NAKURU COUNTY

PHYSICS WORKSHOP

PHYSICS PRACTICAL (232/3)

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OBJECTIVES/ AIMS/SKILLS

The paper tests the ability to:

(1)Follow laid down instructions. (Paper rublics are a must)

(2)Set up the apparatus as shown in the given figures.

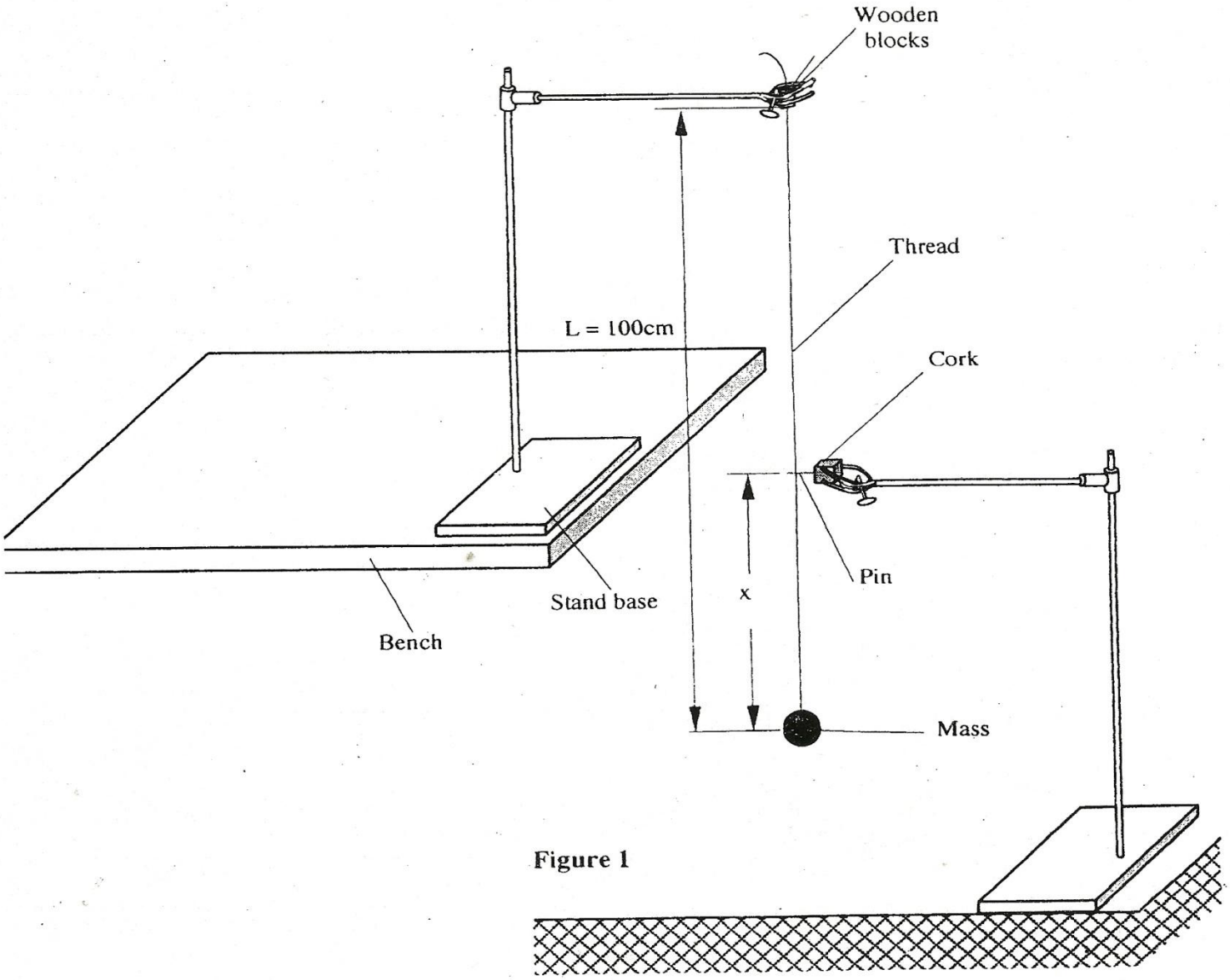
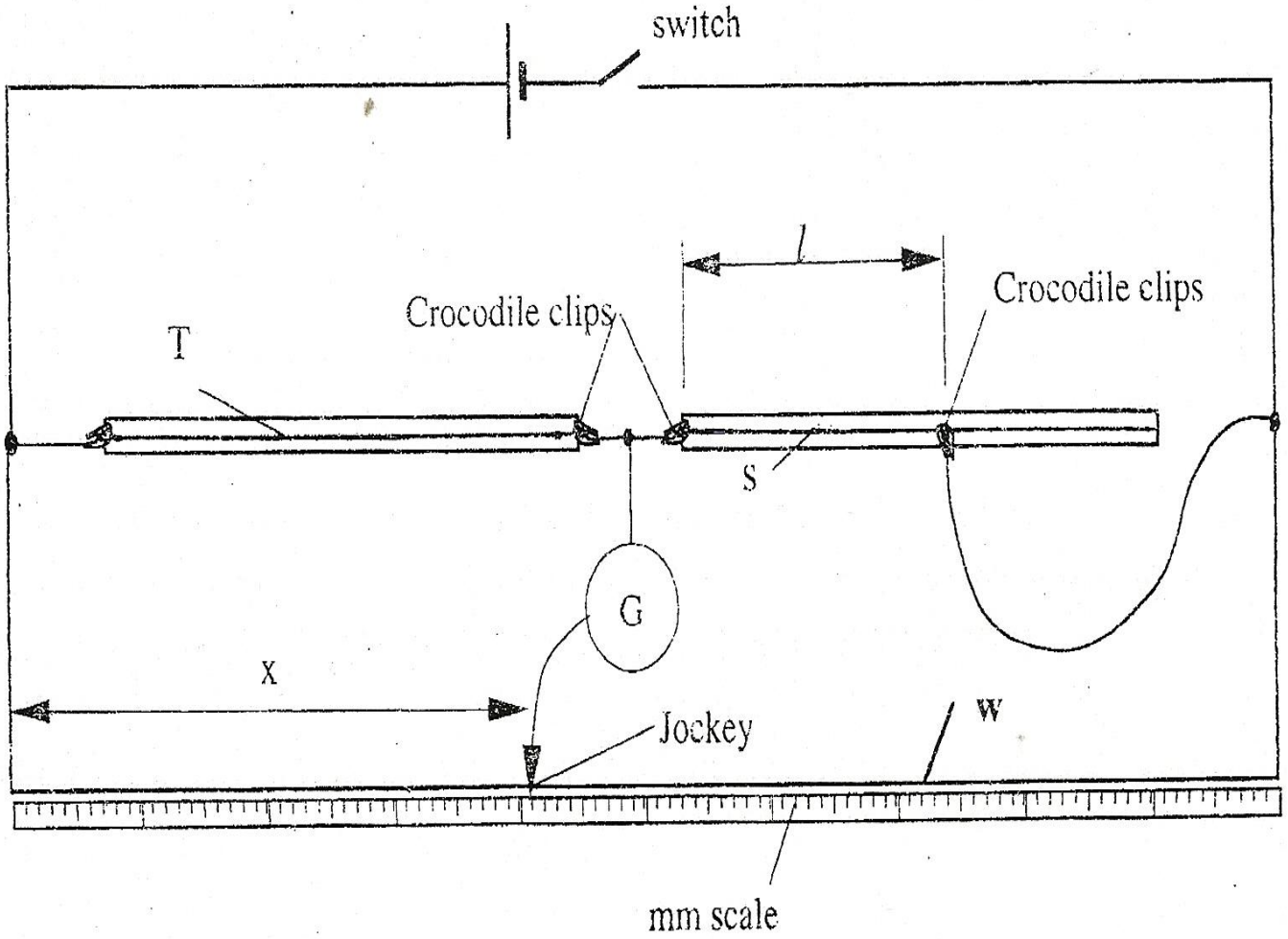
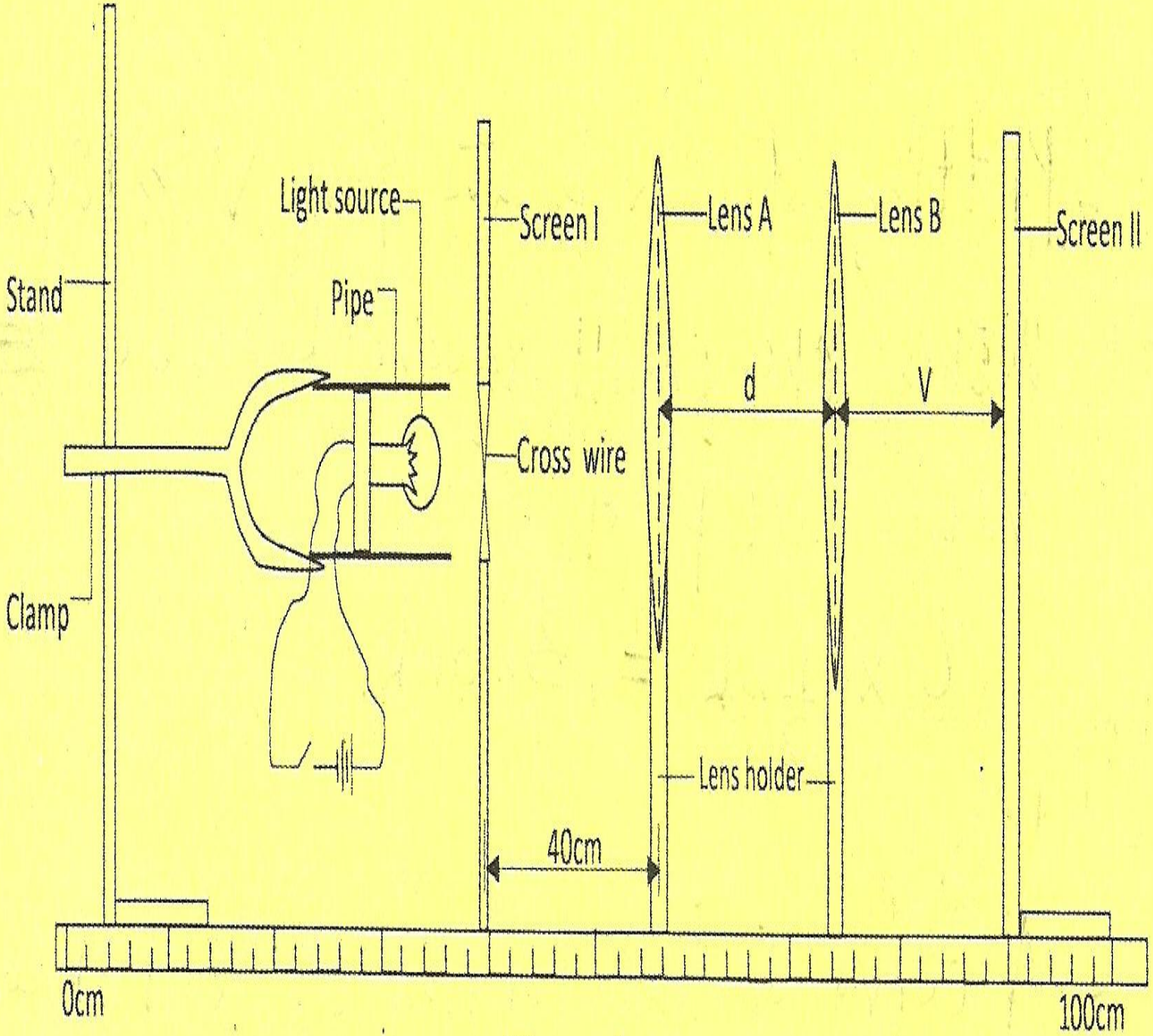

