

A photograph of a laboratory setup. In the foreground, a round-bottom flask containing a red liquid is heated over a Bunsen burner, with a bright orange flame visible. A glass condenser tube rises from the flask, connected to various pieces of glassware. One piece of glassware has a skull and crossbones hazard symbol and the word "DUDS" printed on it. The background is dark and out of focus.

NEW

2023

HARROAN  
S.2  
**CHEMISTRY**

Learner's book

Second edition

With 100  
Lesson periods

2023

Guide notes  
Group activities  
Project guidelines

Practical  
Questions  
And more

Revised from 2022 version and  
reviews from those who used it



HARROAN'S

# New curriculum work book for s.2 **Chemistry**



This book has been made & revised basing on new curriculum for lower secondary education syllabus

## Student's information.

This book belongs to:

Name .....

School .....

Class .....

Stream .....

# CHAPTER 01 ACIDS AND ALKALIS



**By the end of the chapter you should;**

- Recognize that locally available materials and substances are either acidic or alkaline.
- Explain the concept of PH as a measure of strength of acids and alkalis
- Understand neutralization reaction and its application in daily life.

NCDC TOPIC PROPOSED TIME FOR THE CHAPTER

Lesson Periods - 12

Weekly periods - 3

Coverage time - 4 weeks

# Lesson period 1 1.1 classifying substances as acids or alkaline

## Introduction

In this period, you are to classify the given substances as acids or alkalis using taste and texture

## Lesson learning objectives;

- To define an acid and alkali
- To outline properties of acids and alkalis
- To classify substances as acids or alkalis

## Guide notes

### Common sources of acids and alkali

We use acids and alkali in our daily lives for things like cleaning, cooking and you even eat and drink some substances that are acidic or alkaline.

The word **acid** means 'sour' and all acids possess this property. They are also soluble in water and are corrosive.

**Alkalis** are very different from acids. They are the chemical 'opposite' of acids.

They remove the sharp taste from an acid. They have a soapy feel.

Acids release hydrogen ions when dissolved in water. It's the hydrogen ions in an aqueous solution that make the substance acidic.

Therefore an acid is a compound which when dissolved in water produces hydrogen ions as the only positively charged ion.

**Examples of acids include** sulphuric acid, hydrochloric acid, nitric acid, carbonic acid.

**Alkalis release hydroxide ions when dissolved in water.** It's the hydroxide ions that make a substance alkaline in an aqueous solution. Therefore an alkali is a base that dissolves in water to produce hydroxide ions as the only negatively charged ion. A solution of a base in water is called an alkaline solution. **Examples of alkalis** include sodium hydroxide, calcium hydroxide, and potassium hydroxide.

Acetic acid is found in vinegar as well as products that contain vinegar. Citric acid is found in jams and jellies and it adds a tangy flavour to other foods. Lactic acid is found in milk and other dairy products.



Sulphuric acid is found in car acid

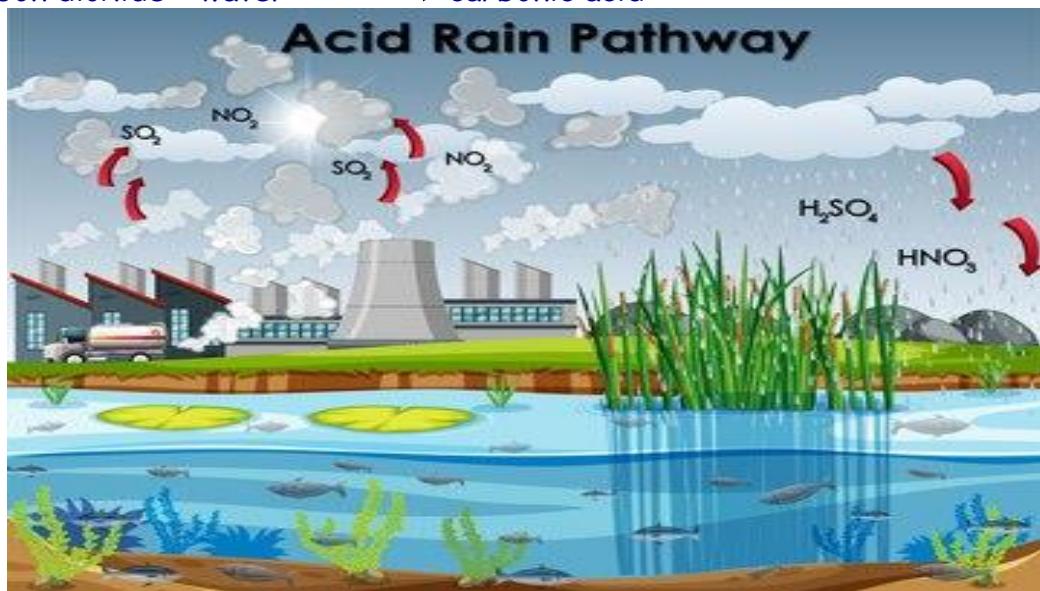
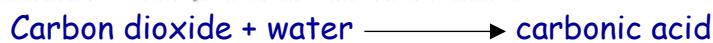


