P510/3
PRACTICAL
PHYSICS
Paper 3
August, 2018
3¼ hours

JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS – AUGUST, 2018

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 the Young's modulus, E, of the material of the metre rule labelled B.

METHOD I

a) Measure and record the thickness, t, and the breadth, w, of the metre rule labelled B.

b) Calculate k from the expression

$$k = 4wt^3$$

c) Clamp the metre rule B at the edge of the table leaving a free length, $x = 0.900$ m as in the Figure 1.1.

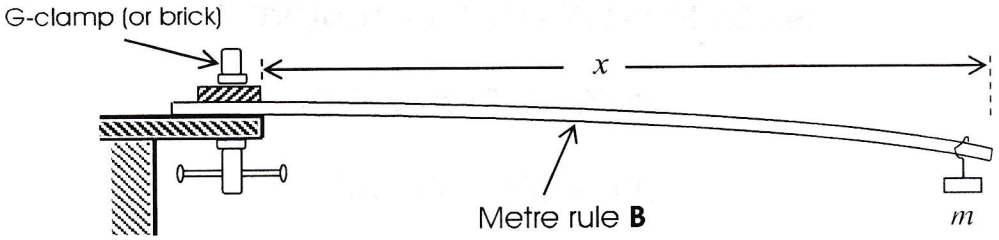

Fig. 1.1

d) Suspend a mass, $m = 0.100$ kg at the free end of the metre rule.

e) Depress the mass, m, through a small distance and release it.

f) Measure and record the time for 20 oscillations and determine the period, T.

g) Calculate Young's modulus, E, from the expression

$$E = 6.32 \times 10^2 \left(\frac{mx^3}{kT^2} \right)$$

METHOD II

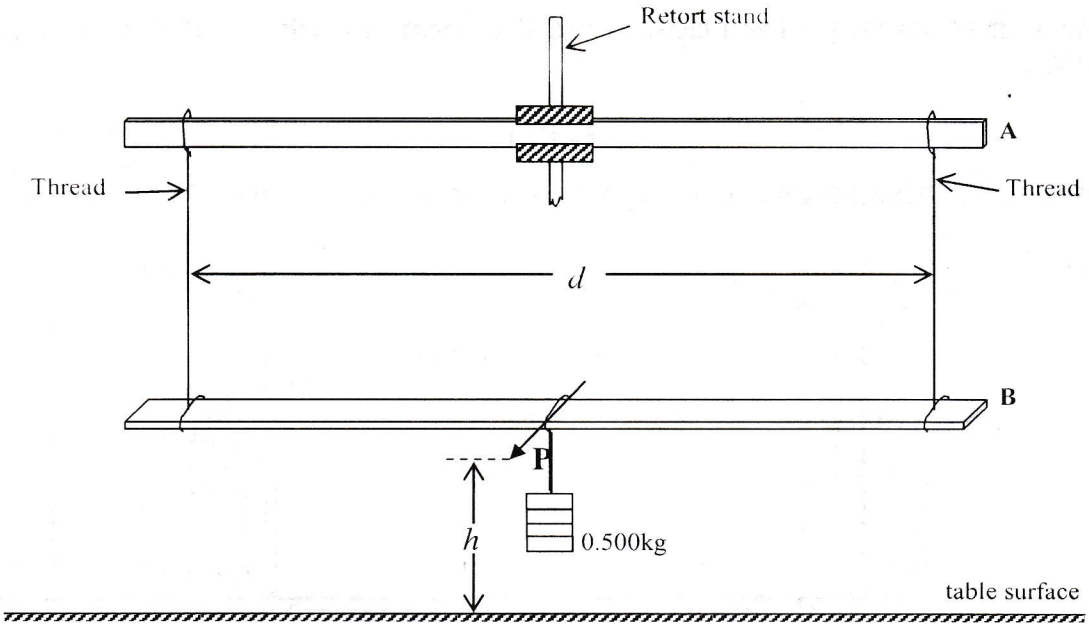

Fig. 1.2

a) Clamp the metre rule labelled **A** horizontally such that the graduated face is towards you.

