

PHYSICS PAPER 2 (PRACTICAL)

Question 1

This experiment determines the focal length of the given convex lens by **no parallax** method.

You are provided with:

- (i) A convex lens
- (ii) A lens holder
- (iii) Two optical pins
- (iv) An optical bench.

Note: *If an optical bench is not available, the experiment may be performed on a table top, using a metre scale.*

Mount the given convex lens **L** on a lens holder. Keep the object pin **O** to the left and the image pin **I** to the right of the lens (See **Figure 1**). Adjust their heights till their tips lie on the principal axis of the lens.

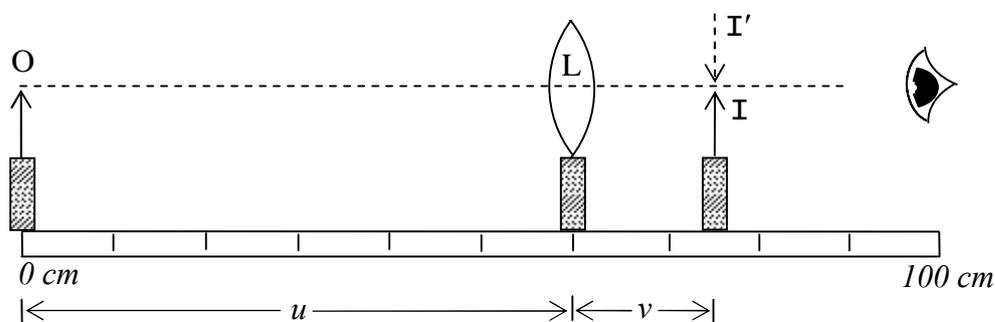


Figure 1

Keep the object pin at 0 cm mark and the lens at 60.0 cm mark, so that object distance $OL = u = 60.0$ cm. Look at the object pin through the lens, from a distance. You should see an **inverted** and **diminished** image I' of the object pin O. Adjust the position of the image pin I so that there is **no parallax** between I and I' . Ensure that 'tip to tip' parallax is removed. If required, you may adjust the heights of the two pins O and I. At no parallax, note the position I of the image pin on the metre scale, correct up to **one decimal place**.

Determine the image distance $v = LI$, correct up to **one decimal place**. Record this value of v in your answer booklet. **Show this reading to the Visiting Examiner**. Calculate **linear magnification** $m = \frac{v}{u}$, correct up to **two decimal places**.

Repeat the experiment for **five more values** of u i.e. $u = 50$ cm, 40 cm, 30 cm, 20 cm and 15 cm. Each time, remove the parallax and find v and m .

Now, tabulate all **six** sets of values of u , v and m with their **units** (if any).

Plot a graph of m vs v , taking m on Y axis. Do not choose the origin at (0, 0). Choose the scales such that you use more than half the graph.

Draw the line of best fit. It must be a thin and uniform line. Find its slope **S** using:

$$S = \frac{\text{change in } m}{\text{change in } v}$$

Record the value of **S**, rounded up to **three significant figures**.

Then, find f , using $f = \frac{1}{S}$

and record its value in your answer booklet, correct up to **one decimal place**, with proper unit.

Comments of Examiners

Record:

- In some cases, the trend(V vs U) was not followed i.e. U increases, V decreases; the Parallax error was not removed completely.
- Many candidates did not express V upto 1dp with unit.
- The calculation of $m=v/u$ upto 2dp after correct rounding-off was not done by many candidates.

Graph:

- Many candidates did not take a uniform scale; kink was taken and origin not marked properly. A few candidates took an inconvenient scale such as 15 div = 1unit.
- The understanding of the concept of line of best fit was found to be lacking amongst many candidates.
- For slope calculation, some candidates took plotted points; less than half of the line was taken in some cases. Many candidates did not calculate slope upto 3 significant figures.

Calculation:

- Many candidates did not write the unit of 'f'.

Suggestions for teachers

- Explain to students the concept of parallax error and the reason for the same.
- Tell students about the least count of various instruments, significant figures and rules for rounding off the values upto proper decimal place.
- Explain to students the difference between 'significant figures' and 'decimal places'.
- Instruct students to read the question paper properly and to underline the important points.
- Ask students to write the observations in a proper tabular form; tell students that the readings should be consistent with least count; readings should be written with proper unit, and significant figures after rounding off as per the instructions in Question paper.
- Teach students how to draw graphs with proper labeling of the axes, with unit, correct marking of origin without kink.
- Ask students to take a convenient, uniform and wide range scale so that the last plot covers atleast 60% of both the axes.
- Explain to students the concept of the line of best-fit and teach them how to calculate slope.

MARKING SCHEME

Question 1.