Lactic acid is found in milk



Ascorbic acid is found in oranges

A scorbic acid is vitamin C found in citrus fruits as well as some other fruits and juices. Sulphuric acid is found in car batteries and some drain cleaners  
Another source of acids in nature is through the acidic rain. The acidity of rain water is due to the carbon dioxide in the atmosphere, the carbon dioxide dissolves in rain water to produce carbonic acid



Gases produced by motor cars and industry produce large amounts of sulphur dioxide and nitrogen oxides. When these are absorbed in rain water, the rain becomes acidic causing acidic rain

Environmental effects of acidic rain include death of aquatic plants and animals, metal and limestone corrosion, leaching of minerals such as calcium.

Acid mine drainage is a pollutant from mines. It contains corrosive and toxic mixture of sulphuric acid and heavy metal ions

Its environmental effects include, it can kill aquatic life, it damages light penetration in water and causes damage to fish gills

Other sources of acids include carbonated drinks such as soda, fizzy drinks, beer and some wines

Common sources of alkalis include sodium bicarbonate. It is found in most homes and it is also known as baking soda. It is used as a cooking ingredient

Calcium carbonate or limestone is another source of alkalis. It is used to make chalk, farmers use it to neutralize soils and humans take pills of calcium carbonate to neutralize stomach acid.

Slaked lime cement calcium hydroxide, and household ammonia are other common sources of alkalis

## Group activity 1

### Classifying substances as either acidic or alkaline

You are provided with the following substances which are either acidic or alkaline.

You are to carry out investigations to identify the nature of each



Lemons



Tooth paste



Baking powder



Soda



Okra



Avocado



Kaziire



Tomatoes



Detergent powder



Pineapple



Orange



Red pepper

### What to do

- Wash the lemons, avocado, okra, orange, pineapple, red pepper and tomatoes
- Cut a piece of each of the fruits and taste.
- Touch on the cut piece of the fruits and feel them
- Pour a small portion of the soda on the ground and observe. You can also taste part of it
- Pour a small portion of kaziire on the ground and observe. Taste part of it
- Taste a small portion of the baking powder. Touch and feel it
- Pour some detergent in water. Touch and feel. Do not taste the detergent
- Touch and feel part of the opened Colgate. Taste a piece of it.

Note, don't taste the detergent

Complete the table below by filling in the texture and taste of the substances

substance	texture	taste	Is it acidic or alkaline
Lemons			
Toothpaste			
Baking powder			
Okra			
Avocado			
Kaziire			
Tomatoes			
Red paper			
Orange			
Pine apple			
Detergent			

**State your observation when you poured:**

Soda on the ground

## Kaziire on the ground

From the activity, outline the properties of,

### Acids

### Alkalines

## Lesson period 2 1.2 Importance of acids in daily life

**Introduction** In this period, you are to describe the various uses of acids in daily life

**Lesson learning objectives;** • To describe the uses of acids in daily life

### Guide notes

#### Uses of acids in daily life

The five common acids have several uses in medicine, industries and at home. The five common acids are sulphuric acid, lactic acid, hydrochloric acid, nitric acid and acetic acid

**Sulphuric acid;** It is an oily highly corrosive liquid. It is formed naturally in Sulphide minerals. It is a dangerous chemical and should be handled with caution

**Hydrochloric acid;** It is formed when hydrogen chloride is dissolved in water. It is a strong acid, which is colourless and viscous. It is extremely corrosive and has a distinctively pungent smell

**Nitric acid;** Is a strong acid which is colourless, highly corrosive and toxic. It reacts with hydroxide metals and oxides to form nitrate salts

**Lactic acid;** Is an organic acid also known as milk acid. It is formed when milk sugar (lactose) undergoes fermentation. It is found in cottage cheese, sour milk, yogurt etc.