b) Suspend metre rule **B** from the clamped one by means of two vertical threads tied at the 2.0 cm and 98.0 cm marks so that the graduated face is upwards as in the Figure 1.2.

c) Adjust the length of the threads to about 20.0 cm.

d) At the 50.0 cm mark of metre rule **B**, suspend a mass of 0.500 kg and attach a pointer, **P**, horizontally.

e) Measure and record the initial height, h_0, (in metres) of the pointer from the table surface.

f) Remove a mass $m = 0.150$ kg from the mass hanger.

g) Measure and record the new height, h_1, (in metres) of the pointer from the table surface.

h) Find the change, $y = (h_1 - h_0)$ in the position of the pointer.

i) Repeat procedures (f) to (h) for $m = 0.200$, 0.250, 0.300, 0.350 and 0.400 kg.

j) Tabulate your results including values of $\frac{1}{m}$ and $\frac{1}{y}$.

k) Plot a graph of $\frac{1}{y}$ against $\frac{1}{m}$.

l) Find the slope, S, of the graph.

m) Calculate Young's modulus, E, from the expression

$$E = \frac{gSd^3}{k}$$ where g = 9.81 ms^{-2}.

n) Calculate the average value of E obtained by the two methods.

2. In this experiment, you will determine the focal length, f, of the converging lens provided.

PART I

a) Arrange your apparatus in a straight line as shown in Figure 2.1.

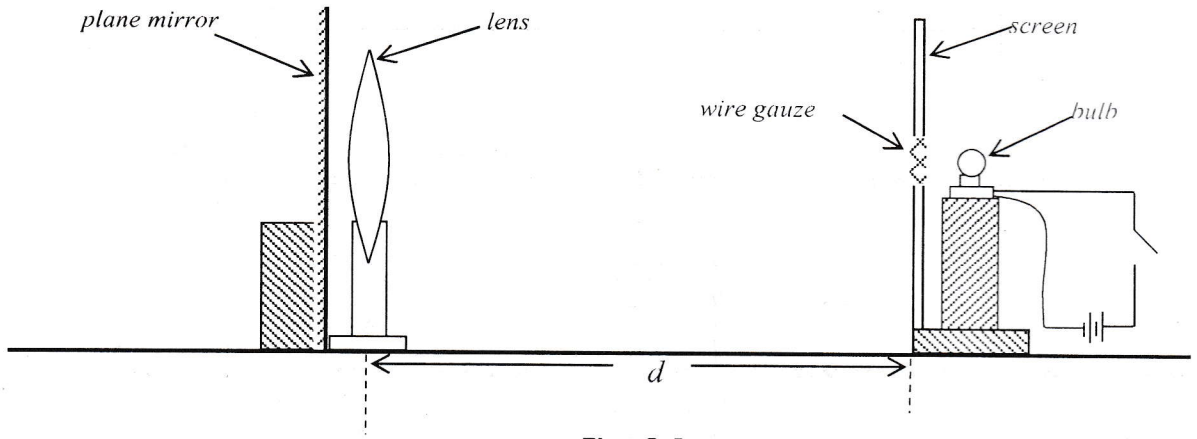

Fig. 2.1

b) Close the switch and move the lens together with the mirror to and fro the screen until a sharp distinct image of the wire gauze is formed beside the wire gauze on the screen.

c) Measure and record the distance, d, between the screen and the lens.

