# PHYSICS SPECIAL BOOK

# FOR

# NEW ORDINARY LEVEL

# CURRICULUM

## ( DETAILED )

**SENIOR ONE TO SENIOR FOUR**

## "LEARNER'S RESEARCH BOOK"

BASED ON THE NEW LOWER SECONDARY CURRICULUM

by

**LWANGA WILLIAM**



**1st Edition**

**2023**

lwangawilliam11@gmail.com
+256750549201 / +256771803014

## *Table of contents*

# Preface

This learner's research book has been written in line with the revised physics syllabus for the new lower secondary curriculum.

The main reason as to why I have written this book, is to make research easier to learners as they are making their own notes in physics. Therefore, this is a detailed research book for the new revised physics ordinary level syllabus.

Also this book is written in line with the book called "New Ordinary Level Physics Practical Work Book" (of the same author) to reinforce hands-on experiments designed in it as learners will be making more detailed research from this learner's research book to carryout those experiments.

This learner's research book is one of the materials which are to be used to support the teaching and learning process of the new lower secondary curriculum .

**I feel confident that this Book will be of immense value to both the learners and the teachers.**

Any suggestions for improvement of this book are most welcomed, thanks.

- **Excel In Ordinary Level Mathematics( S.4 2023)**
- **S.1-S.2 Physics Project Work Book ( 1st Edition)**
- **S.1-S.4 Physics Project Work Book (2nd Edition)**
- **S.1-S.4 Mathematics Project Work Book ( 1st Edition)**
- **S.1-S.4 New Ordinary Level Physics Practical Work Book**
- **S.1-S.4 Physics Learners Research Book( Detailed)**

**Books by the same author**

**NB: "Search"{ lwanga william} on youtube and subscribe ( also tap on the notification bell) to that you-tube channel and watch the subject based project lessons that are on-going. " subscription is for free"**

# Acknowledgement

I would like to express my sincere appreciation to all those who worked tirelessly towards the production of this learner's research book.

First and foremost, I would like to thank my family and friends for supporting all my initiatives both financially and spiritually, my parents; **Mr. William Lwanga** and **Mrs. Harriet Lwanga,** my brother; Mr. Nsubuga Grace.

My gratitude also goes to the various institutions which provided staff that natured and supported me to become the physics teacher I am today. My thanks goes to Broadway high school, Mita college kawempe and St. Lawrence College Paris Palais which provided the best environment to work from and best reference books.

I thank God for the wisdom He has given me to produce this volume of work. May the Almighty God bless all the students that will use this book with knowledge of making their own notes as they are making research.....**AMEN**.

I welcome any suggestions for improvement to continue making my service delivery better.

- **Excel In Ordinary Level Mathematics( S.4 2023)**
- **S.1-S.2 Physics Project Work Book ( 1st Edition)**
- **S.1-S.4 Physics Project Work Book (2nd Edition)**
- **S.1-S.4 Mathematics Project Work Book ( 1st Edition)**
- **S.1-S.4 New Ordinary Level Physics Practical Work Book**
- **S.1-S.4 Physics Learners Research Book( Detailed)**

**Books by the same author**

**NB: "Search"{ lwanga william} on youtube and subscribe ( also tap on the notification bell) to that you-tube channel and watch the subject based project lessons that are on-going. " subscription is for free"**

# Introduction to Physics Concepts

***Defn:*** Physics is the study of the relationship between matter and energy. The people who study physics are called physicists.

**Science**

***Defn:*** Science is the scientific study of nature. For Example, how cooling effect occurs.

**Technology**

***Defn:*** Technology is the application of science. For Example, cooling effect used in refrigerator to cool different items.