RECORD (R)

- (i) Correct set of 5 values of u and v
(v decreases as u increases)
 v recorded up to one decimal place
Unit of v (cm) given
- (ii) Correct calculation of m upto two decimal places

GRAPH (G)

- (i) Axes labelled correctly (interchange of axes and kink not allowed), Scale uniform and consistent, Origin may or may not be (0,0)
- (ii) 5 correct plots (a blob is a misplot)
- (iii) Line of bestfit (At least line passes very close to the four points or within 5 division or 1cm perpendicular distance on the both sides of the line drawn .
Thin and uniform(the line should be extended on both sides is at least for 4 plotted points)

DEDUCTION (D)

Correct calculation of slope using two distant points (more than 50% of the line drawn) at least one point being an unplotted one. Slope should be calculated up to three significant figures (proper rounding off is necessary).

QUALITY: (Q)

Candidate's $f = \text{Supervisor's } f \pm 2.5\text{cm}$

Question 2

[7]

This experiment determines the resistance per unit length of the given metallic wire. You are provided with:

- (i) A 100 cm long and uniform wire **AB** stretched on a wooden board with a meter scale attached to it.
- (ii) A battery eliminator **D** of emf 4V.
- (iii) A resistance box **R.B.** of range 0 to 10 .
- (iv) A plug key **K**
- (v) A jockey **J**
- (vi) A fresh dry cell **E** kept in a battery box / holder.
- (vii) 0 – 3V voltmeter **V**
- (viii) 0 – 1A ammeter **A**
- (ix) A central zero galvanometer **G**
- (x) Connecting wires

Set up a circuit as shown in **Figure 2** below:

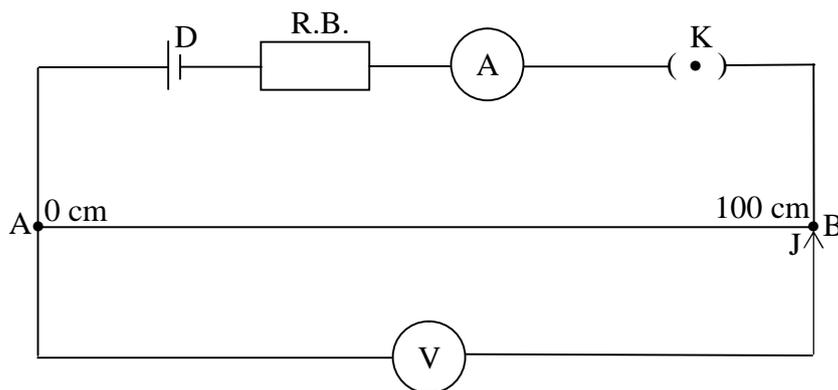


Figure 2

Determine and record the least count of the given ammeter and the voltmeter.

Place the jockey gently at the point B of the wire AB. Adjust the resistance R in the resistance box R.B. so that the reading of the voltmeter is maximum and the reading of the ammeter is within its scale. Record in your answer booklet, the readings R, V and I of the **resistance box, voltmeter** and **ammeter** respectively.

Show these readings to the Visiting Examiner.

By taking different values of resistance R in the resistance box, repeat the experiment to obtain **four more** values of V and I, with the jockey **always touching the point B** of the wire AB.

Tabulate all the **five** sets of values of R, V and I.

Plot a graph of V vs I, taking V on Y axis. Draw the **line of best fit**.

Find its slope S' using:

$$S' = \frac{\text{change in V}}{\text{change in I}}$$

Calculate $r = S'/100$ and record its value up to **three significant figures**, with proper unit.

Comments of Examiners

Record:

- Some candidates wrote the least count of Ammeter and Voltmeter without unit or with wrong units.
- A few candidates wrote least count of Ammeter and Voltmeter which did not match with the supplied Ammeter and Voltmeter.
- In many cases, the readings were not consistent with the least counts of Ammeter and Voltmeter. (e.g. L.C of $A=0.05A$, the reading recorded $0.9A$ instead of $0.90A$)
- In some cases, proper trend of V and I was not observed with respect to resistance.
- Some candidates recorded absurd values of R, such as, 10.5, 23.5 ohms.

Graph:

- In the graph, the error were repeated, such as, interchange of axes; plotted points taken for slope.

Suggestions for teachers

- Make students see various types of ammeters and voltmeters with various ranges and tell them to write the least count and range before starting the experiment.
- Teach students how to record their observations in the observation table.
- For slope calculation, tell students to take two unplotted points on the best-fit line and separated from each other through a distance of more than 50% of the line down .

Calculation:

- Calculation of 'r' was not done correctly by many candidates and the value was not recorded up to three significant figures, with proper unit.

MARKING SCHEME

Question 2.

RECORD (R)

- LC of Ammeter with unit
LC of Voltmeter with unit
- Correct sets of 4 values of V and I (V and I decrease as R increases)
Record of V and I must be consistent with least count (at least in 6 values)

GRAPH (G)

- Axes labelled correctly
- 4 correct plots
A thin uniform line of best fit, covering extreme plots

DEDUCTION (D)

Correct calculation of S'

Question 3

[3]

This experiment determines emf of the given cell.

