

**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.

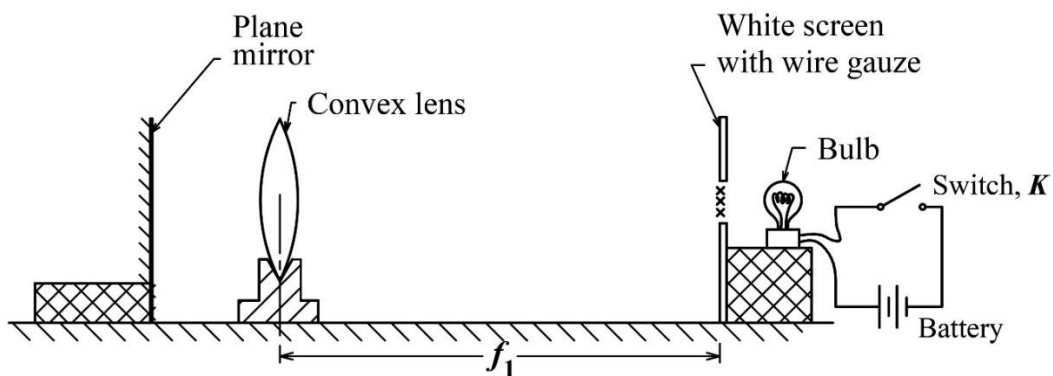
**Variables:**

- **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:**

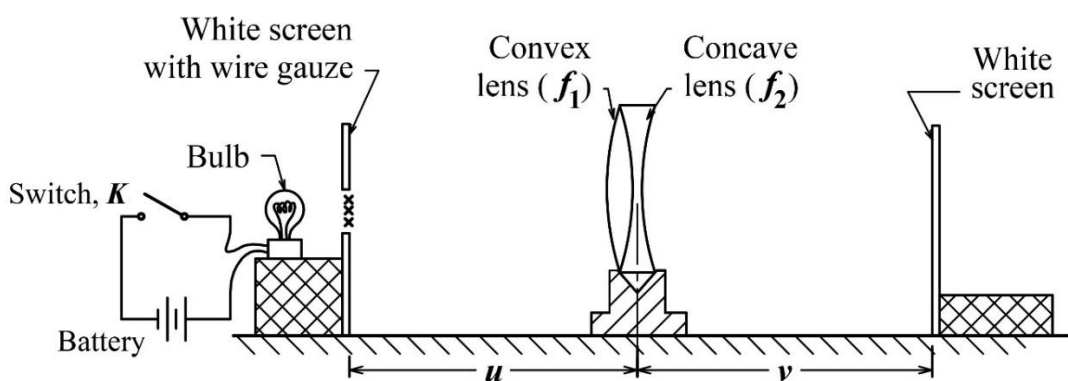


