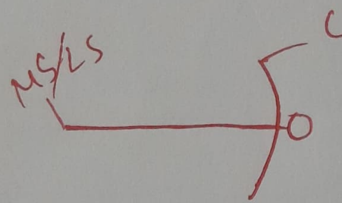
Group - 2
Section - 11

10

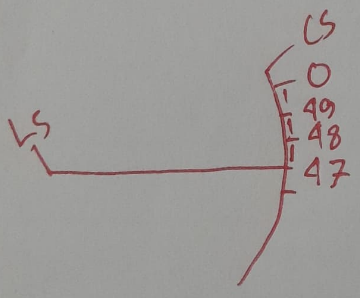
Lab Report

Name of the Experiment	: Introduction to Measurement and Statistical Error
Your Name	: Joy kumar Ghosh
Your ID #	: 2211424642
Name of the Lab Partner	: Sazid Hasan - 2211513642 ; Sazzad Ul Islam - 2031736642
Date	: 15 October, 2022

Instructor's comments:



error = 0

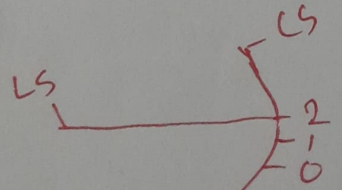


+ (3×LC)

LC = .001 cm

+ (3×.001)

+ .003



− (2×LC)

− (2×.001)

− .002

Table 1: Ruler measurements

Data No.	Length, L (cm)	Radius, R (cm)	$\bar{L}$ (cm)	$\bar{R}$ (cm)
1	3·7	0·3	3·7	0·3
2	3·8	0·3		
3	3·7	0·3		
4	3·7	0·3		
5	3·7	0·3		
6	3·7	0·3		

$\frac{L}{R}$?

Table 2: Finding Length using Vernier Scale

Vernier constant: 0·005 cm

Data No.	Main Scale reading (cm)	Vernier scale division, d	Length (cm)	$\bar{L}$ (cm)	$(\bar{L}-L_i)^2$	σ_L (cm)
1	3·800	1	3·805	3·841	$1{\cdot}296\times10^{-3}$	~~$9{\cdot}771\times10^{-3}$~~ $4{\cdot}421\times10^{-2}$
2	3·800	2	3·810		$9{\cdot}610\times10^{-4}$	
3	3·800	4	3·820		$4{\cdot}410\times10^{-4}$	
4	3·800	3	3·815		$6{\cdot}760\times10^{-4}$	
5	3·800	20	3·900		$3{\cdot}481\times10^{-3}$	
6	3·800	19	3·895		$2{\cdot}916\times10^{-3}$	

For table-1 :

$$\bar{L} = \frac{3.7 + 3.8 + 3.7 + 3.7 + 3.7 + 3.7}{6} \text{ cm}$$

$$= 3.7 \text{ cm}$$

$$\bar{R} = \frac{0.3 + 0.3 + 0.3 + 0.3 + 0.3 + 0.3}{6} \text{ cm}$$

$$= 0.3 \text{ cm}$$

For table-2 :

$$V.C. = \frac{0.1}{20} = 0.005 \text{ cm}$$

$$L_1 = (3.8 + 1 \times 0.005)\text{cm} = 3.805 \text{ cm}$$

$$\bar{L} = \frac{3.805 + 3.810 + 3.820 + 3.815 + 3.900 + 3.895}{6} \text{ cm}$$

$$= 3.841 \text{ cm}$$

$$\sigma_L = \sqrt{\frac{\Sigma (L_i - \bar{L})^2}{N-1}}$$

$$= \sqrt{\frac{1.296 \times 10^{-3} + 9.61 \times 10^{-4} + 4.410 \times 10^{-4} + 6.760 \times 10^{-4} + 3.481 \times 10^{-3} + 2.916 \times 10^{-3}}{6-1}} \text{ cm}$$

$$= \sqrt{\frac{9.771 \times 10^{-3}}{5}} \text{ cm}$$

$$= 4.421 \times 10^{-2} \text{ cm}$$

Table-3: Data for the radius of the cylinder

Least count, LC= 0·001 cm

Instrumental error (if any) = +0·001 cm

Data	Linear scale reading, x (cm)	Circular scale reading, $y = d \times L_c$ (cm)	Diameter $x + y$ (cm)	Instrumental error (cm)	Corrected diameter, D (cm)	Radius, $r = \frac{D}{2}$ (cm)	Mean radius, (cm)	$(r - r_i)^2$ (cm^2)	σ_r (cm)
1	0·6000	~~50~~ × L 0·0500	0·6500		0·6510	0·3255		2.5×10^{-7}	
2	0·6000	~~49~~ ·0490	0·6490		0·6500	0·3250		0	
3	0·6000	~~48~~ 0·0480	0·6480	+0·001	0·6490	0·3245	0·3250	2.5×10^{-7}	~~2.0×10^{-7}~~
4	0·6000	~~48~~ ·0480	0·6480		0·6490	0·3245		2.5×10^{-7}	4.472×10^{-4}
5	0·6000	~~50~~ ·0500	0·6500		0·6510	0·3255		2.5×10^{-7}	
6	0·6000	~~49~~ ·0490	0·6490		0·6500	0·3250		0	

For table-3

$$L.C. = \frac{0.05 \text{ cm}}{50} = 0.001 \text{ cm}$$

Corrected Diameter, $D_1 = (0.6 + (50 \times 0.001) + 0.001)$ cm

$= (0.6 + 0.05 + 0.001)$ cm

$= 0.6510$ cm

Mean radius, $\bar{r} = \dfrac{0.3255 + 0.3250 + 0.3245 + 0.3245 + 0.3255 + 0.3250}{6}$ cm

$= \dfrac{1.9500}{6}$ cm

$= 0.3250$ cm

Standard deviation,

$$\sigma_r = \sqrt{\frac{\Sigma (r_i - \bar{r})^2}{N-1}}$$

$$= \sqrt{\frac{2.5\times10^{-7} + 0 + 2.5\times10^{-7} + 2.5\times10^{-7} + 2.5\times10^{-7} + 0}{6-1}} \text{ cm}$$

$$= \sqrt{\frac{1\times10^{-6}}{5}} \text{ cm}$$

$$= \sqrt{2\times10^{-7}} \text{ cm}$$

$$= 4.472\times10^{-4} \text{ cm}$$

Calculation for Volume and its error:

Volume of a cylinder = $\pi r^2 l$

1. Using the ordinary ruler: Volume of the cylindrical rod, $V1$ =

$V_1 = \pi \bar{r}^2 \bar{l}$

$= \pi \cdot (0.3)^2 \cdot (3.7) = 1.046 \ cm^3$

Here,
$r = \bar{R} = 0.3$ cm
$l = \bar{l} = 3.7$ cm
} from table-1

2. Using the Vernier scale and screw gauge: Volume of the cylinder, $V2$ =

$V_2 = \pi \bar{r}^2 \bar{l}$

$= \pi \cdot (0.3250)^2 \cdot (3.841) = 1.275 \ cm^3$

Here,
$r = \bar{r} = 0.3250$ cm [from table-3]
$l = \bar{l} = 3.841$ cm [from table-2]

3. Error in volume calculation from Vernier ruler and screw gauge measurement (use **propagation of error**, equations 6.7).