**Acetic acid;** It is also known as ethanoic acid. It is clear, colourless with a pungent smell. Vinegar is a dilute form of acetic acid. Acetic acid is the main component of vinegar and gives its characteristic smell

#### Some of the uses of the acids above include:

- ❖ Sulphuric acid is used as an ingredient in skin ointments to treat skin infections such as canker sores. Concentrated sulphuric acid is harmful to the skin, it can cause severe skin injury. So a dilute one is used in skin ointments
- ❖ Sulphuric acid can damage cancerous cell DNA, thus it is used to manufacture chemotherapy drugs
- ❖ Hydrochloric acid is mixed with other chemical ingredients to make fertilizers for plants which grow in acidic soils
- ❖ Nitric acid is used in making explosives when mixed with incompatibles, it results into violent spontaneous reactions, and explosions
- ❖ Lactic acid is used as a flavouring agent and preservative in processed cheese, and carbonated beverages
- ❖ Acetic acid is used in medical field as an antiseptic agent, postoperative scar reduction and managing soft tissue injuries



Nitric acid is used in explosives



Sulphuric acid is used  
in skin ointments



Hydrochloric acid is used in fertilizers

## Group activity 2

Carry out research from internet and text books and describe other uses of each of the five acids above

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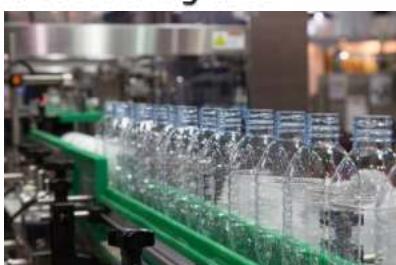
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The pictures below show various ways acids are used in daily life. For each, identify the acid being used



# Making plastics



## Making mayonaise



## Laundry and cleaning



## Leather tanning



## Car batteries



## Textile dyeing



## Fireworks



# Furniture vanish



# Removing metal stains



## Liquid fuelled rockets

Identify the acid used in each

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Lesson period 3 1.3 Importance of alkali in daily life

## Introduction

In this period, you are to describe various ways how alkalis are used in daily life

**Lesson learning objectives:** • To describe how alkalis are used in daily life

## Guide notes

## **Uses of alkalis in daily life**

The most used alkalis in daily life include; sodium hydroxide, sodium fluoride, sodium bicarbonate, magnesium hydroxide, calcium hydroxide and ammonia

## Sodium hydroxide

It is sometimes called caustic soda. It is a common ingredient in cleaners and soaps. At room temperature, it is a white, odorless solid, liquid sodium hydroxide is colourless and has no smell.

## Sodium bicarbonate

It is commonly known as baking soda or bicarbonate of soda. It's a white solid that is crystalline, but often appears as a fine powder

## Magnesium hydroxide

It's an inorganic compound which occurs in nature as the mineral brucite. It's a white solid with low solubility in water. It's a common component of antacids.

## Ammonia

Is a colourless highly irritating gas with a sharp suffocating smell. It dissolves easily in water to form ammonium hydroxide solution which can cause irritation and burns

Ammonia gas is easily composed and forms a clear, colorless liquid under pressure

## Sodium fluoride

It is a white solid that is readily soluble in water. It is used in trace amounts in fluoride of drinking water to prevent tooth decay

### Some of the uses of alkalis above include

- Toothpaste which we mostly use contains sodium fluoride which is slightly basic in nature. This kills the bacteria in the mouth
- Sodium hydroxide is used in pharmaceutical industry in the manufacturing of various drugs like aspirin which is a pain reliever
- Sodium bicarbonate is used as an antacid to relieve heart burn and ulcers



Toothpaste which we  
mostly use contains



Sodium hydroxide is used in the  
manufacturing of various drugs

- Magnesium hydroxide is used to make laxative medicines which are used to treat constipation in children and adults. It works by causing water to be retained with stool
- Ammonia is used in the manufacture of fertilizers to replenish nitrogen in the soil

## Group activity 3

Carry out research from internet and text books and list other uses of the alkalis

The pictures below show various ways alkalis are used in daily life. For each, identify the alkali being used



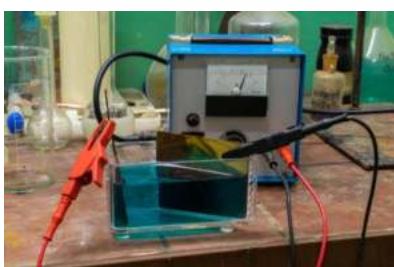
## Unclogging pipes



## Cleaning agents



## Paper production



## Electroplating



## Water treatment



## Manufacture of soap

Identify the alkalis used in each

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## Lesson period 4    1.4 Effects of acids and alkalis