Replace the voltmeter in the circuit of *Figure 2* with a dry cell **E** and a central zero galvanometer **G** and set up a new circuit as shown in *Figure 3* below:

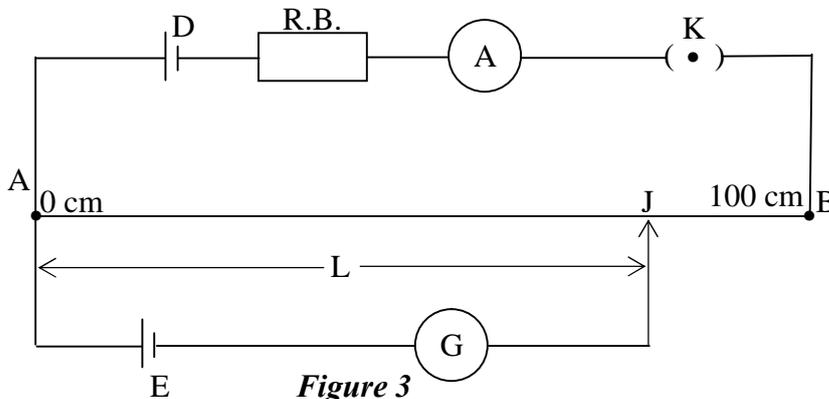


Figure 3

Close the key K. Take out 1 Ω plug from the resistance box R.B. so that $R = 1 \Omega$. Press the jockey J gently on the wire AB such that the galvanometer shows **no deflection**. Read and record the length $L = AJ$. Also record the ammeter reading I_0 .

Show these readings to the Visiting Examiner.

Determine $E = I_0 r L$, correct up to **one decimal place**. (Use the value of r found in Question 2.)

Repeat the experiment for $R = 2 \Omega$ and calculate the new value of E.

Find E_m , the mean value of E and record its value in your answer booklet, correct up to **two decimal places**, with proper unit.

Comments of Examiners

Some common errors made by candidates are as follows:

- Many candidates did not write the value of I_0 in consistence with the least count of ammeter; at times, the unit was missing.
- The null point length 'L' was not expressed upto 1dp (e.g. written as 68 instead of 68.0) and without unit.
- In a few scripts the trend of R, I_0 and L was not observed.
- Some candidates calculated emf E incorrectly and did not express it with 1dp; in a few cases, the unit was missing.
- In some cases, in calculation of emf E, instead of the value 'r' from Question 2, the value of resistance 'R' was taken.
- Several candidates made mistakes in calculation of the average value of emf E_m .
- In a few scripts, the average value of emf E_m obtained was beyond the range.

Suggestions for teachers

- Give practice to students in writing related physical quantities like, length, current, voltage, diameter, etc. regularly with the respective least counts of the instruments - metre scale/ optical bench, ammeter, voltmeter, screw gauge.
- Ask students to write the sample sets of observations, in consistence with the least count and with correct units.
- Instruction must be given to students to record their own observations from the experiment.
- Give practice in doing correct calculations and expressing the result with proper decimal point or significant figure, after proper rounding off and with unit, as per the instruction given in the Question paper.
- Instruct students to read the question paper thoroughly and to underline important instructions.

MARKING SCHEME

Question 3.

RECORD (R)

Two Values of L and I_0 recorded up to 1 decimal place with unit.

DEDUCTION (D)

Correct calculation of both the values of E and E_m

QUALITY (Q)

Candidate's value of E_m = Supervisor's value of emf of dry cell ± 0.3 volt

GENERAL COMMENTS:

(a) Topics found Difficult and Confusing by candidates in the question paper:

- Removal of parallax.
- Finding L.C. of instruments and the correct way of presentation of observations, in consistence with L.C.
- Mentioning the correct unit of the physical quantity measured.
- Difference between decimal place and significant figure.
- Graph: marking of origin, concept of kink, taking a convenient uniform and wide range of scale.
- Drawing the best-fit line.
- Calculation of slope.

(b) Suggestion for students:

Record:

- Read the question carefully and follow the instructions, using only the formula given in the question paper for all the calculations.
- Ensure that all observations are consistent with L.C. of the measuring instrument and recorded in tabular form with unit. Note down the L.C. of the instruments used before starting the experiment.
- All values calculated should be rounded off to the d.p. asked for the in the question.
- The question paper should be read carefully in the reading time allotted.
- While doing any optical experiment with lens, always record the positions of object pin, image pin and the lens.

Graph:

- Scale should be uniform and convenient with axes properly labelled.
- Origin should begin from zero if the intercept is to be found. Co-ordinates of the origin must be given/ marked on graph paper.
- Plots should be small encircled dots, correct to the nearest division of the graph sheet.
- Line of best fit means the aggregate of all plotted points drawn symmetrically and extended on both sides of the last plotted points.
- Slope calculation should be from two widely separated, unplotted points lying on the best fit line.
- The scale of the graph should be such that at least $\frac{2}{3}$ of the graph paper is used.