Wooden
blocks
Thread
L = 100cm
Cork
Pin
x
Stand base
Bench
Mass

Figure 1

Figure 3

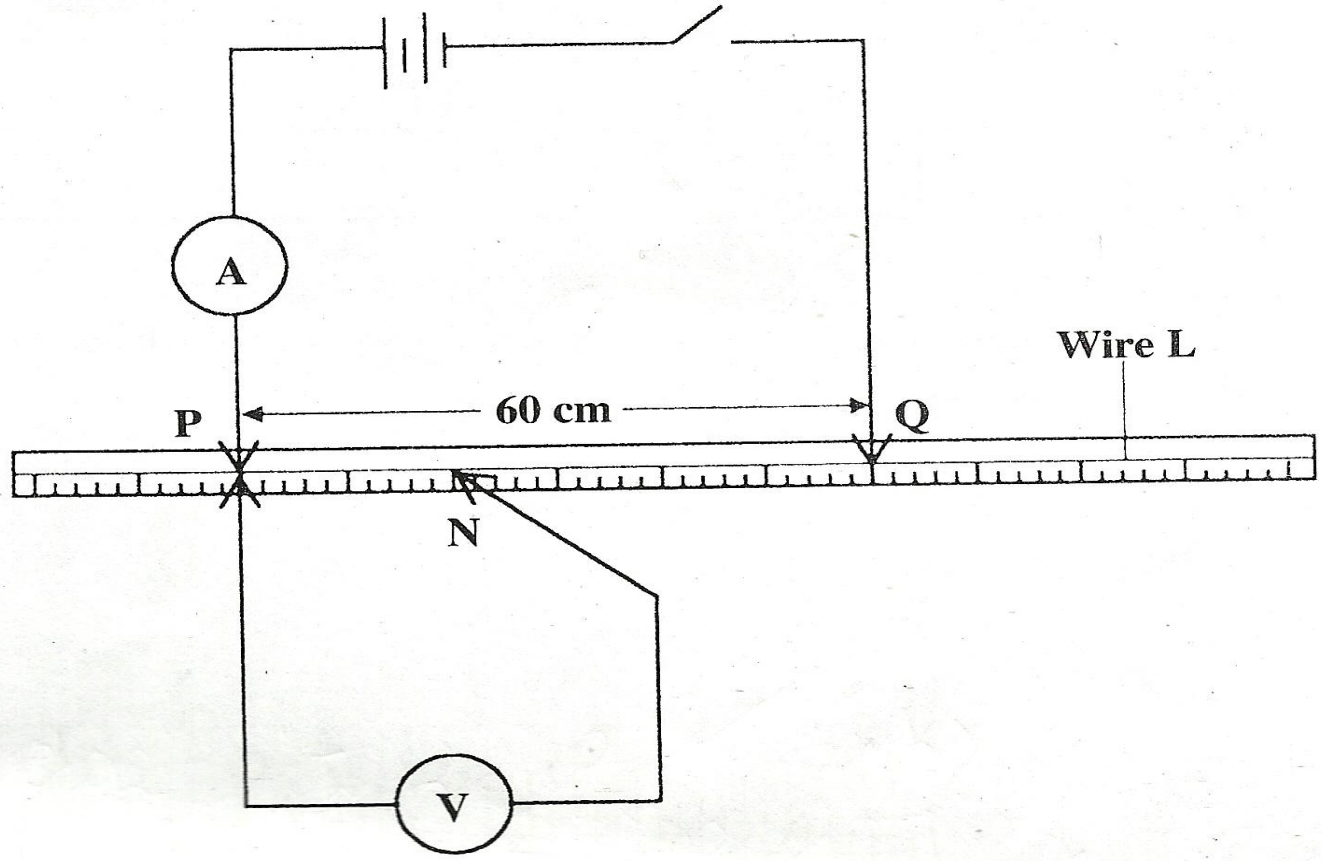

switch
l
Crocodile clips
Crocodile clips
T
S
G
X
Jockey
W
mm scale


Light source
Screen I
Lens A
Lens B
Screen II
Stand
Pipe
d
V
Cross wire
Clamp
Lens holder
40cm
0cm
100cm

KCSE 2015 Q2

9

Starting with the switch open, connect the circuit as shown in **figure 5**. **P** and **Q** are points on the wire **L** such that **PQ** is 60 cm. *(**PQ** should remain 60 cm throughout the experiment)* **N** is a point on the wire such that **PN** is 10 cm (0.1 m).



KCSE 2015 Q1

Proceed as follows:

(k) Place the 100 ml beaker on a meter rule and pour 80 cm^3 of water into it. Arrange a lamp (source of light) and a screen on either side of the beaker. *(see figure 4)*

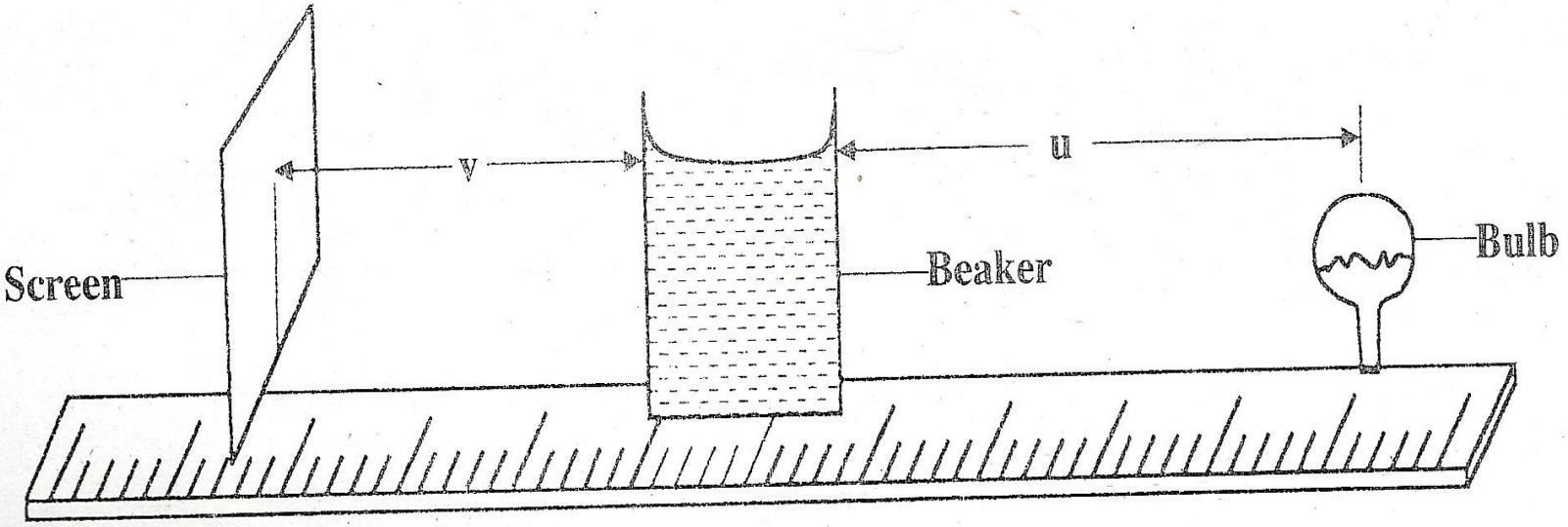


Figure 4

(l) Adjust the position of the lamp on the metre rule so that its centre is a distance **u** = 12 cm from the beaker. Switch on the light. Adjust the position of the screen until a well focused vertical line *(the image of filament)* is formed on the screen. Measure and record in **table 1** the image distance **V** between the screen and the beaker.

2017 Q1

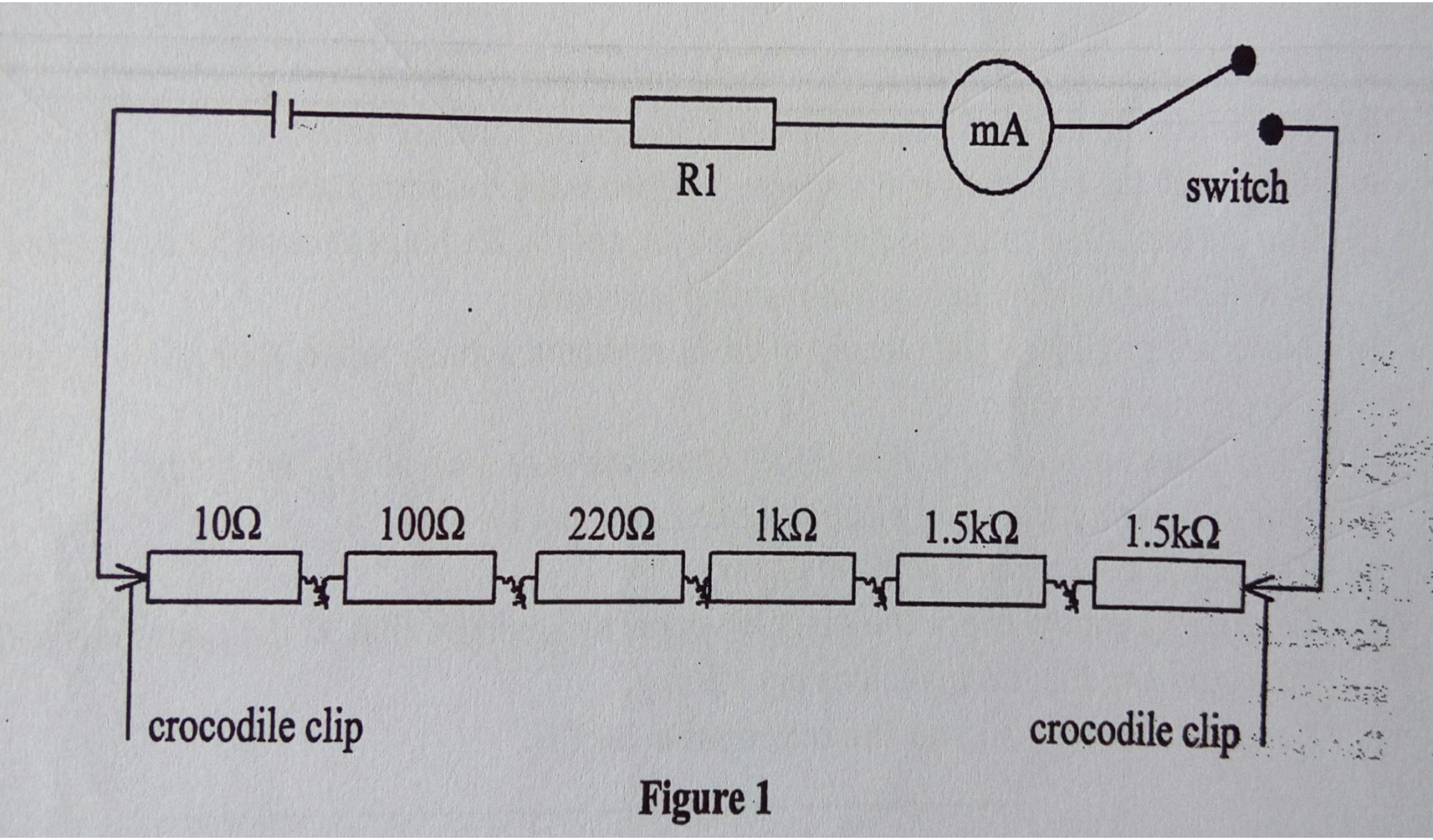


Figure 1

(3)Use measuring instruments to measure respective quantities/metric conversions.

Continued.....

- **length**-metre rule, vernier calipers, micrometer screw gauge.
- **Time**- Stop watch
- **Potential difference**- voltmeter
- **Current**-Ammeter, Milliameter

Continued……

- **Mass**- Beam balance
- **Weight**- spring balance
- **Angles-** protractor
- **Temperature**-thermometer

Continued.....

(4)Use calculators to perform mathematical operations e.g addition, subtraction, multiplication , squares, reciprocals, square roots, logarithms, Trigonometric ratios etc

(5)Choose suitable scales (uniform and simple) and plot graphs

Continued.....