**Relationship between Physics and Other Subjects**

Physics is the fundamental subject in which other subjects use its applications; the following are the relationships;

i. Chemistry

Composition and decomposing of matter involves energy. For Example,

- In Cooking stoves, fuel burn to release heat Energy.
- Insect killers and Perfumes packed in containers by compression which come out with high pressure.
- Fertilizers when they synthesize, the heat energy must involved.
- When tea and other foods are cooked, the heat energy should be involved.

ii. Biology

Since biology is the scientific subject,which involves living and non-living things, which may be micro and macro organism, it uses application of physics. For Example,

- Microscopes which are made by physicists, are used to observe micro organism.
- Syringes are based on pressure.

iii. Mathematics

Physicists should master mathematics because most of the physics problems involve calculation

iv. Astronomy

***Defn:*** Astronomy is the scientific study of universe. A universe is comprised by the moon, sun, stars, comets, planets etc. Astronomy uses different instruments to study the universe which are made by physicists. For Example,

- Periscope and telescope are used to observe distant objects like stars etc.
- Materials used to build the space-like satellites are determined by physicists.

v. Geography

***Defn:*** Geography is the study of man and his environment. It includes soil, rainfall, mountains etc. It uses application of physics, for example,

- Many instruments like rain gauge, wind vane are developed by physicists.
- Barometers which are used to measure the atmospheric pressure are made by physicists.
- Formation of soil and rocks can be explained by physics.

**Applications of Physics in Real Life**

Physics influences our lives in the following aspects;

1. At home

They include;

i. All tools and machinery: such as Crowbars, Hammers, door handles, cutlery, hinges, car jack, pulleys, tillage implements etc made by knowledge of physics.

ii. Electrical appliances: such as cooker, iron, heater, electric lamps, washing machine etc, are made by knowledge of physics.

2. Medical field

They include;

i. Machines such laser, x-ray, incubators, ultrasound and infrared machines.

ii. The knowledge used in handling and even actual use of these machines are based on the knowledge and skills acquired in Physics.

3. Source of energy

They include;

i. Batteries and generators provide electrical energy.

ii. Bulbs provide light energy.

iii. Speakers provide sound energy.

4. Transport
All Vessels used in transportation are as a result of the concept of physics, for-example, cars, ships, aeroplane, trains etc.
5. Communication
All Devices used in communication systems are as a result of the concept of physics, for example, telephones, modems, television, cables etc.
6. Entertainment
Physics enables people to enjoy a variety of leisure activities as its evident in photography, digital appliances, exercise machines and other sport equipments.
7. Industry
Physicists have been able to come up with tools and processes that have resulted in advanced technological equipments and new discoveries.
8. Schools
The instruments and apparatus used in school laboratories are made through the application of the knowledge and skills acquired in a Physics class.

**Importance of Learning Physics**

i. The study of physics enables us to answer many questions concerning physical properties of matter.
ii. Enables different people to acquire skills that are required in different professions. For Example, engineering, teaching and architecture.
iii. Enables us to design and manufacture different items. For Example, dry cell, simple machines, mobile phones etc.
iv. Enables us to enjoy since it involves practicals.

# Introduction to Laboratory Practice

**Defn:** *Laboratory is a working room for scientists*
OR
*Laboratory is the special room that has been designed and equipped for carrying out scientific experiments for the purposes of study or research.*

**Features of the Laboratory**

The laboratory should have the following;
i. Water supply system
ii. Drainage system
iii. Electricity supply system
iv. Well illuminated system
v. Well ventilated system
vi. Doors must open out wards
vii. Gas supply system

**Laboratory Apparatus**

***Defn:*** Laboratory apparatus are special tools and instruments commonly used to carry out experiments in the laboratory.

Laboratory Apparatus

| Items | Uses |
|---|---|
| Measuring cylinder | For measuring volume of liquids |
| Thermometer | For measuring temperature of substances |
| Stop watch | To measure time |
| Micrometer screw gauge | For measuring diameter of a wire |
| Vernier caliper | For measuring depth, length, internal and external diameters of objects |
| A ruler | For measuring length |
| Relative density bottle | For measuring relative density |
| Microscope | For magnifying very small objects |
| Beaker | Used as container for chemicals and other liquids. Also can be used to estimate the volume of liquids |
| Calorimeter | Used in an experiment aimed at determining the quantity of heat. |
| Spring balance | For measuring force in Newton (weight) |
| Slotted masses | Used for measuring for the quantity of matter. |
| Magnets | For demonstrating attraction and repulsion |
| Ball and ring apparatus | For demonstrating thermal expansion |

| | |
|---|---|
| Bar breaking apparatus | To show forces that can be exerted during thermal expansion and contraction |
| Tripod stand | For providing a platform for heating for stability |
| Wire gauze | For providing equal distribution of heat while burning |
| Bunsen burner | As source of heat |
| Retort stand | For holding/gripping materials |
| Triple beam balance | Measuring mass |
| Flasks | For holding liquids during experiment |
| Pipette | For transferring specific but small volume of liquids |
| Burette | For measuring volume of liquid |
| Electronic balance | For measuring mass in more precise values |

