

P510/2
PHYSICS
Paper 2
(Practical)
2026
3 hours



UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

*This examination paper consists of **two** compulsory items.*

*Use **blue** or **black** ink. Any work done in pencil **except** graphs and diagrams will **not** be scored.*

Scores are awarded mainly for a clear record of the observations actually made, for their suitability, accuracy and for the use made of them.

Details on the question paper should not be repeated in the responses.

Graph paper is provided.

Silent non-programmable scientific calculators may be used.

1. A patient visited a health centre complaining of not seeing the distant objects clearly, yet nearby objects appear clear. After medical examination, the Optician discovered that the eye muscles were unable to make the eye lens thin enough to focus light from a distant object on the retina.

The Optician prescribed spectacles fitted with lenses, which he claimed were of focal length in the range, 14.0 - 15.0 cm. The patient purchased the spectacles and began using them. However, after a few days, the patient experienced some level of discomfort and felt that the spectacles provided may not be of the right specifications.

Determined to verify the cause of the discomfort, the patient went back to the Optician. The Optician then suggested that there is a need to verify the properties of the lenses using a **scientific investigation**.

You are provided with the concave and convex lenses that were given to the patient for verification. One of the lenses has similar properties to the ones in the spectacles.

Task:

Investigate whether the lenses in the spectacles conform to the required specifications, and present your findings in a scientific report.

2. The heating element of an electric kettle is made of a thin wire whose resistance per metre length is $14.0 - 16.0 \Omega \text{ m}^{-1}$. Recently while one of the teachers was boiling water for tea, the element got damaged.

The laboratory attendant wishes to replace the damaged element. Available is a thin bare wire which she intends to use for the replacement. She remembers that one of the conditions prescribed in the manual is that, the replacement of the material of the heating element of the electric kettle requires a bare wire of similar properties to that of the original one the manufacturer had fitted. However, the resistance per metre length of the wire the attendant has is not known.

You are provided with the bare wire and the other apparatus required for the investigation.

Task

Follow the instructions provided and use the result obtained to give feedback to the attendant.

Part I:

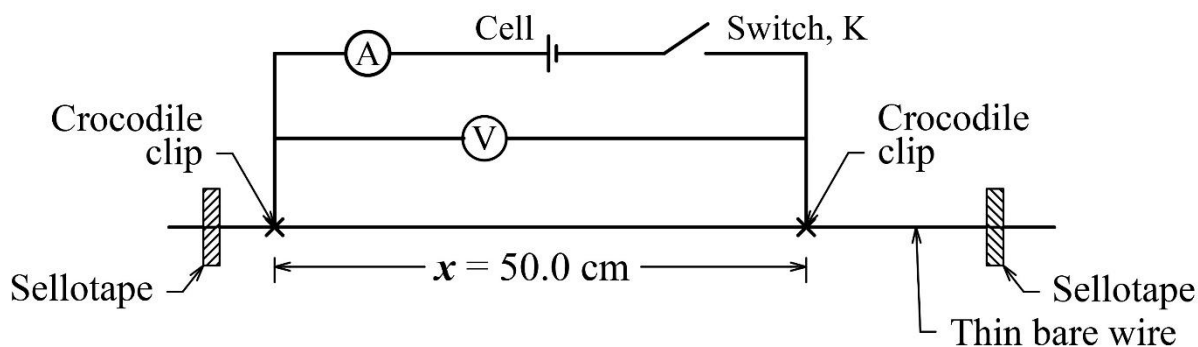


Fig. 1

- (a) Connect the circuit as shown in the figure 1.
- (b) Close switch, K.
- (c) Read and record the ammeter and voltmeter readings, I and V , respectively.
- (d) Open the switch.
- (e) Calculate the resistance per metre length, T_1 , of the bare wire using the expression: $V = IT_1x$.