**Introduction** In this period, you are to describe the effects of acids and alkalis to the environment

**Lesson learning objectives:** • To describe how acids and alkalis can affect environment

## Group activity 4

Using the pictures below as reference, describe various ways acids and Alkalies can affect people and substances if their use is not controlled







## By the end of the chapter you should;

- Should be able to prepare various salts
- Understand the importance of common salts
- Know how to write chemical formula of compounds
- Be able to define solubility of salts

NCDC TOPIC PROPOSED TIME FOR THE CHAPTER

Lesson Periods - 12

Weekly periods - 3

Coverage time - 4 weeks

## Lesson period 16

### 2.1 Defining salts

**Introduction** In this period, you are to identify examples of different groups of salts and their natural sources

**Lesson learning objectives;**

- To define a salt
- To outline examples of different groups of salts
- To identify natural sources of salts

#### Guide notes

##### Salts

A salt is a compound formed when either all or part of the ionizable hydrogen ions of an acid is replaced by metallic or ammonium ions.

Salts are ionic compounds containing positively charged cations and negatively charged anions. During salt formation, cation is coming from base and anion is coming from acid



Example in sodium chloride,



In sodium chloride formation, cation sodium is coming from sodium hydroxide and anion chloride is coming from hydrochloric acid.

Salts can be categorized in to types namely;

- Normal salt
- Acidic salt
- Basic salt

**Normal salt**, this is a salt produced when all the ionisable hydrogen of the acid is replaced by a metallic or ammonium ion.

These salts don't contain ionisable hydrogen. Example include; sodium chloride, ammonium nitrate, magnesium sulphate.

**Acidic salts**, these are salts formed when only part of the ionisable hydrogen of an acid is replaced by a metallic or ammonium ion. Examples include, sodium hydrogen carbonate, potassium hydrogen sulphate.

**Basic salts**, these are formed when insufficient acid is present to neutralize the available base.

#### Group activity

- a) Complete the table below by outlining the categories of salts and name of salts in that example

Parent acid	Category of salts	Names of salts
Hydrochloric acid (HCl)	Chlorides	Potassium chloride, sodium chloride, ammonium chloride
Sulphuric acid ( $H_2SO_4$ )		
Nitric acid ( $HNO_3$ )		
Carbonic acid ( $H_2CO_3$ )		

### Sources of salts

Though many salts are found to exist in nature, we can also prepare the salts in the laboratory from chemical reactions

#### Natural sources of salts

Salt is found naturally at low levels in all foods. It is one of the most abundant minerals on earth and an essential nutrient for many animals and plants. Sodium chloride is naturally found in sea water and in underground rock formations.



Collecting salt along sea shore

#### Group activity 15b,

Carry out research and outline the natural sources of common salts like magnesium chloride, sodium nitrate, magnesium sulphate, calcium carbonate, potassium chloride and calcium sulphate

## Lesson period 17 2.2 Preparing a salt using baking soda and vinegar

**Introduction** In this period, you are to prepare a salt using baking soda and vinegar  
**Guide notes**

### Formation of salts

Some salts can be extracted by mining but others need to be prepared in the laboratory. Naturally existing salts contain a lot of impurities and it becomes very costly to obtain them in pure form.

Pure salts are manufactured in industries by action of dilute acids on either a base, or a metal

### Group activity 16, Reaction of baking soda and vinegar

#### Materials you need

- Plastic water bottle
- Vinegar
- A balloon
- Baking soda
- Spatula

#### Procedure



Half fill a plastic water bottle with vinegar. You can use a funnel as shown in the picture that the vinegar doesn't pour



Stretch the balloon over the funnel



Fill the balloon with around 2 spatula  
endfuls or tablespoons of baking soda

Carefully place the balloon over the  
bottle without dropping the baking soda



Lift the balloon to sprinkle the  
baking soda into the bottle

Observe what happens to the balloon



### Questions

a) State your observations

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b) What do you think caused the observation above?

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c) What are the formed products when the baking soda reacted with vinegar?

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d) Write a general word equation for the reaction

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# Lesson period 18 2.3 Action of an acid on a metal preparation of salts

## Introduction

In this period, you are to prepare Zinc chloride salt using Zinc granules and dilute hydrochloric acid

## Guide notes

### Preparation of salts

There are two key ideas to consider when preparing salts;

- Is the salt being formed soluble or insoluble?
- Is there water of crystallization present in the salt crystals?