PART II

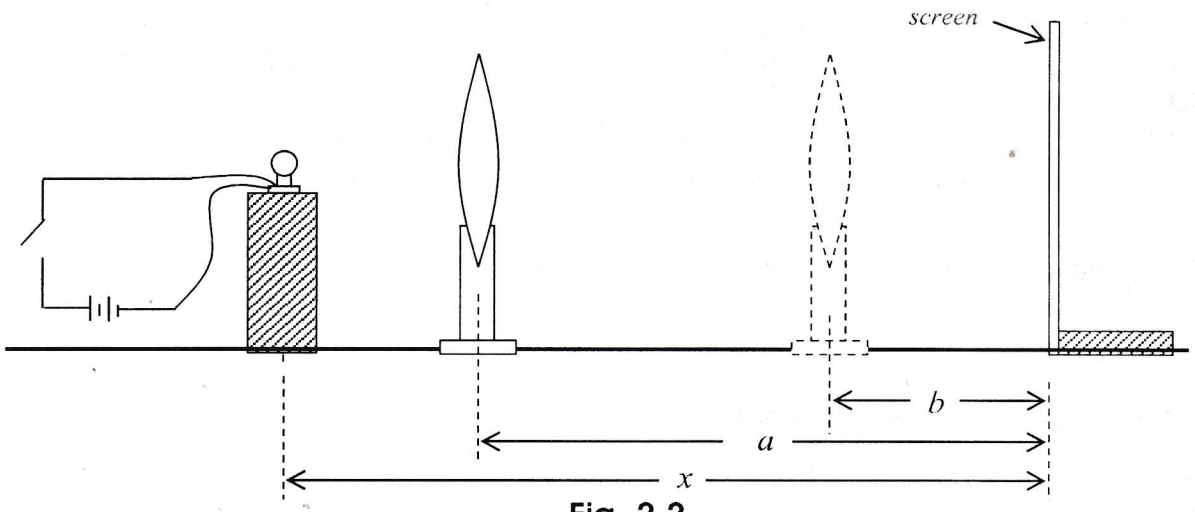

Fig. 2.2

a) Arrange the apparatus in a straight line as shown in Figure 2.2 with the distance, x, between the bulb and the screen equal to 95.0 cm.

b) Close the switch and move the lens starting from near the bulb towards the screen until a sharp magnified image of the filament of the bulb is focused on the screen.

c) Measure and record the distance, a, between the lens and the screen.

d) While keeping the distance, x, between the bulb and the screen fixed, move the lens towards the screen until a sharp diminished image of the filament of the bulb is focused on the screen.

e) Measure and record the new distance, b, between the lens and the screen.

f) Determine the distance, $y = (a-b)$.

g) Repeat procedures (a) to (f) for values of x = 90.0, 85.0, 80.0, 75.0 and 70.0 cm.

h) Tabulate your results including values of $(x+y)$, $(x-y)$ and $z = \frac{x}{(x-y)}$.

i) Plot a graph of $(x+y)$ against z.

j) Find the slope, S, of the graph.

k) Calculate the focal length, f, of the lens from the expression

$$f = \frac{4d+S}{8}.$$

3. In this experiment, you will determine the electrical resistivity, ρ, of the material of the bare wire labelled W provided.