$$\sigma_V = |V_2| \times \sqrt{2\times\left(\frac{\sigma_r}{\bar{r}}\right)^2 + \left(\frac{\sigma_l}{\bar{l}}\right)^2} = 1.275 \times \sqrt{2\times\left(\frac{4.472\times10^{-4}}{0.3250}\right)^2 + \left(\frac{4.421\times10^{-2}}{3.841}\right)^2} \ cm$$

$$= \cancel{0.0149} \text{ or } 1.488\times10^{-2} \ cm$$

4. Final result, $V2 \pm \sigma_V$ = $1.275 \pm 1.488\times10^{-2}$

$V_2 + \sigma_V = 1.275 + 1.488\times10^{-2} = 1.290 \ cm^3$

$V_2 - \sigma_V = 1.275 - 1.488\times10^{-2} = 1.260 \ cm^3$

interval is $[1.260, 1.290] \ cm^3$

Questions:

1. How many of the length readings lie in the interval $L_{av} \pm \sigma_L$?

$L_{av} = 3.841$ cm

$\sigma_L = 4.421 \times 10^{-2}$ cm

$L_{av} \pm \sigma_L = (3.841 \pm 4.421 \times 10^{-2})$ cm

$L_{av} + \sigma_L = 3.841 + 4.421 \times 10^{-2} = 3.885$

$L_{av} - \sigma_L = 3.841 - 4.421 \times 10^{-2} = 3.797$

interval : [3.797, 3.885]

There are 4 readings in this interval. They are 3.805 cm, 3.810 cm, 3.820 cm, 3.815 cm

2. What fraction of the 6 readings is this?

fraction = $\frac{4}{6} = \frac{2}{3}$

3. How does the percentage compare with 68.3 %?

Percentage = $\frac{2}{3} \times 100\% = 66.67\%$

1.63% less than 68.3%.

4. Which is a more precise measuring tool: ruler or Vernier caliper? Why?

Vernier calliper is a more precise measuring tool than a ruler because of its measurement accuracy. While a standard ruler may only be able to read measurements up to 0.1 cm, a vernier calliper can measure as precisely as 0.005 cm. Using a vernier calliper, we can measure both outer and inner dimentions and depth with only a tiny margin on error. For its accuracy the vernier calliper is the best option for measuring a small length.

Group-2
Section-11

10

Lab Report

Name of the Experiment	: Bouncing Ball Experiment
Your Name	: Joy kumar Ghosh
Your ID #	: 2211424 6 42
Name of the Lab Partner	: Sazid Hasan - 2211513642; Md. Sazzad Ul Islam - 2031736642
Date	: 22 October, 2022

Instructor's comments:

Table A

Drop Height, H_1 (m)		First Bounce height (m)					Mean bounce height, H_2 (m)	Ratio of heights, H_1/H_2
		Trail 1	Trail 2	Trail 3	Trail 4	Trail 5		
Tennis	1.0	0·58	0·60	0·63	0·57	0·62	0·60	1·67
Golf	1.0	0·77	0·75	0·79	0·76	0·77	0·77	1·30
Table Tennis	1.0	0·69	0·70	0·68	0·71	0·71	0·70	1·43

Mass of the Tennis ball = 0·0570 kg

Mass of the Golf ball = 0·0438 kg

Mass of the Table Tennis ball = 0·0028 kg

Table B

Ball	PE_1 (J)	v_1 (m/s)	KE_1 (J)	$E_1 = PE_1 + KE_1$ (J)	PE_2 (J)	v_2 (m/s)	KE_2 (J)	$E_2 = PE_2 + KE_2$ (J)	Lost energy (J)	% Energy loss
Tennis	0·559	4·427	0·559	1·118	0·335	3·429	0·335	0·67	0·448	40·072%
Golf	0·429	4·427	0·429	0·858	0·331	3·885	0·331	0·662	0·196	22·844%
Table Tennis	0·027	4·427	0·027	0·054	0·019	3·704	0·019	0·038	0·016	829·630%

For table tennis,

$PE_1 = mgH_1 = 0.0028 \times 9.8 \times 1 = 0.027\,J$

$v_1 = \sqrt{2gH_1} = \sqrt{2 \times 9.8 \times 1} = 4.427\,ms^{-1}$

$KE_1 = \frac{1}{2}mv_1^2 = \frac{1}{2} \times 0.0028 \times 4.427^2 = 0.027\,J$

$E_1 = PE_1 + PE_2 = 0.027 + 0.027 = 0.054\,J$

$PE_2 = mgH_2 = 0.0028 \times 9.8 \times .7 = 0.019\,j$

$V_2 = \sqrt{2gH_2} = \sqrt{2 \times 9.8 \times .7} = 3.704\,ms^{-1}$

$KE_2 = \frac{1}{2}mv_2^2 = \frac{1}{2} \times 0.0028 \times 3.704^2 = 0.019\,J$

$E_2 = PE_2 + KE_2 = 0.038$

Lost Energy $= E_1 - E_2 = 0.054 - 0.038 = 0.016\,j$

% Energy loss $= \frac{E_1 - E_2}{E_1} \times 100\% = \frac{0.016}{0.054} \times 100\% = 29.630\%$

Table C

Drop Height, H_1 (m)		First Bounce height (m)					Mean bounce height, H_2 (m)	Standard deviation, σ_{H2} (m)
		Trail 1	Trail 2	Trail 3	Trail 4	Trail 5		
Golf ball	1.0	0.77	0.76	0.77	0.79	0.75	0.77	13.27×10^{-3}
	0.9	0.72	0.70	0.71	0.72	0.71	0.71	7.48×10^{-3}
	0.8	0.61	0.63	0.62	0.60	0.63	0.62	11.66×10^{-3}
	0.7	0.55	0.56	0.55	0.54	0.56	0.55	7.48×10^{-3}
	0.6	0.48	0.49	0.47	0.48	0.47	0.48	7.48×10^{-3}

You have already learned how to calculate standard deviation, σ (see Experiment 1). The standard deviation of a distribution of measurements is defined as follows:

$$\sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(H_i - \bar{H})^2} \text{ Where } \bar{H} = \frac{\sum_{i=1}^{N} H_i}{N}$$

You can easily do it by using your scientific calculator in STAT mode.

