P510/3
PRACTICAL
PHYSICS
Paper 3
August, 2014
3¼ hours

JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS – AUGUST, 2014

PHYSICS PRACTICAL

(PRINCIPAL SUBJECT)

Paper 3

3 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

*Answer **Question 1** and **one** other question.*

Candidates are not allowed to use the apparatus or write for the first fifteen minutes.
Graph papers are provided.
Mathematical tables and non – programmable silent electronic calculators may be used.
Write on one side of the paper only.
Candidates are expected to record on their scripts all their observations as these observations are made and to plan the presentation of the records so that it is not necessary to make a fair copy of them. The working of the answers is to be handed in.

*Details on the question paper should **not** be repeated in the answer, nor is the theory of the experiment required unless specifically asked for.*

Candidates should, however, record any special precautions that they have taken and any particular features of their method of going about the experiment.

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

1. In this experiment you will determine:

(i) The mass M_0 of a metre rule provided.

(ii) The constant, K of the metre rule provided.

(34 marks)

Part I

(a) Make a loop knot on each of the short pieces of thread provided.

(b) Attach each loop on the metre rule, to one thread, attach a mass $m_1 = 0.050$ kg and to the other thread, clamp it between 2 small pieces of wood as shown in figure 1.

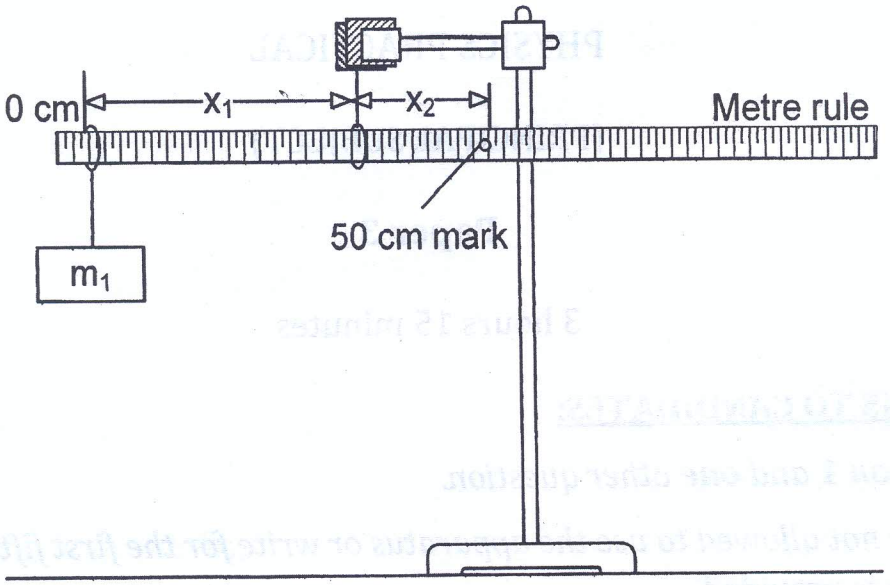

Fig.1

(c) Adjust the position of the clamped thread along the metre rule until the metre rule balances horizontally.

(d) Measure and record distances x_1 and x_2.

(e) Determine the value, of M from $M = \frac{0.050\,x_1}{x_2}$

(f) Dismantle your set up and weigh the metre rule alone on the beam balance.

(g) Read and record the mass M' of the metre rule in kilograms.

(h) Calculate M_0 from the expression, $M_0 = \frac{1}{2}(M + M')$

Part II

(a) Clamp the spring provided between two small pieces of wood and tie a long thread at the free end of the spring as shown in figure 2.

(b) Tie the thread towards the end of the metre rule while the zero end of the metre rule is resting against a large piece of wood (or brick) as shown in Fig.2.