METHOD I

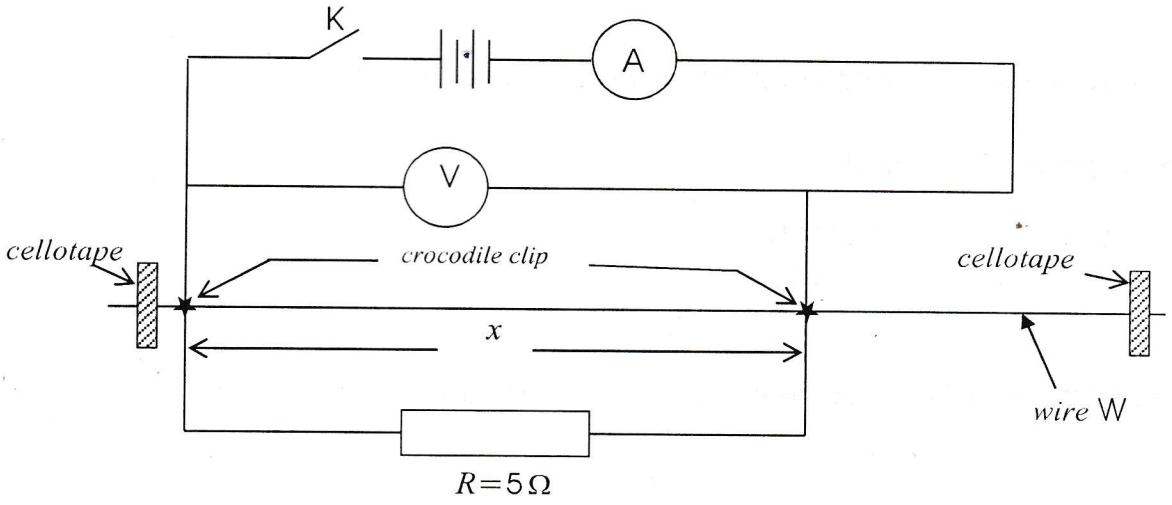

Fig. 3.1

a) Measure and record the mean diameter, D, of the bare wire W.

b) Set up the circuit in Figure 3.1 with length x = 0.800 m.

c) Close switch K.

d) Read and record the ammeter reading, I, and the voltmeter reading, V.

e) Open switch K.

f) Calculate β from the expression

$$\beta = 0.79D^2$$

g) Calculate ρ_1 from the expression

$$\rho_1 = \frac{\beta VR}{x(IR - V)}$$

METHOD II

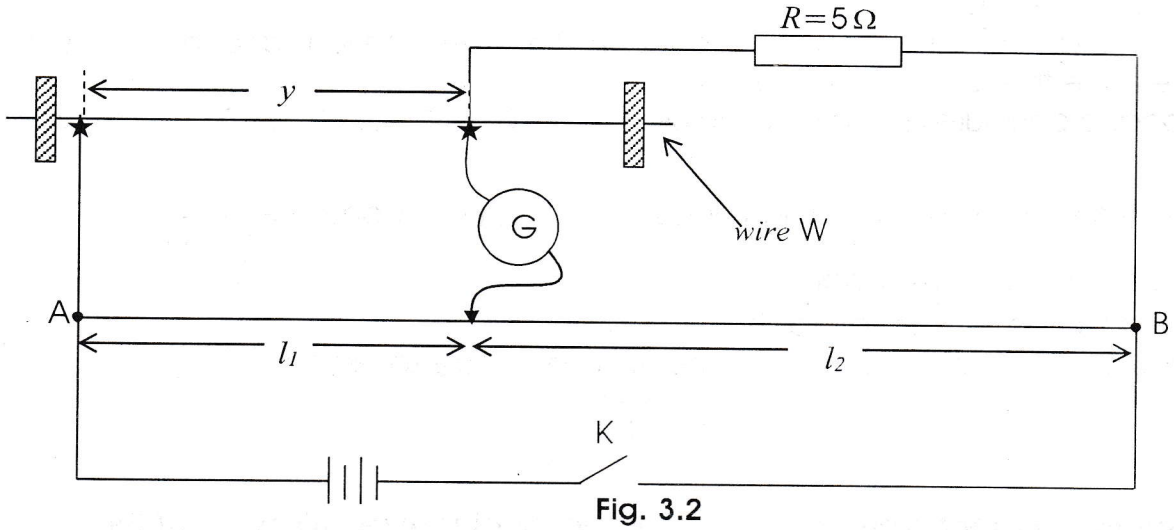

Fig. 3.2

a) Connect the circuit in Figure 3.2 with a length, y = 0.200 m.

b) Close the switch and move the sliding contact along the potentiometer wire AB until the galvanometer G shows no deflection.

c) Measure and record the balance lengths l_1 and l_2, in metres.

d) Repeat procedures (a) to (c) for values of y = 0.300, 0.400, 0.500, 0.600 and 0.700 m.

e) Enter all your results in a suitable table, including values of $\frac{l_1}{l_2}$ and $\frac{y}{R}$.

f) Plot a graph of $\frac{y}{R}$ against $\frac{l_1}{l_2}$

g) Find the slope, S, of the graph.

h) Calculate ρ_2 from the expression

$$\rho_2 = \frac{\beta}{S}$$

i) Calculate the electrical resistivity, ρ, of the material of the bare wire W from the expression

$$\rho = \frac{\rho_1 + \rho_2}{2}$$

 End.