Slope^{-1} coefficient of bouncing for table golf ball = 1.30

Interpolated bounce height for example at 0.85 m = 0.665m

Extrapolated bounce height for example at 1.10m = 0.860m

Mean bounce height, $H_2 = \frac{.77 + .76 + .77 + .79 + .75}{5} = .77m$

Standard deviation, $\sigma_{H_2} = \sqrt{\frac{(.77-.77)^2 + (.77-.76)^2 + (.77-.77)^2 + (.77-.79)^2 + (.77-.75)^2}{5-1}}$

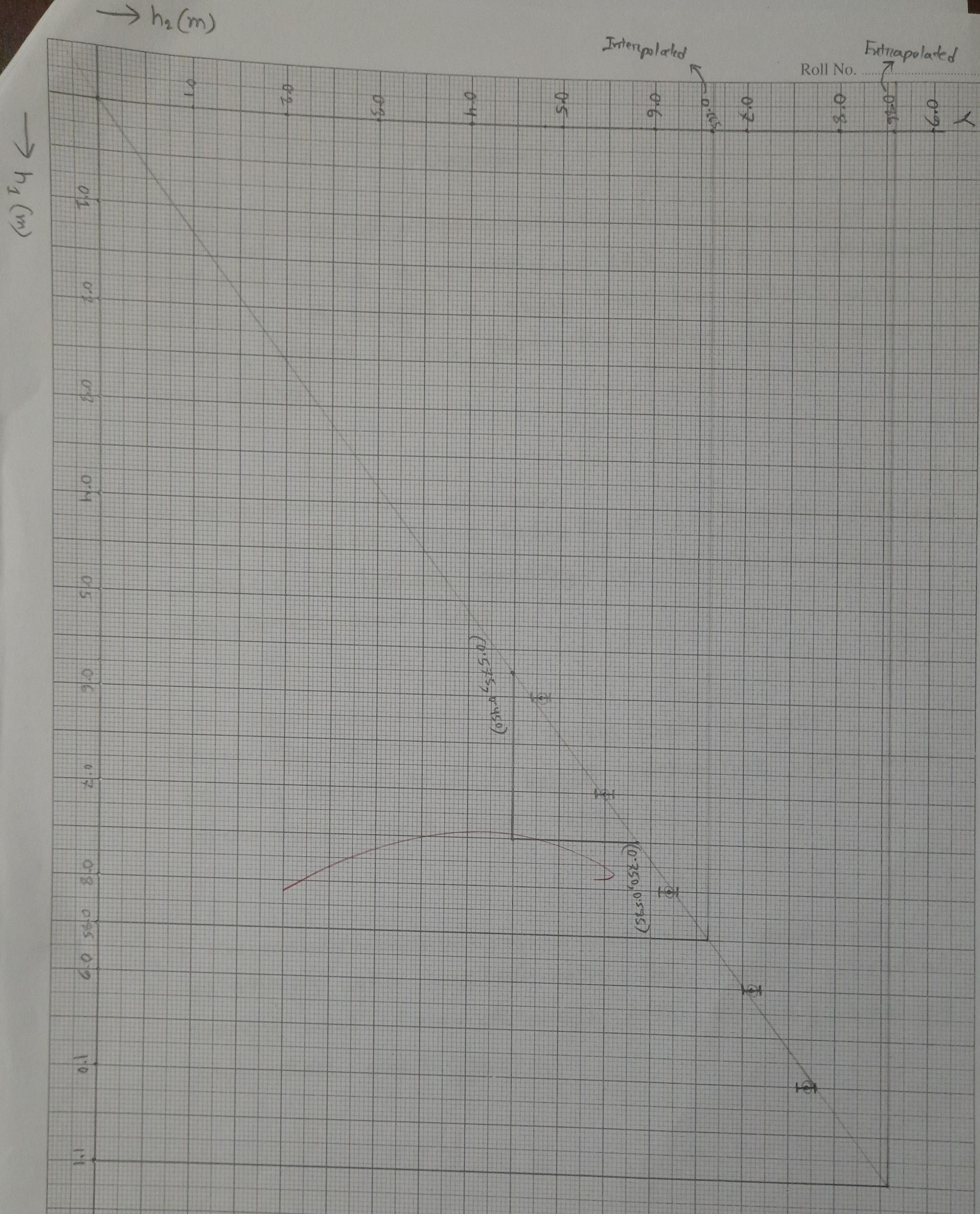
$= 13.27 \times 10^{-3}$

$\left.\begin{array}{l} P_1 = (0.575, 0.450) \\ P_2 = (0.750, 0.585) \end{array}\right\rangle$ 2 points

$\therefore$ slope $= \frac{0.585 - 0.450}{0.750 - 0.575} = 0.77$

$\therefore$ coefficient $=$ slope$^{-1} = \frac{1}{0.77} = 1.30$

Roll No. ....



MICRO

N.P. 20 cm x 25 cm

Questions:

1. Which ball was the most efficient? What characteristics does that ball have that you think helped it be efficient?

Golf ball is the most efficient ball. It's most efficient because it's weight is more than the others and surface area is less than the others. So it looses less energy.

what else?

2. Why is it impossible for a ball to be 100% efficient?

It is impossible for a ball to be 100% ~~effic~~ efficient because it looses energy due to friction, air resistance and heat.

3. How did the GPE change with height?

From the formula, we know that, GPE $\propto$ H so, it's clear that if Height increases, GPE also increases and vice versa.

4. What percentage of the initial potential energy was 'wasted' as the ball was hitting the ground?

No energy was wasted here. The initial potential energy was transformed into kinatic energy and other energys.

Group: 02
section: 11

Lab Report

10

Name of the Experiment	: Demonstration of Hooke's Law using spiral spring
Your Name	: Sazid Hasan
Your ID #	: 2211513642
Name of the Lab Partner	: Joy kumar Ghosh - 2211424642; Md. Sazzad Ul Islam - 2031736642
Date	: 29/10/2022

Instructor's comments:

Table 1. Static Determination of the Spring Constant, *k*

Mass added to the spring, m (kg)	Force, m×g (N)	Length after stretch, X (m)	Time for 10 Oscillations (sec)		Average Time Period (T_{av}) (sec)	Time Period² (T^2) (sec²)
0.000	0	0.12	-	-	-	-
0.150	01.43	0.12	-	-	-	-
0.200	01.96	0.14	6.03	6.18	0.61	0.37
0.250	2.45	0.17	8.56	8.68	0.86	0.74
0.300	2.94	0.21	9.94	9.84	0.99	0.98
0.350	3.43	0.24	10.78	10.84	1.08	1.17
0.400	3.92	0.29	11.59	11.78	1.17	1.37
0.450	4.41	0.33	12.41	12.44	1.24	1.54
0.500	4.90	0.36	13.06	13.03	1.30	1.70

From graph-1, Slope = $\frac{dL}{dF}$ = 0.07 m/N

Spring constant, k = $slope^{-1}$ = 14.29 N/m

Work done from the F-L graph, W = 0.88 J

Elastic potential energy, U = 0.93 J

$$\text{slope} = \frac{0.26 - 0.22}{3.58 - 3.0} = \frac{0.04}{0.58} = 0.07 \text{ m/N}$$