### Procedure:

- 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:**

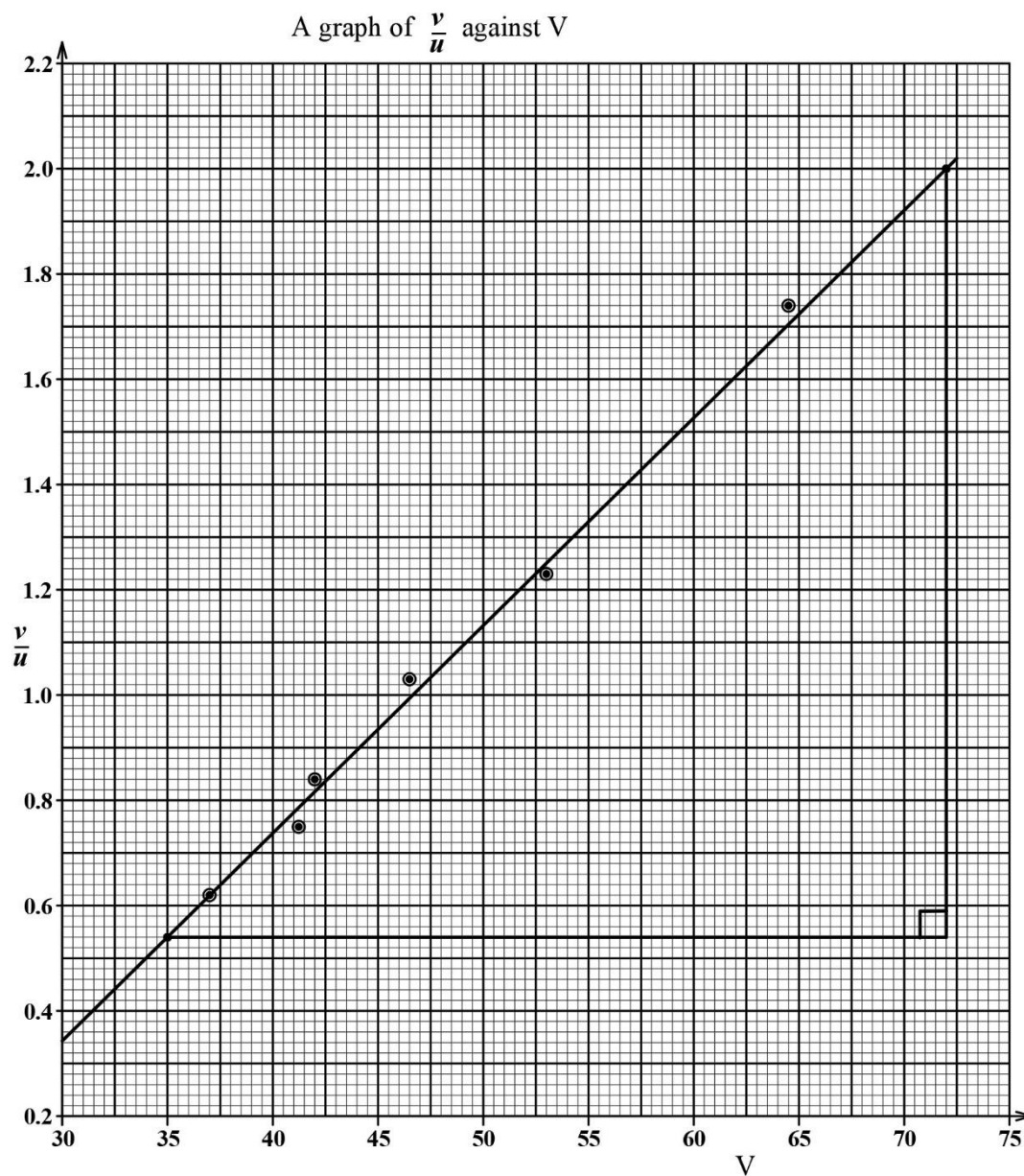
$$f_1 = 10.0 \text{ cm}$$

**Table of results:**

<b>u (cm)</b>	<b>v (cm)</b>	<b><math>\frac{v}{u}</math></b>
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:**