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UGANDA ADVANCED CERTIFICATE OF EDUCATION

P510/3 PHYSICS PRACTICAL

SAMPLE RESULTS

AND

MARKING GUIDE 2018

Q.1

METHOD II

e) $h_0 = 0.376m$

g) $h_1 = 0.385m$

h) $y = 0.385 - 0.376$

$= 0.009m$

j)

$m(kg)$	$h_1(m)$	$y(m)$	$\frac{1}{m}(kg^{-1})$	$\frac{1}{y}(m^{-1})$
0.150	0.385	0.009	6.67	111
0.200	0.389	0.013	5.00	77
0.250	0.392	0.016	4.00	63
0.300	0.396	0.020	3.33	50
0.350	0.399	0.023	2.86	43
0.400	0.403	0.027	2.50	37

l) $S = \frac{117 - 28}{7.2 - 2.0}$

$= 17kgm^{-1}$

m) $E = \frac{9.81 \times 17 \times \left[(98.0 - 2.0) \times 10^{-2}\right]^3}{2.84 \times 10^{-8}}$

$= 5.2 \times 10^9 Nm^{-2}$

n) $E = \frac{1}{2}(5.89 + 5.2) \times 10^9$

$= 5.6 \times 10^9 Nm^{-2}$

Q.2

QUESTION 2

PART I

c) $d = 16.5cm$

PART II

c) $a = 73.5cm$

e) $b = 21.0cm$

f) $y = 73.5 - 21.0$

$= 52.5cm$

h)

$x(cm)$	$a(cm)$	$b(cm)$	$y(cm)$	$(x+y)(cm)$	$(x-y)(cm)$	z
95.0	73.5	21.0	52.5	147.5	42.5	2.24
90.0	68.0	22.0	46.0	136.0	44.0	2.05
85.0	62.1	22.7	39.4	124.4	45.6	1.86
80.0	56.5	23.5	33.0	113.0	47.0	1.70
75.0	50.0	24.5	25.5	100.5	49.5	1.52
70.0	43.0	26.7	16.3	86.3	53.7	1.30

j) $S = \dfrac{166 - 70}{2.52 - 1.06}$

$= 65.8cm$

k) $f = \dfrac{(4 \times 16.5) + 65.8}{8}$

$= 16.5cm$

QUESTION 3

Q.3

METHOD I

a) $D = \dfrac{0.37 + 0.37 + 0.37}{3}$

$= 0.37mm$

d) $I = 0.76A$

$V = 2.20V$

f) $\beta = 0.79 \times (0.37 \times 10^{-3})$

$= 1.1 \times 10^{-7} m^2$

g) $\rho_1 = \dfrac{1.1 \times 10^{-7} \times 2.20 \times 5}{0.800 \times [(0.76 \times 5) - 2.20]}$

$= 9.5 \times 10^{-7} \Omega m$

METHOD II

c) $l_1 = 0.240m$ $\quad$ $l_2 = 0.760m$

e) $R = 5\Omega$

$y(m)$	$l_1(m)$	$l_2(m)$	$\frac{l_1}{l_2}$	$\frac{y}{R}(m\Omega^{-1})$
0.200	0.240	0.760	0.32	0.040
0.300	0.324	0.676	0.48	0.060
0.400	0.372	0.628	0.59	0.080
0.500	0.422	0.578	0.73	0.100
0.600	0.477	0.523	0.91	0.120
0.700	0.506	0.494	1.02	0.140

g) $S = \dfrac{0.147 - 0.036}{1.09 - 0.29}$

$= 0.14m\Omega^{-1}$

h) $\rho_2 = \dfrac{1.1 \times 10^{-7}}{0.14}$

$= 7.9 \times 10^{-7} \Omega m$

i) $\rho = \dfrac{(9.5 + 7.9) \times 10^{-7}}{2}$

$= 8.7 \times 10^{-7} \Omega m$

QUESTION 1 (40 marks)