$$K = \text{slope}^{-1} = 0.07^{-1} = 14.29 \text{ N/m}$$

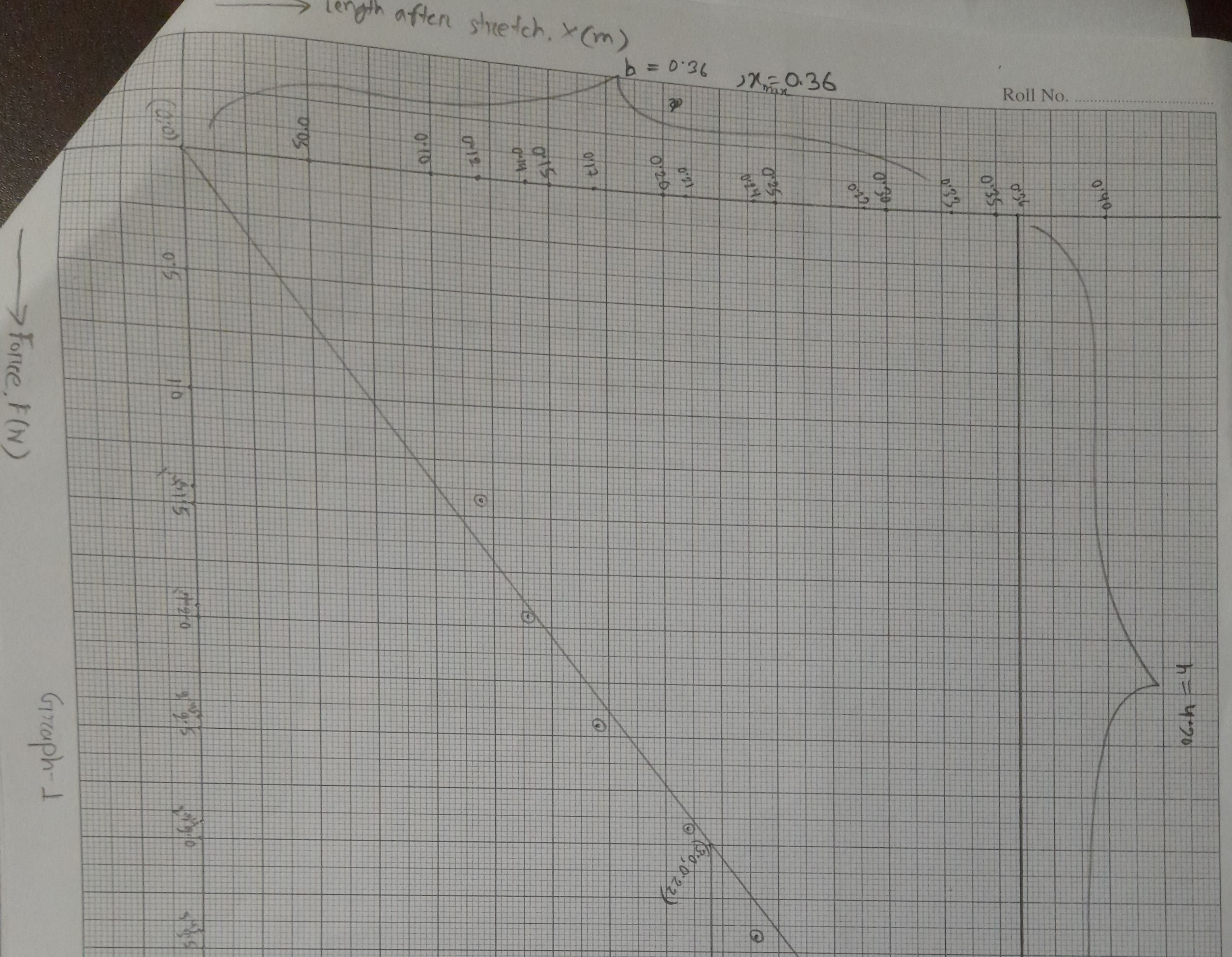
$$W = \frac{1}{2} \times b \times h = \frac{1}{2} \times 0.36 \times 4.90$$

$$= 0.88 \text{ J}$$

$$U = \frac{1}{2} k x^2 = \frac{1}{2} \times 14.29 \times (0.36)^2$$

$$= 0.93 \text{J}$$

Roll No. ....



Graph-1

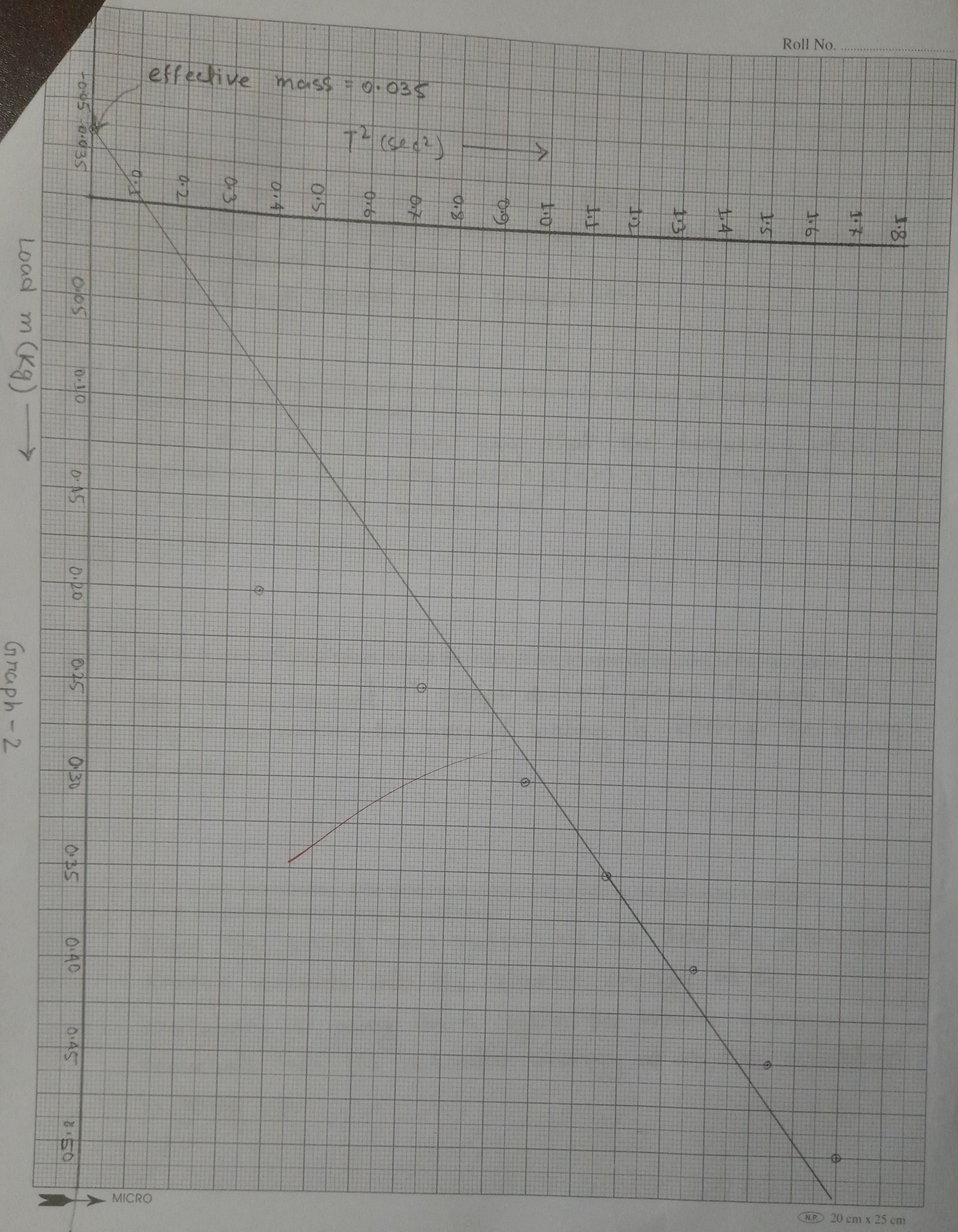
MICRO

N.P. 20 cm x 25 cm

Table2. Calculation of Effective mass

Mass of spring by digital balance, M_s	0·072	kg
Effective mass of the spring (take x intercept from the T^2 vs m graph), m_e	0·035	kg
Mass of the spring, $M_{s,exp} = 3 \times m_e$	0·105	Kg
Percentage Error	31·424%	

$$\text{Erron} = \frac{0{\cdot}105 - 0{\cdot}072}{0{\cdot}105} \times 100\% = 31{\cdot}424\%$$



Roll No.
effective mass = 0.035
T² (sec²) →
Load m (Kg) →
Graph-2
MICRO
N.P. 20 cm x 25 cm

Questions:

1. To what extent does your graph agree with Hooke's Law?

According to Hooke's Law, $F = -Kx \Rightarrow F \propto x$
Again, from our graph, we see that, the lenght is increasing in proportional to F (force).
So our graph agreed with Hooke's Law.