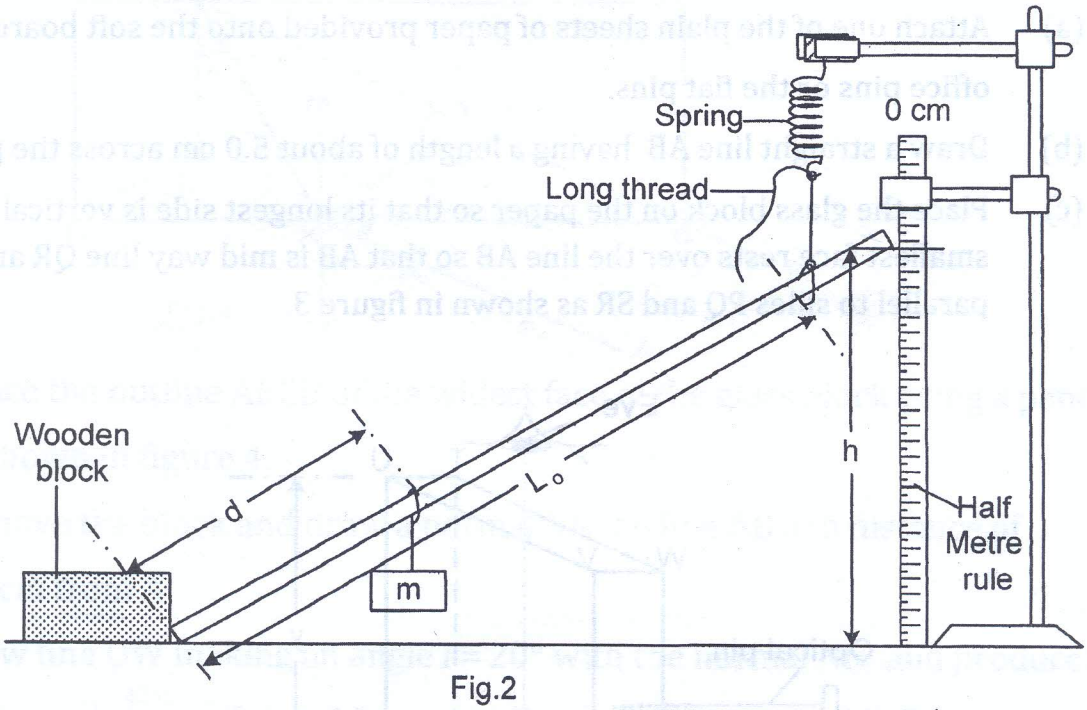

Fig.2

(c) Adjust the length of the thread attached to the spring so that the height h of end of the metre rule is 30cm above the table.

(d) Measure and record length L_o in metres.

(e) Read and record the position P_o of the metre rule against the vertical half metre rule.

(f) Suspend a mass m using the short piece of thread at a distance d = 30.0 cm from the lower end of the metre rule.

(g) Read and record the new position P_1 of the metre rule against the vertical scale.

(h) Determine the extension, e, of the spring.

(i) Repeat procedures (f) to (h) for values of d = 40.0, 50.0, 60.0, 70.0 and 80.0 cm.

(j) Tabulate your results in a suitable table including values of $\log_{10} e$ and $\log_{10} d$.

(k) Plot a graph of $\log_{10} e$ against $\log_{10} d$.

(l) Determine the slope S_1 of the graph.

(m) Find the value of the constant K, from the expression,

$$K = \left(\frac{0.98}{S_1 \times L_o}\right)$$

2. In this experiment, you will determine the;
   (i) Constant, n of a glass block and
   (ii) The breadth b, of the glass block provided.

(33 marks)

PART I

(a) Attach one of the plain sheets of paper provided onto the soft board using the office pins or the flat pins.

(b) Draw a straight line AB having a length of about 5.0 cm across the paper.

(c) Place the glass block on the paper so that its longest side is vertical and its smallest face rests over the line AB so that AB is mid way line QR and is parallel to sides PQ and SR as shown in figure 3.

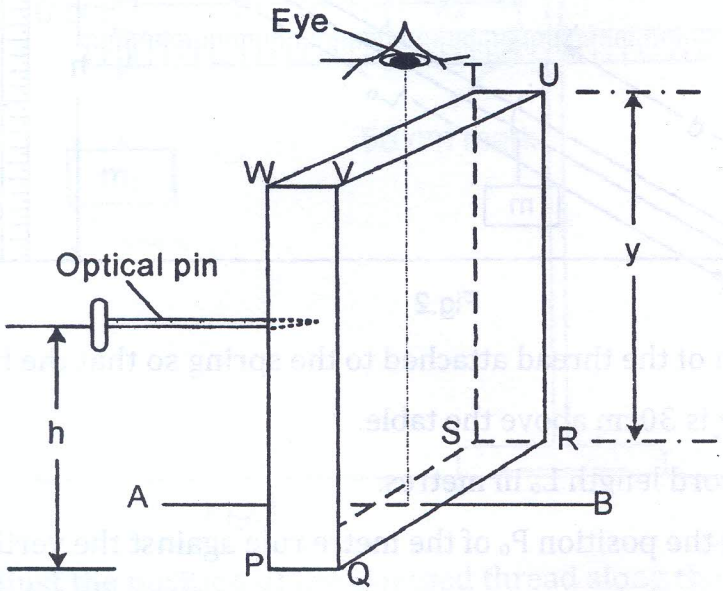

Fig.3

(d) Hold an optical pin using your hand horizontally and directly above line AB with its tip touching face PSTW of the glass prism.