A_1	Thickness t measured at least three times.....	½
A_2	Value of t = 6.20 – 7.00, **2dp**; unit: *mm* (*correct symbols*).....	½ + ½
A_3	Width w measured at least three times.....	½
A_4	Value of w = 2.30 – 2.70, **2dp**; unit: *cm* (*correct symbols*).....	½ + ½
A_5	Substitution in SI in $k=wt^3$.....	½
A_6	Correctly calculated value of k = (2.00 – 3.50) x 10^{-8} [3sf x 10^{-8}]; unit:m^4 (*correct symbols*)	1+ ½
A_7	Time for 20 oscillations (SC: **0** or **1dp**, SW: **2dp**); unit: *s*	½ + ½
A_8	Correctly calculated value of T; unit: *s*	½ + ½
	Stop Clock: 1dp if time for 20 oscillations is 0dp <10s 2dp if time for 20 oscillations is 0dp >10s or 1dp < 10s 3dp if time for 20 oscillations is 1dp >10s Stop Watch: 3dp if time for 20 oscillations is <10s 4dp if time for 20 oscillations is > 10s	
A_9	Substitution in expression $E = 6.32\times10^2\left(\frac{mx^3}{kT^2}\right)$	½
A_{10}	Correctly calculated value of E = (2.00 – 7.00) x 10^9 [3sf x 10^9]; unit:Nm^{-2} (*correct symbols*)	1+ ½
		09
B_1	Value of h_0, **3dp**; unit: *m* (*correct symbols*)	½ + ½
B_2	Columnar table labelled: m, h_1, y, $\frac{1}{m}, \frac{1}{y}$ (*correct symbols*) @ ½	2 ½
B_3	Units in brackets: *kg*, *m*, *m*, kg^{-1}, m^{-1} (*correct symbols*) @ ½	2 ½
B_4	Values of h_1, **3dp** increasing @ ½	3
B_5	Values of y correctly calculated, **3dp** @ ½	3
B_6	Values of $\frac{1}{m}$ correctly calculated, **2dp** @ ½	3
B_7	Values of $\frac{1}{y}$ correctly calculated, **0dp** @ ½	3
		18

C_1	Title: A graph of $\frac{1}{y}$ against $\frac{1}{m}$, [*no units, correct symbols*]	½
C_2	Axes perpendicular with arrows at end, correctly labelled; VA: $\frac{1}{y}(m^{-1})$	
	HA: $\frac{1}{m}(kg^{-1})$ [*correct symbols*] @ ½	1
C_3	Uniform scales, half page at least, starting values indicated, marked at least three times @ ½	1
C_4	Correctly plotted points [no shading] @ ½	3
	[*If axes not labelled or reversed, no mark*]	
C_5	Line of best fit provided 4 points correctly plotted	½
C_6	Indication of slope covering all plotted points	½
	[*If right angled triangle, must touch line of best fit*]	06 ½
D_1	Coordinates for slope correctly read @axis ½	½ + ½
D_2	Correctly calculated S = (15 – 19), **0dp**; unit: kgm^{-1}	1+ ½
D_3	Substitution in SI in expression for E	½
D_4	Correctly calculated value of E = (2.00 – 7.00) x 10^9 [3sf x 10^9]; unit:Nm^{-2} (*correct symbols*)	1+ ½
D_5	Determining average value of E	½
D_6	Correctly calculated average value of E = (2.00 – 7.00) x 10^9 [3sf x 10^9]; unit: Nm^{-2} (*correct symbols*)	1+ ½
		06 ½

QUESTION 2 (40 marks)