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2. According to your understanding what is the relation between the added mass and frequency of oscillations of the spring mass system?

from Graph-2, we can say that the frequency of oscillations of the spring mass system is increasing in propotional to the added mass.

3. Did the *m* against T^2 graph passes through the origin? If not, interpret the meaning of the intercept in horizontal axis.

No, the m against T^2 graph doesn't passes through the origin. That means, the mass of spring is effting the spring oscillation.

4. From your understanding of the spring mass system, what would be the relation between kinetic energy and potential energy during the oscillations?

From the spring mass system, we see that, the potential energy converts into the kinetic energy as the oscillation is going down again the kinetic energy converts into the potential energy ~~at~~ as the oscillation is going up.

10

Group-2
Section - 11

Lab Report

Name of the Experiment : Determination of sheer modulus using Dynamic Method

Your Name : Sazid Hasan

Your ID # : 2211513642

Name of the Lab Partner : Md. Sazzad Ul Islam; ID: 2031736642, Joy kumar Ghosh - 2211424642

Date : 05/11/2022

Instructor's comments:

Data:

Vernier Constant (V.C.) of the slide calipers,

$$V.C = \frac{\text{The value of one smallest division of the main scale}}{\text{Total number of divisions in the vernier scale}} = \frac{0.1}{20} = 0.005\text{cm}$$

Least Count (L.C.) of the Screw Gauge

$$L.C. = \frac{\text{Pitch}}{\text{Total number of divisions in the circular scale}}$$

Table-1: Data for the radius of the cylinder

No. of obs.	Main scale reading, x (cm)	Vernier scale division, d	Vernier constant V_C (cm)	Vernier scale reading, (Diameter) $y = V_c \times d$ (cm)	Mean diameter, D (cm)	Radius, $a = \frac{D}{2}$ (cm)	Diameter $D = x + y$
1	4.4	11		0.055			4.455
2	4.4	7		0.035			4.435
3	4.4	9	0.005	0.045	4.447	2.224	4.445
4	4.4	12		0.060			4.460
5	4.4	8		0.040			4.440

$$V.C. = \frac{\text{smallest value of main scale}}{\text{Total number of div in VS}} = \frac{0.1}{20} = 0.005 \text{ cm}$$

$$D = x + V_c \times d$$

$$= 4.4 + 0.005 \times 11 = 4.4 + 0.055$$

$$= 4.455$$

Table-2: Data for the radius of the wire

No. of obs.	Linear scale reading, x (cm)	Circular scale division, d	Least count, L_c (cm)	Circular scale reading, (Diameter) $y = d \times L_c$ (cm)	Mean diameter, D (cm)	Instru-mental error (cm)	Corrected diameter, D (cm)	Radius $r = \frac{D}{2}$ (cm)	$D = x + y$
1	0.05	8		0.008					0.058
2	0.05	7		0.007					0.057
3	0.05	11	0.001	0.011	0.058	+0.001	0.059	0.030	0.061
4	0.05	9		0.009					0.059
5	0.05	6		0.006					0.056

$$L.C. = \frac{\text{smallest value of Linear scale}}{\text{Total no of div in cs}}$$

$$= \frac{0.05\ \text{cm}}{50} = 0.001\ \text{cm}$$

$$\text{Diameter}, D = x + d \times L_c$$

$$= (0.05 + 8 \times 0.001)\ \text{cm}$$

$$= (0.05 + 0.008)\ \text{cm}$$

$$= 0.058\ \text{cm}.$$

Table-3: Data for the time period

No. of obs.	Time for 10 oscillations, *t* (sec)	Time period, T= t/10 (sec)	Mean *T* (sec)
1	23.63	2.363	2.368
2	23.85	2.385	
3	23.59	2.359	
4	23.69	2.369	
5	23.62	2.362	

Length of the wire, *l*: (i) 52.70 cm (ii) 52.80 cm (iii) 52.50 cm

Average length of the wire, *l* = 52.67 cm

Mass of the cylinder, M= 0.9054 kg

Calculations:

Moment of Inertia of the cylinder, $I = \frac{1}{2}Ma^2 = \frac{1}{2} \times 0.9054 \times \left(\frac{2.224}{100}\right)^2 \, kgm^2$

$$= 2.24 \times 10^{-4} \, kgm^2$$

Modulus of rigidity of the wire, $\eta = \frac{8\pi I l}{T^2 r^4}$ (SI Unit) $= \frac{8 \times 3.14 \times 2.24 \times 10^{-4} \times \frac{52.67}{100}}{(2.368)^2 \times \left(\frac{0.03}{100}\right)^4}$

$$= 6.53 \times 10^{10} \, kg\,sec^{-2}\,\cancel{m^{-1}}$$

Error Calculation:

Standard value of the modulus of rigidity of the material of the wire = 7.7×10^{10} Pa SI Unit.

$$\text{Percentage error} = \frac{\text{Stanard value} \sim \text{Experiment al value}}{\text{Standard value}} \times 100\,\%$$

$$= \frac{7.7 \times 10^{10} - 6.53 \times 10^{10}}{7.7 \times 10^{10}} \times 100\%$$

$$= 15.19\%$$

$$\eta = \frac{kg\,m^2 \times m}{sec^2 \times m^4}$$

$$= kg\,sec^{-2}\,m^{-1}$$

9.5

Lab Report

Name of the Experiment : Period of Oscillation for a Simple Pendulum

Your Name : Joy kumar Ghosh

Your ID # : 2211424642

Name of the Lab Partner : Sazid Hasan-2211513642 ; Md. Sazzad Ul Islam-2031736642

Date : 12 November, 2022

Instructor's comments:

Table 1. Mass Dependence of the Period

Length of Pendulum, L = 0.58 m Degree = 10°

Mass (grams)	A Single Period (sec)			T_{avg} (sec)	T_{avg}^2 (sec²)
13.2	15.47	15.42	15.44	1.544	2.385
21.8	15.59	15.62	15.57	1.559	2.432
82.2	15.47	15.44	15.50	1.530	2.342

(Const) .