(6)Interpret graphs- slope, read intercepts(x and y)

(7)Speed and accuracy

Continued……

- **<u>Measuring instruments and accuracy</u>**
- **Metre rule**- 1 d.p in cm e.g. 6.0, 5.5, 10.0

2009- Q2

Number of 10Ω carbon resistors	One	Two	Three	Four	Five	Six
a(cm)	70.0	56.0	44.8	39.2	33.0	29.4
$\frac{1}{R}$ (Ω^{-1})						
$\frac{1}{a}$ (cm^{-1})						

2012 – Q1

d(cm)	65	67	69	71	73	77	80
V(cm)	38.0	34.0	31.6	29.0	28.9	25.1	24.0

TABLE 7

U(CM)	12	16	20
V(CM)	5.0	4.5	4.0
$Y = \frac{UV}{U+V}$ (CM)			

- **Vernier calipers**- 2 d.p in cm e.g 2.50, 3.44, 6.00

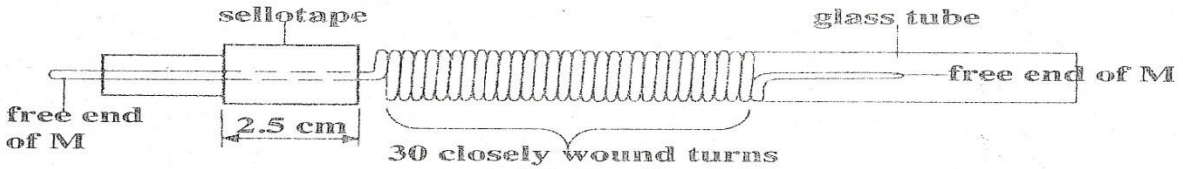


Figure 1

(c) Remove the sellotape and release the spring from the tube.
(The spring will slightly unwind and some turns will disappear)
Bend the free ends as shown in figure 2.

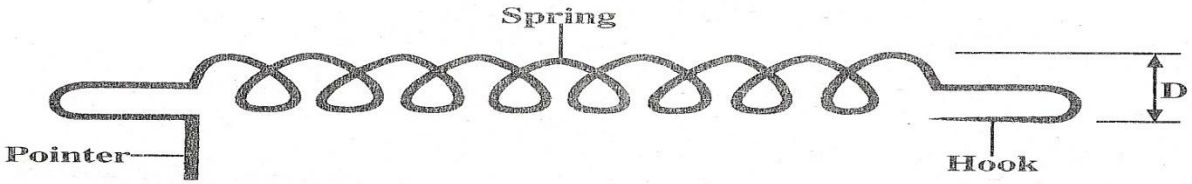


Figure 2

(d) Using a vernier callipers, measure and record the external diameter D of the spring. (1 mark)

D = 0·81 ± 0·05 cm to 2 d.p ✓ (½ mk)

D = Correct conversion to 4 d.p. ✓ (½ mk)

(e) Suspend the spring and a 50 g mass from a retort stand as shown in figure 3.

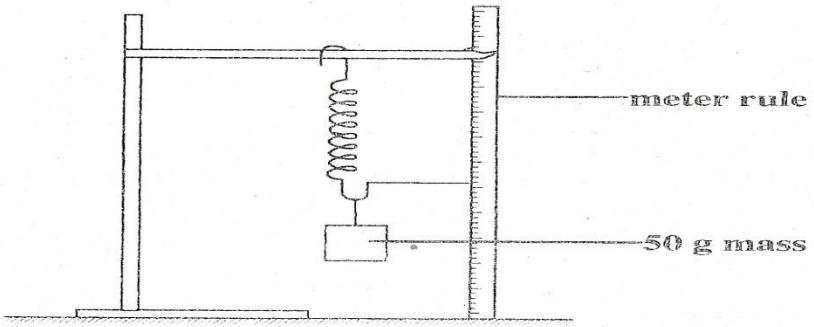


Figure 3

2010 – Q1

Length L(mm)	900	800	700	600	500
Height h(mm)	83.0	85.5	87.0	90.3	92.0
Depression d (ho-h)mm					
Log L					
Log d					

- **Micrometer screw gauge**- 2 d.p in mm e.g. 2.50, 3.44.

QUESTION 1

You are provided with the following:

- a voltmeter
- a milliammeter
- a micrometer screw gauge (to be shared)
- a stopwatch
- a centre zero galvanometer
- a switch
- ten connecting wires (at least five with a crocodile clip on one end)
- a resistance wire mounted on a millimetre scale labelled AB.
- a resistance wire labelled P.
- a resistance wire labelled Q.
- a capacitor labelled C.
- a metre rule or half metre rule.
- two dry cells and a cell holder.
- a carbon resistor labelled R.

Proceed as follows:

PART A

(a) Using the micrometer screw gauge provided, measure the diameter:

(i) D of wire P.

D = 0·37 ± 0·05 mm (2 d.p) ✓(1mk) (1 mark)

(ii) d of wire Q

d = 0·29 ± 0·05 mm (2 d.p) ✓(1mk) (1 mark)

(b) Determine C_1 the value of the ratio $\frac{D}{d}$.

C_1 = Correct substitution ✓(½ mk)
Correct evaluation to 3 s.f (Round off ✓(½mk) only). (1 mark)

Question one

You are provided with the following:

- a micrometer screw gauge (to be shared)
- a vernier calliper (to be shared)
- glass tube
- a wire labelled **M**
- some sellotape
- one 50 g mass
- some masses (totalling 40 g)
- a meter rule
- 100 ml beaker
- a stand boss and clamp
- a stop watch
- a source of light
- a screen
- some water
- a measuring cylinder

PART A

Proceed as follows:

(a) Using a micrometer screw gauge, measure and record the diameter of the wire labelled **M**. (1 mark)

d = 0.35±0.02 mm to 2 d.p ✓(½ mk)

d = correct conversion to 5 d.p ✓(½ mk)

(b) Using wire **M**, make a spring as follows:

(i) Use some sellotape to fix one end of the wire M (about 2.5 cm) along the glass tube;

(ii) Hold firmly the part of the wire under the tape with one hand. Use the other hand to wind 30 turns as closely and tightly as possible. *(see **figure 1**)*

Question two

You are provided with the following:

- an ammeter
- a voltmeter
- two cells (size D)
- a cell holder
- a switch
- a wire labelled **L** mounted on a millimetre scale
- a micrometer screw gauge (to be shared)
- six connecting wires at least four with crocodile clips

Proceed as follows:

(a) Using a micrometer screw gauge, measure and record the diameter **d** of the wire **L**.

(1 mark)

d = 0.30 ± 0.02 mm to 2 d.p ✓ (½ mk)

d = Correct Conversion to 5 d.p or 1 d.p in 5.15×m ✓ (½ mk)

(b) Place the two cells **in series** in the cell holder and use the voltmeter to measure the total electromotive force (emf) $\mathbf{E}_0$ of the battery.

(1 mark)

$\mathbf{E}_0$ = 3.1 ± 0.1 V. to 1 d.p R/T ✓ (1 mk)

- **Stopwatch**- 2d.p in seconds e.g. 15.00, 18.45

TABLE 3

Height X (cm)	35	40	45	50	55	60
Time t for 20 oscillations (S)	31.51 ±2.00	33.35	34.54	35.43	36.25	36.64
Periodic time, T(S)						

TABLE 4

D (cm)	20	25	30	35	40	45	50
T (S)	11.52	9.50	6.95	5.60	4.41	3.40	2.80
$f = \frac{1}{T}$ (S^{-1})							

TABLE 5

L (CM)	60	55	50	45	40	35
Time t for20 oscillations (S)	44.40	42.53	40.55	38.32	36.39	33.80
T (S)						
Log T						
Log L						

Continued……

- **Voltmeter**- 2 d.p
- **Ammeter**- 2 d.p
- **Protractor**- Whole number/1 d.P
- **Beam balance**- 2 d.p
- **Spring balance**-1 d.p
- **Thermometer**- 1 d.p

THE PAPER -Time-$2^{1}/_{2}$Hours

- -Spend at most 15 minutes going through the whole paper.
- -Set up the apparatus.
- -Record the observations as soon as they are made.

Continued……

- **PARTS OF THE PAPER**
- **Table**
- **Graph**
- **Questions on graph interpretations.**

Continued.....

TABLE

- **Fill the values read from various instruments as per the accuracy of each instrument.**
- **Any mathematical operations e.g. squares, square roots, reciprocals, logarithms etc should be written to 4 significant figures or exact**

TABLE 1

Length PN(m)	0.1	0.2	0.3	0.4	0.5	0.6
P.D (V)	0.30	0.70	1.00	1.30	1.60	2.00
Resistance (Ω)	1.000	2.333	3.333	4.333	5.333	6.667

TABLE 2

$\Theta(^0c)$	22	30	40	50	60	70	80
$T=(273+\Theta)$	295	303	313	323	333	343	353
$Log_{10}\ T$	2.470	2.481	2.496	2.509	2.522	2.535	2.548
$L_1(cm)$	61.5	55.5	47.0	39.0	32.0	25.0	19.5
$L_2=100-L_1$ (cm)	38.5	44.5	53.0	61.0	68.0	75.0	80.5
$R_A=200x\ \frac{L_1}{L_2}$	319.5	249.4	177.4	127.9	94.12	66.67	48.45
$Log_{10}\ R_A$	2.504	2.397	2.249	2.107	1.974	1.824	1.685

TABLE 3

Height X (cm)	35	40	45	50	55	60
Time t for 20 oscillations (S)	31.51	33.35	34.54	35.43	36.25	36.64
Periodic time, T(S)	1.576	1.668	1.727	1.772	1.813	1.832
T^2 (S^2)	2.484	2.782	2.983	3.140	3.287	3.356

TABLE 4

D (cm)	20	25	30	35	40	45	50
T (S)	11.52	9.50	6.95	5.60	4.41	3.40	2.80
$f = \frac{1}{T}$ (S^{-1})	0.08681	0.1053	0.1439	0.1786	0.2268	0.2941	0.3571

TABLE 5

L(CM)	60	55	50	45	40	35
Time t for 20 oscillations (S)	44.40	42.53	40.55	38.32	36.39	33.80
T (S)	2.210	2.127	2.028	1.916	1.820	1.690
Log T	0.3444	0.3278	0.3071	0.2824	0.2601	0.2279
Log L	1.778	1.740	1.699	1.653	1.602	1.544

TABLE 6

R X $10^3\Omega$	0.330	1.0	1.33	1.5	2.5	4.0
I (mA)	0.69	0.53	0.48	0.44	0.35	0.26
I (A)	0.00069	0.00053	0.00048	0.00044	0.00035	0.00026
$\frac{I}{I}$ (A^{-1})	1449	1887	2083	2273	2857	3846