Part II:

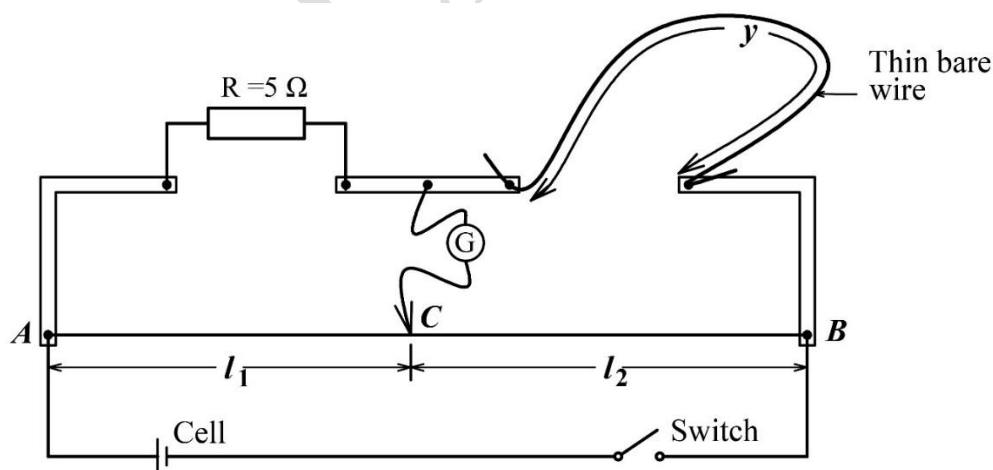


Fig. 2

- (a) Connect the circuit as shown in the figure 2.
- (b) Adjust the length of the thin bare wire provided to, $y = 0.200 \text{ m}$.
- (c) Close the switch and locate the balance point, C, along the bridge wire AB.
- (d) Read and record (in metres), the balance lengths, l_1 and l_2 .

- (e) Open the switch.
- (f) Repeat steps (b) to (e) for other values of, $y = 0.300, 0.400, 0.500, 0.600$ and 0.700 m.
- (g) Tabulate the results including values of $\frac{l_1}{l_2}$ and $\frac{1}{y}$.
- (h) State sources of errors and their corresponding precautions taken to mitigate them.
- (i) Plot a graph of $\frac{l_1}{l_2}$ against $\frac{1}{y}$.
- (j) Obtain slope, S , of the graph.
- (k) Obtain the resistance per unit length, T_2 , of the bare wire using an appropriate expression containing T_2 , T_1 and S .
- (l) Provide feedback to the laboratory attendant, based on your finding.



UGANDA NATIONAL EXAMINATIONS BOARD
Uganda Advanced Certificate of Education

P510/2 PHYSICS

SCORING GUIDE
FOR THE SAMPLE PAPER

Item 1

In order to obtain the highest level of achievement, the candidate is expected to:

i) Plan for experimentation:

- Generate the **Aim** of the experiment/investigation.
In the aim there should be: the nature of the experiment, relationship between variables to be manipulated and the purpose (generated from the scenario) for carrying out the experiment/investigation.
- Identify all the **variables** under each category.
- Generate **hypothesis** to guide the experiment/investigation.

ii) Prepare Method of experimentation:

- Draws correct/workable setup.
- Writes relevant and coherent steps in the procedure, able to produce results.
- Appropriate apparatus/materials should be correctly mentioned and used in the procedure.
- Appropriate quantities of the independent variable should be mentioned/used in the procedure.
- Identify sources of errors and their corresponding precautions taken.

iii) Present data:

- Records data in an organized format. e.g. a table.
- Presents complete data sets. i.e. at least 5 sets of independent variable values and their corresponding dependent variable values.
- Writes quantities with correct units (where units exist) and no units (when dealing with ratios).
- Records dependent variable data that is accurate. i.e. with correct decimal places (read from the instrument), within acceptable ranges and having correct trend.
- Manipulates and records data with correct significant figures and decimal places per column.

iv) Analyse data:

- Writes the title of the graph correctly and labels the drawn axes correctly with quantities and units where applicable.
- Uses uniform scales on each axis.

- Marks and labels the starting value of each axis.
- Plots at least 5 points correctly.
- Draws the best line of fit correctly.
- Reads 4 coordinates/intercept(s)/minimum/maximum value/intercept value with units where appropriate, correctly.
- Obtains the slope/minimum/maximum/intercept value with units (where applicable) correctly.

v) Conclude and recommend:

- Relates the obtained value to what is being investigated correctly.
- Gives appropriate advice/recommendation based on the value obtained.