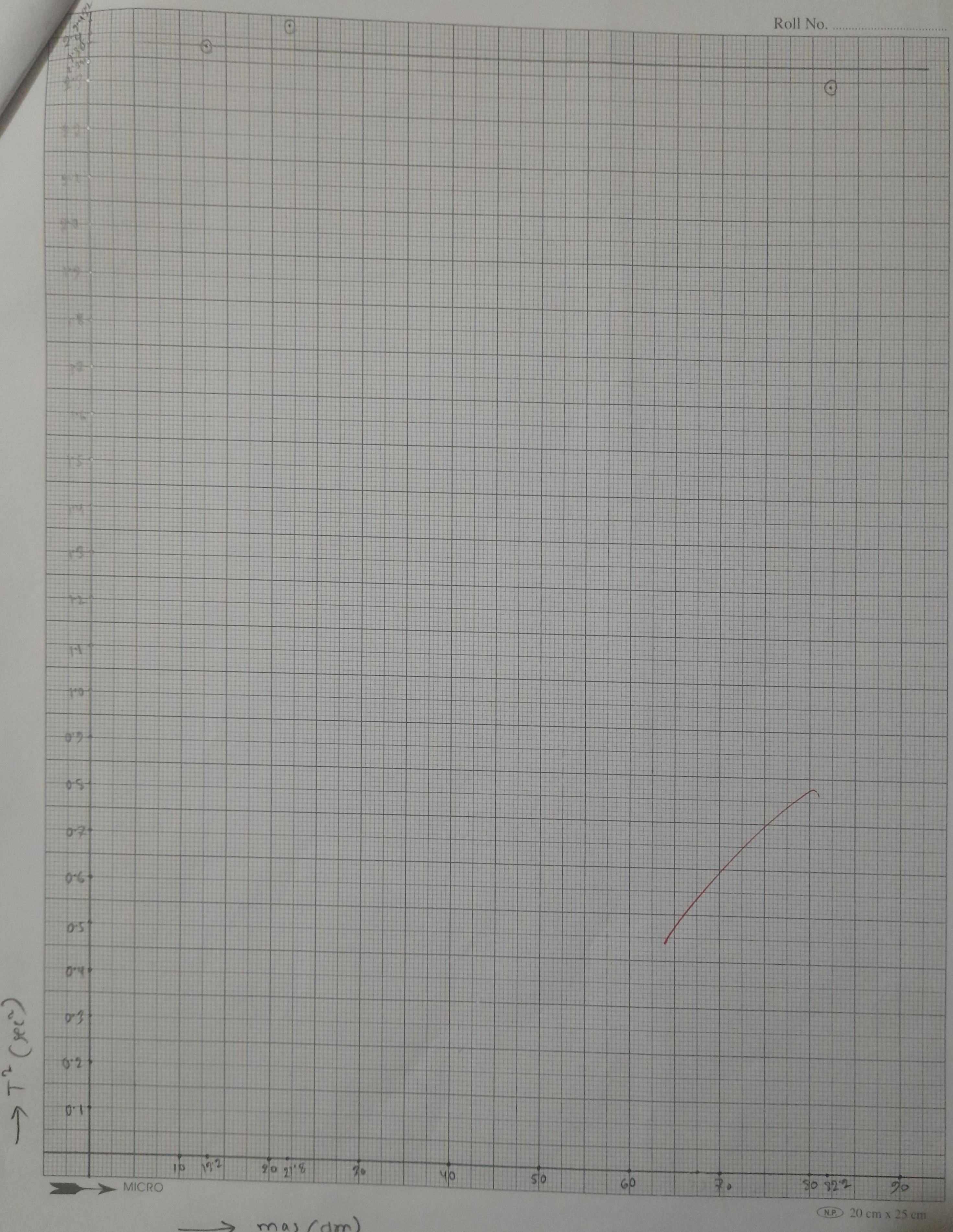
Table 2. Angle Dependence of the Period

Mass of Pendulum = 13.2 grams Length, L = 0.58m

Angle (degrees)	A Single Period (sec)			T_{avg} (sec)	T_{avg}^2 (sec²)
10	15.43	15.47	15.44	1.545	2.386
15	15.49	15.50	15.47	1.549	2.398
20	15.58	15.62	15.61	1.560	2.435
30	15.69	15.74	15.72	1.572	2.470
40	15.88	15.83	15.80	1.584	2.508

(Const) .

Roll No. ....



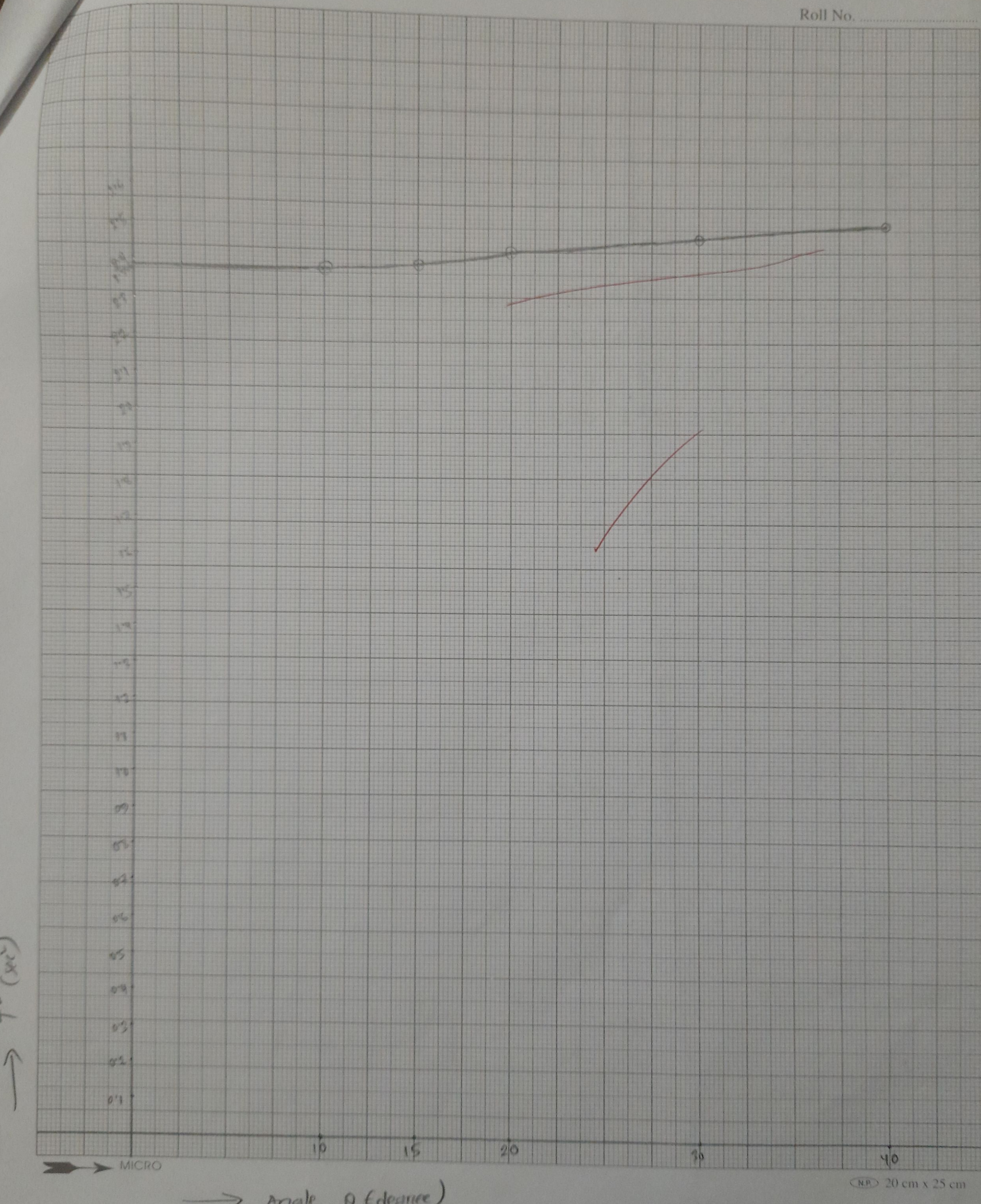
N.P 20 cm x 25 cm

Graph-1

$L = 0.58$ m

Angle $= \theta = 10°$

Roll No. ....