### Solubility of common salts

Salts	Soluble	Insoluble
Sodium, potassium and ammonium	All	None
Nitrates	All	None
Chlorides	Most are soluble	Silver and lead (ii) sulphate
Sulphates	Most are soluble	Barium, calcium and lead (ii) sulphate
Carbonates	Carbonates of sodium, potassium and ammonium	Most are insoluble
Hydroxides	Hydroxides of sodium and potassium	Most are insoluble

### Selecting a method of preparation

When deciding the method of preparation, it is important to first know whether the salt being produced is soluble or insoluble

If it is soluble, then it can be prepared by action of acid on a metal, hydroxides or carbonates and neutralization

If it is insoluble, then it must be prepared by precipitation using soluble reactants

### Action of an acid on a metal

## Group activity 17,

Preparing Zinc chloride by action of hydrochloric acid on Zinc powder

### Materials

- ❖ Heat source
- ❖ Beaker
- ❖ Stirring rod
- ❖ Zinc powder

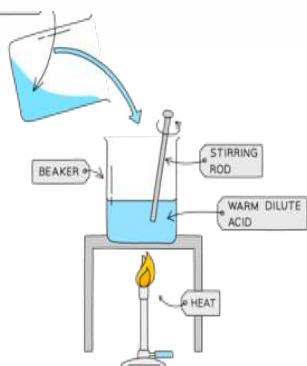
- ❖ Evapourating dish
- ❖ Hydrochloric acid

**Caution: Be careful while heating an acid**

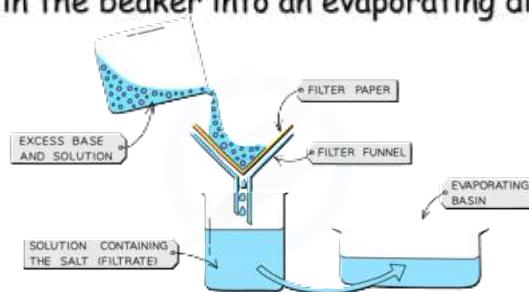
### Procedure

- a) Add dilute hydrochloric acid into a beaker and heat using a heat source
- b) Add Zinc powder a little at a time to the warm dilute acid. Observe what happens

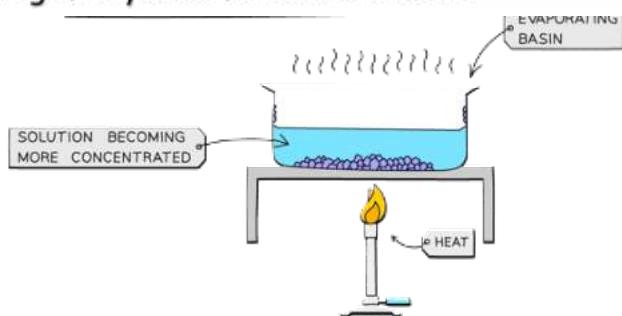
Zinc powder



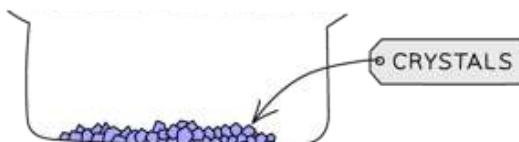
- c) Keep adding the Zinc powder until no further reaction occurs
- d) Filter the mixture to remove excess zinc which has not reacted
- e) Pour the solution in the beaker into an evaporating dish



- f) Heat the solution to evaporate water and make the solution saturated. Check the solution is saturated by solution by dipping a glass rod into the solution and seeing if crystals form on the end



- g) Leave the filter in a warm place to dry and crystallize
- h) Decant excess solution and allow crystals to dry



### Questions

Explain why,

- i) Zinc powder is used instead of zinc granules

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- ii) Why it is necessary to filter the mixture before evaporation is done

Write the word equation for the reaction that took place

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Outline other examples of salts which can be prepared by action of an acid on the metal, for each. Write the word equation for its formation

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## Lesson period 23 2.8 Uses of salts in daily life

**Introduction** In this period, you are to describe the different uses of salts

**Lesson learning objectives;** • To describe the different uses of salts

### Guide notes

#### Uses of salts in daily life

Salts play an important role in our lives. They are used in homes and industries. Salts are also important in proper functioning of the body. **Some of the salts that we use in daily life include;** Potassium nitrate, sodium chloride, sodium phosphate, ammonium chloride, lead chloride, calcium carbonate and barium sulphate

#### Importance of potassium nitrate

Potassium nitrate also known as niter, is an ionic salt with chemical formula  $\text{KNO}_3$ . It is commonly used as a fertilizer for high-value crops that provide nitrogen and potassium. Due to its exceptional oxidizing nature, potassium nitrate is also used in rocket propellants, fireworks and gun powder



**potassium nitrate is used in fire works** Potassium nitrate is used in rocket propellants  
Potassium nitrate is also an active ingredient in tooth paste, exerting an anti-sensitivity action. It provides increased protection against painful sensitivity of the teeth to cold, heat, sweets, acids or contact. It is used in food industry to preserve meat against microbial agents



**It is used in food industry to preserve meat against microbial agents**

### Group activity 22 a

Carry out research and describe the other importance of other salts in daily life

### Group activity 22b,

The pictures below show applications of salts in daily life. For each, identify the salts used in it.