**NB:**
After experiment, apparatus should be cleaned and returned/stored to their position

**Physics Laboratory**

**Defn:** *physics laboratory is a working room for physicists.*
OR
*Physics laboratory is a special room where physics apparatus are kept and physics experiments are carried out.*

**Laboratory Rules**

***Defn:*** Laboratory rules are set of regulations governing physicists in conducting experiments and also maintaining the laboratory.
*They include the following;*
i. Do not enter laboratory without permission.
ii. Do not do an experiment without permission.
iii. Do not start an experiment without procedure information.
iv. Follow instructions carefully to avoid damage of apparatus.
v. Follow instructions carefully to avoid wrong results.
vi. Handle apparatus with care to avoid damaging them.
vii. Avoid handling apparatus and chemicals until you are asked by your teacher to do so.
viii. Avoid running, screaming or playing in the laboratory
ix. Avoid tasting, eating or drinking anything in the laboratory.
x. Keep the window open for any fumes to flow out.
xi. Do not touch any electrical equipment with wet hands.
xii. Close gas and water taps before leaving the laboratory.
xiii. All exits should be cleared of any obstruction.
xiv. Arrange in orderly way materials you want to use.
xv. Report any accident and injuries to the teacher.
xvi. Never use bare hands to handle hot Objects.
xvii. Do not use dirty or broken apparatus.
xviii. Solid wastes should not be disposed in the sinks.
xix. Clean the working areas before leaving the laboratory.
xx. Wash your hands with water and soap after carrying out an experiment.

**Laboratory Safety**

***Defn:*** Laboratory safety is the condition in the laboratory where physicists are protected from danger, risk or injury.
*They include the following;*
i. Laboratories should be well ventilated and doors should open outwards.
ii. Fire extinguishers should be fitted in an accessible position with using instructions.
iii. Laboratory floors should not be polished to avoid slippery.
iv. First aid kits must be present in the laboratories.
v. Cabinets and drawers must be present for storing apparatus.
vi. All apparatus should be checked regularly to ensure that they are safe to use.
vii. Emergency exits should be present and

easy to be accessed for use.

**First Aid**

**Defn:** *First aid is the immediate assistance / care given to a sick / injured person before getting professional medical help.*

**Importance of First Aid**

i. It helps to preserve life.
ii. It prevents the victim's condition from becoming worse.
iii. It promotes recovery by bringing hope and encouragement to the victim.
iv. It helps to reduce pain and suffering.
v. It prevents infection.

**First Aid Kit**

**Defn:** *First aid kit is a small box containing items, which are used to give help to a sick person*.

Usually labeled as "FIRST AID" and stored in a safe and easily accessible place.

**Items Found in First Aid Kit**

| Items | Uses |
|---|---|
| antiseptic soap | washing hands,wounds and equipments |
| Assorted bandage | Preventing direct contact with the victim's body fluids. |
| cotton wool | |
| Disposable sterile gloves | |
| Liniment | Reducing muscular pain |
| Painkillers | Relieving pain |
| Adhesive bandage (plaster) | Covering minor wounds |
| Thermometer | Measure body temperature |
| Sterile gauze | Covering wounds to protect them from dirt and germs |
| Safety pins, clips and tape. | Securing bandages or dressing. |
| Scissors and razor blades | Cutting dressing Materials |
| Petroleum jelly | Smoothening and soothing skin. |
| Antiseptic solution | Cleaning fresh cuts and bruisers |

**Causes of Laboratory Accident**

1. Slippery floors,
2. Incorrect use and handling of apparatus,
3. Gas leakages from faulty gas taps,
4. Fires,
5. Failure to follow the right experimental procedures and laid down safety rules.