A_1	Value of d = (14.5 – 17.0), 1dp; unit: *cm*	2+½
A_2	Columnar table labelled: x, a, b, y, $(x+y)$, $(x-y)$, z (*correct symbols*)@½	3½
A_3	Units in brackets: cm, cm, cm, cm, cm, cm, - (*correct symbols*)@½	3½
A_4	Values of a = (75.0 – 40.0), decreasing, 1dp in cm or 3dp in m @½	3
A_5	Values of b = (20.0 – 28.0), increasing, 1dp in cm or 3dp in m @½	3
A_6	Values of y correctly calculated, 1dp in cm or 3dp in m @½	3
A_7	Values of $(x+y)$ correctly calculated, 1dp in cm or 3dp in m @½	3
A_8	Values of $(x-y)$ correctly calculated, 1dp in cm or 3dp in m @½	3
A_9	Values of z correctly calculated, 2dp	3
		27½
B_1	Title: A graph of $(x+y)$ against z [*no units, correct symbols*]	½
B_2	Axes perpendicular with arrows at end, correctly labelled; VA: $(x+y)(cm)$, HA: z [*correct symbols*] @½	1
B_3	Uniform scales, half page at least, starting values indicated, marked at least three times @½	1
B_4	Correctly plotted points [no shading] @½ ..... [*If axes not labelled or reversed, no mark*]	3
B_5	Line of best fit provided 4 points correctly plotted	½
B_6	Indication of slope covering all plotted points ..... [*If right angled triangle, must touch line of best fit*]	½
		06½
C_1	Coordinates for slope correctly read @axis ½	½ + ½
C_2	Correctly calculated S = (58.0 – 68.0), **1dp**; unit: *cm*	2+½
C_3	Correctly calculated value of f = (14.5 – 17.0), **1dp**; unit: *cm* ..... [*provided correct substitution in expression* $f = \frac{4d+S}{8}$, *(correct symbols)*]	2+½
		06

QUESTION 3 (40 marks)

A_1	Diameter D measured at least three times	½
A_2	Value of D = 0.36 – 0.39, **2dp**; unit: *mm*	1+ ½
A_3	Value of I = 0.50 – 1.00, **2dp**; unit: A	1+ ½
A_4	Value of V = 2.00 – 2.80, **1dp** or **2dp**, unit: V	1+ ½
A_5	Correctly calculated value of β =1.1 or 1.2 x 10^{-7}, **1dp**; unit: m^2 ..... [0.11 or 0.12, **2dp** in mm^2]	1+ ½
A_6	Correctly calculated value of $\rho_1 = (1.0 - 9.9) \times 10^{-7}$ [2sf x 10^{-7}]; unit: Ωm ...	1+ ½
		08
B_1	Columnar table labelled: y, l_1, l_2, $\frac{l_1}{l_2}$, z (*correct symbols*) @½	2½
B_2	Units in brackets: m, m, m, - , $m\Omega^{-1}$ (*correct symbols*) @½	2½
B_3	Values of l_1 = 0.200 – 0.600; **3dp**, *increasing* @1	6
B_4	Values of l_2 = 0.800 – 0.400; **3dp**, *decreasing* @1	3
B_5	Values of $\frac{l_1}{l_2}$, correctly calculated, **2dp** @½	3
B_6	Values of $\frac{y}{R}$, correctly calculated, **3dp** @½	3
		20

C_1	Title: A graph of $\frac{y}{R}$ against $\frac{l_1}{l_2}$ [*no units, correct symbols*]	½
C_2	Axes perpendicular with arrows at end, correctly labelled; VA: $\frac{y}{R}(m\Omega^{-1})$, HA: $\frac{l_1}{l_2}$ [*correct symbols*] @.....	1
C_3	Uniform scales, half page at least, starting values indicated, marked at least three times @ ½	1
C_4	Correctly plotted points [no shading] @ ½ ..... [*If axes not labelled or reversed, no mark*]	3
C_5	Line of best fit provided 4 points correctly plotted	½
C_6	Indication of slope covering all plotted points ..... [*If right angled triangle, must touch line of best fit*]	½
		06½
D_1	Coordinates for slope correctly read @axis ½	½ + ½
D_2	Correctly calculated S = (0.12 – 0.23), **2dp**; unit: $m\Omega^{-1}$	1½
D_3	Correctly calculated value of ρ_2 = (1.0 – 9.9) x 10^{-7} [2sf x 10^{-7}]; unit: Ωm (*correct symbols*)	1½
D_4	Correctly calculated value of ρ = (1.0 – 9.9) x 10^{-7} [2sf x 10^{-7}]; unit: Ωm (*correct symbols*)	1½
		05½
	END.	

Candidate's Name .....
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Subject Name .....