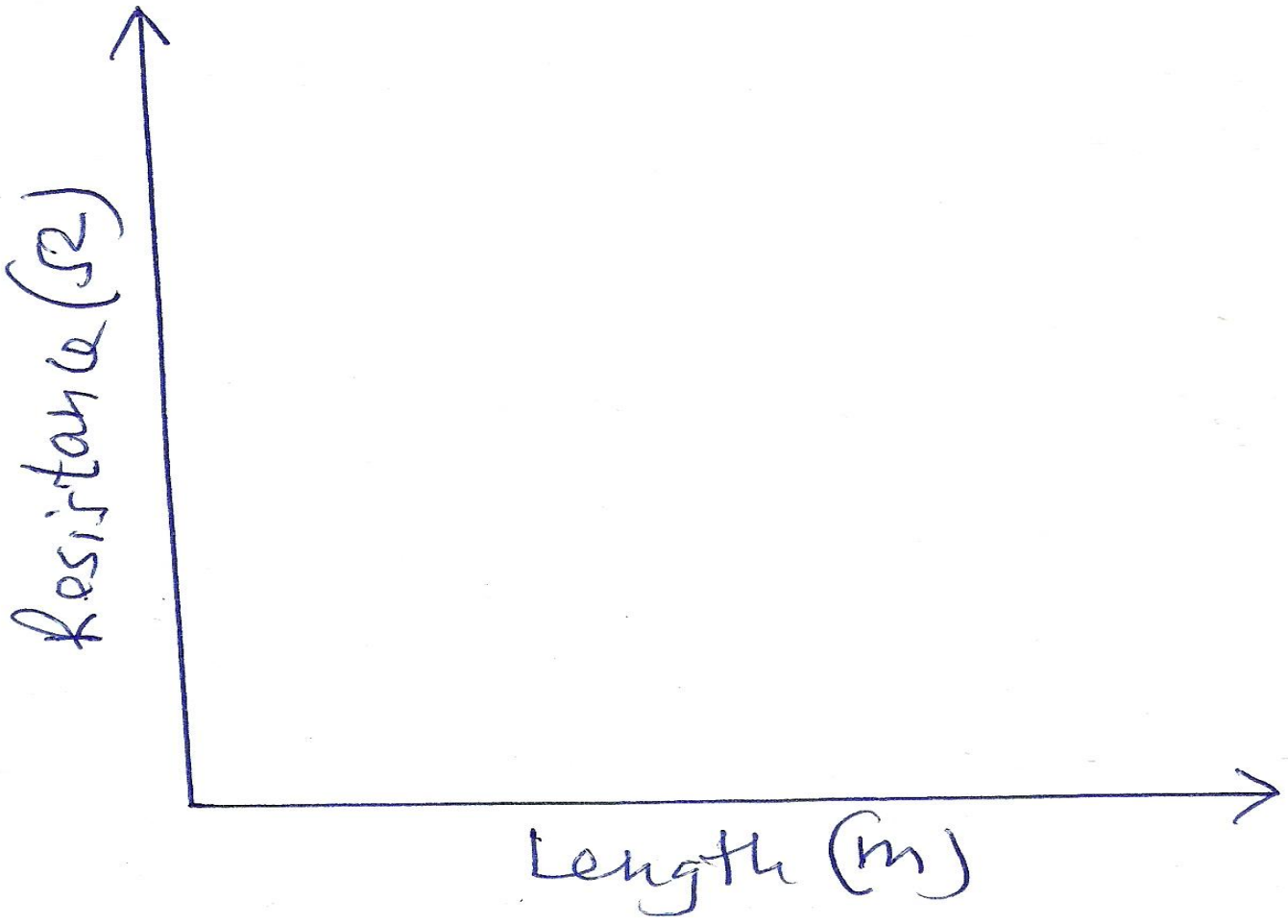
TABLE 7

U(CM)	12	16	20
V(CM)	5.0	4.5	4.0
$Y = \frac{UV}{U+V}$ (CM)	3.529	3.512	3.333

Continued……

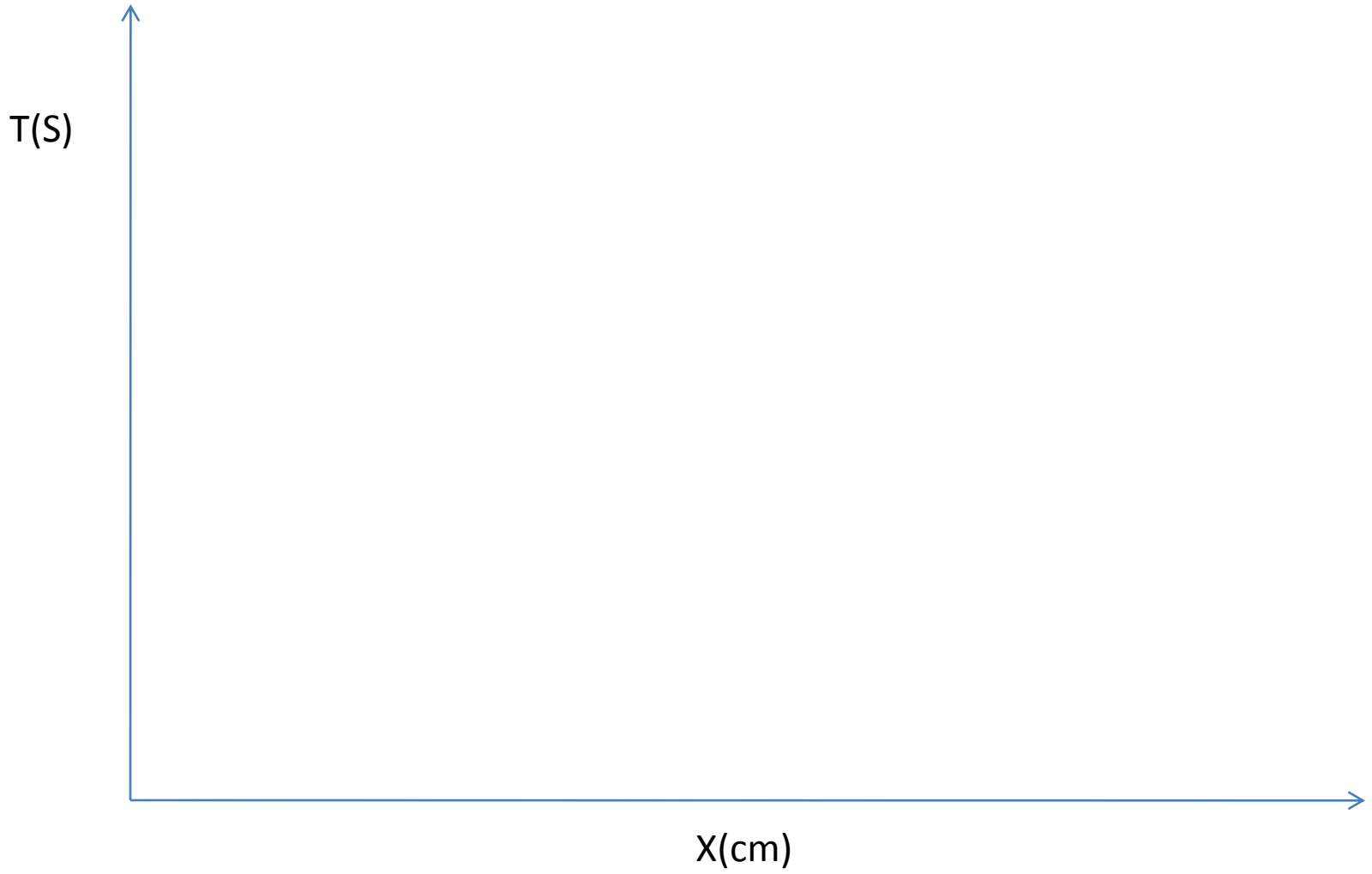
- **GRAPH**
- (1) Labeling of axes- indicate **quantity** and **unit** (except where there are no units)

Q1

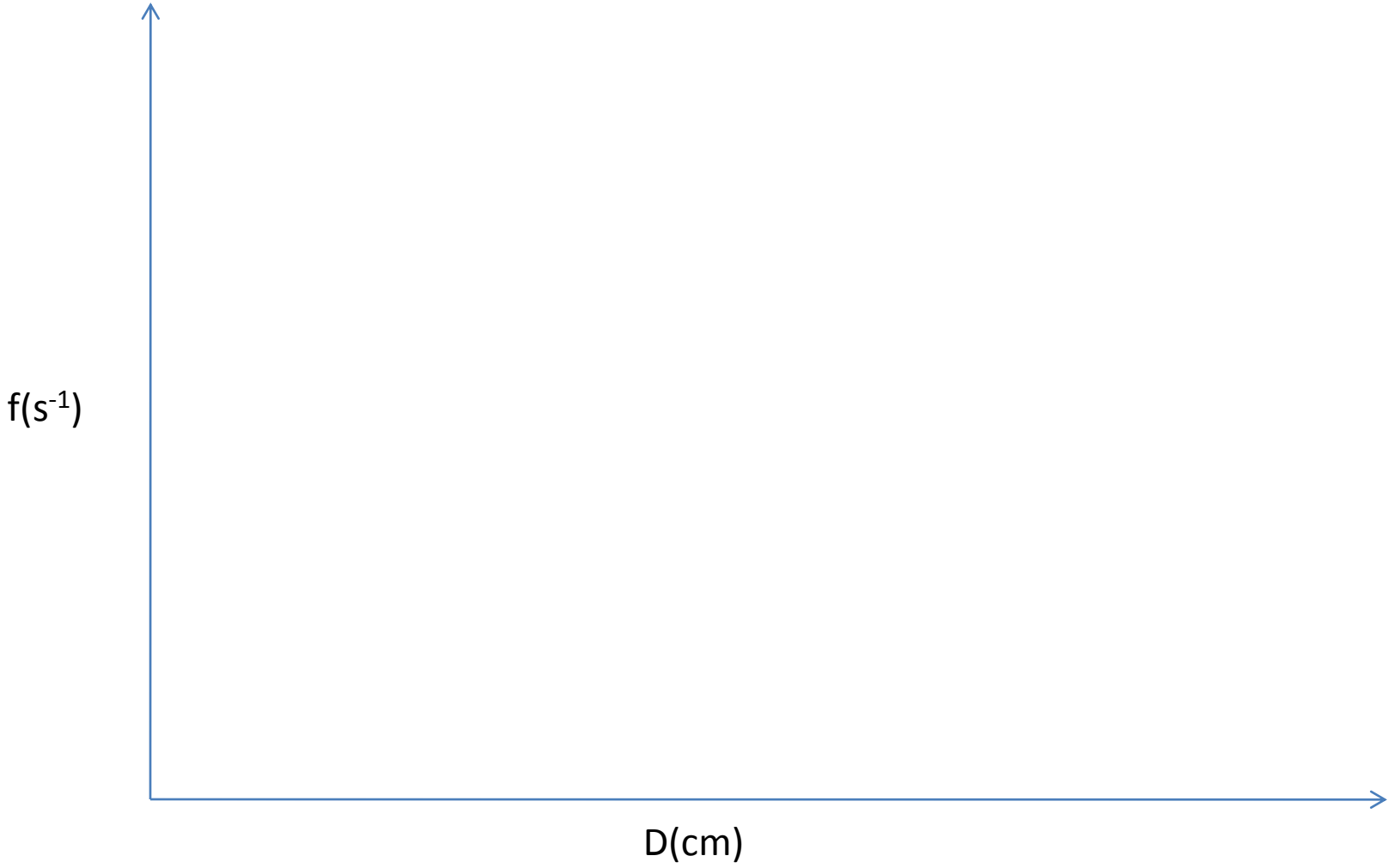


Q2. GRAPH OF $Log_{10}R_A$ AGAINST $LOg_{10}T$

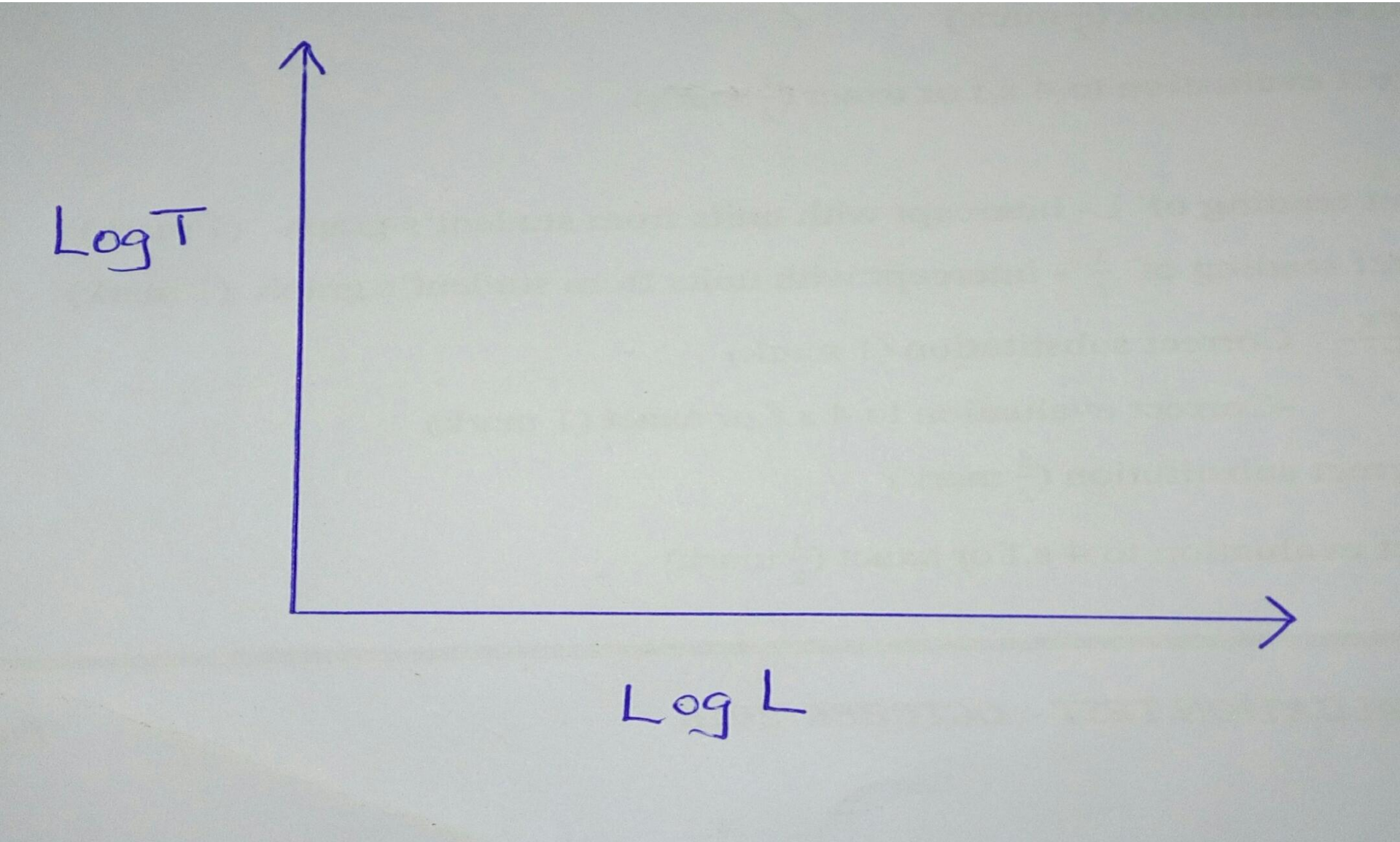
Q3. GRAPH OF T(S) AGAINST X(cm)