(e) Move the eye slowly up and down while observing line AB through the glass block until a position is reached where the pin appears to coincide with line AB by no parallax.

(f) Measure and record the height h, of the pin above the paper.

(g) Measure and record the length y, of side RU of the glass block.

(h) Determine the constant n, from

$$n = \frac{y}{(y - h)}$$

PART II

(a) Use a second plain sheet of paper and pin it on the soft board using office pins or flat pins.

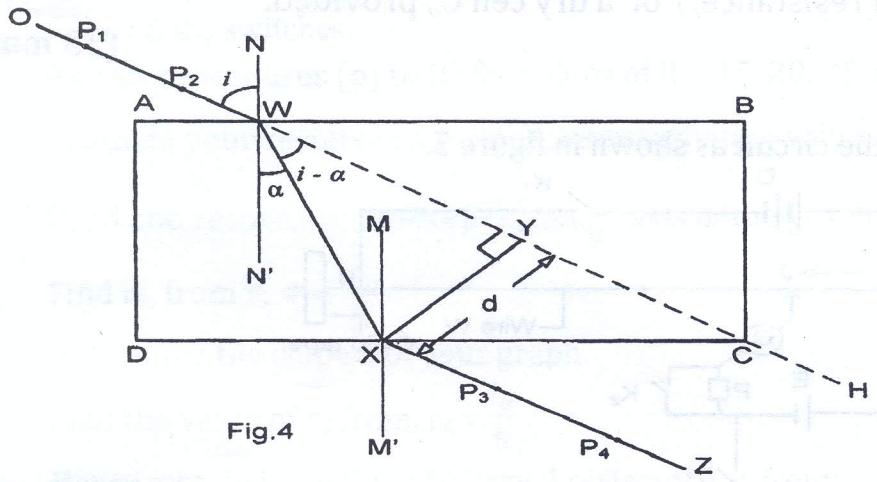

Fig.4

(b) Trace the outline ABCD of the widest face of the glass block using a pencil as shown in figure 4.

(c) Remove the block and draw a normal NN' on line AB at a distance of 2.0 cm from A.

(d) Draw line OW making an angle $i = 20°$ with the normal NN' and produce it backwards beyond line DC to point H.

(e) Stick pins P_1 and P_2 vertically on line OW a reasonable distance apart.

(f) Replace the glass block on its outline.

(g) While viewing from the opposite face CD, stick pins P_3 and P_4 vertically so that they appear to be in line with pins P_1 and P_2.

(h) Remove the glass block and the pins P_3 and P_4.

(i) Draw a line ZX through the pin-marks of P_4 and P_3 so as to meet DC at X.

(j) Draw a line to join W to X.

(k) Draw a perpendicular XY from X onto the line WH.

(l) Measure and record angle α and distance d from X to Y.

(m) Repeat procedures (d) to (l) for values of $i = 30°, 40°, 50°, 60°$ and $70°$.

(n) Tabulate your results in a suitable table including values of $(i - \alpha)$

(o) Plot a graph of $d \cos \alpha$ against $\sin(i - \alpha)$

(p) Determine the slope, **b** of your graph.

ATTACH ALL YOUR TRACING PAPERS TO THE ANSWER SHEET & HAND IN.

3. In this experiment you will determine;

(i) The potential difference per cm, k_o of a bare wire W provided and

(ii) The internal resistance, r of a dry cell C , provided.

(33 marks)

Part I

(a) Connect up the circuit as shown in figure 5.

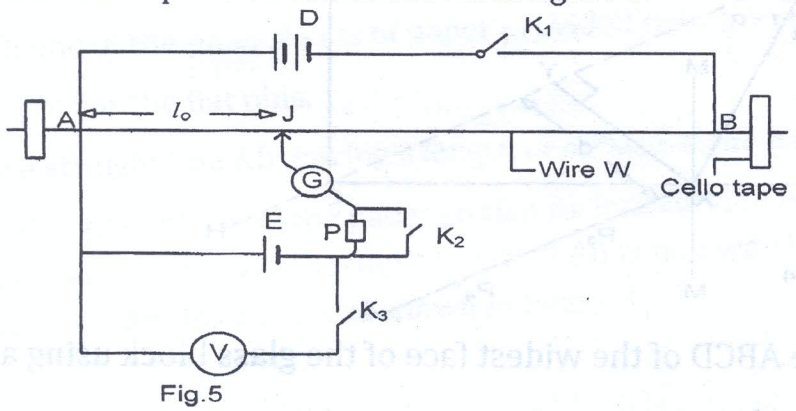

Fig.5

(b) Stretch the bare wire W provided alongside a cm scale on the metre rule using cello tape so that the length of wire, AB = 100 cm.