POSSIBLE RESPONSES:

Aim: To determine the focal length of a lens by varying the object distance to measure the resulting image distance, in order to tell whether the spectacles purchased by the patient contain the right lenses.

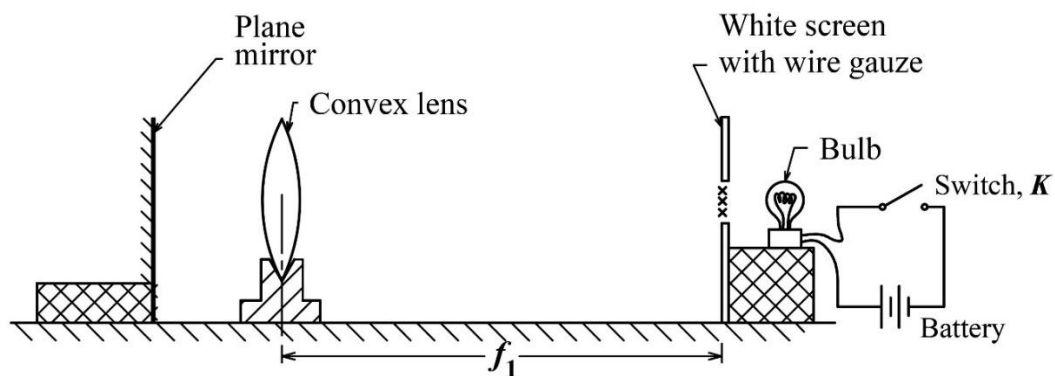
Variables:

- **Independent variable:** Object distance (u).
- **Dependent variable:** Image distance (v).
- **Controlled variable:** Light intensity, Nature of the material, $e.m.f$ of the dry cell(s).

Hypothesis: Focal length of the concave lens provided is between
 -13.0 cm to -17.0 cm .

Method 1

Experimental Setup:

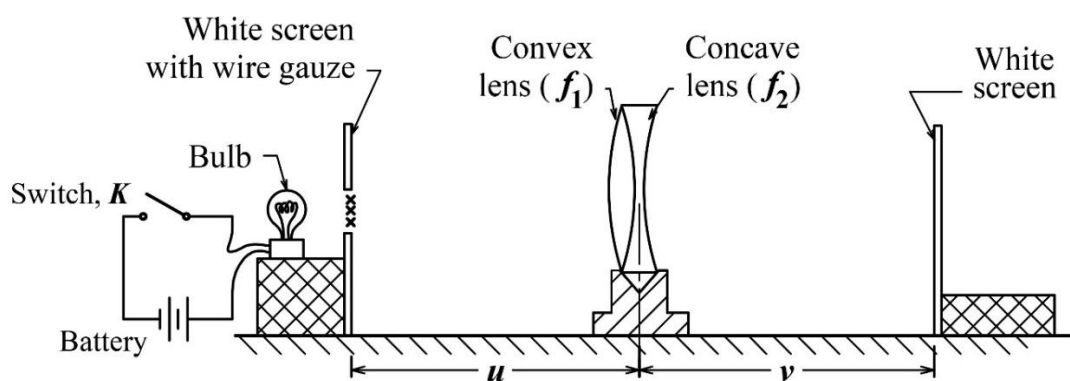


Procedure:

- The set of apparatus were arranged as shown in the diagram above.
- Switch, K, was closed.
- Position of the lens and the plane mirror was adjusted until a clear image of the illuminated wire gauze was formed beside it.
- Distance, f_1 , was measured using the metre rule and recorded.

Method 2

Experimental Setup:



Procedure:

- The set of apparatus were arranged as shown in the diagram above.
- Starting with the distance, $u=35.0$ cm, switch, K, was closed.
- The position of the white screen was adjusted until a sharp image of the wire gauze was formed on it.
- Image distance, v , was measured and the value recorded.
- Switch, K, was opened.