**First Aid Procedure**

When an accident occurs, we have to help the victim by following these procedures, *consider the following accidents;*

- Electric Shock

When dealing with a victim of electric shock, remember to take the following action;

1. Do not touch the victim who is still in contact with electric current.
2. BREAK the contact by switching off the current at the switch or meter box if it can be reached easily.
3. If it is not possible to switch off the current, move the person from the current using a dry non-metallic object, for instance a piece of dry wooden plank or a bloom.
4. If you suspect that the area has high voltage electricity, call for professional help immediately.
5. If the victim is unconscious, check the breathing and pulse rate. If he or she has breathing problem, prepare to resuscitate if necessary.
6. Administer First Aid for shock, burns or other injuries sustained by the victim.
7. Seek for medical assistance.

- Cuts (Or Wounds)

*For a small cut or wound:*

1. Wash your hands using soap and cleaning water.
2. Put on your gloves.
3. Wash your wounds using salty water and clean cloth.
4. Cover the wounds or cut with an adhesive bandage or plaster.

*For a large cut or wounds:*

*1.* Let the victim lay under a shade or allow her to sit comfortably.
*2.* Wash your hands using soap and clean water.
*3.* Put on your gloves.
*4.* Prevent further blood loss by applying

pressure over the wound using a folded but clean handkerchief or cloth.
*5.* Use another cloth to secure the first one in place.
*6.* Take the injured person to hospital.

- Fainting

Fainting is the situation where by victim is weak and unable to stand. Its caused by too much heat and congestion.

**Steps taken to *Help* the Victim**
*1.* Take the person to a cool place or under a shade.
*2.* Let him/her lie on his back with his legs raised higher than the head.
*3.* Loosen his clothes and ensure sufficient supply of air.
*4.* Dip a clean handkerchief in water and press on his forehead.
*5.* Give him/her clean water to drink when He/she regains consciousness.
*6.* If not, take the victim to the nearest hospital.

- Fire

***Defn:*** Fire is the state / process of combustion which results into light, heat, smokes and flames.

**Fire Triangle**
***Defn:*** Fire triangle are the components needed to start fire. They include;
i. Fuel
ii. Oxygen
iii. heat

**Causes of Laboratory Fire**
i. Electrical faults
ii. Smoking materials
iii. Carelessness
*iv.* Ignorance and negligence

**Basic Principles of Fire Prevention**
i. No lighting of open fires near buildings
ii. No smoking in prohibited areas
iii. No interference with electrical installations
iv. All electrical appliances must be put off after use.
v. All sources of heat should not be kept near the bench edge where they can be easily knocked down.
*vi.* All flammable substances should be locked up in drawers or cabinets.

**Fire Extinguisher**
Fire extinguisher is the one which is used to fight / stop fire from continuing.

**Types of Fire Extinguishers**
The following are types of extinguishers;
i. Water / APW extinguishers
ii. Sand extinguishers
iii. Fire Blanket extinguishers
iv. Dry chemical extinguishers
v. Carbon dioxide extinguishers
vi. Halon extinguishers
vii. Foam extinguishers
viii. Wet chemical extinguishers
ix. ABC extinguishers

**Mechanism of Fighting Fire**
Fire extinguishers stop fire by preventing one among of the fire components / fire triangle.

**Classes of Fire**
Fire is classified according to materials burnt, therefore, we have six classes of five namely;
i. Class A
ii. Class B
iii. Class C
iv. Class D
v. Class E
vi. Class F

***Class A***
The burning materials are organic/ordinary solid combustible materials such as paper, wood, plastic, wool, clothing etc.

**Suitable Fire Extinguisher**
Use any type of Fire extinguisher except carbon dioxide. However, water is suitable

**Why carbon dioxide is not suitable**
Answer: When molecules of carbon dioxide reach the fire, they gain heat and this results into lowering their density thus escaping away from the fire and the fire continues.

***Class B***
The burning materials are flammable liquids such as petrol, paraffin, alcohol, kerosene etc.

**Suitable Fire Extinguisher**
i. Use fire blanket or sand extinguisher if fire is a small.

ii. Use dry powder, foam or carbon dioxide extinguisher if fire is large.
**NB:** Water extinguisher is not suitable.
**Why water not suitable?**
Answer: Water is denser than flammable liquids, so flammable liquids will float over water thus the fire continues.
***Class C***
The burning materials are flammable gases such as methane, butane, propane etc.
**Suitable Fire Extinguisher**
Use dry powder, foam or carbon dioxide extinguishers.
***Class D***
The burning of combustible metals such as magnesium, sodium, lithium etc.