Q4. GRAPH OF $f(S^{-1})$ AGAINST D(cm)



Q5



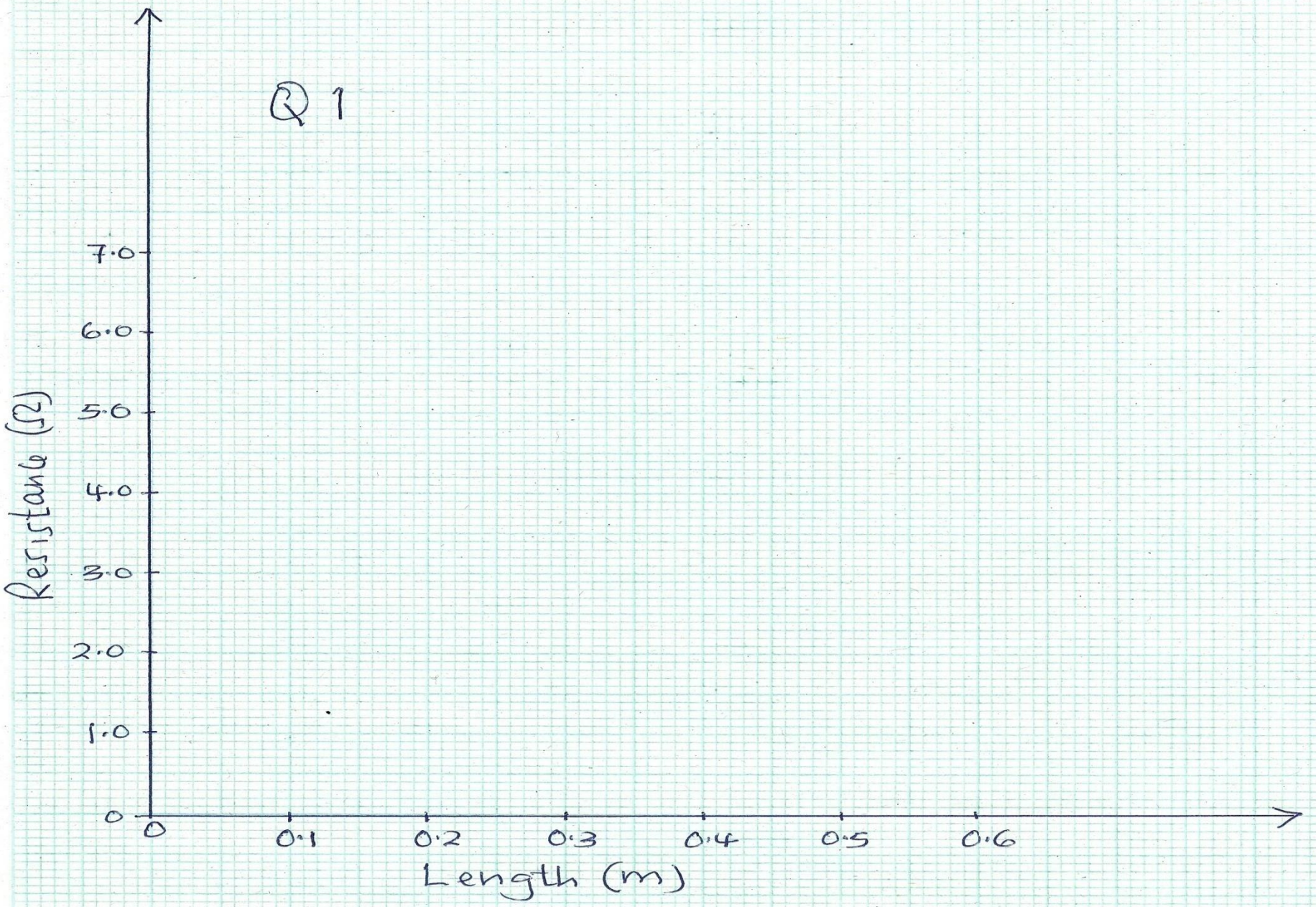
GRAPH Continued……

- (2) Scale should be **uniform, simple** and **accommodate** all values.
- **EXAMPLES OF SIMPLE SCALES**
- 0, 10, 20, 30……
- 0, 2.5, 5.0, 7.5, 10……
- 1.55, 1.60, 1.65, 1.70……..