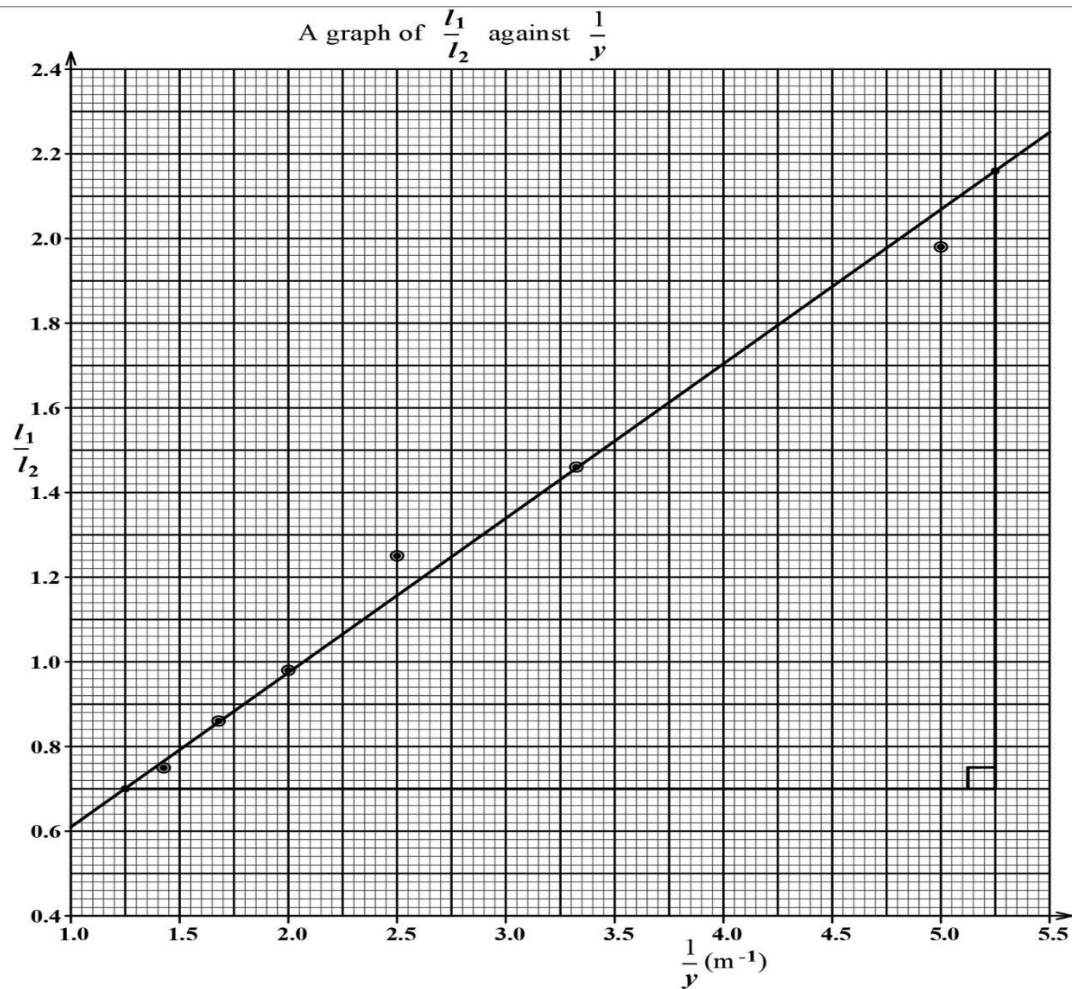
y (m)	$l_1(m)$	$l_2(m)$	$\frac{l_1}{l_2}$	$\frac{1}{y} (m^{-1})$
0.200	0.664	0.336	1.98	5.00
0.300	0.594	0.406	1.46	3.33
0.400	0.556	0.444	1.25	2.50
0.500	0.495	0.505	0.98	2.00
0.600	0.463	0.537	0.86	1.67

0.700	0.428	0.572	0.75	1.43
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**Table 2: Sources of Errors and the corresponding Precautions:**

<b>Source of Errors</b>	<b>Corresponding Precautions Taken</b>
<ul style="list-style-type: none"> <li>• Parallax error in reading the ammeter, voltmeter and the metre rule.</li> </ul>	<ul style="list-style-type: none"> <li>• Mitigated by keeping the eye normal (at right angle) to the point being read.</li> </ul>
<ul style="list-style-type: none"> <li>• Loose connections at the points of contact.</li> </ul>	<ul style="list-style-type: none"> <li>• Mitigated by ensuring that the connections are tight.</li> </ul>
<ul style="list-style-type: none"> <li>• Overheating of the wires.</li> </ul>	<ul style="list-style-type: none"> <li>• Mitigated by reading the values quickly and opening the switch immediately.</li> </ul>

**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.