**Suitable Fire Extinguisher**
Use dry powder, foam or foam extinguishers.
***Class E***
The burning of electrical equipments such as damaged electrical cables, switch boards etc.
**Suitable Fire Extinguisher**
Use carbon dioxide extinguishers.
**NB:** First switch off power from the main switches.
***Class F***
The burning of cooking appliances with oils and fats at high temperatures.
**Suitable Fire Extinguisher**
Use wet chemical extinguishers.
**Warning Signs**
A warning sign is a symbol established to ensure safety in the laboratory and in other fields like goods or commodities. These signs should be obeyed to avoid accidents and they include the following;
i. Toxic
ii. Irritant / harmful
iii. Flammable
iv. Oxidizing agent
v. Corrosive
vi. Radio active
vii. Danger of electric shock
viii. Fragile
ix. Explosive
x. Careful
xi. Keep away from water

❖ Toxic

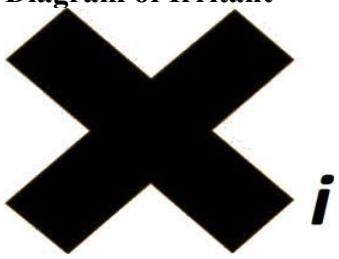
Toxic symbol means that a substance is dangerous and can cause death within a short time. Toxic substances containing poisonous ingredients. Examples of toxic substance include jik, mercury etc.
**Diagram:**

Toxic substances enter the body through;
i. Ingestion (by eating and drink)
ii. Inhalation (by breathing)
iii. By injection (by syringe, bite or insect)
iv. Contact (by touching)

❖ Irritant / Harmful

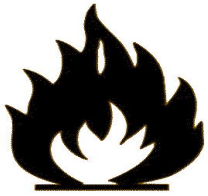
Harmful symbol means that a substance is dangerous and can affect our health for long time. Examples of harmful substance are alcohol, paint, insecticide, tobacco, ammonia, mercury etc.
**Diagram of harmful**

**Diagram of Irritant**



❖ Flammable

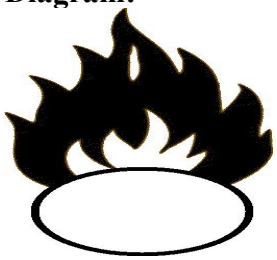
Flammable symbol means that the substance can catch fire easily. Forexample, gas-oil, kerosene, petrol, butane, methane, spirit, nail polish remover, turpentine etc
**Diagram:**



❖ Oxidizing Agent

Oxidizing agent symbol means that the substance can speed up the rate of burning. For example, oxygen gas, chlorine gas, fluorine gas and hydrogen peroxide.

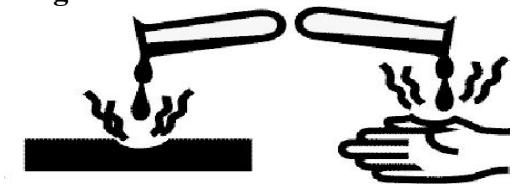
**Diagram:**



❖ Corrosive

Corrosive symbol means that the substance causes gradual change if it's in contact with various materials. Forexample, concentrated sulphuric acid, concentrated hydrochloric acid, concentrated nitric acid, concentrated sodium hydroxide, concentrated ammonia etc.

**Diagram:**



❖ Radio active

Radioactive symbol means that the substance emits harmful radiations that penetrate human body and cause damage. For example, uranium, plutonium etc

**Diagram;**

❖ Danger of Electric Shock

Danger of electric shock symbol means that the substance has high voltage which should not be touched.

**Diagram:**

❖ Fragile

Fragile symbol means that the substance should be handled with much care to prevent them from breaking. For example, glass etc.

**Diagram:**

❖ Explosive

Explosive symbol means that the substance can erupt /explode easily.

Always store it in a special container.

**Diagram:**

**NB:**

Never store explosive materials in glass containers because when it explodes, pieces of glass would fly all over and injure people.

❖ Careful

Careful symbol means that the caution advises you to be carefully.