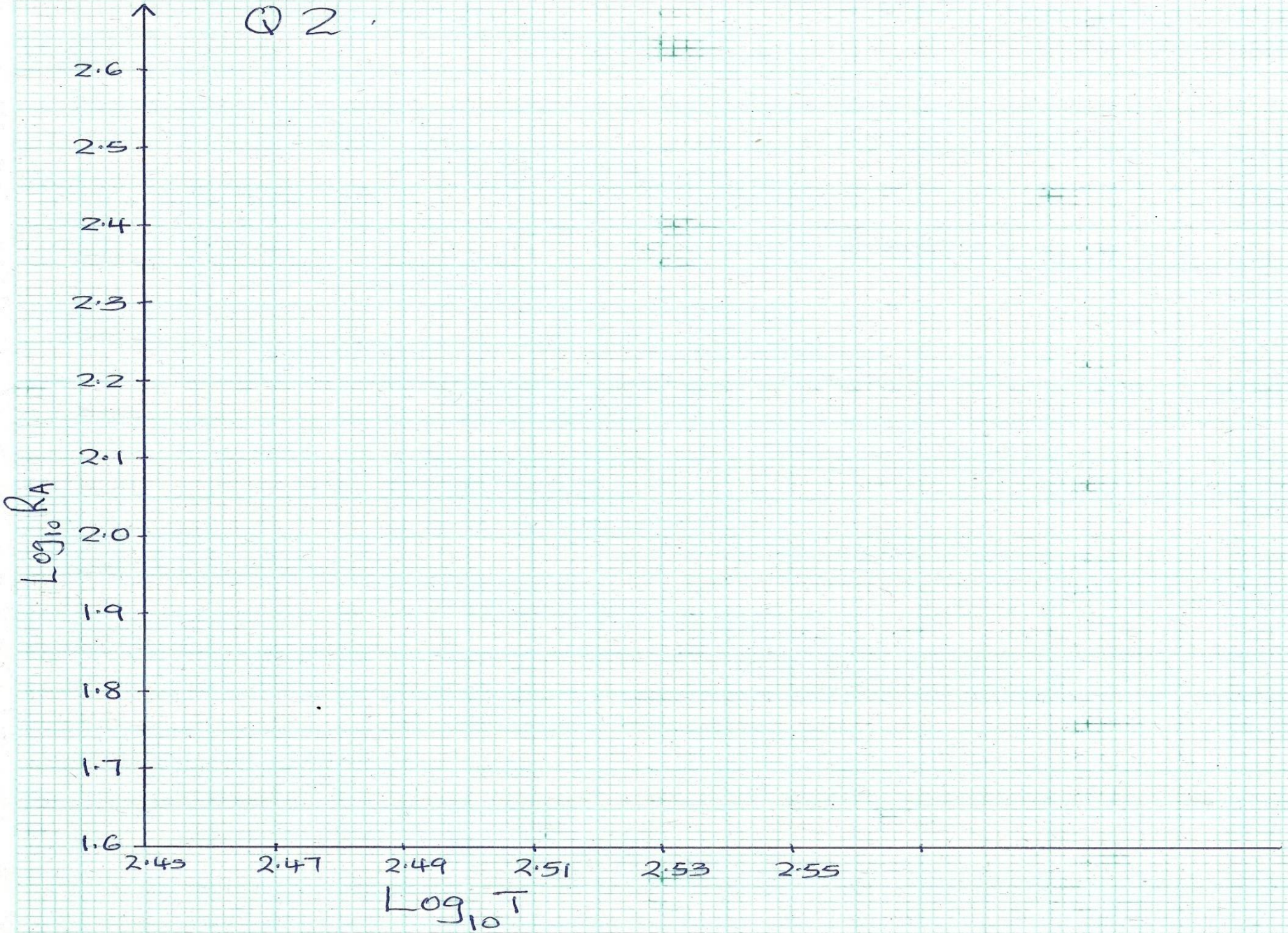
EXAMPLES OF COMPLEX SCALES

- 0, 3, 6, 9, 12, ……
- 0, 0.7, 1.4, 2.1, ……
- 50.0, 51.5, 53.0, 54.5, ……

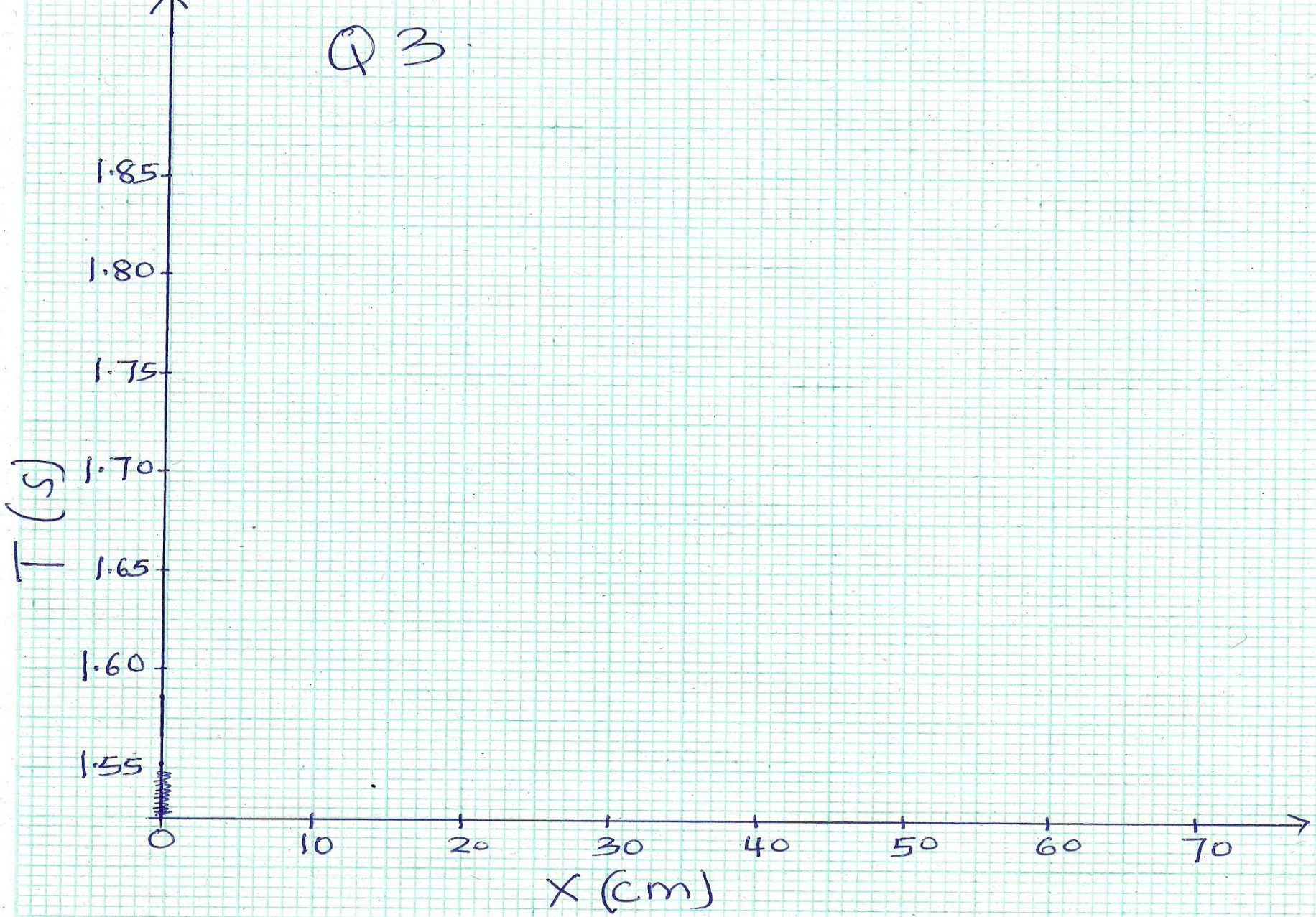
Q 1



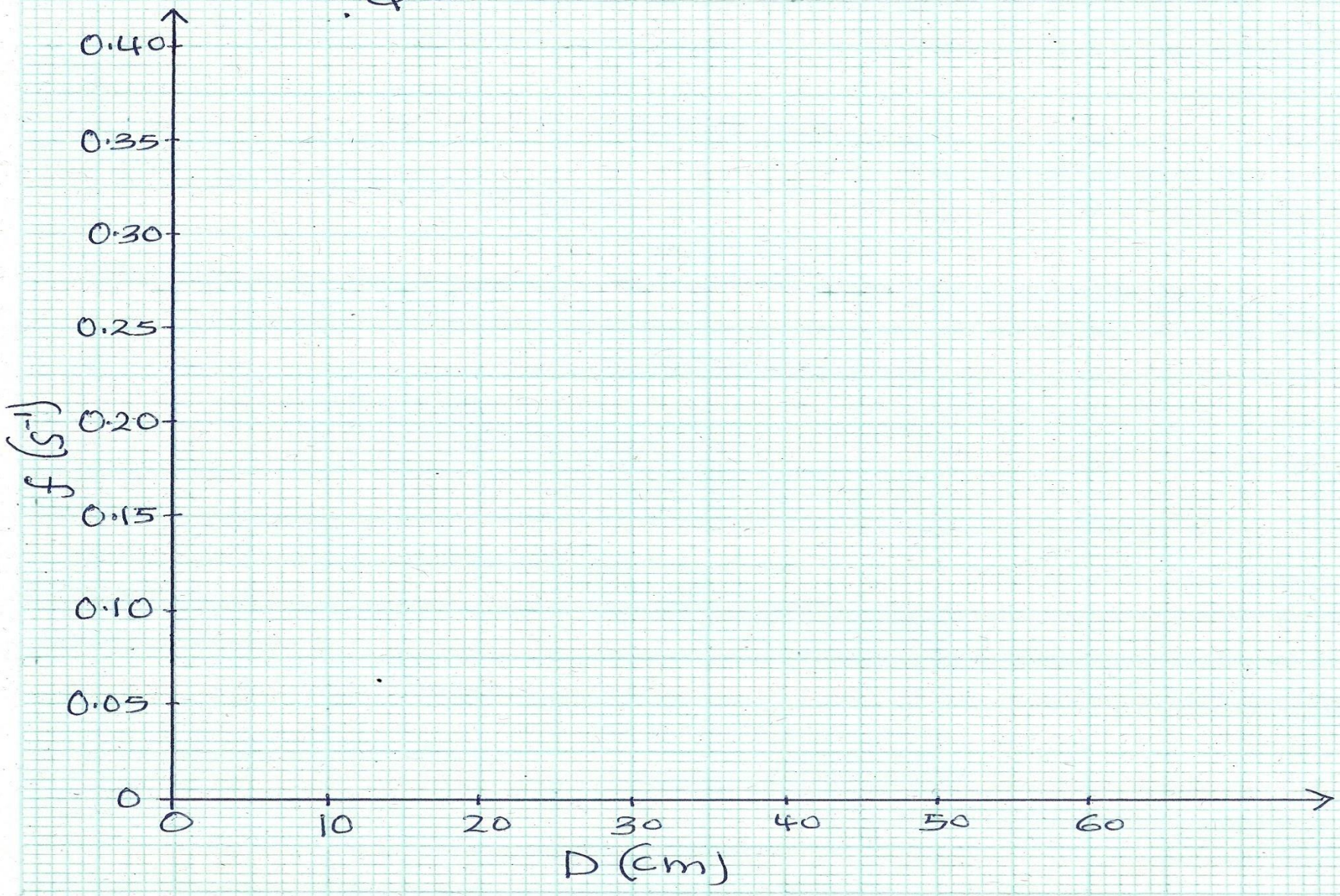
Q 2.


2·6
2·5
2·4
2·3
2·2
2·1
2·0
1·9
1·8
1·7
1·6
Log10 RA
2·45
2·47
2·49
2·51
2·53
2·55
Log10 T

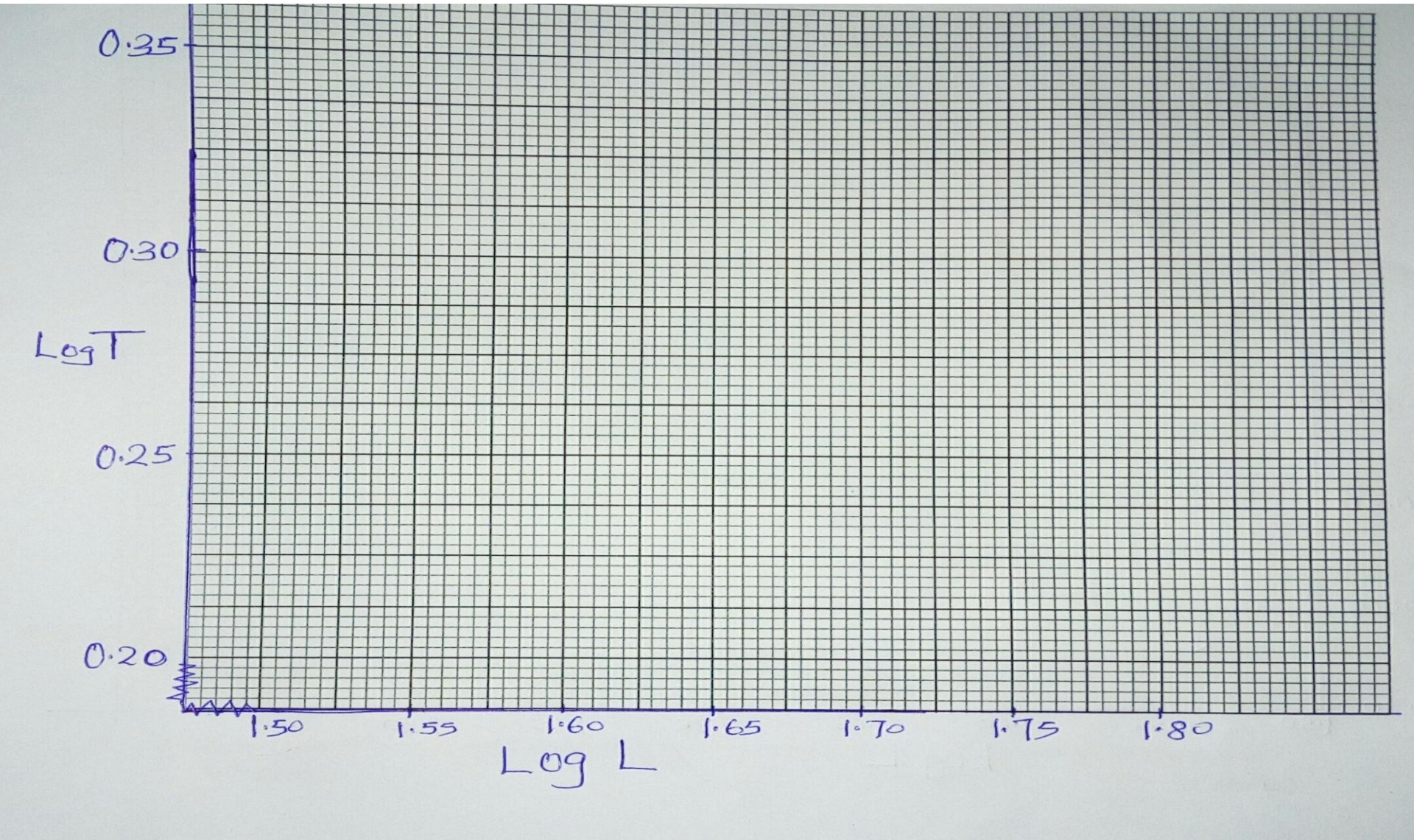
Q3.



Q 5



Q5



- 3) **Plotting**: Plot the exact values or if not possible round off to at least 2 d.p e.g. 4. 5 6 7≈ 4.5 7, 0.5432≈ 0.54

- 4) **Line** or **curve** should pass at least more than half of total table entries (The points must be correctly plotted)

DETERMINING WHETHER GRAPH IS A LINE OR CURVE

- **LINE**
- (i) Determine the slope of the graph.
- (ii) Given the equation of the graph which can be related to the general equation of a straight line $Y = M x + C$

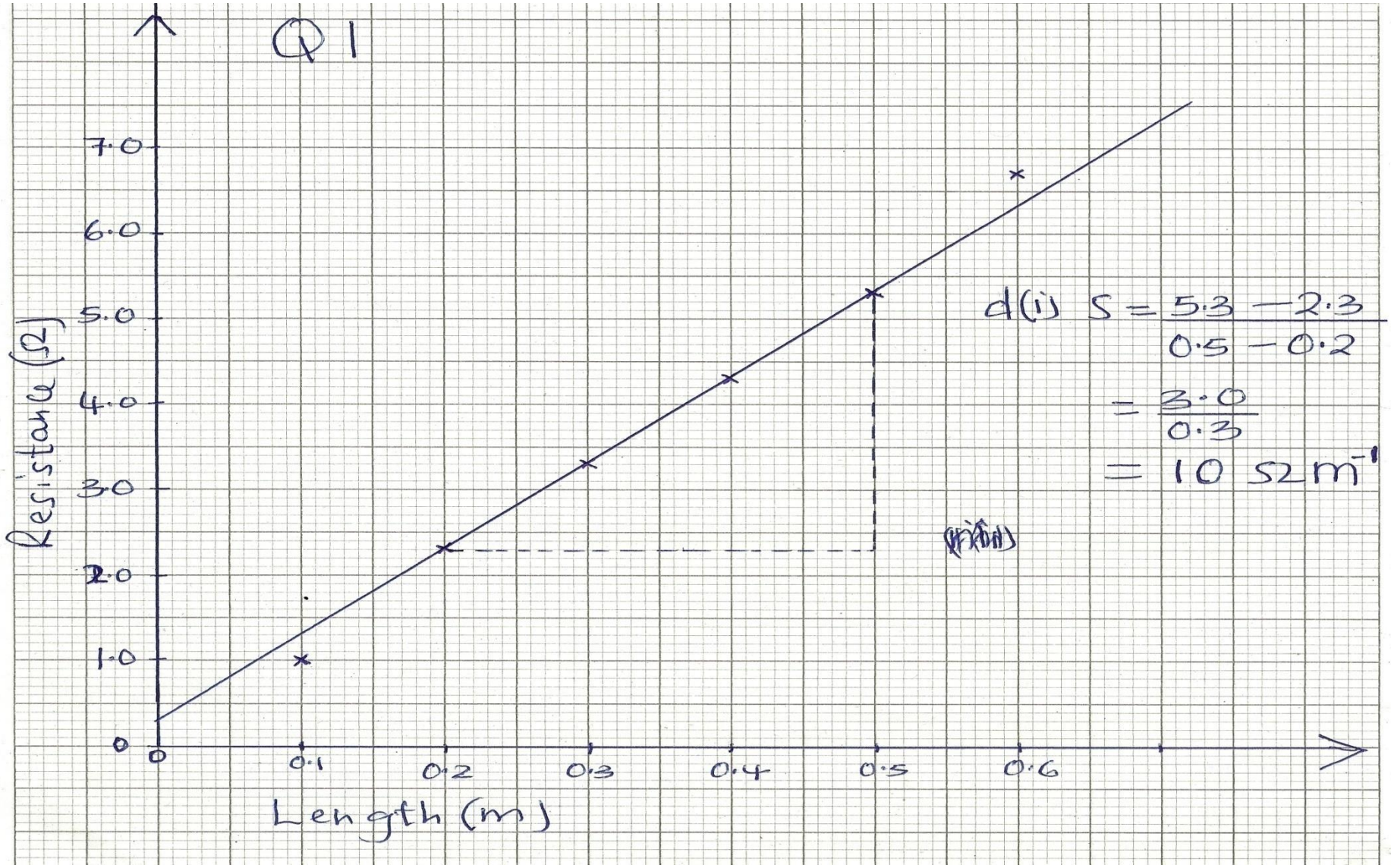
Continued……

- **CURVE**
- Determine the slope of the graph at a point.
- **CURVE/LINE**
- Determine the value of one quantity when given the other