(c) With the sliding contact J **not** in contact with wire AB, close switch K_3.

(d) Read and record the voltmeter reading V_o.

(e) Open switch K_3.

(f) Close switch K_1 while K_2 is left open.

(g) Move the sliding contact, J slowly along AB until G shows no deflection.

(h) Close switch K_2 and determine a position accurately when G shows no deflection.

(i) Measure and record the balance length l_o.

(j) Open all the switches.

(k) Calculate, k_o from the expression,

$$k_o = \frac{V_o}{l_o}$$

Part II

(a) Connect up the circuit shown in figure 6.

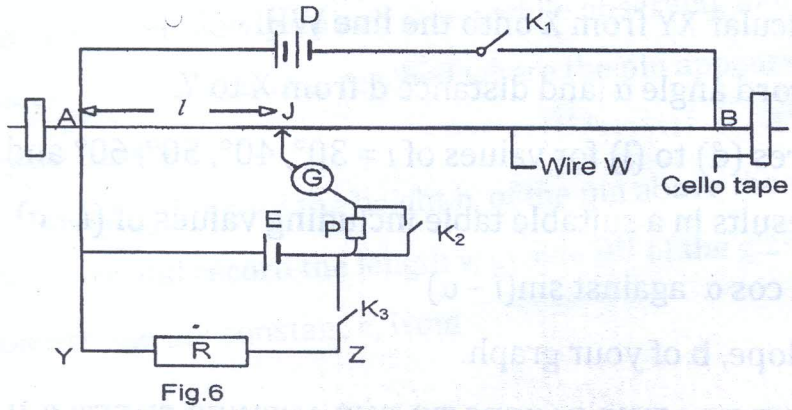

Fig.6

(b) Starting with a resistor R = 10 Ω connected across YZ, close switches K_1 and K_3.

(c) Tap lightly the sliding contact J on wire AB, until G shows no deflection.

(d) Close switch K_2 and locate the point where G shows no deflection accurately.

(e) Measure and record the balance length l, from A to J.

(f) Open all the switches.

(g) Repeat procedures (b) to (f) for values of R = 15, 20, 25 and 30Ω.

(h) Tabulate your results in a suitable table including values of $\frac{1}{R}$ and $\frac{1}{l}$.

(i) Read and record the intercept c_o, on $\frac{1}{R}$ axis of the graph.

(j) Find r_1, from $r_1 = -\frac{1}{c_o}$

(k) Determine the slope **S** of your graph.

(l) Find the value of r_2 from, $r_2 = \frac{l_o}{S}$

(m) Hence, obtain the value of internal resistance, r from:

$$2r - r_1 = r_2$$

= END =

 END.

PROPOSED JJEB - MARKING GUIDE 2014

FOR PHYSICS PRACTICAL

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QUESTION 1

Part I

R_1 – Recording distance $x_1 < 37.0$ (in cm - 1dp or in m – 3 dp) + unit, @ ½ mark. = 01

R_2 – Recording distance x_2: (50.0 – x_1) (cm - 1dp or in m – 3 dp) + unit, @ ½ mark. = 01

R_3 – Substitution of values for x_1 and x_2 in (m) into M @ ½ mark + value, 3sf (no unit) = 01

R_4 – Correctly calculated value of M (3sf or 3 dp) + unit (kg) (or no unit) @ ½ mark. = 01

Sub total = 04

Part II

B_1 - Recording initial pointer position P_o(in cm - 1dp or in m – 3 dp) + unit @ ½ mark = 01

B_2 - Recording Final pointer position P_1(in cm - 1dp or in m – 3 dp) + unit @ ½ mark = 01

B_3 - Recording the extension of the spring, e (in cm - 1dp or in m – 3 dp) + unit @ ½ mk = 01

B_4 - Recording length L_o, (in m – 3dp [value ,< 0.950m] @ ½ mark = 01

Sub total = 04

T_1 - Closed columnar table labeled d, P_1, e , $\log_{10}$ e and $\log_{10}$d @ ½ mark = 2½

