 Oxygen**<br>- describe combustion of elements e.g., magnesium.<br>- state the uses of oxygen including use in oxygen tents, in hospitals and with acetylene in welding.<br>- describe, in simple terms, respiration, combustion and rusting.<br>- describe methods of rust prevention: paint and other coatings e.g., galvanizing to exclude oxygen.<br>**C12.5 Carbon dioxide**<br>- describe formation of carbon dioxide from:<br>the complete combustion of carbon containing | - describe formation of hydrogen as a product of electrolysis of water (see C11 – Electricity and Chemistry) |

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| substances, as a product of respiration and as a product of the reaction between an acid and a carbonate.<br>**C12.6 Nitrogen**<br>- describe the need for nitrogen, phosphorus and potassium compounds in plant life.<br>- name the uses of nitrogen in the manufacture of ammonia.<br>- name the uses of ammonia in the manufacture of fertilisers e.g., ammonium sulfate, ammonium nitrate and in the manufacture of household detergents.<br>**C12.7 Carbon and carbonates**<br>- define allotropy as an existence of an element in two or more forms in the same physical state.<br>- name the allotropes of carbon as graphite and diamond.<br>- describe the manufacture of calcium oxide (quick lime) from calcium carbonate (limestone) in terms of the chemical reaction involved.<br>- state some uses of lime and slaked lime in treating acidic soil and neutralising acidic industrial waste products.<br>- state the uses of calcium carbonate in the manufacture of iron, glass and cement. | - describe the essential conditions for the manufacture of ammonia by the Haber process.<br><br>- relate their structures to the use of graphite as a lubricant and in diamond cutting.<br><br>include thermal decomposition when revising syllabus |
| **C13. Organic chemistry** | |
| All learners should be able to:<br>**C13.1 Name of compounds**<br>- name, and draw the structure of unbranched alkanes, alkenes, alcohols and acids containing up to four carbon atoms; and the products of the reactions stated in C13.5 -C13.8.<br>- state the type of compound present given a chemical name, ending in *-ane, -ene, -ol* or *-oic acid* or a molecular structure.<br>**C13.2 Fuels**<br>- name as fuels coal, natural gas and petroleum.<br>- name methane as the main constituent of natural gas.<br>- describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation.<br>**C13.3 Uses of petroleum fractions**<br>- name the uses of the fractions:<br>Liquefied petroleum gas, as a fuel for cooking,<br>petrol in petrol engines,<br>the paraffin fraction in oil stoves and aircraft fuel,<br>the diesel fraction for fuel in diesel engines,<br>the lubricating fraction for lubricants and making waxes and polishes,<br>bitumen for making roads.<br>- appreciate the hazards associated with the use of petroleum fractions.<br>**C13.4 Homologous series**<br>- describe the homologous series as a 'family' of similar compounds with similar properties due to the presence of the same functional group.<br>- describe the general characteristics of a | - name, and draw the structure of unbranched alkanes, alkenes, alcohols and acids containing up to six carbon atoms; and the products of the reactions stated in C13.5 -C13.8. |

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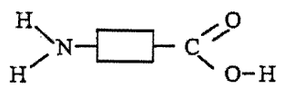
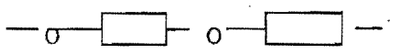
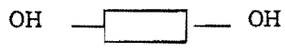
| homologous series.<br>**C13.5 Alkanes**<br>- describe the properties of alkanes (exemplified by methane) as being generally unreactive, except in terms of burning. | |
| **C13.6 Alkenes**<br>- describe the properties of alkenes in terms of addition reactions with bromine, hydrogen and steam.<br>- distinguish between saturated and unsaturated hydrocarbons from molecular structures and by simple chemical tests. | - describe the manufacture of alkenes and of hydrogen by cracking. |
| **C13.7 Alcohols**<br>- describe the formation of ethanol (and carbon dioxide) by fermentation and its importance to the wine and brewing industry.<br>- name the uses of ethanol as:<br>a solvent,<br>a fuel,<br>for sterilization. | - describe the formation of poly(ethene) as an example of addition polymerisation of monomer units.<br>- describe the pollution problems caused by non-biodegradable plastics. |
| **C13.8 Acids** | - describe the formation of ethanoic acid by the oxidation of ethanol and by the action of atmospheric oxygen.<br>- describe the reaction of ethanoic acid with ethanol to give an ester (ethyl ethanoate), a sweet-smelling compound. |
| **C13.9 Natural polymers** | - describe macromolecules in terms of large molecules built up from small unites, different macromolecules having different units and/ or different linkages.<br>- name proteins, fats and carbohydrates as the main constituents of food.<br>- describe proteins as possessing the amide linkages as nylon, but with different units.<br>  <br>- describe the hydrolysis of proteins to amino acids (structures and names not required).<br>- describe the carbohydrate starch, as a macromolecule represented as:<br>  <br>being formed by condensation polymerisation of smaller carbohydrate units called sugars, represented as<br>  |