ANALYSIS OF THE GRAPH

- (a) **Slope**: Pick the points that are on the line and evaluate to at least four significant figures or exact
- (b) **Y and X** - Intercepts should be read from the graph.
- (c) Determination of constants given the formulae; Ensure correct substitution and evaluation to at least 4 significant figures or exact

Q1



d(i) $S = \frac{5.3 - 2.3}{0.5 - 0.2}$

$= \frac{3.0}{0.3}$

$= 10\ \Omega m^{-1}$

Q1

d(ii) $S = \frac{4K}{\pi d^2}$

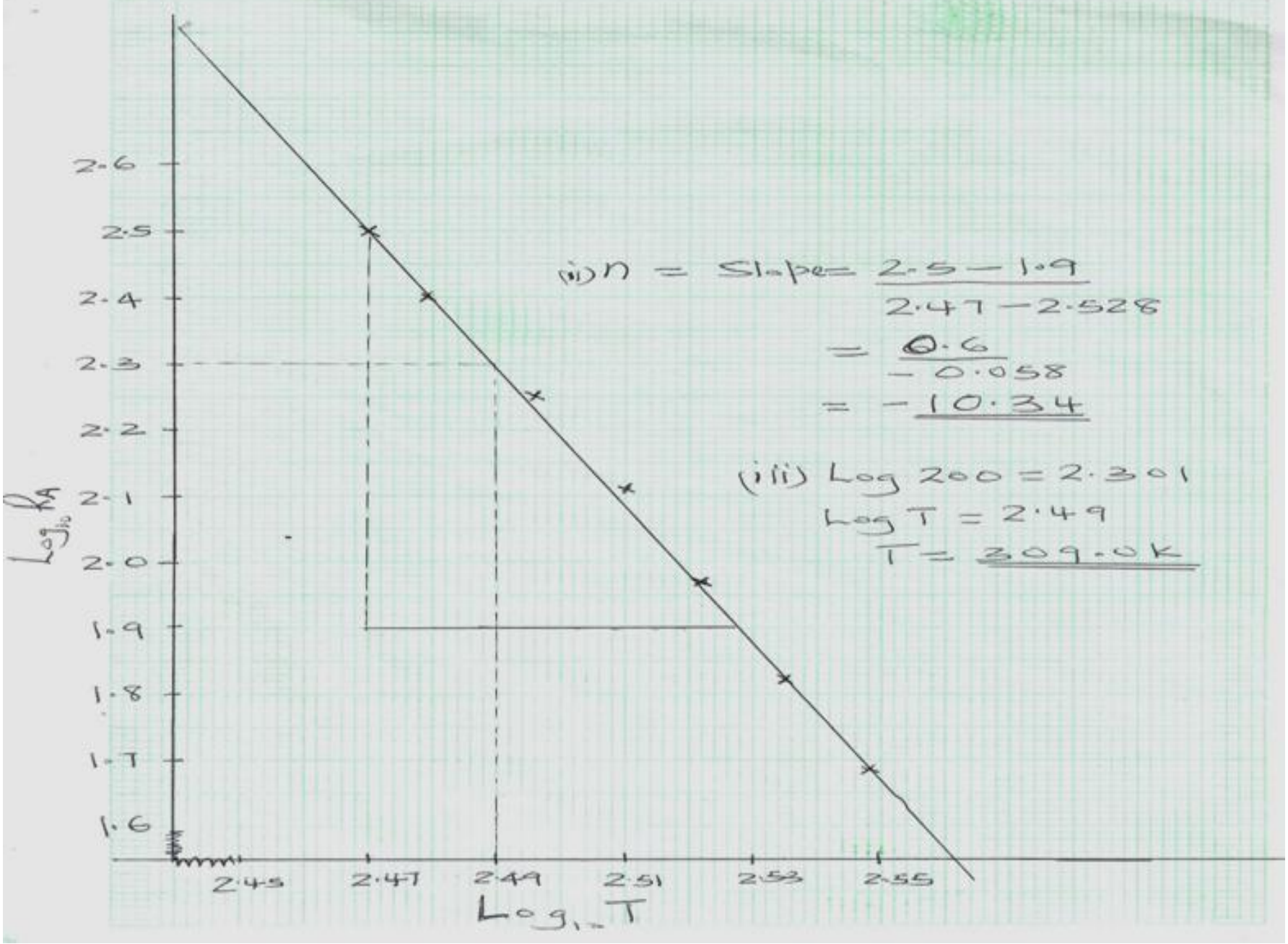
$10 = \frac{4K}{3.142 \times (0.00030)^2}$