T_2 - Units on labels; cm, cm, cm, no unit, and (no unit) respectively @ ½ mark = 2½

T_3 - Column of at least 5 values of, d, copied down, in increasing order. = 01

T_4 - Column of correctly read & recorded values of P_1 increasing, (1dp) @ 1 mark = 05

T_5 - Column of correctly calculated values of e (in cm, 1 dp, in m 3dp) increasing, @ ¼ mk = 1½

T_6 - Column of correctly calculated values of $\log_{10}$ e (no unit 3dp) increasing, @ ¼ mk = 1½

T_7 - Column of correctly calculated values of $\log_{10}$ d (no unit 3dp) increasing, @ ¼ mk = 1½

Sub total = 15 ½

G_1 - Title of the graph i.e. A graph of $\log_{10}$ e against $\log_{10}$d with no units. = 0½

G_2 - Axes drawn, labeled and marked with convenient origins @ ½ mark = 01

G_3 - No units on the axes @ ½ mark, deduct ½ mark for each axis with a unit. = 01

G_4 - Scale covering atleast ½ graph page for each axis @ ½ mark = 01

G_5 - Correctly plotted points using table values @ ½ mark = 03

G_6 - Best line drawn through the majority of correctly plotted values or (points) = 0½

G_7 - Indication of Δ covering all plotted points and atleast ½ graph page = 0½

Sub total = 07½

H_1 - Calculation of slope, S_1, reading of coordinates & sub.,@ pair ½ mark value + unit = 01

H_2 - Calculation of K; sub.of S_1 , 0.98 and L_o , in SI units @ ½ mark = 1½

H_3 - Correctly calculated value of K, [value + unit, (3sf.)] = 0½

Sub total = 03

GRAND TOTAL FOR QUESTION NUMBER 1 = 34 MARKS

QUESTION 2

Part I

M_1 - Recorded measured height h, (in cm metre rule 1 dp.) (3.8 – 4.2) cm @ ½ mark = 01
M_2 - Recorded measured value of y in cm, (Vernier 2 dp. Metre rule 1 dp) @ ½ mark = 01
M_3 - Correctly calculated value of n, sub of h and (y – h) @ ½ mark + value (1.48 – 1.55) = 01½

Sub total = 03½

Part II

D_1 - Evidence of a normal NN' drawn or constructed at W @ ½ mark = 0½
D_2 - Evidence of a perpendicular drawn or constructed from X to Y @ ½ mark = 0½
D_3 - Recorded value of the angle α + unit (° + 0 dp) @ ½ mark = 01
D_4 - Recorded value of the distance, d + unit (cm + 1dp) @ ½ mark = 01

Sub total = 03

L_1 - Closed columnar table labeled; i, d , α , $(i - \alpha)$, sin $(i - \alpha)$, cos α and dcos α @ ½ mark = 3½
L_2 - Units on all corresponding quantities (°), cm, (°), (°), no unit, no unit, and cm @ ¼ mark = 1½
L_3 - Column of at least 5 values of i , recorded down in increasing order. = 01
L_4 - Column of atleast 5, increasing values of d, (1 dp); (0.5 – 5.0 cm), @ ½ mark. = 2½
L_5 - Column of atleast 5, increasing values of α, (0 dp); (13° – 42°), @ ½ mark. = 2½
L_6 - Column of correctly calculated values of $(i - \alpha)$, (0 dp) @ ¼ mark =1½
L_7 - Column of correctly calculated values of sin$(i - \alpha)$,(3 dp)@ ¼ mark =1½
L_8 - Column of correctly calculated values of cos α , (3 dp)@ ¼ mark =1½
L_9 - Column of correctly calculated values of d cos α , (1 or 2 dp)@ ¼ mark =1½

Sub total = 17

G_1 - Title of the graph [A graph of d cos α against sin $(i - \alpha)$] with no units = 0½
G_2 - Axes drawn, labelled, marked with convenient origins = 01
G_3 - Unit on the d cos α axis and no unit on sin $(i - \alpha)$ axis @ ½ mark deduct ½ if unit is put. = 01
G_4 - Scale covering atleast ½ graph page for each axis, @ ½ mark = 01
G_5 - Correctly plotted points using values from table of results @ ½ mark = 03
G_6 - Best line drawn through the majority of correctly plotted values or (points) = 0½
G_7 - Indication of Δ covering all plotted points and atleast ½ graph page = 0½