Dry cell



## Photographic films



### **fertilizers**



## Cement



## Tooth paste



## Crowns for teeth replacement



Chalk



## **Plaster of paris**

# CHAPTER 03 THE PERIODIC TABLE

## Periodic Table of Elements

The periodic table displays the following information for each element:

- Atomic Number:** The number of protons in the nucleus.
- Symbol:** The one or two-letter abbreviation for the element.
- Name:** The common name of the element.
- Atomic Mass:** The average mass of the element's isotopes.
- Electronegativity (Pauling):** A measure of an atom's ability to attract electrons.
- Properties:** Melting point, boiling point, density, and other physical characteristics.

**Legend:**

- Alkali metals
- Alkaline earth metals
- Transition metals
- Noble gases
- Other metals
- Nonmetals
- Metalloids



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National Institute for  
Science and Mathematics  
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Source: <http://upnac.org> (with permission)

## By the end of the chapter you should;

- Group elements as metals and non-metals
- Relate the physical properties of metals to their uses.
- Understand the periodic table
- Relate the arrangement of electrons in the first 20 elements to their positions in the periodic table
- Understand the relationships between position of elements

NCDC TOPIC PROPOSED TIME FOR THE CHAPTER

Lesson Periods - 12

Weekly periods - 3

Coverage time - 4 weeks

# Lesson period 3.1 Defining the periodic table

29

## Introduction

In this period, you are to define a periodic table and describe the arrangement of elements in the periodic table

## Lesson learning objectives;

- To define a periodic table
- To describe arrangement of elements in the periodic table

## Guide notes

### The periodic table

Is a table of chemical elements arranged in order of atomic number, usually in rows, so that elements with similar atomic structure appear in vertical columns. The periodic table arranges all elements in accordance with their increasing atomic number and recurring chemical properties. They are assorted in a tabular arrangement where in the horizontal rows of the elements are periods and are represented by numbers 1, 2, 3 up to 7. The vertical columns of elements are the groups, and are represented by capital roman numbers e.g. group I, group II, and group III etc. Elements are arranged from left to right and top to bottom in order of increasing atomic numbers. Thus,

- Elements in the same group will have same valence and hence similar chemical properties
- Elements in the same period will have an increasing order of valence electrons

The first 94 elements of the periodic table are naturally occurring, while the rest from 95 to 118 have only been synthesized in laboratories

## Periodic Table of the Elements

The Periodic Table of the Elements is a tabular arrangement of all known chemical elements. It consists of 18 groups (vertical columns) and 7 periods (horizontal rows). The groups are color-coded according to their chemical properties:

- Groups 1-2 (IA, IIA):** Alkali metals (red), Alkaline earth metals (orange), and Helium (pink).
- Groups 3-12 (IIIA-VIIB):** Transition metals (blue), Actinides (purple), and Lanthanides (light blue).
- Groups 13-18 (VIIIA-VIIA):** Post-transition metals (yellow), Noble gases (pink), and Halogens (green).

Each element entry includes the following information:

- Atomic Number:** The element's position in the periodic table.
- Symbol:** The standard one- or two-letter symbol for the element.
- Name:** The element's name.
- Atomic Weight:** The element's mass number.
- Electrons per shell:** The number of electrons in the outermost shell.
- State of matter (color of name):** The element's physical state at room temperature (gas, liquid, solid, or unknown).
- Subcategory in the metal-metallloid-nonmetal trend (color of background):** Elements are categorized into metals (red), metalloids (orange), and nonmetals (green).
- Unknown chemical properties:** A legend indicating elements with unknown chemical properties.
- Group Trends:** A legend for groups 13-18 showing trends in atomic radius, ionization energy, and electron affinity.

## Lesson period 33 3.5 Sonority and lustre properties of elements

**Introduction** In this period, you are to describe the applications of sonority and lustre properties of elements in daily life.

### Lesson learning objectives;

- To define sonority
- To define lustre
- To describe the importance of sonority and lustre in daily life.