- (f) Steps (b) to (c) were repeated for values of; $u=40.0, 45.0, 50.0, 55.0,$ and 60.0 cm.
- (g) Results were tabulated including values of $\frac{v}{u}$.
- (h) A graph of $\frac{v}{u}$ against v was plotted and slope, S , determined.
- (i) The focal length, f_2 , of the concave lens was obtained from the expression:

$$S = \frac{1}{f_1} + \frac{1}{f_2}$$

Sources of errors and their corresponding precautions:

Sources of error	Corresponding Precaution
Parallax error in reading the image distance using metre rule.	Positioning the eye vertically (normal) to the point being read.
Too much light in the room.	Reducing the intensity of light in the room.
Aligning the wire gauze, lenses and white screen in a perfect straight line.	Using a metre rule to confirm that the wire gauze, lens and the screen are in line.
Positioning of the lenses perfectly vertical in the holder.	By using a metre rule or set square to ensure that the lens is perfectly vertical in the holder.

RESULTS:

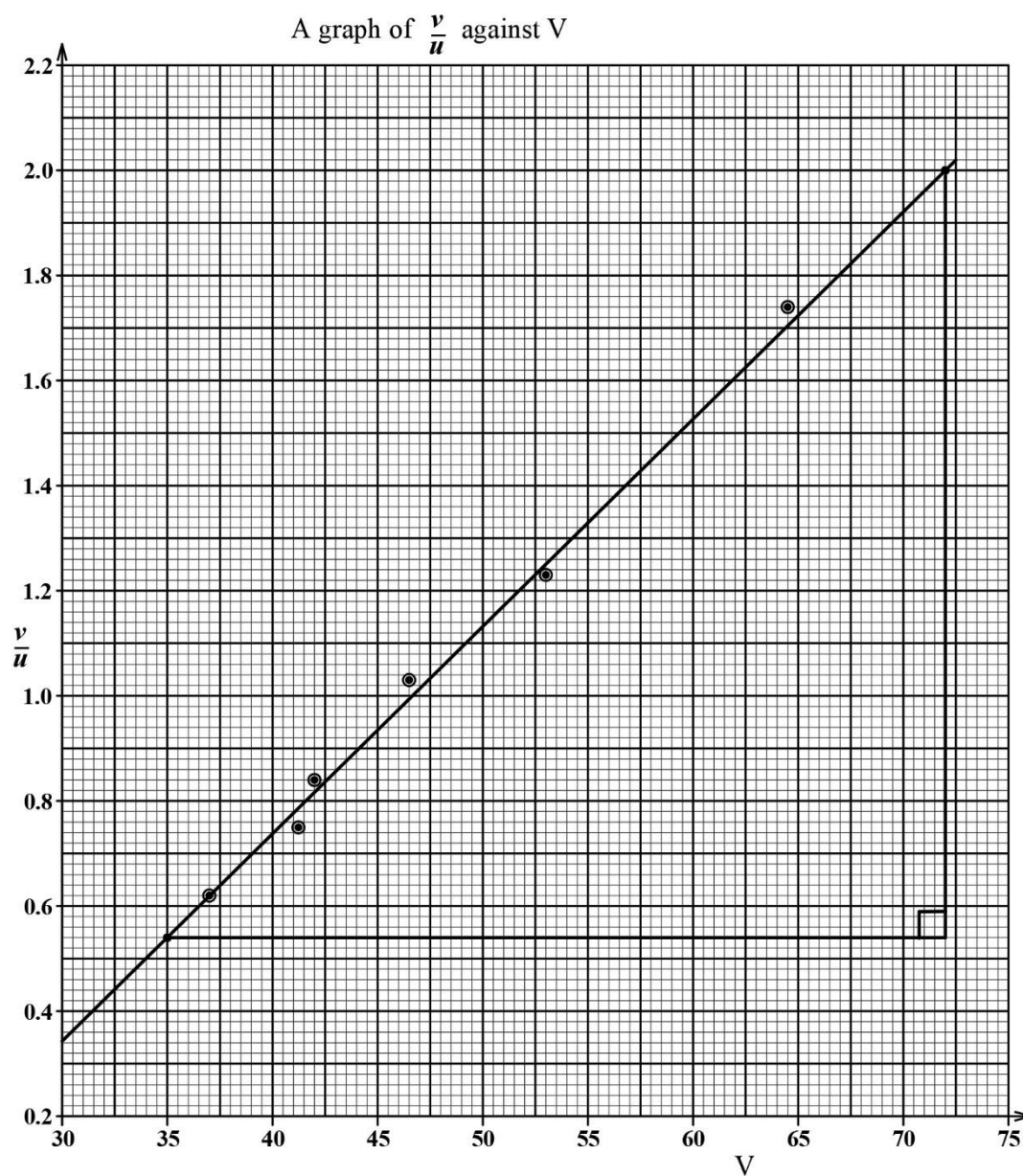
$$f_1 = 10.0 \text{ cm}$$

Table of results:

u (cm)	v (cm)	$\frac{v}{u}$
35.0	64.4	1.84
40.0	53.2	1.33
45	46.4	1.03
50.0	42.0	0.84

55.0	41.2	0.75
60.0	37.0	0.62

The Graph:



$$\begin{aligned}
 \text{Slope, } S &= \frac{2.00 - 0.54}{72.0 - 35.0} \\
 &= \frac{1.46}{37.0} \\
 &= 0.039 \text{ cm}^{-1}
 \end{aligned}$$

$$S = \frac{1}{f_1} + \frac{1}{f_2}$$

$$0.039 = \frac{1}{10.0} + \frac{1}{f_2}$$

$$\frac{1}{f_2} = 0.0395 - 0.100$$

$$= -0.0605$$

$$f_2 = -16.5 \text{ cm}$$

Conclusion :

The focal length of the concave lens is -16.5 cm.

Recommendation:

The focal length of the concave lens is in the range of -13.0 cm to -17.0 cm . therefore, the doctor is right.

Item 2

In order to obtain the highest level of achievement, the candidate is expected to:

vi) *Present data:*

- *Records data in an organized format. e.g. a table.*
- *Presents complete data sets. i.e. at least 5 sets of independent variable values and their corresponding dependent variable values.*
- *Writes quantities with correct units (where units exist) and no units (when dealing with ratios).*
- *Records dependent variable data that is accurate. i.e. with correct decimal places (read from the instrument), within acceptable ranges and having correct trend.*
- *Manipulates and records data with correct significant figures and decimal places per column.*

vii) *Analyse data:*

- *Writes the title of the graph correctly and labels the drawn axes correctly with quantities and units where applicable.*
- *Uses uniform scales on each axis.*
- *Marks and labels the starting value of each axis.*

- Plots at least 5 points correctly.
- Draws the best line of fit correctly.
- Reads 4 coordinates/intercept(s)/minimum/maximum value/intercept value with units where appropriate, correctly.
- Obtains the slope/minimum/maximum/intercept value with units (where applicable) correctly.

viii) Conclude and recommend:

- Relates the obtained value to what is being investigated correctly.
- Gives appropriate advice/recommendation based on the value obtained.

RESULTS:

Method 1:

$$I = 0.22 \text{ A}$$

$$V = 0.22 \text{ V}$$

$$K_1 = \frac{V}{Ix}$$

$$= \frac{1.35}{0.22 \times 0.500}$$

$$K_1 = 12 \Omega \text{ m}^{-1}$$

Method 2:

Table 1: Table of results:

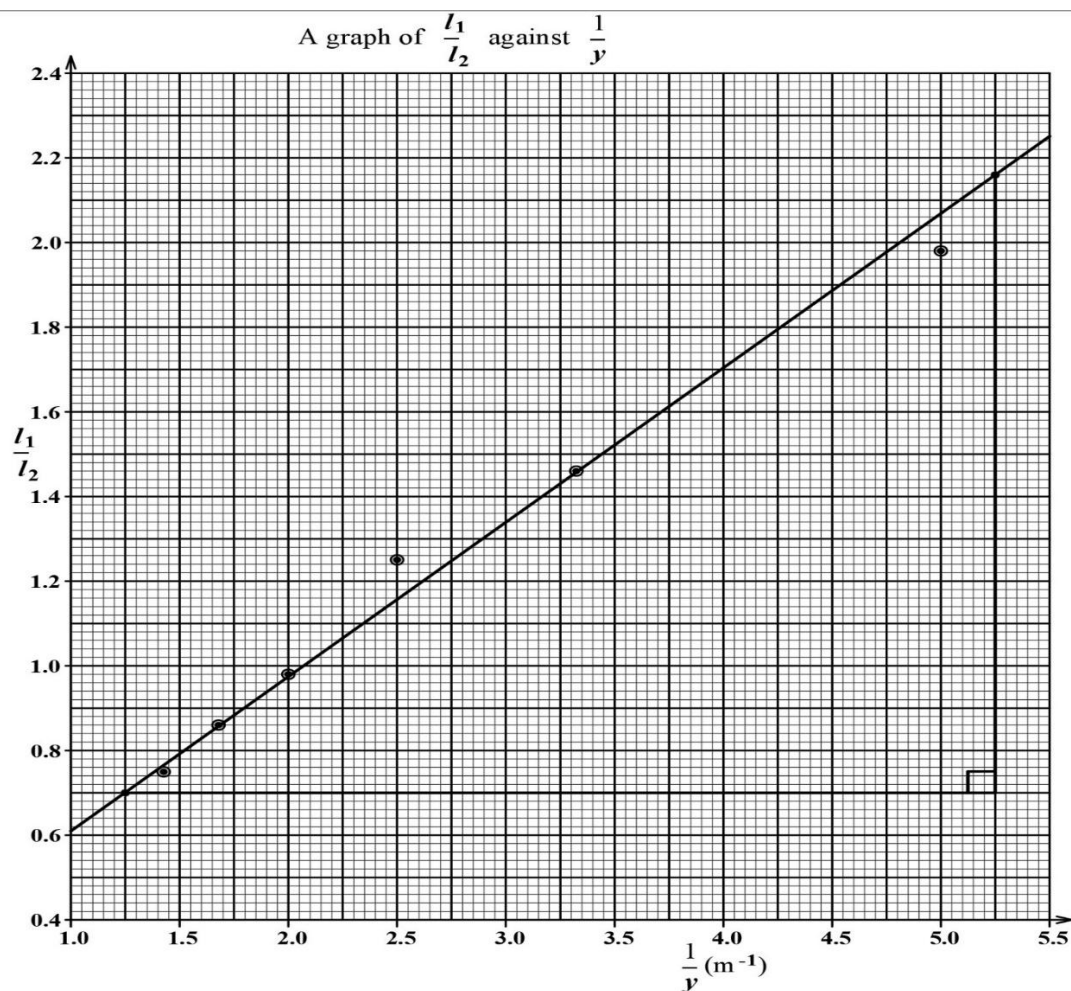
y (m)	$l_1(\text{m})$	$l_2(\text{m})$	$\frac{l_1}{l_2}$	$\frac{1}{y} (\text{m}^{-1})$
0.200	0.664	0.336	1.98	5.00
0.300	0.594	0.406	1.46	3.33
0.400	0.556	0.444	1.25	2.50
0.500	0.495	0.505	0.98	2.00
0.600	0.463	0.537	0.86	1.67

0.700	0.428	0.572	0.75	1.43
-------	-------	-------	------	------

Table 2: Sources of Errors and the corresponding Precautions:

Source of Errors	Corresponding Precautions Taken
Parallax error in reading the ammeter, voltmeter and the metre rule.	Mitigated by keeping the eye normal (at right angle) to the point being read.
Loose connections at the points of contact.	Mitigated by ensuring that the connections are tight.
Overheating of the wires.	Mitigated by reading the values quickly and opening the switch immediately.