20 cm x 25 cm

Graph-2

Mass = 13.2 gm

Length = 0.58 m

Table 3. Length Dependence of the Period

$\theta = 10°$

mass = 13.2 gm

Length l (m)	A Single Period (sec)			T_{avg} (sec)	T_{avg2} (sec²)
0.40	13.09	13.06	13.03	1.306	1.706
0.45	13.82	13.88	13.86	1.385	1.919
0.50	14.57	14.62	14.56	1.458	2.127
0.55	15.24	15.29	15.27	1.527	2.331
0.60	15.84	15.84	15.87	1.585	2.512

Slope of the best fit line = 4 s²/m.

g_{exp} = 9.8596 m/s².

Percent error = 0.61 %

$$\text{Slope} = \frac{1.5-1.3}{0.35-0.3} = 4 \ \text{sec}^2/\text{m}$$

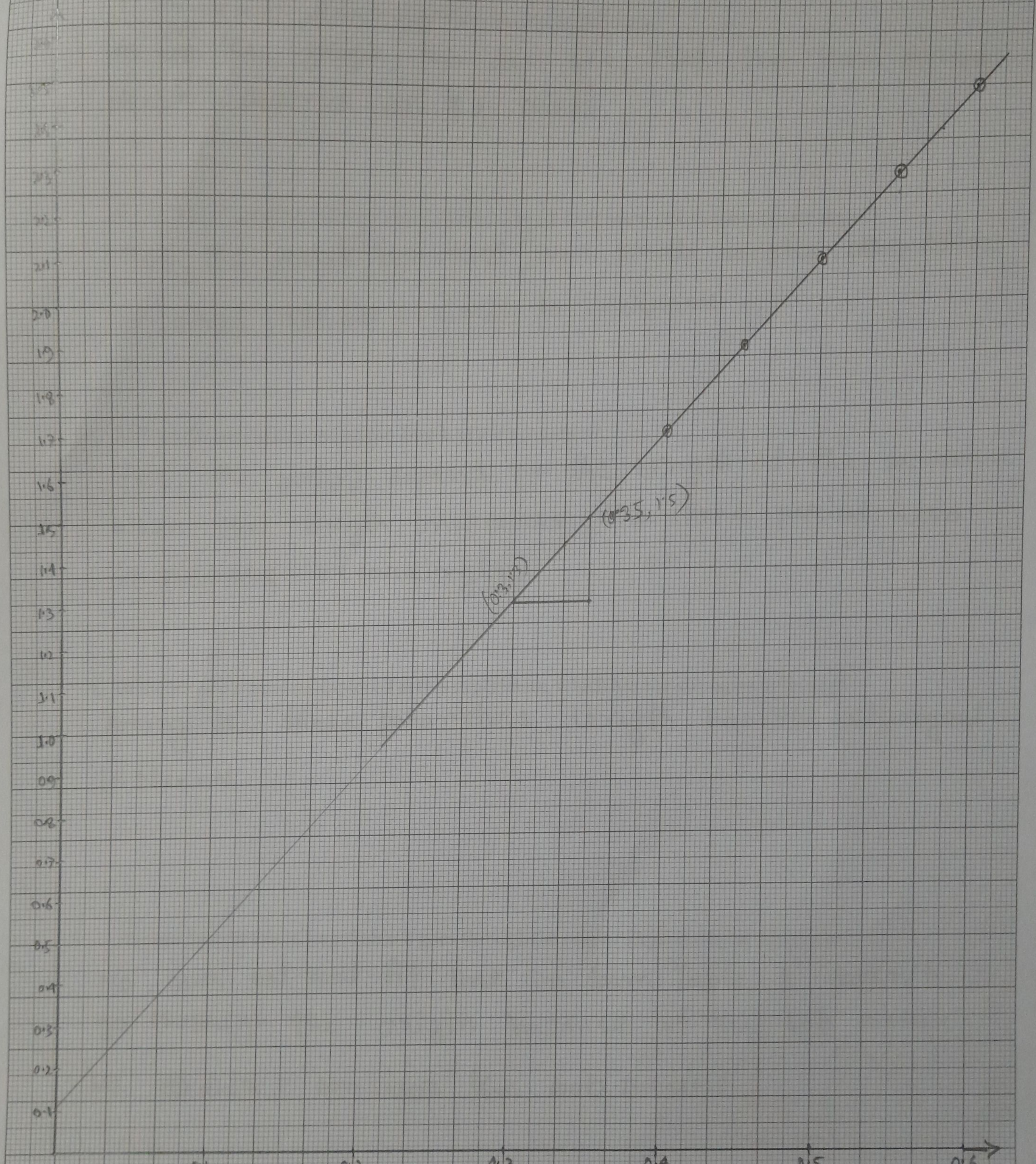
$$m = \frac{4\pi^2}{g}$$

$$\therefore g_{exp} = \frac{4\pi^2}{m} = \frac{4\times(3.14)^2}{4} = 9.8596 \ \text{ms}^{-2}$$

$$\text{Error} = \left| \frac{g_{theory} - g_{exp}}{g_{theory}} \right| \times 100\% = \left| \frac{9.8 - 9.8596}{9.8} \right| \times 100\%$$

$$= 0.61\%$$

Roll No. ....



MICRO

N.P. 20 cm x 25 cm

→ length. L (m)

$\theta = 10°$

mass = 19.2 gm

Graph - 3

Questions:

1. Does the period of a simple pendulum depend on the mass?

As ~~vee~~ per the graph, we can see that the time period doesn't depend on the mass.

2. Is the period constant over small angles? Does it vary when one reaches larger angles?

Yes, the period is constant ~~is~~ over small angles. ~~one~~ After 20°, angel, ~~it sta~~ it starts to increase. 12

3. Does the period depend on the length of the pendulum?

Yes, the period depend on the length of the pendulum. When the length increases, the time period also increases accordingly.

4. Of the three parameters explored in this experiment, which has the strongest influence?

Among the three parameters, length has the strongest influence.

5. Is your best-fit line in form Table-3 goes through the origin? Explain why or explain not?

No, our ~~bed~~ best-fit line in form Table-3 doesn't go through the origin because of the bob radius. We ~~do~~ didn't consider the bob radius.