#### Guide notes

##### SONORITY

Is the property of a material producing a ringing sound when struck. Most metals are sonorous in nature and almost all non-metals are not sonorous.

##### Applications of sonority property of metals in daily life

###### 1. Sonorous metals are used in the manufacture of bells.

Electric bells are made using sonorous metals like iron which when electric current is applied, the hammer hits the sonorous metal which then produces sound.



Electric bells have been mainly used at railroads crossing, in telephones, fire alarms, door bells school bells. Electronic bells are made of metals such as copper, tin and iron.

###### 2. Sonorous metals are used in the manufacture of cymbals.



A cymbal is a common procession instrument often in pairs.



It consists of a circular flat or concave metal plate that is struck with a drum stick or is used in pairs stuck together.



3. Sonorous metals are used in making guitar strings.

Guitar strings are made from elements such as Nickel, Copper, Tin. Sound is produced by striking the strings making them vibrate.

### Group activity 31

Carry out research and describe the lustre property of elements. Write short notes on it. Your notes should include;

- definition of lustre
- Application of lustre in daily life present to the class.

## Lesson period 33      3.6 Investigating hardness

**Introduction** For this period, you are to investigate hardness property of elements.

### Guide notes

#### Hardness of elements

Is the property of a metal to resist pressing, cutting, scratching or bending.

Hardness can also be a measure of how a metal resists permanent shape change when a force is applied.

Hardness is a physical property; you can determine whether a substance is hard or soft by feeling it or breaking it into pieces. By doing this, you may be changing its appearance, but you aren't chemically changing the composition of the substance.

### Group activity 32

#### Investigate the hardness of elements

##### Requirements.

- ❖ Iron metal
- ❖ Aluminum metal
- ❖ Carbon rod
- ❖ Copper metal
- ❖ Sulphur stick
- ❖ Knife



Sulphur stick



Carbon rod



Copper wire



Iron nail



Aluminium foil



Knife

##### Procedures

- Using a sharp knife attempt to cut though each element carefully.

Note: your observations in terms of the ability to cut though the elements whether easily or not or can't be cut.

Record your observations

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Which conclusions can you make

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Describe the applications of the hardness property in daily life

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Explain the following in relation to activities of daily life

- i) Screw drivers are made of steel iron



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- ii) rods used in building houses are made of iron, not copper



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## Lesson period 34 3.7 Electrical conductivity

### Introduction

In this period, you are to plan and investigate electrical conductivity in elements

### Lesson learning objectives;

- To define electrical conductivity
- To investigate electrical conductivity

### Guide notes



## By the end of the chapter you should;

- Understand how and why carbon compounds are used as fuels.
- Know and appreciate the difference between renewable and non-renewable fuels.
- Know and appreciate the impacts of burning carbon based fuels on the environment.
- Understand the process of making charcoal.

NCDC TOPIC PROPOSED TIME FOR THE CHAPTER

Lesson Periods - 36

Weekly periods - 3

Coverage time - 12 weeks

## Lesson period 43 **4.1 Carbon cycle**

**Introduction** In this period, you are to describe the carbon cycle and state its importance

**Lesson learning objectives;**

- To describe the carbon cycle
- To state the importance of the carbon cycle

### Guide notes

#### Carbon cycle

Carbon cycle refers to the series of processes which carbon atoms are inter converted in the environment from the atmosphere to the earth and then back to the atmosphere. Carbon is the primary building block of life, including DNA, proteins, sugars and fats. One of the most important carbon compounds in the atmosphere is carbon dioxide, while rocks carbon is the major component of limestone, coal, oil and gas



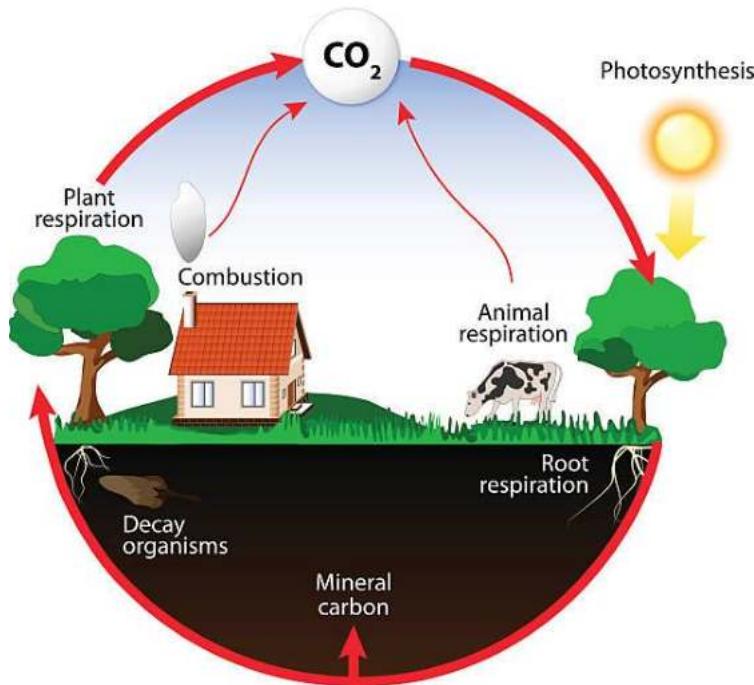
The picture above shows coal mining. Rock carbon is the major component of coal