Sub total = 07½

E_1 - Calc. of, slope **b**, reading of co-ords of d cos α and sin $(i - \alpha)$] from the graph @ ½ mark = 01
E_2 - Correctly calculated value of **b**, accuracy + unit (6.0 – 8.0 cm)@ ½ mark =01

Sub total = 02

GRAND TOTAL FOR QUESTION NUMBER 2 = 33 MARKS

QUESTION 3

Part I

M_1 - Recorded voltmeter reading V_o (1.50 $\pm$ 0.05 V) 2 dp. Value + unit @ ½ mark = 01

M_2 - Recorded balance length l_o (3 sf or 1dp.in cm) value ($l_o > l$ for R = 10Ω) + unit @ ½ = 01

M_3 - Calculation of k_o; sub. of V_o, l_o, value + unit (V cm^{-1}) @ ½ mark = 02

Sub total = 04

T_1 - Closed columnar table labeled, R, l, $\frac{1}{R}$, $\frac{1}{l}$ @ 1 mark = 04

T_2 - Units on all corresponding quantities (Ω, cm, Ω^{-1}, cm^{-1}), @ ½ mark = 02

T_3 - Column of at least 5 values of R, recorded down in increasing order. = 01

T_4 - Column of atleast 5 values of l, increasing, (70.0 – 85.0 cm) (1 dp) @ 1 mark = 05

T_5 - Column of calculated values $\frac{1}{R}$ recorded (2sf, or 2 dp.) @½ mark = 2½

T_6 - Column of calculated values $\frac{1}{l}$ recorded (3sf, or 4 dp.) @½ mark = 2½

Sub total = 17

G_1 - Title of the graph without units (A graph of $\frac{1}{R}$ against $\frac{1}{l}$) without units. = 0½

G_2 - Axes drawn, labeled and marked with convenient origins @ ½mark = 01

G_3 - Units on each axis (Ω^{-1}, cm^{-1}) @ ½ mark = 01

G_4 - A convenient scale with $\frac{1}{l}$ axis starting at 0, @ ½ mark = 01

G_5 - Correctly plotted values from the table of results @ ½ mark = 2½

G_6 - Best line drawn through the majority of correctly plotted points = 0½

G_7 - Indication of Δ covering all plotted points. = 0½

Sub total = 07

F_1 - Recorded value of the intercept c_o on $\frac{1}{R}$ - axis (2 sf or 2 dp), Value + unit @ ½ mark = 01

F_2 - Calculation of r_1, Sub of c_o, (value + unit)@ ½ mark = 01

F_3 - Calculation of slope, S, (reading of coordinates & sub., value + unit)@ ½ mark = 01

F_4 - Calculation of r_2, Sub of l_o and S. (value + unit)@ ½ mark = 01

F_5 - Calculation of r, sub. of r_1, r_2 and value of, r + unit @ ½ mark. = 01

Sub total = 05

GRAND TOTAL FOR QUESTION NUMBER 3 = 33 MARKS

- END -

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SAMPLE RESULTS 2014

QUESTION 1:

P_O = 20.5 cm

x_1 = 34.5 cm $\qquad$ x_2 = 15.5 cm

d(cm)	P_1(cm)	e (cm)	$\log_{10}$e	$\log_{10}$d
30.0	21.5	1.00	0.000	1.477
40.0	21.8	1.30	0.114	1.602
50.0	22.2	1.70	0.230	1.699
60.0	22.5	2.00	0.301	1.778
70.0	22.8	2.30	0.362	1.845
80.0	23.2	2.70	0.431	1.903

QUESTION 2:

h = 4.0 cm

y = 11.8 cm

i(°)	d(cm)	α (°)	(i - α) (°)	Sin(i – α)	cos α	d cos α (cm)
20	0.8	15	5	0.087	0.966	0.8
30	1.6	19	11	0.191	0.946	1.5
40	2.0	25	15	0.259	0.906	1.8
50	2.7	30	20	0.342	0.866	2.3
60	3.6	35	25	0.423	0.819	2.9
70	4.7	39	31	0.515	0.777	3.7

QUESTION 3:

V_o = 1.50V $\qquad$ l_o = ... cm

Standard resistors | resistance box | resistance box values

R(Ω)	l(cm)	l(cm)	$\frac{1}{R}(\Omega^{-1})$	$\frac{1}{l}(cm^{-1})$
10	75.6	71.6	0.10	0.0140
15	77.0	73.4	0.07	0.0136
20	78.4	74.5	0.05	0.0134
25	79.0	75.2	0.04	0.0133
30	80.0	75.7	0.03	0.0132

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