Section : 11
Group : 02

Lab Report

Name of the Experiment	:	Compound Pendulum and simple harmonic motion
Your Name	:	Joy kumar Ghosh
Your ID #	:	2211424642
Name of the Lab Partner	:	Sazid Hasan - 2211513642 ; Md. Sazzad Ul Islam 2031736642
Date	:	19.11.2022

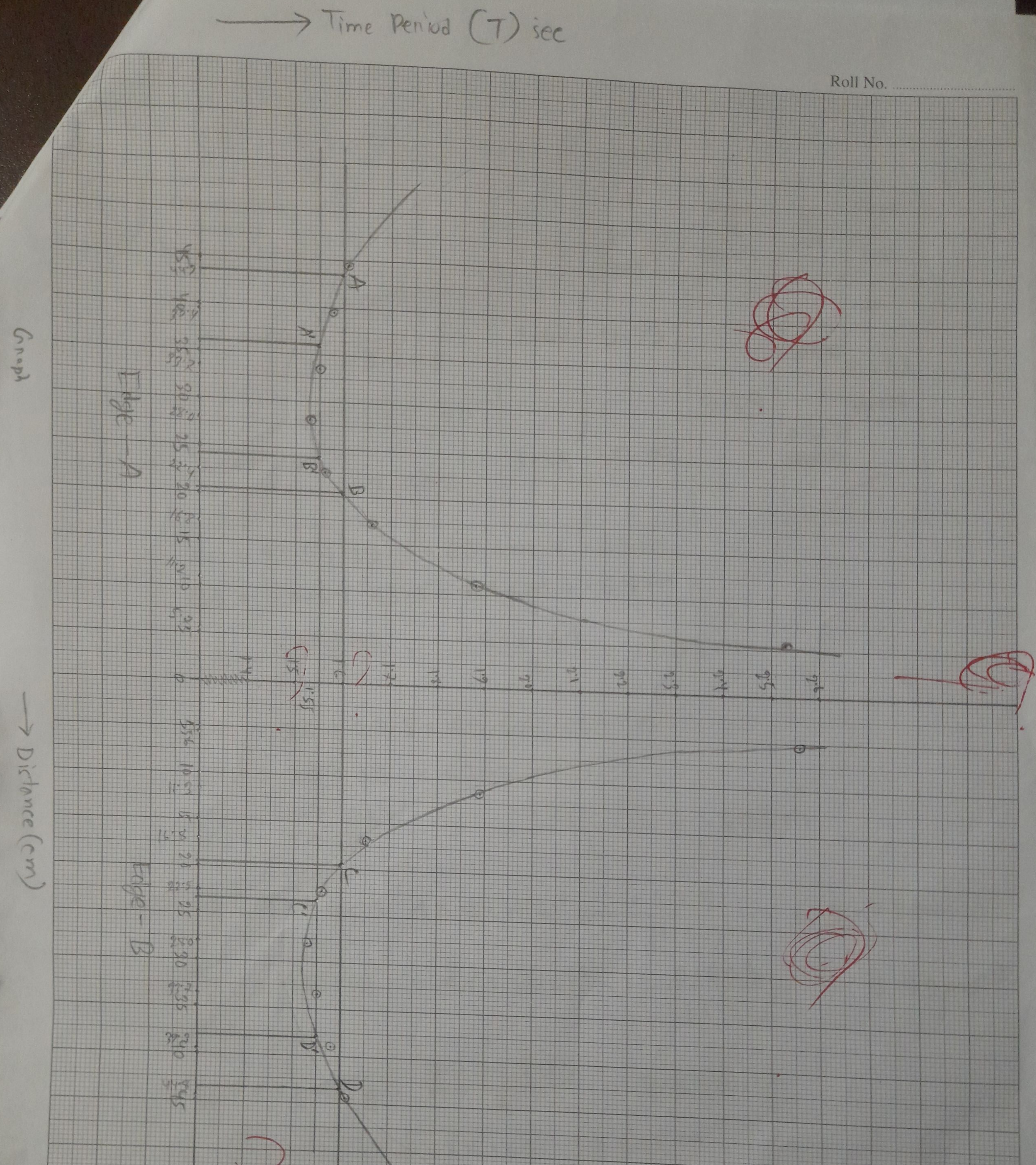
Instructor's comments:

Table 1

Angle, $\theta = 10^{\circ}$

Hole Number		Height h (cm)	Time for 10 oscillations (s)		Mean time t (s)	Time Period $T=\frac{t}{10}$ (s)
Edge A	1	5.7	25.28	25.35	25.32	2.532
	2	11.2	18.78	18.85	18.82	1.882
	3	16.8	16.53	16.58	16.56	1.656
	4	22.4	15.52	15.59	15.56	1.556
	5	28.0	15.37	15.31	15.34	1.534
	6	33.7	15.50	15.53	15.52	1.552
	7	39.4	15.76	15.81	15.79	1.579
	8	44.9	16.06	16.12	16.09	1.609
Edge B	1	5.6	25.57	25.63	25.60	2.560
	2	11.3	18.91	18.86	18.89	1.889
	3	16.8	16.53	16.47	16.50	1.650
	4	22.5	15.56	15.62	15.59	1.559
	5	28.0	15.31	15.27	15.29	1.529
	6	33.7	15.44	15.50	15.47	1.547
	7	39.3	15.73	15.82	15.78	1.578
	8	44.8	16.12	16.08	16.10	1.610

Roll No. ....



MICRO

20 cm x 25 cm

TABLE 2 (From the graph)

Observations from the horizontal lines	L (m)	T (sec)	$g = 4\pi^2 \frac{L}{T^2}$ (m/s^2)	Mean g (m/s^2)	K (m)	Mean K (m)
1. ABCD	$L = \frac{AC+BD}{2}$ 0.635	1.60	9.79	9.89	0.635	0.621
2. $A'B'C'D'$	$L' = \frac{A'C'+B'D'}{2}$ 0.608	1.55	9.99		0.607	

$AC = 43.5 + 19.5 = 63\ cm = .63\ m$

$BD = 20.5 + 43.5 = 64\ cm = .64\ m$

$\therefore L = \frac{AC+BD}{2} = \frac{.63+.64}{2} = .635\ m$

$A'C' = 36 + 23.5 = 59.5\ cm\ .595\ m$

$B'D' = 24 + 38 = 62\ cm = .620\ m$

$L' = \frac{A'C'+B'D'}{2} = \frac{.595+.620}{2} = .608\ m$

$g = 4\pi^2 \frac{L}{T^2} = 4 \times (3.1416)^2 \times \frac{.635}{(1.60)^2} = 9.79\ ms^{-2}$

$g' = 4\pi^2 \frac{L}{T^2} = 4 \times (3.1416)^2 \times \frac{0.608}{(1.55)^2} = 9.99\ ms^{-2}$

$\therefore$ mean $g = \frac{9.79+9.99}{2} = 9.89\ ms^{-2}$

$K = \sqrt{AC \times BD} = \sqrt{.63 \times .64} = 0.635\ m$

$K' = \sqrt{A'C' \times B'D'} = \sqrt{.595 \times .620} = 0.607\ m$

Mean $K = \frac{K+K'}{2} = \frac{0.635+0.607}{2}$

Questions:

1. According to your understanding and the data you have obtained in this experiment, explain the time variation with different suspension of the compound pendulum.

When the rotational axis moves from com, time period for oscillation decrease until it moves to center of the edge A. Again it starts increasing until it reach to end of the edge - A. Same thing happens for edge - B.

2. Do you think compound pendulum in comparison to simple pendulum would show better oscillatory motion in air for measurement of g? Why?

The major difference between both kind of pendulum is that compound pendulum has real object and real length of string while the simple pendulum has no real mass and center of gravity.
It is easy to locate the center of gravity in compound pendulum.
Due to which the calculation of gravitational acceleration is easier with compound pendulum instead of simple pendulum in air.