Carbon cycles through the atmosphere, biosphere, geosphere and hydrosphere via process that include; photosynthesis, burning of fossil fuels, weathering, volcanism.

By understanding how human activities have altered the carbon cycle, we can explain many of the climate and ecosystem changes we are experiencing today.

**Group activity**

## CARBON CYCLE



Using the picture as a reference, carry out research and describe how carbon is recycled within the environment (carbon cycle)

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## Lesson period 45

### 4.3 Fuels

#### Introduction

In this period, you are to identify and compare carbon and non- carbon based fuels

#### Lesson learning objectives;

- To compare carbon and non- carbon based fuels

#### Fuels

A fuel is any substance that can provide heat and produce energy when it is burnt.

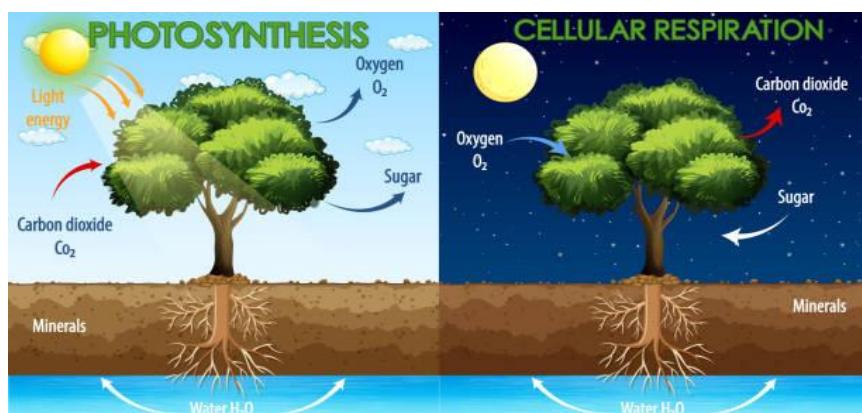
The energy released is in form of chemical energy or heat energy. The recent invention of nuclear technology means now even nuclear energy may be released due to nuclear fission or fusion. The heat energy that fuels release is used for various purposes such as cooking, heaters, for industrial and manufacturing purposes.



Cooking uses heat energy got from burning fuels.

At other times, we use an engine to convert this heat energy into mechanical energy. Like when we use petrol to run our cars. The oil which is used to as a fuel in the engine is known as fuel oil.

And then there is the fuel our bodies use which every cell requires to perform its functions. They get this energy from organic molecules such as carbohydrates, fats etc. This process of using fuels is known as cellular respiration, and these organic molecules are obtained via nutrition, which is why we call found as the fuel of our bodies. Plants also undergo cellular respiration which involves breakdown of carbon fuel (sugars from photosynthesis.) to get energy.



## Carbon and non- carbon fuels

Carbon based fuels are fuels whose combustion results in the release of carbon into the earth's atmosphere. It is estimated that more than 80% of all man-made carbon dioxide originates from fossil fuels combustion

The released carbon-based fuels can be in form of carbon dioxide or carbon monoxide.

Non- carbon fuels are fuels which do not produce carbon on combustion i.e. they do not release carbon dioxide or carbon monoxide.

The non- carbon fuels can also be called the **carbon neutral fuels**.

### Group activity

The pictures below show items which use fuels



A



B



C



D



E



F

For each, identify the name of the fuel used and the importance of the item in daily life

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b) outline examples of

i) carbon-based fuels

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ii) non carbon fuels

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c) describe the

i) advantages of using carbon fuels over the non- carbon fuels

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ii) advantages of using non- carbon fuels over carbon fuels

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## Lesson period 46      4.4 carbon fuels

**Introduction**      In this period, you are to compare biofuels and fossil fuels

**Lesson learning objectives;** • To compare bio fuels and fossil fuels

**Guide notes**