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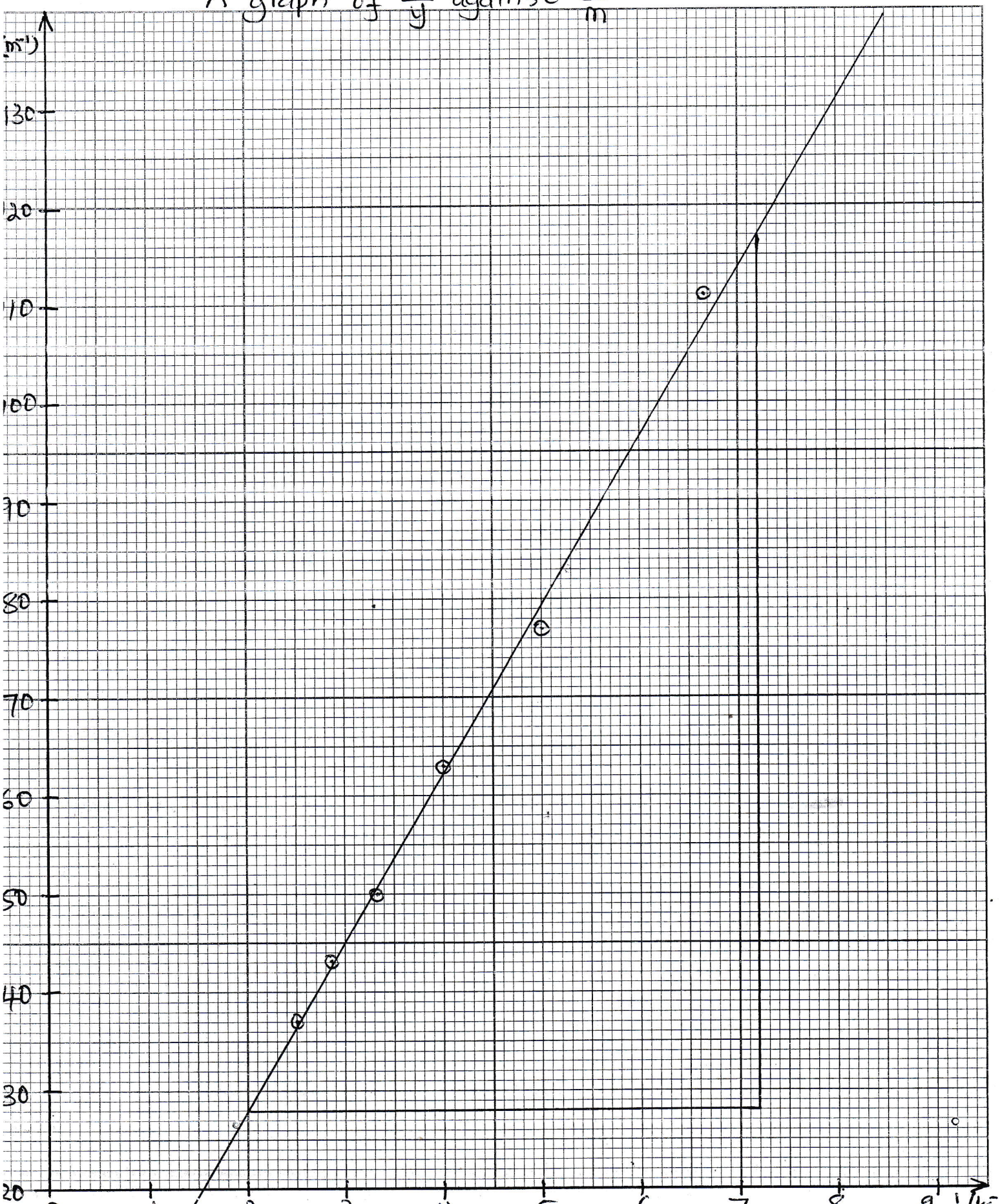
Personal Number					

Paper code .....

QUESTION ONE

A graph of $\frac{1}{y}$ against $\frac{1}{m}$



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(To be fastened together with other answers to paper)

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QUESTION TWO

A graph of (x+y) against z