$K = \underline{\underline{7.0695 \times 10^{-7}\ \Omega m}}$

(e) $t = \frac{E_0 - V_n}{I}$

$= \frac{3.10 - 2.00}{0.30}$

$= \underline{\underline{3.667\ \Omega}}$



(ii) n = Slope = $\frac{2.5 - 1.9}{2.47 - 2.528}$

$= \frac{0.6}{-0.058}$

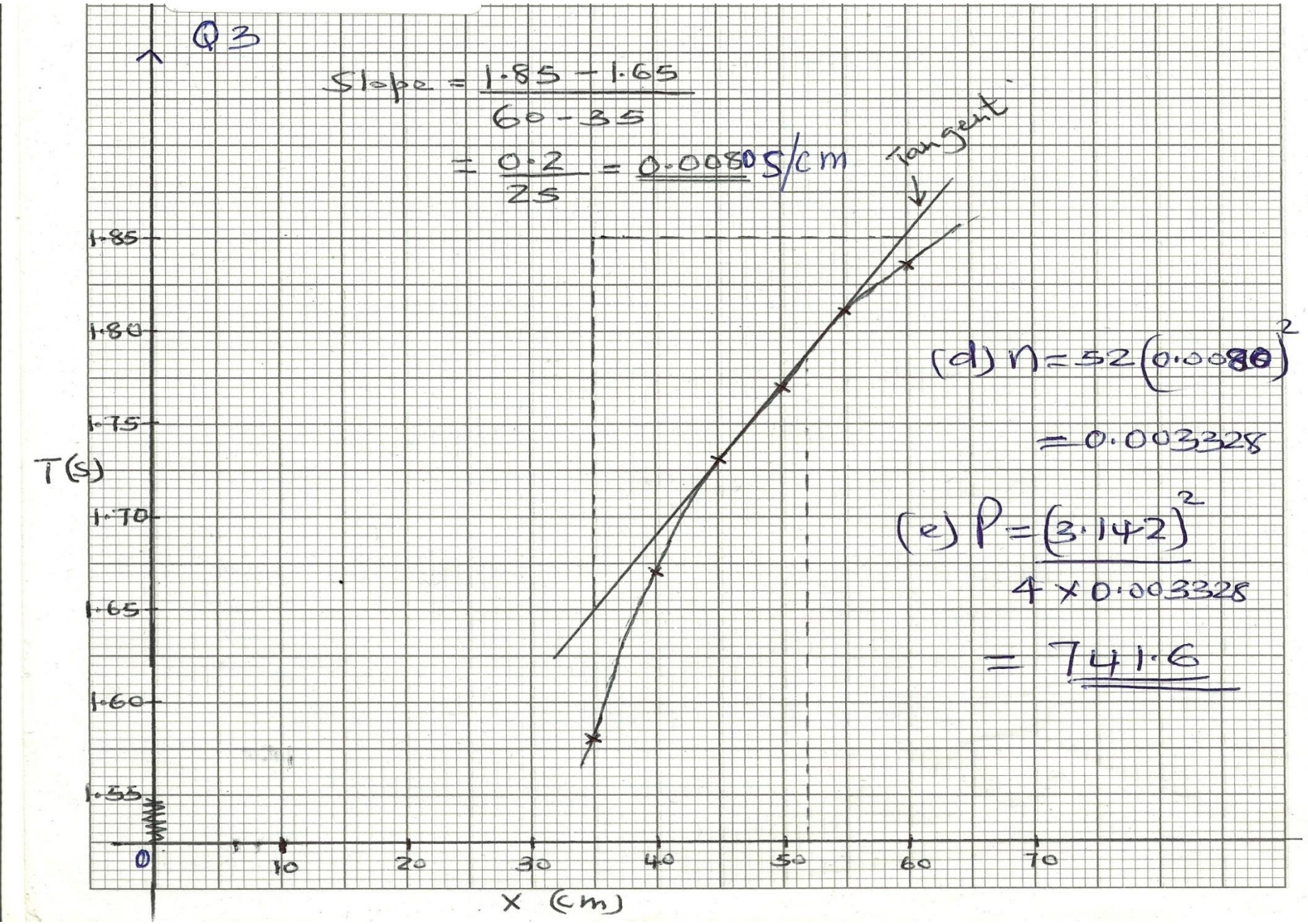
$= -10.34$

(iii) Log 200 = 2·301

Log T = 2·49

T = 309.0 K

Q3



$$\text{Slope} = \frac{1.85 - 1.65}{60 - 35}$$

$$= \frac{0.2}{25} = \underline{0.0080}\ \text{s/cm}$$

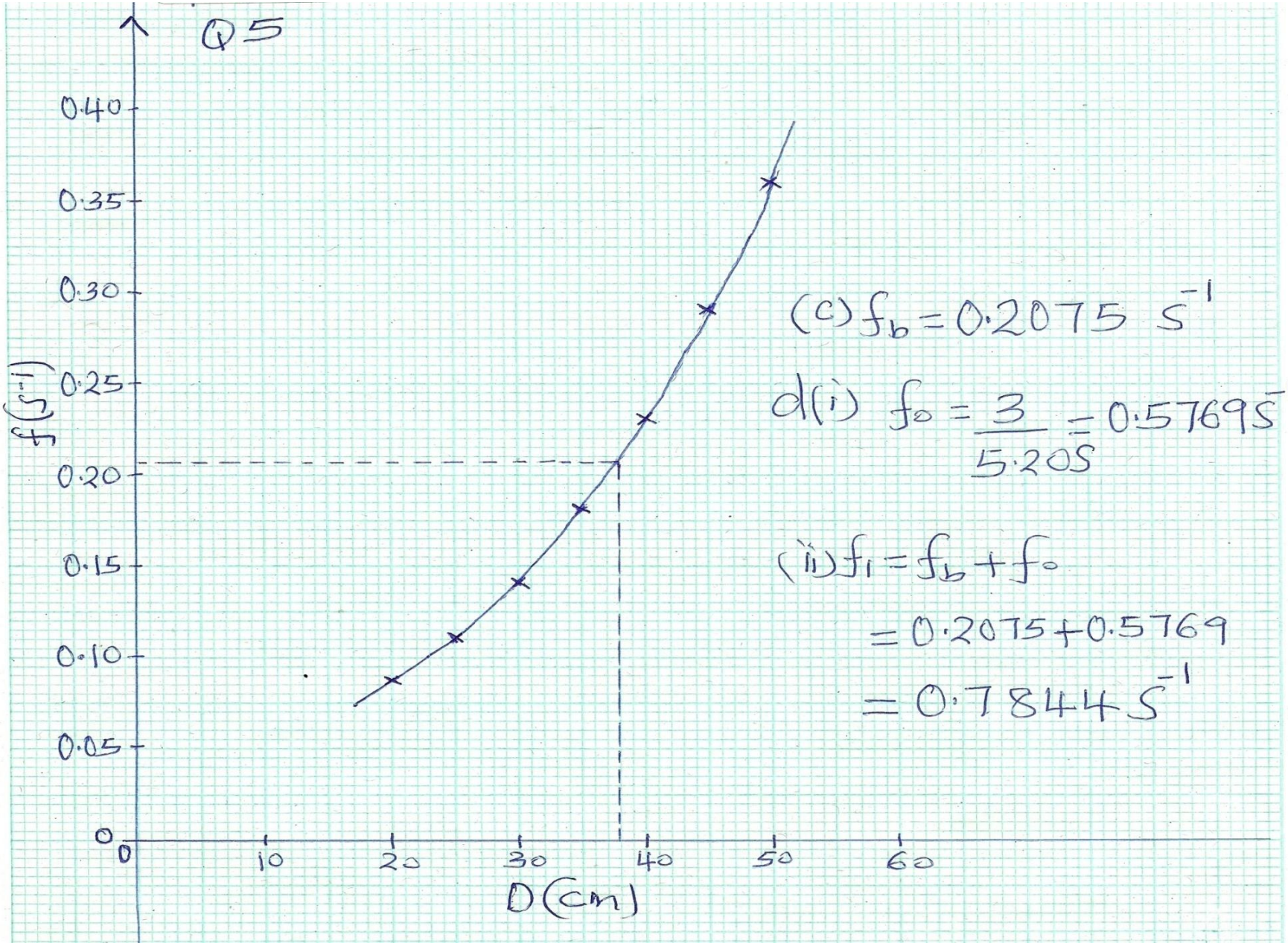
(d) $n = 52(0.0080)^2$

$= 0.003328$

(e) $P = \dfrac{(3.142)^2}{4 \times 0.003328}$

$= \underline{741.6}$

Q5



(c) $f_b = 0.2075\ s^{-1}$

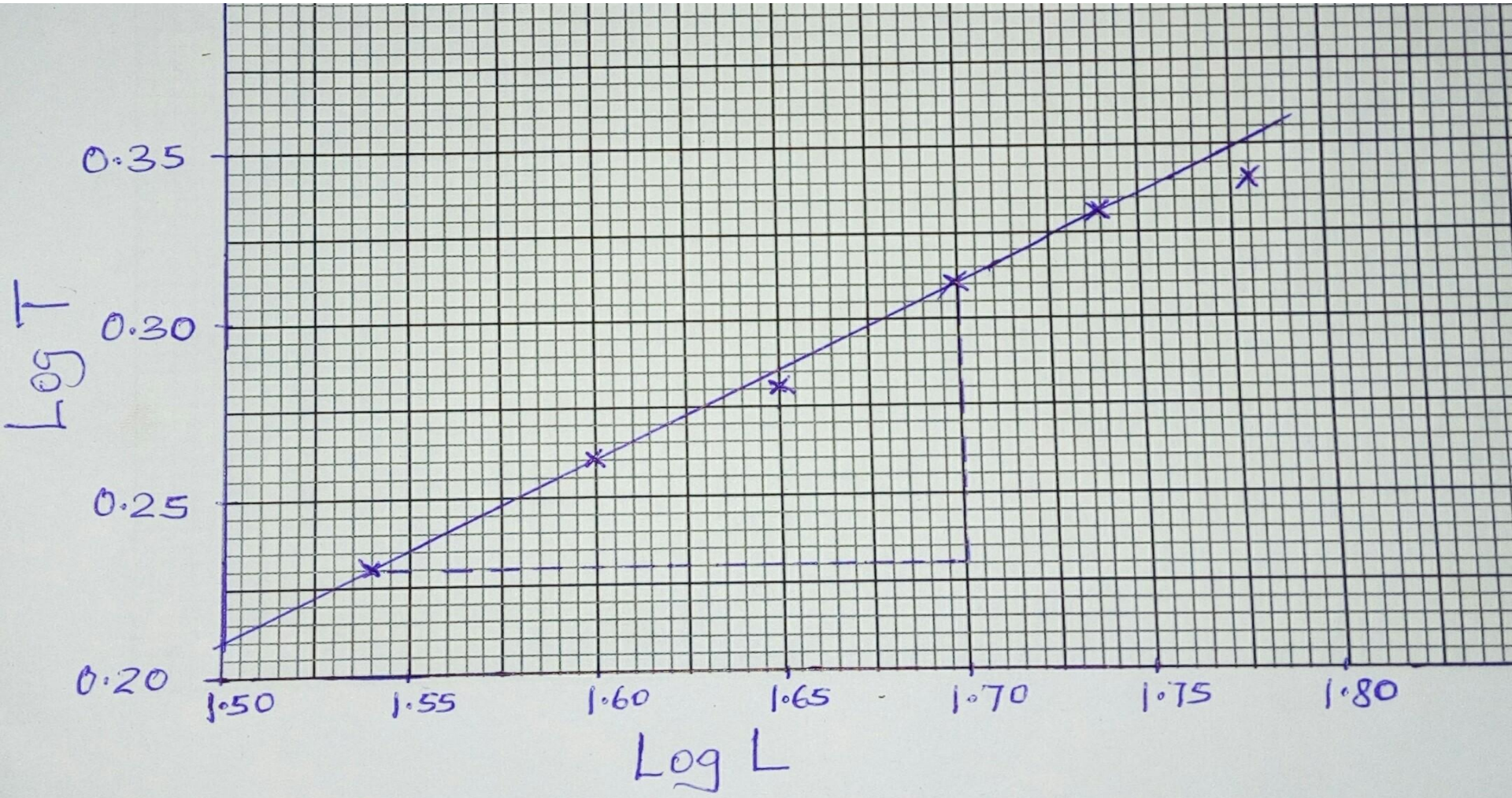
d(i) $f_o = \frac{3}{5.20s} = 0.5769 s^{-1}$

(ii) $f_1 = f_b + f_o$

$= 0.2075 + 0.5769$

$= 0.78445^{-1}$

Q5



(c) $$S = \frac{0.31 - 0.23}{1.70 - 1.54}$$

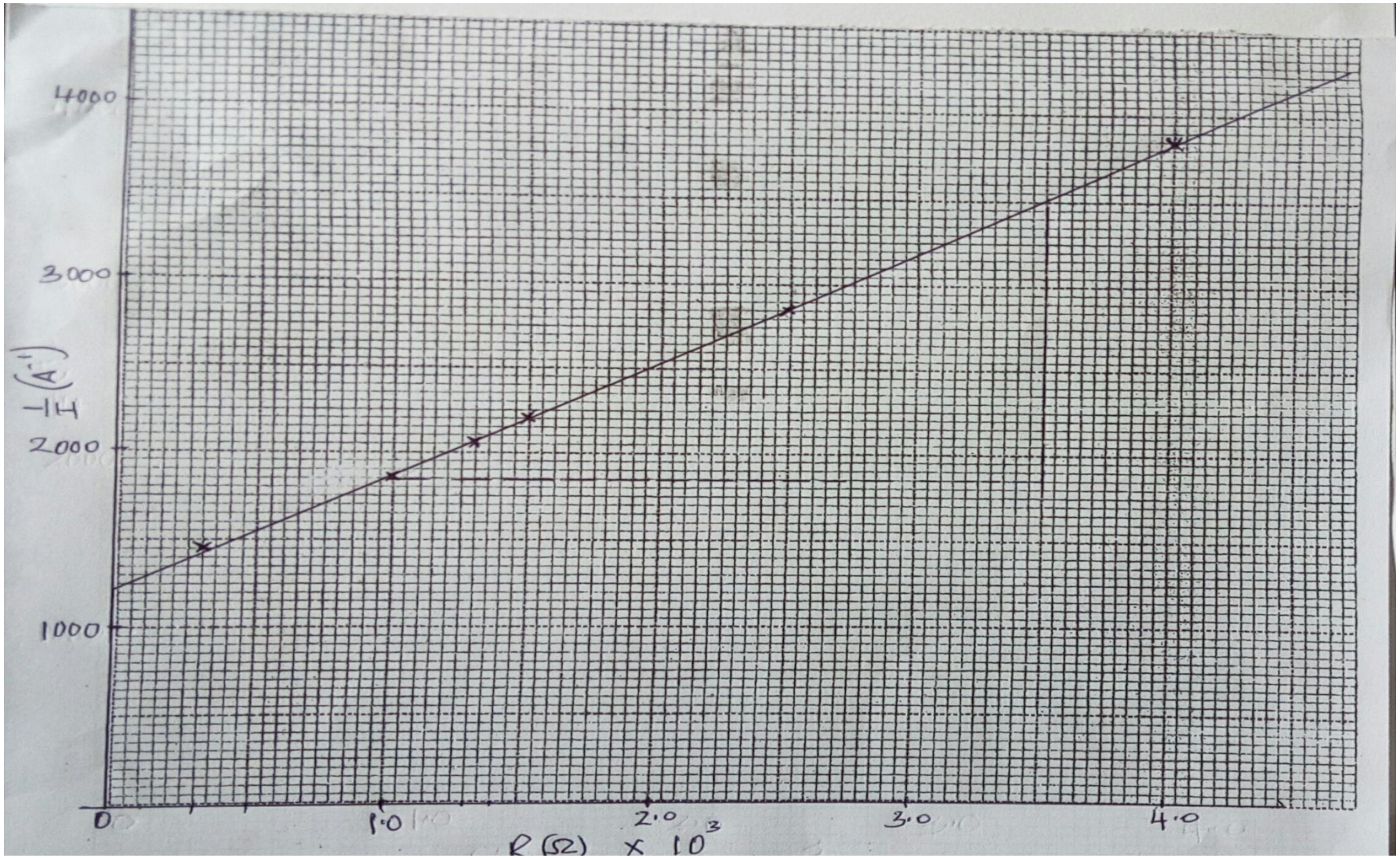
$$= \frac{0.08}{0.16}$$

$$= 0.5$$

(d) $$t = K N L^S D^r$$

$$T = \frac{t}{N} = K L^S D^r$$

Q1 2017



C (i) $S = \frac{3500 - 1850}{(3.5 - 1.0) \times 10^3}$

$= \frac{1650}{2500}$

$= \underline{0.66\ A^{-1}\Omega^{-1}}$

(ii) (I) $\frac{1}{I} = \frac{R}{E} + \frac{R_1}{E}$

$\frac{1}{E} = \text{slope}$

$E = \frac{1}{0.66} = \underline{1.515\ V}$

(II) $\frac{R_1}{E} = \text{Y-intercept}$

$R_1 = 1250 \times 1.515$

$= \underline{1893.75\ \Omega}$

PART B

h(i)

u (cm)	12	16	20
v (cm)	5.0	4.5	4.0
$Y = \frac{uv}{u+v}$ (cm)	3.529	3.512	3.333

(ii) $m = \frac{3.529 + 3.512 + 3.333}{3}$

$= \underline{3.458 \text{ cm}}$

(iii) $p = \frac{5}{\sqrt{h}} = \frac{5}{\sqrt{5.0}} = 2.236$

(iv) $f = \frac{p}{2m} + 1 = \frac{2.236}{2 \times 3.458} + 1$

$= 0.3233 + 1$

$= 1.3233$

$\simeq \underline{1.3}$

Thank you!