**Diagram:**

❖ Keep Away from Water

Keep away from water symbol means that the caution advises you to keep an item away from the water. For example, computer, mobile phones, radio etc.

**Diagram:**

## Scientific Investigation

***Defn:*** Scientific method is a set of techniques used by scientists to investigate a problem / answer question.
Also called *scientific procedure or scientific investigation or scientific methods.*

**Steps of a Scientific Method**

The following are the steps followed when carrying out a scientific investigation;
i. Problem identification
ii. Asking questions
iii. Formulation a testable hypothesis
iv. Performing an experiment
v. Data collection and analysis
vi. Data interpretation
vii. Data presentation
viii. Draw a conclusion

a) **Problem Identification**

In this step, the physicist makes a puzzling observation. For example, change in temperature causes wind.

b) **Asking Questions**

In this step, the physicist asks a specific question based on what he/she has observed and wants to learn. For example, how changes in temperature causes wind?

c) **Formulation a Testable Hypothesis**

A hypothesis is an intelligent guess that tries to explain an observation "The change in temperature causes wind".

d) **Performing an Experiment**

**Defn:** *An experiment is the test under controlled conditions*.
The aim of an experiment is to test whether the hypothesis is true or false. Its based on a variable to test the hypothesis.
***Defn***: A variable is the condition which changes to obtain a set of values.

**Types of Variables**

There are three types of variables and are;
i. Dependent variable
ii. Independent variable
iii. Controlled variable

1) **Dependent Variable**

***Defn:*** A dependent variable is the condition to measure or observed to obtain the results. For example, time.

2) **Independent Variable**

***Defn:*** An independent variable is the condition manipulated to obtain the results. For example, wind.

3) **Controlled Variable**

***Defn:*** A controlled variable is the condition that may be changed (or kept constant) to obtain the results. For example, temperature

e) **Data Collection and Analysis**

It Concerns recording what you have observed during experiment. Always kept in the table for example,

| Temperature (℃) | Wind (m/s) |
|---|---|
| 10 | 200 |
| 20 | 400 |
| 30 | 600 |
| 40 | 800 |

f) **Data Interpretation**

In this step, we look on trends or patterns and explain why they occur that way. Forexample, *from the table above, when temperature increases, also wind's speed increases and therefore temperature is direct proportional to wind speed.*

g) **Data Presentation**

This step involves the use of mathematical concepts to represent the data or results collected. For example, Pie charts, graphs and formulae may be use.

h) **Draw a Conclusion**

This step concerns about summary of the experiment. It includes a statement that either approves or disapproves the hypothesis. For example, in our experiment "change in temperature causes wind".

**Application of Scientific Procedure**

i. When carrying out an experiment, a test is done in order to study what happens and gain new knowledge.
ii. When carrying out project work, a project is a planned piece of work that involves careful study of a subject/problem over a period of time so as to find information on the subject/problem.

iii. When carry out field study: A field study involves doing practical work in order to find answers to the problems and to test the hypothesis. A field study is also called field work.

**Significance of the Scientific Procedure**

i. It helps us to solve scientific problems.
ii. It helps us to gain new knowledge.
iii. It helps us to conduct project work.
iv. It helps us to carry out field study.
v. It helps us to solve problems or answer scientific questions.

## Measurement

**Contact the author on +256750549201 or +256771803014 to get a complete copy for your self. You can also email on lwangawilliam11gmail.com**

**NB:**

**This physics special book for new ordinary level curriculum( learner's Research Book) was written in line with the new ordinary level physics practical work book by the same author.**

- **Excel In Ordinary Level Mathematics( S.4 2023)**
- **S.1-S.2 Physics Project Work Book ( 1st Edition)**
- **S.1-S.4 Physics Project Work Book (2nd Edition)**
- **S.1-S.4 Mathematics Project Work Book ( 1st Edition)**
- **S.1-S.4 New Ordinary Level Physics Practical Work Book**
- **S.1-S.4 Physics Learners Research Book( Detailed)**

Books by the same author

**NB: "Search" { Iwanga william } on youtube and subscribe ( also tap on the notification bell) to that you-tube channel and watch the subject based project lessons that are on-going. " subscription is for free"**