The Graph:



$$\text{Slope, } S = \frac{2.16 - 0.70}{5.25 - 1.25}$$

$$= \frac{1.46}{4.00}$$

$$= 0.365 \text{ m}$$

$$K_2 = \frac{R}{S}$$

$$= \frac{5}{0.365}$$

$$= 13.7 \Omega \text{ m}^{-1}$$

$$K = \frac{1}{2}(K_1 + K_2)$$

$$= \frac{1}{2}(12 + 13.7)$$

$$K = 13 \Omega \text{ m}^{-1}$$

Conclusion:

The resistance per metre length, K , of the bare wire is $13 \Omega m^{-1}$.

Recommendation:

The resistance per metre length of the wire is in the range of $13 \Omega m^{-1}$ to $17 \Omega m^{-1}$.

Therefore, it can be used to repair the kettle.

NOTE:

- i) Items 1 and 2 will be set from any of the four constructs.
- ii) Item 1 will be scenario-based while item 2 will be manipulation.

**P510/2 Inst. Sch.
PHYSICS
PRACTICAL
INSTRUCTIONS
2026**



UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

PHYSICS PRACTICAL INSTRUCTIONS

P510 Inst. Sch.

CONFIDENTIAL

Great care should be taken that the information given below does not reach the candidates either directly or indirectly.

INSTRUCTIONS FOR PREPARING MATERIALS AND APPARATUS

The head teacher **must** ensure that the teacher responsible for preparing the chemicals and apparatus hands in his/her procedures together with the trial results properly sealed in a separate envelope and **firmly** fastened (attached) to the candidates' scripts envelop(s).

1. Candidates are **not** allowed to use reference books (i.e. text books, practical guide/manual, etc.) during the examination.
2. In addition to the materials and apparatus ordinarily contained in a Physics laboratory, each candidate will require:
 - 1 Concave lens of focal length, $f = -15$ cm
 - 1 Convex lens of focal length, $f = 10$ cm
 - 1 Plane mirror on a mirror holder
 - 1 Torch bulb
 - 1 White screen
 - 1 White screen with wire gauze
 - 1 Pair of fresh dry cell (size D) in a holder
 - 1 Ammeter (0 – 1 A) digital ammeter.
 - 1 Voltmeter (0 – 3 V) or (0 – 5 V) or digital voltmeter
 - 2 Switches
 - 1 Fresh dry cell (1.5 V)
 - 1 Single cell holder
 - 1 $5\ \Omega$ standard resistor
 - 1 Centre-zero galvanometer
 - 1 Jockey (crocodile clip can do)
 - 1 Piece of nichrome wire SWG 28 of length of about 105 cm)
 - 2 Metre rules
 - 2 Piece of sellotape
 - 10 Pieces of connecting wire, each of length of about 50 cm
 - 2 Crocodile clips
 - 1 Metre bridge

This form MUST be completed and returned in a separate envelope firmly attached to the script envelope(s).

UGANDA ADVANCED CERTIFICATE OF EDUCATION

2026

REPORT ON PHYSICS PRACTICAL P510/2

Section I:

Any information which the teacher responsible for preparing the apparatus/materials thinks may be useful to the examiners should be given on this sheet. The teacher must try all the items and submit his/her results together with the procedure in the space provided below to guide the scorers about the procedure used, and apparatus/materials.

NB: Teachers who **DO NOT** submit their procedures together with trial results will be held responsible for their candidates' performance.

Procedure and results:

SAMPLE

Handwriting practice lines consisting of 20 horizontal lines. A large, diagonal watermark reading "SAMPLE PAPER" is overlaid across the page.

Section II:

The Invigilator in consultation with the teacher responsible for preparing the apparatus and materials should give details below of any difficulties experienced by particular candidates, giving their names and personal numbers. This should include reference to:

(a) difficulties due to faulty apparatus,

(b) accidents to apparatus or materials,

(c) physical handicaps of candidates,

(d) any other information.

Other cases of hardship e.g. illness, disability, should be reported directly to **UNEB** in the normal way.

A plan of work benches, giving details by personal numbers of the places occupied by the candidates for each experiment, for each session, must be enclosed with the scripts.

Invigilator's Name _____ Signature _____

Signature of the teacher responsible for preparing the apparatus _____

Signature of the head teacher _____

Centre Number _____